

Briefly Noted

New ELA for Smaller Governments

With Esri's new enterprise license agreement (ELA) program, municipal and county governments serving populations between 100,000 and 250,000 can use GIS to build smarter communities. The ELA provides software, training, and data for all government disciplines, including planning, health, economic development, and public safety. Learn more at go.esri.com/SmallGovELA2016.

Improving Public Trust and Police Legitimacy

The ArcGIS Open Data Initiative for Law Enforcement allows police agencies to build and share authoritative data for better policing and community engagement. It makes it easy for law enforcement agencies to participate in the White House Police Data Initiative, which has mobilized 21 US jurisdictions to share knowledge and establish best practices for police departments nationwide. The open data initiative helps police agencies quickly configure and deploy maps and apps for public consumption. Learn more at esriurl.com/policedata.

MRF, LERC Open to Geospatial Community

Esri and NASA are improving access to imagery and raster data stored in the cloud by opening Meta Raster Format (MRF) and Limited Error Raster Compression (LERC) to the geospatial community. By sharing MRF and LERC, NASA and Esri will enable organizations to lower storage costs and gain fast access to imagery and data as web services.

Los Angeles Launched GeoHub

Making Location Data Available as a Service Makes City a World Leader in Open Data Innovation

Los Angeles is an incubator for new ideas. It's where the film industry got its start, the fitness craze took shape, and the modern food truck movement hit the road.

Now, the City of Los Angeles and Esri have partnered on a project that will spur even more innovation in government, business, and other organizations: GeoHub.

Unveiled recently by Los Angeles mayor Eric Garcetti, GeoHub gives city staff, businesses, app developers, nonprofit organizations, and the public access to the city's location-based

data through an online portal. People can download datasets as shapefiles, KML files, or into spreadsheets. They can also visualize the data as online maps using ArcGIS. GeoHub combines the city's geographic data into a location-as-a-service (LaaS) platform, allowing users to access live, continuously updated data directly from the city as a service—rather than as a static download—and create dynamic applications on the fly.

Los Angeles GeoHub is the centerpiece of Garcetti's effort to make the

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↑ By opening up Los Angeles' data, mayor Eric Garcetti hopes to make city operations more efficient and stimulate community partnerships.

Designing a Green Infrastructure

With Geodesign, Nature Can—and Should—Play a Pivotal Role in Planning Our Communities

Andrea Wulf's book *The Invention of Nature: Alexander von Humboldt's New World* was on Esri president Jack Dangermond's mind when he opened the 2016 Geodesign Summit.

Holding up a copy, Dangermond praised Wulf's biography of Humboldt, a German naturalist and geographer whom the author has called "nature's prophet" and whose

geographic explorations and scientific observations 200 years ago still impact how people think about nature today: as a complex, interconnected system.

Designing with Nature in Mind

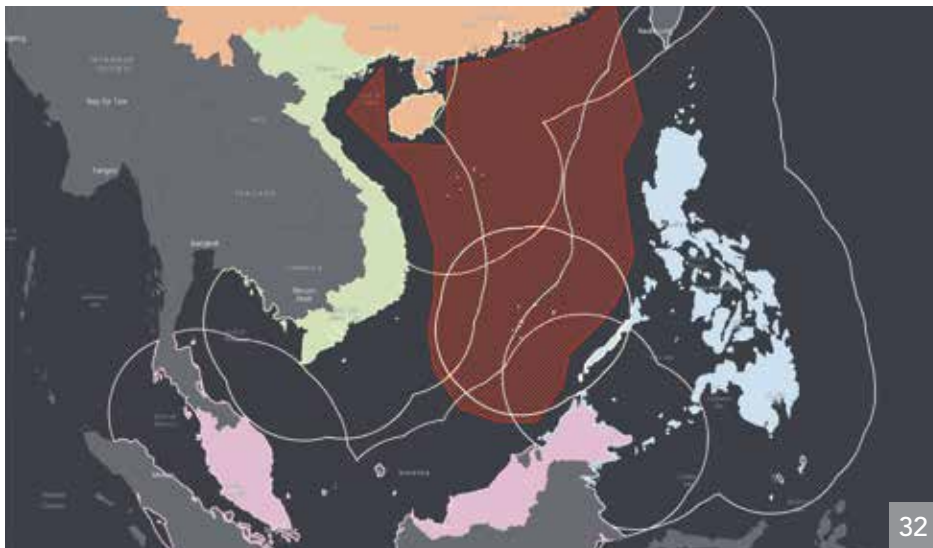
If Humboldt were alive today, he may well have been at the forefront of geodesign, which supports designing with nature in mind and promotes a harmonious ecosystem.

Geodesign combines geographic science and GIS technology with design methodologies to produce data-driven solutions or plans that support healthier, smarter, and more sustainable communities.

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Valencia, Spain, is growing while, at the same time, preserving the region's character and landscape.





Many decisions are made based on the borders drawn on maps. Even when borders are complicated, like in the South China Sea, maps need to inform properly so that people can accurately shape their opinions of a situation.

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Designing a Green Infrastructure

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At the summit, which was held January 27–28 at Esri headquarters in Redlands, California, Dangermond set the context for the 300 attendees, outlining some issues society faces on a global scale.

“You and I are living in a world that’s changing rapidly,” he said. “We are challenged [by] our population growth. And the footprint of that and its impact—on nature, on climate change, and on just about everything—is enormous.”

He called on audience members to learn geodesign methodologies and supporting technologies to make positive changes.

“It’s why we are so passionate about trying to create a better future, considering science and our best design and technology,” Dangermond said. “The world needs you, and the world needs you to be inspired to grasp this whole set of methodologies and tools to work desperately to alter the course of what’s going on. Because the arrows are going in the wrong direction by any measure. The challenge for geodesigners is to turn those arrows around.”

One of the Greatest Geodesigners

One geodesigner who is making strides in the right direction is Spanish landscape architect, urban planner, and architect Arancha Muñoz-Criado. In introducing her to the audience, Dangermond described her as “one of the greatest geodesigners I’ve ever met.”

Muñoz-Criado has devoted much of her career to introducing land conservation and green infrastructure into the planning process in the Valencia region of Spain, where she grew up.

She loves the land—especially the bucolic fishing village on the Mediterranean Sea just south of Valencia where, as a child, she spent weekends and holidays. The people living there were poor, eking out their livelihoods by fishing. But their surroundings were rich and bursting with nature.

“I grew up in a beautiful area in Spain with pristine beaches, mountains [overlooking] the seas, and wonderful terraces full of almond trees and vineyards,” Muñoz-Criado said.

But in the 1960s and 1970s, tourists from other parts of Europe discovered the fishing village and its beaches. Soon, a crop of summer houses replaced many of the almond trees.

“Suddenly [the village] grew very, very rapidly,” said Muñoz-Criado. “It brought a lot of money and resources for the local people, so everybody was happy. But development was allowed anywhere, and that was a total disaster.”

Growing Well While Preserving Place

Seeing what happened in her beloved fishing village influenced Muñoz-Criado in her choice of career.

“I thought there was another way of growing: we could grow but grow well, preserving the character and preserving the landscape of the place,” she said.

After earning a degree in architecture in Spain, where she was also trained as an urban planner, Muñoz-Criado worked briefly for renowned Finnish architect Aarno Ruusuvuori. Sensing her

interest in landscape design, he encouraged her to study landscape architecture in the United States.

Muñoz-Criado was accepted to Harvard University, where she earned her master of landscape architecture degree in the early 1990s. She was a student of professor Carl Steinitz, the author of *A Framework for Geodesign: Changing Geography by Design*.

While visiting friends in Boston, Muñoz-Criado would go to the Emerald Necklace, a seven-mile-long stretch of parks and waterways designed in the 1870s by American landscape architect Frederick Law Olmsted. Muñoz-Criado said the concept of green infrastructure can be traced back to him.

“Every time I went there, I said, ‘What a simple idea,’” Muñoz-Criado remembered. “Find out which places...you [want] to preserve before growing, and then develop around these places.”



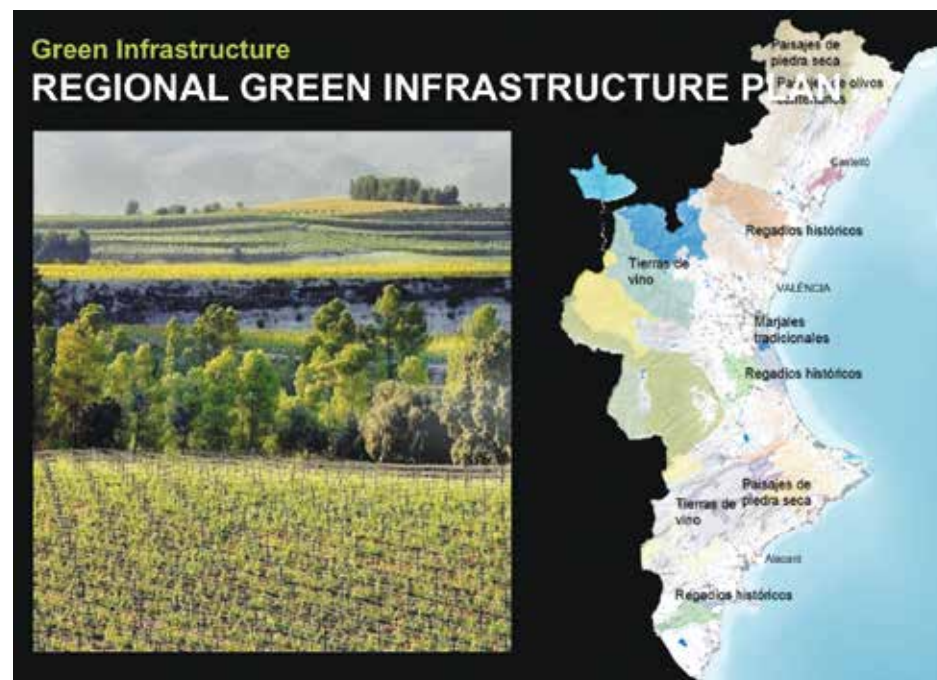
↑ Landscape architect, urban planner, and architect Arancha Muñoz-Criado has brought the principles of geodesign to Valencia, Spain, where land conservation and green infrastructure have become key parts of the planning process.

Greening Infrastructure

She brought those ideas home to Spain but realized that to achieve policy changes, she would have to work for the government to help enact them.

She spent five years working for the government of the autonomous region of Valencia, advocating landscape conservation and green infrastructure requirements in the planning process. Moving up the ranks, she eventually became regional secretary of territorial, urban planning, landscape and environment, where she was able to get the green infrastructure requirements put in place, thanks in part to the European Landscape Convention. The convention, adopted by the Council of Europe, seeks to create sustainable development based on balancing social, economic development, and environmental needs.

Muñoz-Criado also helped to get a European Union Strategic Environmental Assessment (SEA) for the autonomous region of Valencia. The SEA requires by law that the region of Valencia consider sustainability when reviewing development projects.



↑ Today, a plan is in place to create a green infrastructure network in the Valencia region to promote clean air and biodiversity.

Get Involved

Geodesign Summit Europe will be held November 1–2, 2016, in Delft, the Netherlands. The Geodesign Summit will return to Redlands, California, January 25–26, 2017.

grow vegetables, such as tomatoes and onions, and then sell them at local farmers’ markets. Land is being set aside for bike paths, pedestrian walkways, urban gardens, green spaces, and urban parks. Views considered scenic or historic are protected too.

“If you have a beautiful mountain, you should not build anything that blocks the views of that mountain,” Muñoz-Criado said. “That mountain is part of the identity of that place and makes that place different from other places.”

Muñoz-Criado strongly believes that creating green infrastructure doesn’t run counter to economic development but, rather, enhances it.

“Many cities have destroyed prime agricultural lands, but those lands can be the [food] markets for our cities,” she said.

Protecting prime agricultural land provides an economic boost for local farmers and saves energy and money by reducing the need for having food shipped from distant places. More people in cities can then buy locally grown fruits and vegetables. And tourism is stimulated by protecting views of scenic areas such as mountains and historic sites like castles. Recreation opportunities increase when hiking trails are built in green corridors.

“Everyone has different sensitivities, but I have always been very emotional about the landscape,” said Muñoz-Criado, whose home in the fishing village was only five meters from the sea. “I love being in beautiful landscapes. I have appreciated them since I was a child.”

Open Data Aids Recovery of Irish Economy

How Ordnance Survey Ireland Brought the Public Sector Together to Share Geospatial Data

Ordnance Survey Ireland (OSi), the national mapping agency for the Republic of Ireland, recently commissioned an economic report on Ireland's geospatial industry. The assessment, carried out by the independent economic research organization Indecon, concluded that better use of location-based information in Ireland enables the public sector to save 82 million euros annually, frees up enough time to equal 279 million euros, and provides 104 million euros in competition benefits across the country.

Inspired by these findings, OSi took the lead in making Ireland's vast geospatial data resources more widely available via the Internet using ArcGIS Online.

The organization already had a web-based map viewer that attracted more than 1.5 million unique visitors a year. But the technology behind this web service was becoming outdated and couldn't deliver digital cartography to tablet and mobile devices. So OSi launched an ambitious project to replace its existing map viewer with a new online portal that would improve the user experience, as well as make third-party, public-sector data easily accessible from a single location.

An Encompassing Geospatial Data Portal for Ireland

OSi worked closely with Esri Ireland to use the ArcGIS platform to completely redevelop and modernize its online mapping capabilities. Named GeoHive (geohive.ie), the new, free-to-use web service contains significantly enhanced end-user capabilities, including the new Make Your Map tool.

↓ OSi's story map for potential home buyers displays key property considerations—such as proximity to schools, transportation, and hospitals—to help people make informed decisions.

"For the first time, users can access current and historical OSi maps on their mobile phones and tablets whenever they need them," explained Hugh Mangan, general manager of business and marketing for OSi. "GeoHive also gives users the ability to create maps in a much simpler way, save them, and share them instantly with colleagues using any device."

Most importantly, GeoHive combines OSi mapping with data from a wide range of public sector partners to create an authoritative national spatial data infrastructure.

"GeoHive is a classic portal in that it provides an access point to lots of existing sets of spatial data that have already been published," said Mangan. "However, it is unique in Ireland in the way that it combines over 142 layers of third-party data from 35 public sector bodies and presents them seamlessly to the end user from a single site."

Trusted Evidence to Support Investment Decisions

Launched in November 2015 by Ireland's minister for communications, energy, and natural resources, GeoHive improves access to national geospatial information and exposes many more individuals and organizations to Ireland's vast reservoirs of geospatial data.

From a single website, users can combine and layer different datasets against the background of up-to-date OSi maps to discover fresh insights into various situations and easily share that information via mobile devices. This capability is expected to encourage new investments in Ireland that support the recovery of the country's economy.

As part of the GeoHive development project, OSi has used ArcGIS Online and Esri Story Map templates to publish ready-to-use maps that



With GeoHive, users can combine and layer different datasets on up-to-date OSi maps and easily share that information via mobile devices.

are specifically designed to help people make evidence-based investment decisions. For example, OSi created an industry story map that displays information about the working population, skills, infrastructure, and transportation in key locations across Ireland.

"If a business owner is considering opening a new office or factory in Galway, GeoHive presents all the information that they need to help them understand the area and make informed decisions," explained Mangan.

With such detailed information open and available, organizations will be able to access the significant cost-saving opportunities OSi identified in its economic assessment of Ireland's geospatial industry.

"ArcGIS has enabled OSi to deliver a service that has the potential to really boost the value of geospatial data to the Irish economy," said OSi chief executive Colin Bray. "By making location-based data more accessible, usable, and meaningful for everyone, GeoHive will help public and private sector organizations to

reduce costs, save time, and capitalize on new business opportunities."

Improved Public Services for Irish Citizens

GeoHive also benefits individual citizens, who can now find public information more easily. For instance, OSi has built a story map geared toward people buying residential properties. It displays key considerations, such as nearby schools, transportation, employment, hospitals, and crime. With this information at hand, potential homeowners can use simple tools to make informed choices that will enrich their lives.

"We've taken all of the hard work out of finding information by presenting everything that people might want to know in one place [that has] a logical interface," said Mangan.

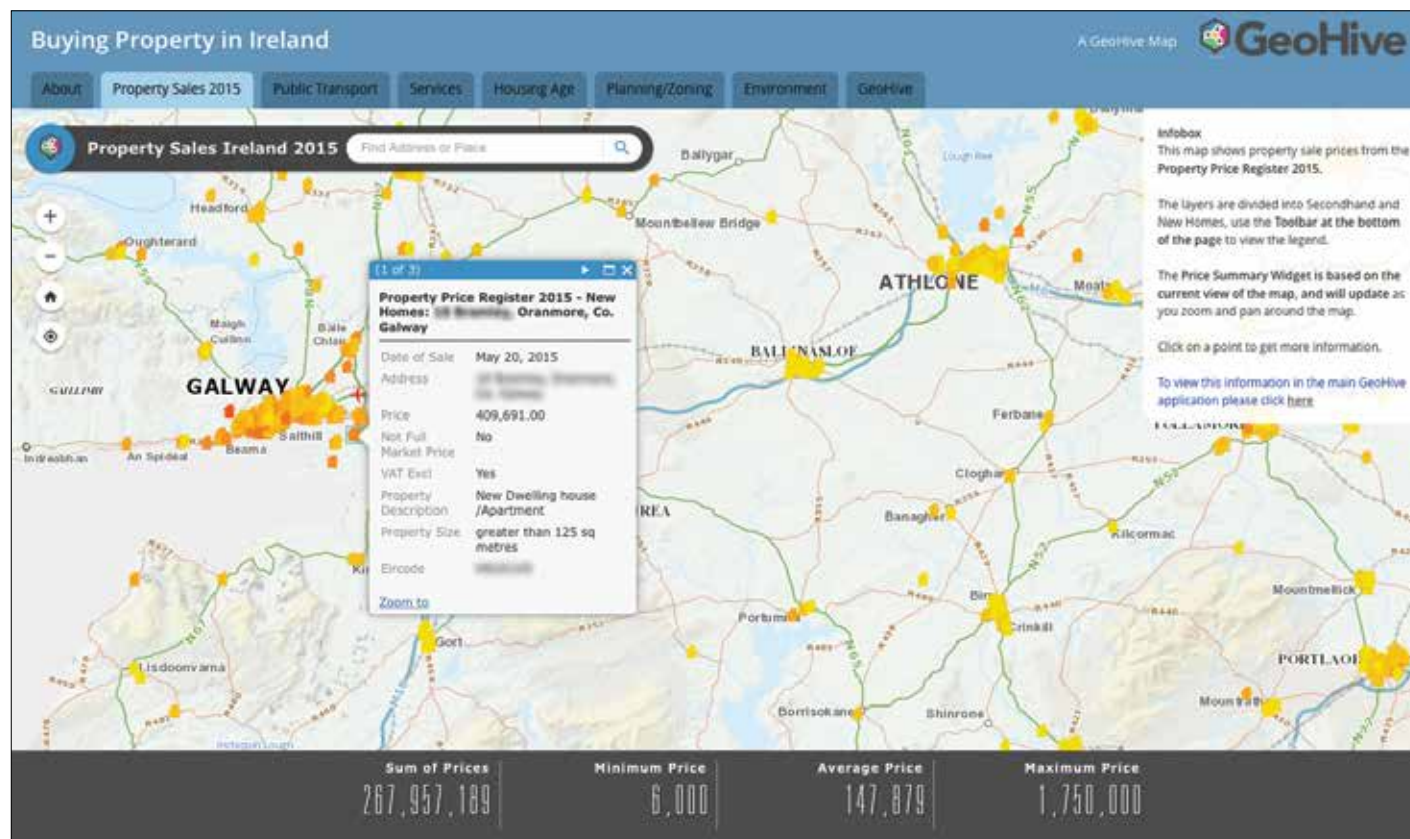
By making data more accessible to a wider audience, GeoHive has helped OSi and all participating public sector organizations improve their customer service. As Mangan observed, "GeoHive provides a window to a wider world."

A Tradition of Innovation

OSi has been driving geospatial and geographic innovation in Ireland since the early 1800s, and GeoHive is just one of a wide range of new and ongoing initiatives that the organization is spearheading to provide improved products and services to customers in Ireland. Another recent project is the multiresolution data store, which OSi is using to deliver a new set of small-, medium-, and large-scale cartography, paper products, and digital web services—all derived automatically from OSi core data holdings—for distribution through multiple channels.

It is through this tradition of innovation, and with solutions like GeoHive, that OSi is gradually unlocking the full potential of geospatial data in Ireland and making location-based information readily available to support the recovery of the Irish economy.

For more information, contact Michael Byrne from Esri Ireland at mbyrne@esri-ireland.ie or Hugh Mangan from Ordnance Survey Ireland at Hugh.mangan@osi.ie.



Los Angeles Launched GeoHub

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Southern California city a world leader in open data and civic innovation. As it rides a wave of transition—with startups launching, the arts thriving, and Angelenos bubbling with ideas—the city is also poised to transform the way people, businesses, and government interact.

By opening Los Angeles' data to everyone, Garcetti hopes to make city operations more efficient, stimulate partnerships between the city and the community, and give residents a greater controlling stake in government.

"Los Angeles is known as a place that thinks big. We are known for our curiosity. We are known for our innovation," said Garcetti at the GeoHub launch on January 29 at the city's La Kretz Innovation Campus. "[GeoHub] will help us reinvent the way that we deliver services and broaden our ability to engage residents and businesses to improve the quality of life in their city."

Free-Range Data

Like many municipalities, Los Angeles' city departments use GIS to manage resources and make better decisions.

While GIS is an invaluable tool for achieving the city's missions, the data and services within each department are not always readily shareable. GeoHub aims to make each department's data available online in real time (or near real time) to boost efficiency and eliminate the information bottleneck. By connecting Los Angeles' datasets across departments, the city will be better equipped to deal with issues such as public safety and homelessness.

"Imagine if police officers, firefighters, emergency workers, and first responders all had access to the city's data for every specific place at any time, anywhere," said Garcetti. "Public safety personnel could make critical, real-time decisions based on solid, map-based data. And GeoHub makes that possible."

He detailed how firefighters would be able to use the portal: "Let's say a firefighter with an iPad or a mobile device is called to respond to an emergency like an earthquake. Well, thanks

to GeoHub, he or she could just pull up more than the 911 data for that call. They could find important facts, like building inspection status, location of the nearest fire hydrants, sewer lines, streetlights—any information that would make it easier to respond to an emergency."

Fewer Stovepipes, More Networks

The story of the firefighter accessing current GIS services represents a paradigm shift in how cities operate. At the GeoHub launch, Esri president Jack Dangermond illustrated how the government of Los Angeles could better serve its people by abandoning hierarchical decision making in favor of a network-based approach through GeoHub.

"I can search for maps, I can mash up [or] combine maps, I can get insights, I can make better decisions," Dangermond said. "[GeoHub] flattens out a shared infrastructure of content."

In other words, a network-based model, where information and feedback can be freely shared among stakeholders (including the public), leads to democratic policy making that is better for the community overall.

The World's Largest Tech Incubator

Mayor Garcetti's vision of an open data platform for the City of Los Angeles goes beyond serving the government. GeoHub aims to create partnerships between the city, academia, nongovernmental organizations, businesses, and startups.

For Los Angeles, startups represent not only potential economic development but also collaboration opportunities for solving some of the city's biggest problems.

One such partnership is actually La Kretz Innovation Campus, where the GeoHub launch took place. Located in the heart of Los Angeles' flourishing Arts District, La Kretz is a clean technology, or "cleantech," incubator owned by the Los Angeles Department of Water and Power, where startups, scientists, engineers, and policy makers can develop energy solutions that support Los Angeles' green economy.

GeoHub provides a similar opportunity for startups interested in solving issues such as reducing traffic or greenhouse gas emissions—and anything else that is spatially related. Developers can access the city's data, along with open APIs, to build apps that they can bring to market.

"What I've said to tech leaders is, 'Use LA as a platform; this is the best platform anywhere in the world,'" said Garcetti. "We are open for business."

Apps Provide Government Transparency

Open data may be old hat to GIS professionals or data scientists, but for others, the concept may be relatively new. If that is the case, GeoHub provides a simple and intuitive user experience for searching and mapping the data, with categories that include infrastructure, safety, business, transportation, and recreation and parks.

GeoHub features web mapping apps that are designed to provide transparency and empower people to take part in their government. Street Wize, for example, allows Angelenos to track current and upcoming permit and construction activity around the city so they can plan accordingly to avoid delays. Vision Zero uses a data-driven approach to reduce traffic-related injuries and deaths—with the goal of eliminating them altogether by 2025. And Road to 2400 shows the 2,400 lane miles of streets that Los Angeles was able to pave on a 2,200-lane budget.

Next Time You Think Los Angeles, Think Open

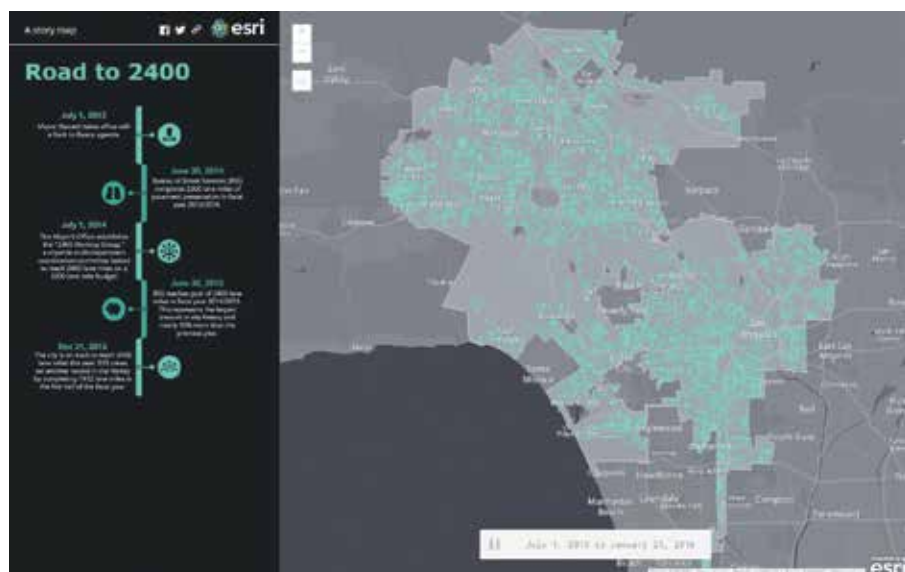
GeoHub marks the beginning of a new era of open data innovation in government. By compiling the city's disparate datasets into a single LaaS platform, Los Angeles is breaking down the barriers that cause inefficiency and is working toward becoming a smarter, safer city. With data available by way of intuitive apps, residents can play a greater role in shaping their government. And by providing opportunities for startups, Los Angeles can continue to ride its wave of high-tech innovation.



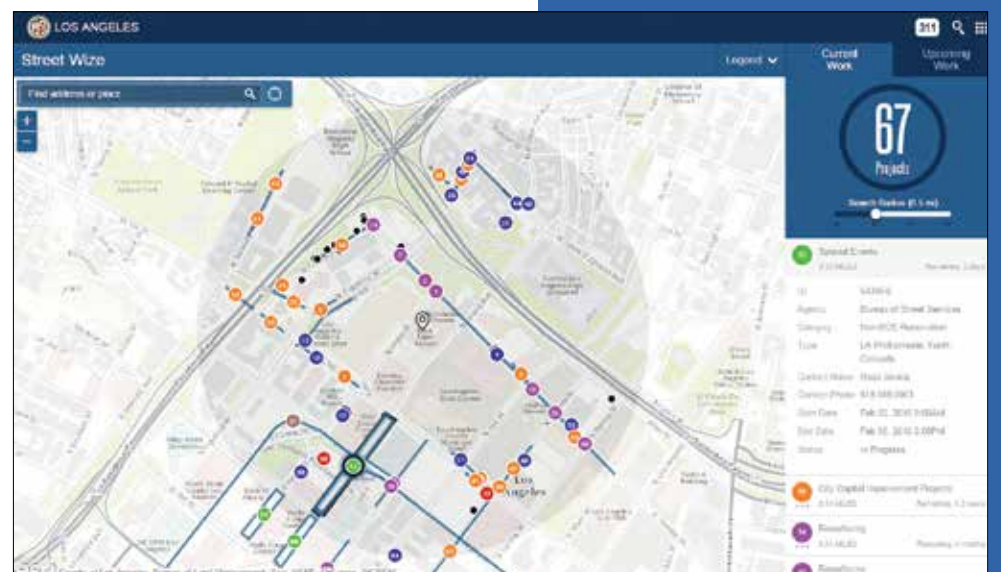
Los Angeles mayor Eric Garcetti launched GeoHub at the city's La Kretz Innovation Campus on January 29.

"Use LA as a platform; this is the best platform anywhere in the world."

Eric Garcetti, Mayor of Los Angeles



↑ The GeoHub app called Road to 2400 shows the 2,400 lane miles of streets Los Angeles was able to pave on a 2,200-lane budget.



↑ Street Wize lets Angelenos track permit and construction activity around the city.

The New ArcGIS: It's All About the Portal

ArcGIS Online, Esri's software-as-a-service (SaaS) GIS, pushes the envelope of what can be done with mapping and spatial analytics in a web browser. It sets the standard for online collaboration and managing geospatial content.

Many organizations use a web-based portal connected to ArcGIS Online to open up their catalog of geographic information to others.

Portals are intrinsically social, enabling them to become a nexus for integrating myriad data types from different sources and turning them into useful information products. They make workflows more efficient and support critical, time-sensitive decision making.

For some organizations, however, some or all of their data is proprietary or too sensitive

to expose through a public portal. These organizations, which include commercial enterprises, specialized government agencies, and nonprofits, often run their business software on infrastructure that they manage, rent, or own.

Portal for ArcGIS, which works with ArcGIS for Server, provides these types of organizations with the same collaborative solutions as ArcGIS Online deployed on an organization's infrastructure.

Getting Caught Up

When Portal for ArcGIS was first introduced, it offered similar capabilities as ArcGIS Online but not everything. Today, Portal for ArcGIS is rapidly catching up.

In 2015, Portal for ArcGIS began allowing users to create and share 3D content via web scenes and scene services. An imagery service type for publishing elevation surface data was also added. The map viewer got smart mapping capabilities as well, which lets enterprise users automatically visualize information based on the nature of the data and the basemap and helps users quickly define how data is rendered in the map.

At ArcGIS 10.4, Portal for ArcGIS has received even more capabilities that increase its parity with ArcGIS Online. Now ArcGIS users have more ways to deliver the right information to the people who need it, wherever they are—all while staying within their organization's secure environment.

Perform analysis

The Portal for ArcGIS map viewer now provides a set of analysis tools previously only available

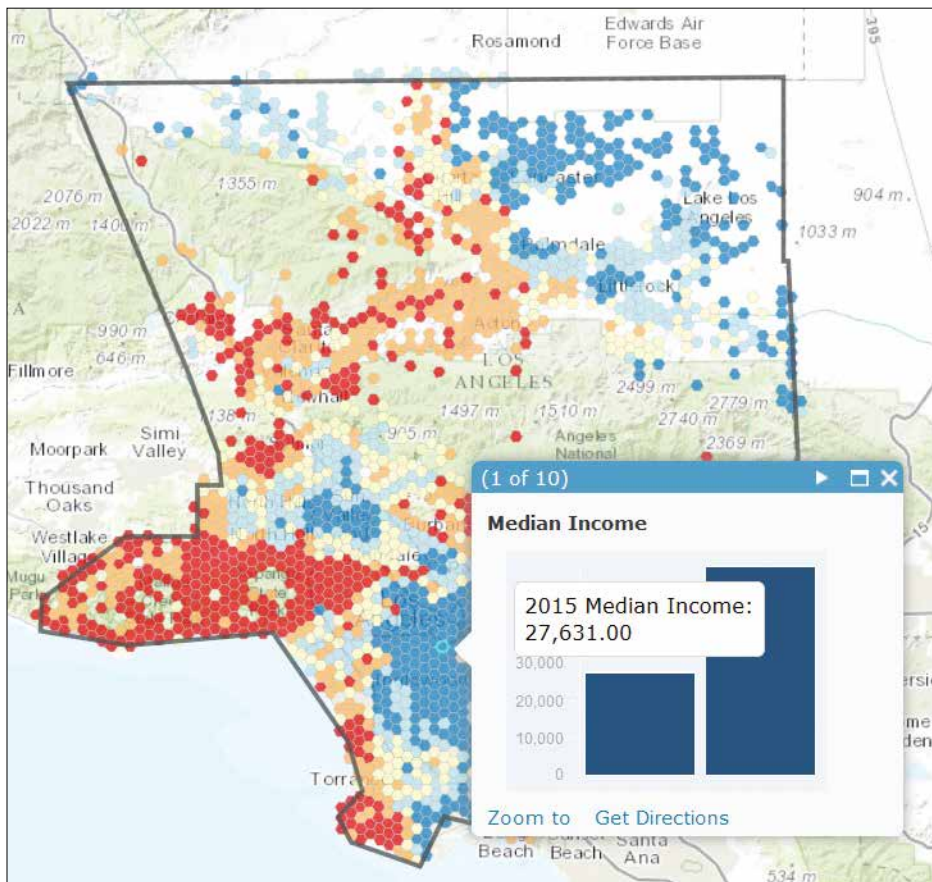
in ArcGIS Online. These spatial analysis tools, available in the Perform Analysis pane, allow users to quantify patterns and relationships in the data and display the results as maps, tables, and charts. The toolset includes nearly two dozen tools for summarizing data, finding and deriving locations, calculating density, locating hot spots, creating buffers, extracting data, dissolving boundaries, and overlaying layers.

Use standards-based metadata

To provide more information about an item than what is available on the details page, Portal for ArcGIS administrators can enable metadata for items and configure the metadata editing and viewing experience with a supported standard. This feature also applies a style to the metadata—such as the Federal Geographic Data Committee's Content Standard for Digital Geospatial Metadata (CSDGM) or the internationally recognized North American Profile of ISO 19115:2003—to support metadata standards.

Update shared items in groups

Portal members can now create groups that allow those with access to the group to update affiliated items. For example, shift workers in an operations center can update the maps underlying their apps and dashboards and be sure that employees on another shift (who are also members of the group) see and use the new information. When members share an item with a group, they remain the owner of the item. While other group members can update the item—adding layers to a map and saving the map with the updated content—only the item's owner can delete it and change its sharing properties.



↑ New spatial analysis tools allow users to quantify patterns and relationships in the data and display the results as maps, tables, and charts.

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With Drone2Map for ArcGIS, customers can use drones to quickly create orthomosaics, 3D meshes, point clouds, and other professional imagery products.

Make custom print layouts

When printing from the map viewer, Portal for ArcGIS users can now make custom layouts. Layouts are based on what the organization's print service provides, but administrators can configure custom print options that allow users to choose dynamic text options for map elements such as title, date, and time.

Configure trusted servers

At 10.4, the Portal for ArcGIS map viewer, Web AppBuilder for ArcGIS, and configurable apps fully support editing feature services secured with web tier authentication. To take advantage of this, administrators can configure trusted servers that allow Portal for ArcGIS to automatically pass through credentials.

Apps for the Portal

New and improved apps in ArcGIS 10.4 provide fast, focused, and easy ways to collect, create, and visualize maps, analyses, and reports. GIS portals, whether public or private, make it easy to share these apps in a secure and scalable environment. Portal for ArcGIS users have access to the following updated and new apps:

ArcGIS Earth

This recently developed and evolving app, which works with a variety of 2D and 3D map data formats (including KML files), is fully integrated with the ArcGIS platform, both on-premises and in the cloud. With ArcGIS Earth, users can securely access, share, and publish enterprise maps and data. Customers working inside a firewall can use the app to create their own basemaps and services that anyone using ArcGIS Earth can view.

Esri Maps for Office

The recent release of Esri Maps for Office gives

users new options for enhancing Microsoft PowerPoint presentations with interactive, dynamic maps. Users can now add time-aware layers to maps in Microsoft Excel and run an animation that shows how patterns in the data change over time. Additionally, they can filter spreadsheets to display only selected map features before using standard Excel functions to work with data subsets.

Web AppBuilder for ArcGIS

The newest version of WebApp Builder for ArcGIS has five new layout themes and 12 new widgets, as well as an improved user experience. With it, users will soon be able to create 3D apps.

Operations Dashboard for ArcGIS

At 10.4, Operations Dashboard for ArcGIS introduces a JavaScript extensibility framework that provides Portal for ArcGIS developers with the ability to extend widgets to make them compatible with desktop and web viewers.

Collector for ArcGIS

With the release of 10.4, Collector for ArcGIS works with Windows 10. An upcoming release will allow the app to support high-accuracy data collection.

Navigator for ArcGIS

This premium navigation app, which can be seamlessly integrated with Collector for ArcGIS as well as third-party apps, now works with Portal for ArcGIS.

AppStudio for ArcGIS

This groundbreaking tool that lets users easily convert maps into consumer-friendly mobile apps has been integrated with Portal for ArcGIS.

Drone2Map for ArcGIS

Drone2Map for ArcGIS (currently in beta) lets customers use drones to quickly create orthomosaics, 3D meshes, point clouds, and other professional imagery products. The app now works with Portal for ArcGIS.

Survey123 for ArcGIS

At 10.4, Portal for ArcGIS supports enterprise logins for Survey123 for ArcGIS using OAuth. This intuitive and formcentric data-gathering solution is currently in beta.

Workforce for ArcGIS

Workforce for ArcGIS (in beta), which facilitates better coordination and teamwork among field workforces, will be integrated with Portal for ArcGIS later this year.

Where ArcGIS Is Going

More and more organizations are finding that they need and want multiple GIS portals—both public and private—so they can provide authoritative GIS services and applications to specific audiences inside and outside the organization as well as across departments, regions, and continents.

Looking ahead, ArcGIS customers will see a distributed GIS platform that spans on-premises and cloud implementations. Organizations will be able to have multiple GIS portals distributed within an enterprise and across geographies—all interconnected and synchronized to enable mapping, reporting, analysis, and collaboration at local and global scales.

The new ArcGIS is just getting started.

What's New in ArcGIS Online?

The March update for ArcGIS Online included a number of enhancements and new features, such as new options for creating 3D web apps, improvements to smart mapping, and upgrades for administering ArcGIS Online subscriptions.

Here are some highlights from the release:

3D Web Apps

Users can now create 3D web apps based on a scene. Web AppBuilder for ArcGIS includes a set of new widgets and themes with specific 3D tools and layouts. These 3D configurable apps make it easier to compare, visualize, and showcase scenes.

Smart Mapping

With new map styles, users can illuminate multiple attributes in data as well as show which attribute out of several is predominant. For example, in a layer that displays crop production by county, users can see which crop has the highest value and the degree of its predominance compared to other crops. In many cases, these new styles do all the calculations behind the scenes so that users can focus on the map they want to make.

Analysis

The new Choose Best Facilities tool helps determine the optimal facilities based on user criteria. And the Living Atlas of the World analysis layers have been updated with more standard geography layers for various countries around the world.

Administering ArcGIS Online

Administrators now have more control over the security settings for their organization. They can decide whether to allow members to edit and display biographical information, as well as whether other users can choose who can see their profiles. Administrators can also select whether or not to show social media links on item details and group pages. Guides are available as well to help administrators learn more about launching, promoting, and administering ArcGIS Online.

Users themselves can manage communications from Esri through their profile page. They can sign up to receive emails about the latest best practices for ArcGIS software, GIS news in their industry, and customer stories. To do so, the ArcGIS Online account will need to have Esri access enabled.

To get all the details for this release, head to links.esri.com/agolhelp/whatsnew.

New Visualization Capabilities in ArcGIS 10.4

ArcGIS 10.4 includes exciting new capabilities for visualizing and analyzing data. This release builds on recent improvements and new features added to ArcGIS Online and ArcGIS Pro, including vector tiles, 3D scenes, and new formats for imagery.

Extending Vector Tiles

Vector tile maps download quickly, look great on high-resolution displays, and are easy to style and update. Users can customize the look and feel of vector tile maps and layers by simply editing the style of a tile layer. For example, users can change the colors for an existing map style to create a different look for the map, or provide separate styles for two different languages and then present the appropriate one to end users based on their location or preferred region.

In November 2015, ArcGIS Online introduced initial support for vector tiles by providing a set of vector basemaps as both layers and web maps. Now, with the release of ArcGIS Pro 1.2 and ArcGIS 10.4 for Server, users can generate vector tiles from their own data and share them as vector tile layers and vector basemaps using either ArcGIS Online or Portal for ArcGIS.

The vector basemaps can be displayed in most web browsers.

ArcGIS Pro 1.2 users can create and configure vector tiles. Once the vector tile layers are created, users can zip up the content into vector tile packages and upload those packages to their portals (both ArcGIS Online and Portal for ArcGIS). The vector tile package makes it easy to update and restyle vector layers because the package contains both the tiles and the style information for that layer. Users can download a vector tile package, modify the style settings to emphasize specific features based on end-user needs, and then share the new package back to the portal for others to use.

Custom web apps built with ArcGIS API for JavaScript and ArcGIS Runtime SDKs can consume vector tile layers and vector basemaps by loading the web map or adding vector tile layers directly to the map. Developers can customize the style and contents of the map by, for example, turning a layer on or off.

Later this year, vector tile maps will be available in more desktop and mobile apps as well.

A local scene displays slices of geography in a projected coordinate system.



New Ways to Visualize 3D

ArcGIS customers can share 2D and 3D information in standard, scalable formats that allow the same maps and scenes to be reused by multiple clients. At ArcGIS 10.4, customers get new ways to visualize 3D data.

Global scenes, which comprise the Scene Viewer's primary environment, display 3D content in a global coordinate system (WGS84), shown in the form of a sphere. This global canvas is well suited to data that extends across large distances and where the earth's curvature must be taken into account.

At ArcGIS 10.4, Scene Viewer also contains a new local scene view. Local scenes are better suited to small-extent data (for a college campus, for example) and allow the display of layers in projected coordinate systems. These local views can also be very effective for scientific and underground data display, where the relative size of features is a more important display requirement than the physical location of the content on a spheroid.

To improve the performance and visualization of large point datasets (including preset symbols), 3D point layers can now be shared in Portal for ArcGIS 10.4 as scene layers. 3D point layers can be shared as individual web scene layers or as part of a web scene and then used in ArcGIS Pro or Scene Viewer.

At 10.4, content creators can style and publish attribute-based symbology for 3D object layers using ArcGIS Pro. This same capability will be available in other styling and authoring applications later this year.

Packaged Sharing

Mobile map packages allow users to zip up and share basemaps and operational layers in one bundle. This new format supports high compression if the content is delivered as read-only layers. Operational layers can be queried and analyzed within the map viewer and used in

specialized apps, such as Navigator for ArcGIS. At ArcGIS 10.4, ArcGIS Pro 1.2 users can create and publish mobile map packages in Portal for ArcGIS and ArcGIS Online. Later in 2016, a wider array of apps will support mobile map packages as well.

Imagery Gets Augmented

ArcGIS 10.4 includes numerous enhancements to imagery classification, processing, and management. ArcGIS now supports an even wider range of satellite sensors, including Sentinel-2, SPOT-7, WorldView-3, and a variety of Chinese sensors. Additionally, customers who work with massive volumes of imagery can use two new formats: Meta Raster Format (MRF) and Cloud Raster Format (CRF).

MRF makes it easier to store large volumes of imagery and rasters in the cloud. It reduces the cost of storage and enables users to access imagery quickly. MRF uses Amazon Elastic Compute Cloud (EC2) making it simple to scale.

CRF is optimized for analytical results and allows users to do parallel processing of rasters on multiple machines. A base implementation of CRF is included in ArcGIS 10.4. This format will be a key part of new raster analytics capabilities coming later this year.

More Impressive Capabilities

The release of ArcGIS 10.4 introduces many ways to effectively communicate the nuances and patterns that exist in all data. Vector tile layers improve the quality and performance of digital maps. Local scenes provide practical virtual environments that anyone can use to explore and better understand their data in context. And imagery—no matter where it comes from—is getting easier to use and manage.

These improvements with ArcGIS 10.4 are setting the stage for even more impressive capabilities coming in subsequent releases.

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Preserving Machu Picchu

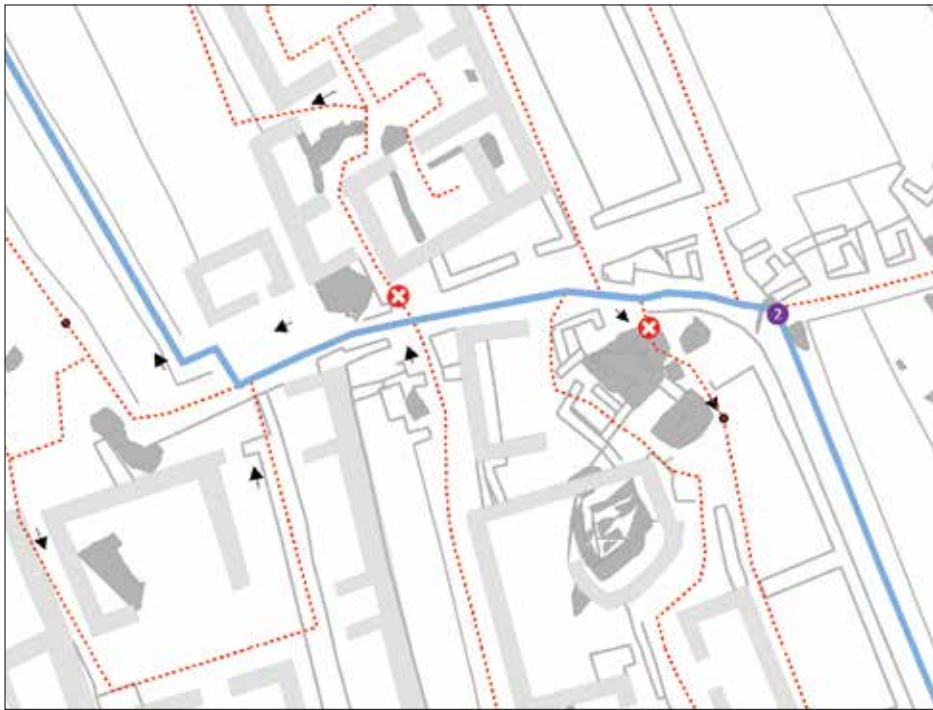
GIS Helps Monitor, Balance Out Visitor Movements at Peruvian Archaeological Site

By Douglas C. Comer, William Megarry, and Bryce Davenport, Cultural Site Research and Management

Archaeological sites are popular tourist destinations. But large numbers of visitors often present unique management and conservation challenges. High volumes of tourists can create congestion, which can harm the visitor experience. Archaeological sites are also vulnerable to erosion and damage caused by large numbers of people.

In 2015, the Peruvian Ministry of Culture wanted to conduct a study to see how many visitors could safely visit Machu Picchu at one time without damaging the sanctuary or diminishing the tourist experience. Cultural Site Research and Management (CSRM), the organization tasked with carrying out the study, used a combination of infrared sensors, visitor observation, 3D modeling, network analysis, and mobile and web-based GIS to assess and improve movement around one of the most visited archaeological sites in the world.





↑ Researchers used ArcGIS Network Analyst to record tourists' typical visit times along paths and in significant locations at Machu Picchu, making it possible to explore alternative routes.



↑ The research team produced a raster heat map that shows congestion around Machu Picchu at different times based on actual numbers of visitors.

An Enigmatic Tourist Destination

While some archaeological sites, such as the great city of Angkor in Cambodia, can accommodate many millions of visitors every year, others are far more sensitive. In extreme cases, like at the cave paintings found in southern France and northern Spain, sites have been closed to the public to protect the relics from damage. That is because each archaeological site has a unique carrying capacity—the number of visitors able to safely visit it at any one time without damaging the site or constricting visitor experience.

The great Inca citadel of Machu Picchu is one of the most stunning and iconic archaeological sites on the planet. It was built in the mid-fifteenth century, never discovered by the invading Spanish, and abandoned at the beginning of the sixteenth century. It was rediscovered amid dense forest by American archaeologist Hiram Bingham III in 1911 and now attracts hundreds of thousands of visitors every year. In 1983, the stunningly beautiful and enigmatic place, shrouded equally in cloud and mystery, was inscribed as one of the first UNESCO World Heritage Sites.

Machu Picchu is a complex site where visitors are free to stay as long as they wish and explore many kilometers of paths, roadways, and open spaces without a guide. Some tourists arrive at the site via bus from the local town, while others reach it on foot from one of the sanctuary's Inca Trails.

At 6:00 a.m., when the site opens, there is a huge rush of visitors—many of whom come to watch the sunrise. By lunchtime, however, 80 percent of tourists have left the site, and afternoon visitors are often treated to a nearly empty citadel.

This suggests that balancing out visitor flow over the course of each day, so that people do not arrive in large waves, would lead to less crowding and a more uniform distribution of people throughout the site. As such, understanding how people get to and move around the site was central to establishing a carrying capacity.

Monitoring and Mapping Congestion

CSRM used three methods to record visitor

flow: giving visitors different-colored stickers depending on when they arrived, tallying tourist numbers using infrared counters, and making qualitative assessments of visitor behavior.

Each tourist who entered Machu Picchu during the study period was given a time-specific sticker according to what time he or she arrived. For example, people who entered between 6:00 a.m. and 8:00 a.m. got blue stickers, those who arrived between 8:00 a.m. and 10:00 a.m. received red stickers, and so on. These easily discernible stickers allowed researchers to visually track people around the site and see how long they stayed, as well as how often people revisited key points like temples or certain vistas.

Researchers also placed infrared counters at strategic locations around the citadel. These recorded the number of people who broke the infrared beams every hour, providing data on which areas and paths were busiest at different times of day.

To evaluate the locations and density of visitors, researchers used ArcPy [a Python site package] to develop a geoprocessing tool that parses the sticker and counter data from comma-separated value (CSV) files, interpolates it using ArcGIS 3D Analyst, and then georeferences it to the architecture of the site. This produces a raster heat map, which uses a set color scheme and shows congestion at Machu Picchu at different times based on actual numbers of visitors.

This process can be scheduled to produce a day's worth of heat maps in just a few minutes. The tool made it possible to visually compare how timed entrants move around the site (based on the color of their stickers) and how these correspond to overall congestion (using the infrared sensors).

While these approaches were valuable, they did not directly reveal information about congestion, which is a much more experiential phenomenon. Thus, the team employed a third technique: using Collector for ArcGIS to record real-time congestion data.

The guards at Machu Picchu installed Collector on their smartphones to periodically record how crowded key congestion hot spots were—sparsely congested, moderately

congested, or very congested. These assessments were time-stamped and recorded on a real-time web map made using ArcGIS API for JavaScript. Intended for ongoing use, the web map compares live quantitative data (exact numbers) with live qualitative observations (congestion levels), enabling the site manager to get a real-time view of crowding. Tour guides and visitors can access the web map as well to better plan their visits around congestion spots. Additionally, the map is designed to archive itself every hour to keep a permanent record of visitor numbers over time.

Researchers also used ArcGIS Network Analyst to generate a geometric network for Machu Picchu. Although typically used for traffic modeling, the ArcGIS Network Analyst extension was ideal for the citadel. Because the vast majority of visitors use a guide when they go to Machu Picchu—and tours tend to stop at open spaces and in key buildings or locations around the site—experienced tour guides have a good idea of how long people spend in specific areas. So the research team consulted these guides to find out typical visit times along paths and in significant locations. Putting these into the geometric network—applied as costs—made it possible to explore alternate routes, what could happen by changing the directionality of some paths, and what the effects would be if parts of the citadel were closed at certain times.

Flexible Crowd Control

Pairing observational methods with mobile and desktop GIS enabled CSRM to better understand how tourists tend to visit Machu Picchu and what the site could do to curb congestion.

While CSRM set out to determine the specific carrying capacity for Machu Picchu, GIS helped researchers discover that it varies depending on a slew of different factors, such as the weather, visitor demographics, and the time of year. Thus, Machu Picchu's carrying capacity needs to be continually monitored.

To alleviate overcrowding, CSRM suggested that the archaeological site implement a permanent geospatial monitoring system (based on the tools used during the study) that can record

visitor movement and congestion over time. The organization advised periodically assessing the data to change routes when necessary and even offering alternative visitor experiences—away from congestion areas—that would change the way people move around the site.

Continued Crowd Mitigation

CSRM's project at Machu Picchu proved that GIS can be used to continually mitigate crowding and damage at popular archaeological sites—especially those that are prone to varying visitor numbers and whose site infrastructure is in danger of being altered by sightseers.

As more people take to traveling around the world to experience its wonders, important archaeological sites are at ever-increasing risk of irreparable damage. Researchers at CSRM hope to soon test the GIS-enabled techniques they employed at Machu Picchu on other sites to ensure not only their preservation but also their continued accessibility.

For more information, email Douglas C. Comer at dcomer@culturalsite.com.

About the Authors

Douglas C. Comer is president of Cultural Site Research and Management (CSRM) and the CSRM Foundation, as well as president of the International Council on Monuments and Sites (ICOMOS)/International Committee on Archaeological Heritage Management (ICAHM). William Megarry, a GIS specialist and archaeologist, is currently an ELEVATE Government of Ireland postdoctoral scholar at CSRM and Johns Hopkins University, where he is developing tools to detect and manage cultural heritage using aerial and satellite remote imagery. Bryce Davenport is a GIS specialist and archaeologist with CSRM, where he has worked on research projects funded by the NASA Research Opportunities in Solid Earth Science (ROSES) program; the US Department of Defense Legacy Resource Management Program; and governments in Peru, Moldova, Sudan, the Dominican Republic, and the United States.

Preserving Indigenous Lands to Ensure a Collective Future

GIS Hero



↑ Richard Chase Smith

He has dedicated his life's work to indigenous peoples and their land rights. He counts conservation among his passions as well—though, at times, the two have come into sobering conflict. With GIS, however, he has ironed out some of those wrinkles and produced extraordinarily innovative work on indigenous communities' landholdings and histories.

Richard Chase Smith is an American who has made his home

in Peru for most of the last five decades. As executive director of the Instituto del Bien Común (the Institute of the Commons, or IBC), he advocates protecting and preserving what is common to human existence—water, air, land, forests, fisheries—even culture. He believes that, in many cases, indigenous peoples are the natural stewards of these vital resources and customs.

"The whole story begins with indigenous peoples," he said. This is true both around the globe and on a personal level for Smith.

In 1966, as a fresh graduate of Dartmouth College with a degree in geography, government, and economics and a curiosity about land reform in Latin America, Smith joined the fairly nascent Peace Corps in Peru.

"I ended up on the eastern side of the Andes in a small, originally German settlement, working in a land reform office in that town," he recalled. "One of the cases that I got involved in almost immediately was a big conflict between a community of indigenous peoples...and the Catholic Church."

The case involved the Yaneshya people, speakers of the Arawak language. They were living in forested areas of the eastern Andes mountains, where a Catholic mission had also been for more than 100 years. The Catholic Church was fighting this small community of original peoples for control of the land.

Smith traveled throughout this upper Amazonian region to visit other Yaneshya settlements. He soon found out that every group was having land issues. And the Peruvian government, which deemed the Yaneshya people *chunchos*, or wild peoples, was uninterested in their situation.

Smith recorded data (such as population statistics and land conflicts) about the Yaneshya people and hand drew maps of their settlements. He got land reformers to start paying attention to these original peoples.

After talking to a number of younger and elderly Yaneshya people, Smith realized that the different groups needed to unite around their shared cause. He visited 24 far-reaching settlements and convinced the groups to meet on July 1, 1969, to talk about the situation and ways to confront land tenure insecurity.

It was an amazing success. People walked for days to get there, and the more than 100 participants agreed to establish an inter-community organization and make the president of Peru aware of their peril. They did both, and that marked the beginning of land rights work for Amazonian peoples in Peru.

To see if he could be of more help, Smith enrolled in a PhD program in anthropology at Cornell University under the tutelage of John Murra, one of the pioneers of Andean anthropology. After completing his coursework, Smith returned to Peru to do his thesis with the Yaneshya people—specifically, on their oral history, social relations, and how they use music to understand *cosmovisión* (how Mesoamerican peoples perceive and interact with

time and space). He also continued to work on land issues, helping to get a law passed that recognized indigenous peoples' land rights.

During this time, Smith discovered the Yaneshya peoples' remarkable vision of their landscapes.

"They have this incredible system of epic narratives, each narrative having 10, 20, 30, 50, 100 chapters—all depending on memory and passed on orally," Smith said.

But it was not myth—something that many people believe to be untrue—that was being conveyed.

"This was actually history that they were talking about—past leaders who had gained incredible importance in their lives, incredible powers," he continued. "I began realizing that these epic narratives were all related to landscape, and that these place-names were markers of where certain things in this oral history took place."

Smith began collecting information on this rich knowledge. But he was frustrated that there was no good way to store the information and display it on maps.

After finishing his thesis, Smith returned to the United States for postdoc work at Harvard University. He then took a position at Oxfam America in Boston, where he and some other program officers set up an on-site program in South America that focused on indigenous peoples.

In 1988, Smith moved to Lima, Peru, to lead the program. That same year, he went to an exposition of maps put on by the United States Agency for International Development (USAID) and the Peruvian government where they showcased, for the first time, GIS.

"It was an epiphany for me," he said. "That was my dream!"

GIS was exactly what Smith had been looking for: a repository for the Yaneshya people's place-names, landscapes, and oral histories. A project that he continues to work on today, it is beginning to revolutionize how the world views the role of Amazonian cultures in ancient civilization.

GIS would help his land rights work as well.

Five years later, Smith presented a paper at the Esri User Conference on the possible uses of GIS for indigenous peoples. Charles Convis, now the Esri Conservation Program coordinator, noticed how insightful Smith was about the importance of indigenous communities in any conservation endeavor.

"It's the folks at the very local level who most truly understand what's going on and what needs to happen," reflected Convis.

Contrary to what many people think, indigenous peoples are not the adversaries of conservation. They understand how nature works in ways that others don't.

The same goes for Smith and his knowledge of how indigenous peoples care deeply for and conserve their land.

"He speaks from a depth of experience that's not common," said Convis.

Smith was given a complimentary copy of *ARC/INFO*, which he took back to his research groups at Oxfam so that they could learn to use it immediately.

Shortly thereafter, the group did a pilot study using GIS and GPS to map the lands of the Witoto and Bora peoples around the Ampiyacu River in the Peruvian Amazon. This gave rise to the Native Communities Information System (*SICNA*), a project that, by the end of 2016, will have mapped more than 2,000 native communities in the Peruvian Amazon.



↑ The interactive LandMark map displays shapefiles that show indigenous and community lands all over the world.

By the year 2000, Smith and his newly founded organization, IBC, were producing novel maps of Peru that displayed government-recognized indigenous lands.

"We could begin showing the conflicts between indigenous lands and mining concessions or petroleum concessions or even conservation areas established on top of them," he said. "That was kind of a revolutionary moment here in Peru, when people could begin to visualize those kinds of conflicted relationships."

Just a few years later, Smith and some of his land rights colleagues in the region started the Red Amazónica de Información Socioambiental Georreferenciada, or RAISG, to create Pan-Amazonian maps of indigenous peoples and protected areas. And RAISG is still going strong.

"It's not easy to get mapping groups to come together, partly because people are so protective of their information," Smith said. "As far as I know, we are the only regional mapping group in the world that's stuck together."

The deliberations that were required to get RAISG off the ground paid off tremendously, as RAISG is now a model for an even more ambitious project.

In 2013, at a meeting of select thought leaders on land tenure security for communities and indigenous peoples around the world, Smith volunteered with Peter Veit of the World Resources Institute to head a work group on documenting and mapping community lands. The two of them wanted to build a global platform that allowed people to visualize community and indigenous landholdings all over the world.

In subsequent meetings, the idea stuck. And after two years of vigorous work with a number of international partners to gather information on indigenous and nomadic land claims and uses, the group launched LandMark (landmarkmap.org) in November 2015.

The interactive map shows data at two different levels. First, there are detailed shapefiles of indigenous and community lands. Second, there is country-level data, which shows the percentage of each nation's landmass that is under some kind of community or indigenous control, as well as an index that details each country's laws about land rights for indigenous peoples and/or communities.

"It's a work in progress, and it's going to be a work in progress for years to come," acknowledged Smith.

But, little by little, Smith and his colleagues are getting organizations and government entities to share their data on indigenous and community lands. This puts pressure on world governments and international institutions to respect those lands and the resources of original peoples.

"We push for recognition of communal landholdings not so much to preserve the past but to give security for a future," said Smith. "All of our future."

Documenting Land Rights in West Africa

Rural Communities Use GIS to Map Land and Conserve Rain Forests

By Jamil Hasan, Thomson Reuters

The communities around Sierra Leone's Outamba-Kilimi National Park, near the northern border with Guinea, have survived off the region's lush rain forest for generations. But rapid deforestation—fueled by slash-and-burn agricultural practices, bush fires, hunting and poaching, logging (often illegally), and small-scale mining—is ravaging the area and other parts of the Upper Guinean rain forest, which is home to hundreds of bird species; several primate species; and many other animals, including the endangered pygmy hippopotamus. Although the forest once covered much of Sierra Leone, southeast Guinea, Liberia, southern Ivory Coast, and parts of Ghana, only an estimated 10–15 percent of it now remains.

To conserve what's left of the rain forest, the US Forest Service's International Program (USFS-IP) launched Sustainable and Thriving Environments for West African Regional Development (STEWARD) to present local populations with alternative livelihood options. Funded by the US Agency for International Development (USAID), the regional program—now in its third phase—teaches communities and sustenance farmers in Sierra Leone, Guinea, Ivory Coast, and Liberia how to sustainably manage forests while pursuing environmentally friendly vocations.

One of the major challenges of forest conservation in these areas, however, is figuring out who controls what. In remote areas such as the Upper Guinean rain forest, land is owned by local chiefs and tends to be leased out by word of mouth, so no official registers, or cadastres, exist to delineate who is responsible for various parcels. What's more, the boundaries of community forests—which provide clean water, hunting grounds, and other resources to local communities—had never been mapped. Thus, communities were unaware of how much of the forest had been destroyed by logging, mining, farming, and other activities. Without that knowledge, communities could not develop strategies to use the forest's resources sustainably.

That is why, from 2012 to 2015, Esri partner Thomson Reuters ran a GIS center in Sierra Leone's capital of Freetown—as well as three mini GIS centers in Liberia, Guinea, and Ivory Coast—to help local communities document their land and property rights.

Insufficient Land Records

When STEWARD was launched in Sierra Leone, land records left much to be desired. During the country's 1991–2002 civil war, a considerable number of land records were destroyed (though they weren't all accurate in the first place). And none of the customs that dictated land and resource rights in the forest—which were based on complex relationships among the various clans, settlers, and immigrants living in the area—had ever been recorded.

Traditionally, local communities in the forests have used natural landmarks, such as big trees or prominent streams, to define the boundaries of their land. Thus, if a family had been given permission to farm the land between two mango trees but one of the mango trees got cut down decades later, the family would struggle to prove that the land was theirs.

As Sierra Leone opens up to foreign investment in logging, mining, and agribusiness, swaths of unmarked rural land have been leased and sold to companies without communities' support and, at times, without their knowledge. In some cases, this happens because chiefs, who don't have accurate maps, promise companies sections of land without fully knowing whether that land is theirs to sign away. So rural communities lose their land—and sometimes aren't even compensated for it. If land disputes do arise, the government currently lacks the capacity to survey land or resolve disagreements near Outamba-Kilimi, so land-based conflicts fester.

Documenting Landholdings in the Forest

Thomson Reuters used GIS to determine target areas for documenting local land and property

rights. After the target areas had been determined, USFS-IP ran education programs on land and property rights for volunteers from each community while Thomson Reuters taught them how to use its own program, Aumentum OpenTitle. OpenTitle enables users to record de facto land holdings and furnish documentary evidence of those land rights. It has ArcGIS Engine built into it, allowing users to incorporate dynamic mapping and GIS capabilities.

When the volunteers were trained, they went back to their communities to begin registering property rights. After speaking to other community members about the importance of recording land usage agreements on paper, the volunteers administered surveys to each household to get information about the size of its plots of land and which resources it could access from them. When neighbors disagreed on land boundaries, the volunteers helped mediate and recorded the resolution in OpenTitle. They then took photos of people on their land and of the landmarks that demarcated the plots. The volunteers also used handheld GPS devices to map the boundaries of each household's land and the community forests.

This data—along with satellite images and information garnered from conversations with community elders—was aggregated at the mini GIS centers using ArcGIS. The resultant maps detailed the land and resource rights of each community and all the households within it. Once everything was compiled, each household received a set of papers that contained maps and pictures of its plots of land. Additionally, each village came to know the size of its community forest. Now residents of the Upper Guinean rain forest can resolve land disputes using written records rather than memory and land rights can now be passed down from generation to generation.

What's more, for the first time, the government has a complete record of the local forest and which plots of land and resources belong to specific communities. Although these papers

are not official government documentation of land rights, the government organizations that oversee land and forestry issues were consulted while developing the methodology used to document properties. The data was also formatted to align with other government materials so that it could be easily incorporated into official government documents.

Using the Forest Sustainably

Now that communities know the size of their land, what it contains, and the value of their natural resources, they can plan how to use the forest sustainably. With the help of STEWARD and its partners, communities are now beginning to engage in forest comanagement, which focuses on collectively managing the forest as a shared resource rather than relying on more traditional, top-down administration.

Villages near Outamba-Kilimi have formed forest management committees that include men and women of various ages who meet regularly to discuss how to use their land sustainably. Gradually, community members are instating environmentally friendly activities in their forests, from fostering honey production, cultivating medicinal plants, and cutting back on slash-and-burn agriculture to using farming techniques like crop rotation to keep the land fertile.

Local communities in the area are now starting to have serious conversations about preserving the forest for their children and their children's children, in large part because the new maps of their land and the forest show what they have to save. Moreover, community members are finally empowered to stand up for themselves and their land in the face of pressure from companies looking to invest in the region's natural resources.

For more information, contact Jamil Hasan, project manager for Thomson Reuters, at jamil.hasan@thomsonreuters.com.



Local communities in the Upper Guinean rain forest have traditionally used natural landmarks, such as big trees, to define the boundaries of their land. But as Sierra Leone has opened up to foreign investment, communities have struggled to prove that the land is theirs.

A Vital Tool for Forest Management

US Forest Service Deputy Chief Ranks GIS as Mission Critical

Forests in the United States are under threat. Fire is changing the nation's forest landscape, while forest health is succumbing to warmer weather patterns.

Faced with challenges of such magnitude, James E. Hubbard, the deputy chief for state and private forestry for the US Forest Service (USFS), believes that GIS is the key to forest management.

"Natural resource management in the United States, and particularly forest management, would not be possible today without GIS," he said.

Hubbard is responsible for fire and aviation management, cooperative forestry programs, forest health protection, conservation education, urban and community forestry, and the Office of Tribal Relations. He formulates his thinking on the premise that everything in the forest is geographically based. Thus, decision-making processes—from planning fire management to policy making—must incorporate scientific geographic analysis.

"GIS is mission critical for fire management and response," Hubbard said.

Having direct responsibility for 193 million acres of national forest (which is just a small part of the nation's total forestland), the USFS reaches out to private forestland owners to help them manage their properties more effectively. The agency also works with communities to aid them in building public policy. And GIS underpins all this work.

Managing Wildfires Comprehensively

Today, forest fires are hotter and bigger than they used to be, and real estate is more at risk. Firefighting has become more complex and expensive, and firefighting practices need to be on the cutting edge.

Consider air tankers, one of the Forest Service's primary fire attack resources. They drop fire retardant to keep fires from spreading. But some forest animals can't tolerate the pink slurry. While the retardant can keep flames from spreading across the forest canopy, it can be harmful if washed into streams that are home to endangered species, such as the bull trout. Air tanker pilots need to avoid waterways so that their retardant doesn't negatively impact species. They also need to keep it away from areas where rainfall could wash the retardant down into streams with sensitive fish populations.

Avoiding waterways seems simple enough. But during a fire, vegetation and smoke obstruct ground visibility. This complicates the mission.

To assist, the USFS creates maps that show where endangered species are located and where fire retardant could be washed into their habitats. Using endangered species data from the US Fish and Wildlife Service—along

with waterway data; topographic information; and (if available) information on terrain pitch, existing contaminated areas, wind, and drift—the Forest Service generates ArcGIS maps that show the areas pilots should stay away from. The agency then loads the resultant app onto a laptop that pilots carry with them so they can see pertinent information for any section of ground they cover. To keep track of environmental impacts, the USFS maps out where fire retardant was dropped as well.

The Forest Service also partners with the US Department of the Interior in the LANDFIRE program, a decision support system for wildfire management. Using GIS to manage annually updated survey data, the program produces maps about vegetation and fire fuel characteristics across the country. It includes weather factors and predicts potential wildfire activity 10 days out.

With LANDFIRE, firefighters and land managers know what to expect, which actions to take, and their probability of success. They know how to best position fire suppression resources and set priorities for hazard reduction activities, such as removing fuel and conducting controlled burns. All that leads to better approaches to fighting fires, managing risk, and ensuring successful outcomes.

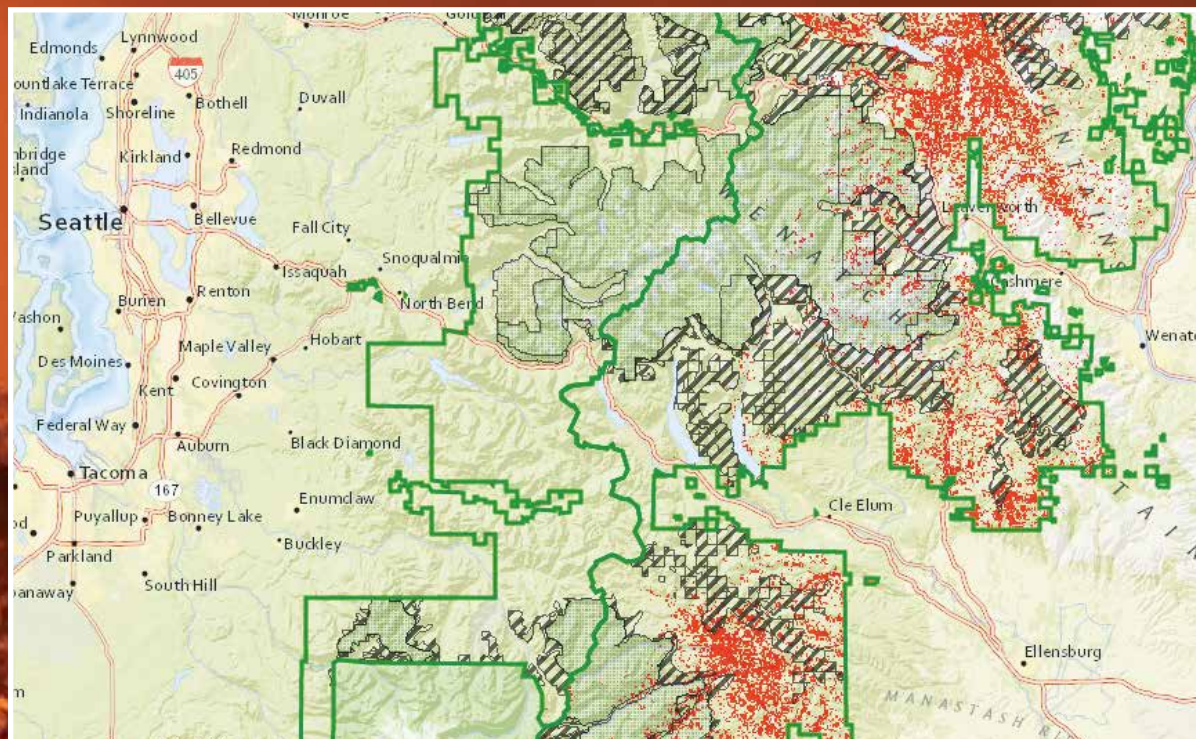
Additionally, when a wildfire is burning, nearby residents want to know where the fire is headed, how much of it has been contained, where to evacuate, and how long it will be until they can return to their homes. The Forest Service provides fire risk information to communities affected by specific wildfires, keeping the public informed during the fire rather than having everyone wait until the fire is out.

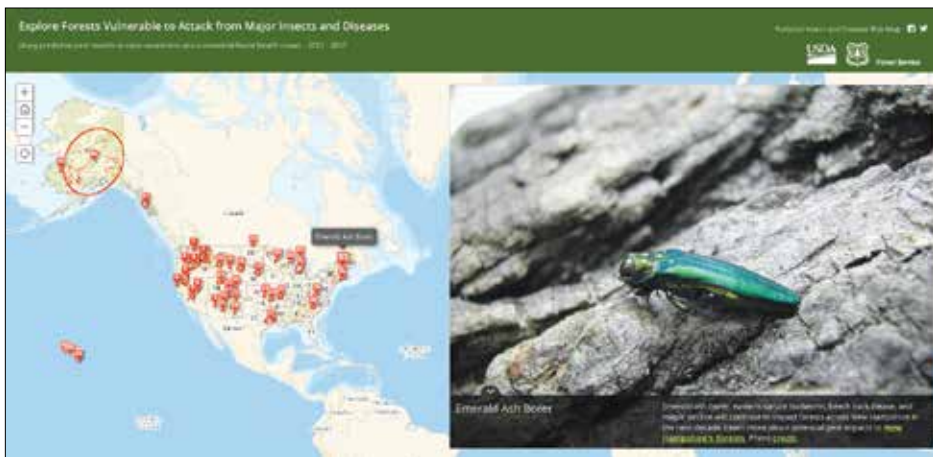
To do this, the USFS distributes status information via ArcGIS for Server and conveys that data through web apps built on Esri technology. The Forest Service's Active Fire Mapping Program website, for example, contains maps, satellite fire detection data, and fire data web services that the public can access anytime.

Keeping Track of Forest Health

Monitoring forest health is another major Forest Service endeavor. Forests evolve and require distinct management approaches at different stages of life. A forest that has been burned, for example, is less vigorous and at greater risk of fire. Forests at the onset of regeneration are prone to attracting insects and disease. New forests also consist of different vegetation than the ones that preceded them, meaning that they require new management strategies.

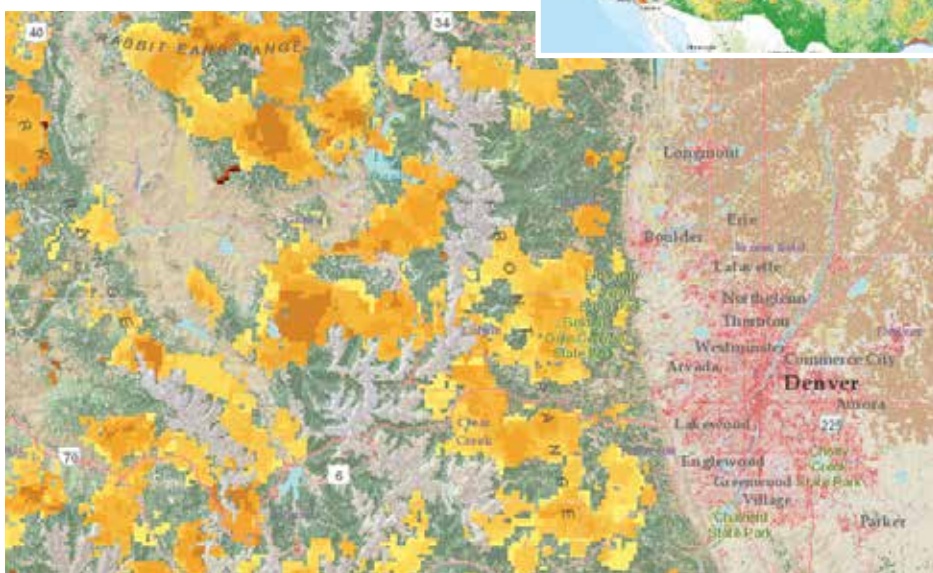
→ The US Forest Service produces maps that display insect and disease risk, such as this one for the Pacific Northwest. Stripes denote wilderness lands, and red indicates infestation.





↑ This Esri Story Map app lets users click on various locations to see insects that affect forests in those areas and learn about diseases that are contributing to forest decline. (Photo courtesy of the Pennsylvania Department of Conservation and Natural Resources–Forestry.)

→ The Wildfire Hazard Potential map helps firefighters and land managers set priorities for hazard-reduction activities.



↑ Using maps like this one, which illustrates fire potential and forest risks from insects and disease, the USFS helps private forestland owners manage their properties and works with communities to build public policy.

Each year, the USFS creates a forest health assessment for 500 million acres of forestland that shows statuses, trends, and changes. ArcGIS drives these assessments by keeping track of ground plots and surveys, aerial surveys, and other data sources. With this information, the USFS studies forest change and analyzes causes and effects, ultimately evaluating forest resilience.

Using 85 years' worth of forest data—plus the geospatial information contained in LANDFIRE—the Forest Inventory and Analysis Program (FIA) produces hundreds of geospatial models that show forest change over time and what is currently happening with the nation's forests. It also compiles projection models that illustrate a forest's future.

With this, the USFS brings scientific information to the table for policy building that is digestible.

"GIS is becoming the underpinning of the dialog that has to occur in order for Congress, the administration, and public land managers to make decisions," Hubbard said. "Decision makers feel good about that kind of dialog. It gets people who have different views, principles, and expectations to find common ground and move forward."

Addressing policies on wildfires, forest health, and climate change must be done on a large scale—on the level of the whole landscape. Maps open a discourse with federal and state legislatures. They create the basis for talking with national forest supervisors about federal priorities and understanding the reasons why one area might be more important than another. Maps also help forest managers pick topics specific to a particular region and open them up for discussion with the community.

Contextualizing Forestland

For private landowners to envision the environment beyond their own properties, their land needs to be put into context. At one time, Forest Service managers wrote their forest plans before inviting people to talk about them. These plans were built on managers' interpretation rather than taking everyone's concerns into account. Sometimes, when people didn't like the plan, they would challenge the Forest Service's management actions—even to the point of going to court to stop the agency from implementing its plans.


Most USFS managers don't take this approach anymore, though. Instead, the agency's larger picture is drawn from real data and mapped in a way that people can understand it, talk about it, and interact with it.

For example, the USFS created an insect- and disease-risk story map that is publicly accessible. The map spans the United States, and users can click on various locations to see insects that affect forests in those areas and learn about diseases that are contributing to forest decline.

Tools like this help foresters have dialog with the public before creating their plans. And, according to Hubbard, the USFS could not have opened up discussions without GIS.

"It helps people visualize, understand, [and] see the differences, trade-offs, and opinions," said Hubbard. "It enables them to come together and mutually decide on the outcomes they want."

With GIS contextualizing forestland dynamics for land managers, firefighters, policy makers, and the public, everyone is more capable of protecting and preserving America's forests as well as preparing for any more changes to come.




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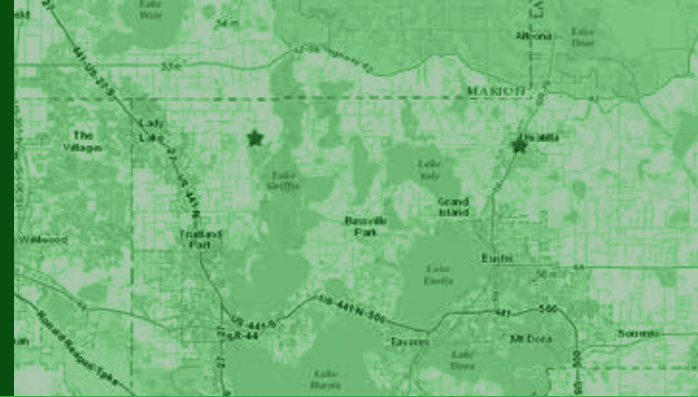
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Crowdsourcer Reporter Keeps Florida County Beautiful

How Lake County Citizens Use Customized App to Clean Up Litter

By Sue Carroll, Lake County Board of County Commissioners



For most of its history, Lake County, Florida, was a rural community of clean lakes and citrus groves. Agriculture was the mainstay of its economy, and in the 1980s, it was considered a rural getaway from adjacent and fast-growing Orlando.

In the late 1980s, however, the county suffered a major blow to its citrus crops when two freezes killed off many of the groves. During the building boom of the 1990s and 2000s, development soared as grove owners turned their unprofitable agricultural lands into highly profitable housing developments.

As Lake County's population increased, the board of county commissioners was determined to maintain a quality of life in the area that would be attractive to residents and visitors alike. Part of this entailed keeping the county clean and litter free. So the county set out to get citizens involved in the project, and, as the board of commissioners quickly found out, the easiest way to do this was to use Crowdsourcer Reporter app from Esri.

Collecting, Prioritizing, and Using Community Data

To advance this initiative, Lake County recently became a local affiliate of Keep America Beautiful, a nonprofit that helps communities clean up litter and improve

recycling. To do this, the county founded Keep Lake Beautiful, a volunteer organization whose mission is to beautify the area by engaging the community.

To start, the organization needed to determine which areas of the county are of most concern for addressing litter and other unsightliness. It also needed to figure out how to collect, prioritize, and utilize this information to facilitate local efforts to manage it.

The executive director of Keep Lake Beautiful approached Lake County's GIS division with these challenges and asked if there was a way to allow citizens to report areas of litter and map them for easy monitoring. After determining specific needs for the project, the solution was obvious: Keep Lake Beautiful would use Crowdsourcer Reporter, a configurable, web-based app template from Esri that allows citizens to submit data about areas of concern, as well as map them and attach photos to illustrate the problem.

A Simple Way to Report Litter

Lake County residents and visitors can access the Crowdsourcer Reporter app online via a link on the Keep Lake Beautiful website or from the Lake County GIS division's Interactive Maps & Apps Gallery. With the app, users can click the Report

Litter tab to see all the litter sites recently submitted or under review. To submit a new report, users click the Submit a Report button, fill out a short form, identify the area on a map, and click the Report It button. They can document litter, graffiti, illegal signs, and abandoned vehicles. If a site has already been identified, other citizens can click Like in the app so the site garners more attention.

To make sure the app was compatible with Keep Lake Beautiful's needs, the GIS staff not only created the feature service for the collected data but also downloaded the code for Crowdsourcer Reporter to further customize the basic template. The GIS team added pertinent logos and map marker symbols, created a help section to assist new users, and manipulated the display for the information being collected. For example, the litter reporter does not display submitters' names or contact information, the description field, or any photos sent in—even though the basic template has those capabilities—to prevent any misuse of the information or public embarrassment.

Meeting Actual Needs

Keep Lake Beautiful monitors submissions and proposes cleanup efforts and community events as needed. The more map

markers added to one area or the more Like clicks submitted for a particular site, the higher the priority becomes for community action. As sites are cleaned up, they are removed from the map to ensure that citizens only see current areas of concern.

"This technology allows us to reach out to the community with a user-friendly interface and allows Keep Lake Beautiful to mobilize its volunteers more effectively," said Brian Sheahan, the executive director of Keep Lake Beautiful.

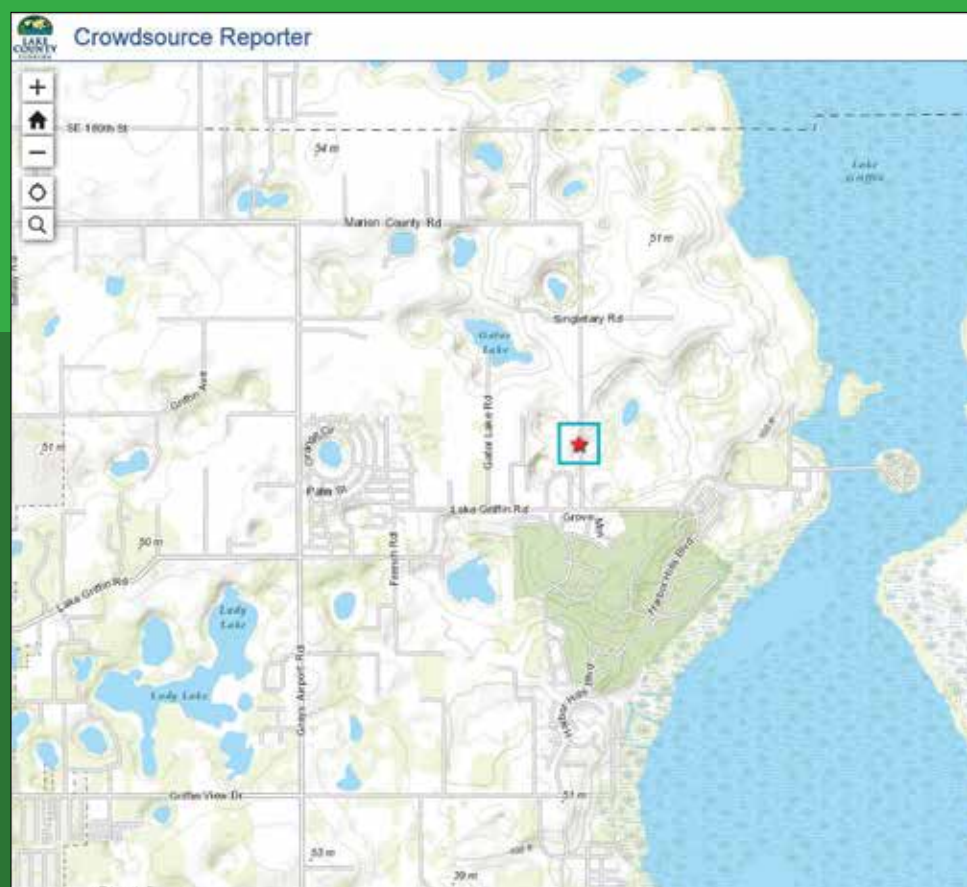
Giving reporting capabilities directly to the citizens of Lake County also allows their voices to be heard. That way, the neighborhoods that they feel need the most attention become the focus of Keep Lake Beautiful, allowing the organization to meet actual needs.

Hosting the application and data on ArcGIS for Server and having county staff maintain it also allow better data management. The GIS team can extract specific information and report it to Keep Lake Beautiful's executive committee for audit purposes and to monitor the program's overall productivity.

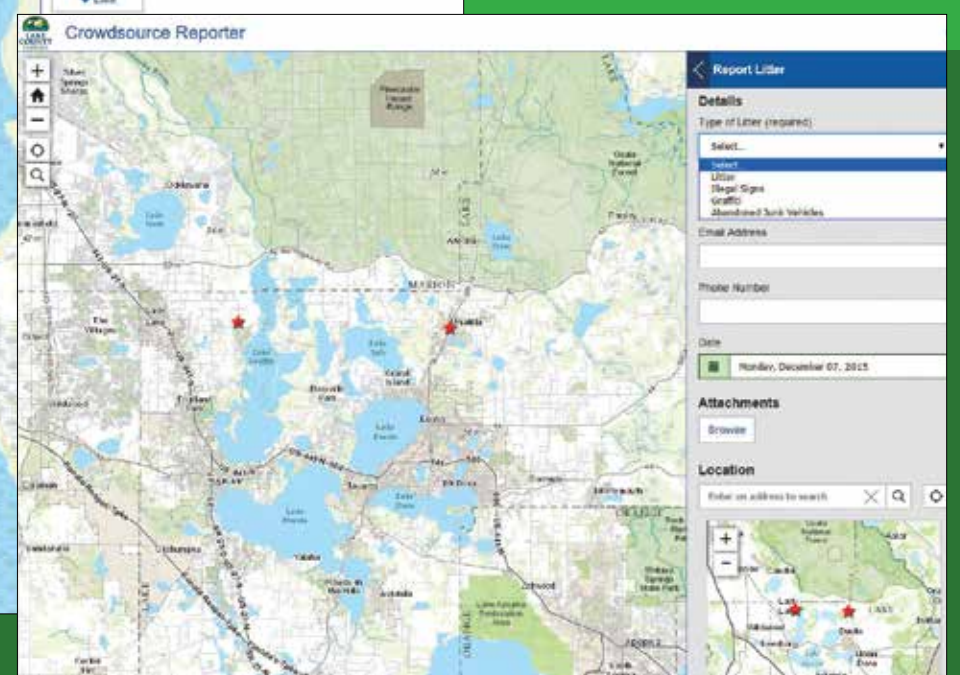
There are financial benefits as well. Other than extra staff time (which was minimal), no additional expenses were incurred by Keep Lake Beautiful or Lake County itself.

For more information, contact Lake County GIS manager Sue Carroll, GISP, at scarroll@lakecountyfl.gov or Lake County systems administrator Brandon Barnett at bbarnett@lakecountyfl.gov.

↓ Using Crowdsourcer Reporter, citizens can identify areas with litter, illegal signs, graffiti, and abandoned vehicles.



↑ Users can see all the litter sites recently submitted in the app and raise the priority of certain sites by clicking the Like button.



Vacant Lots Stimulate Economic Growth

New Bern, North Carolina, Sells City-Owned Properties Using Esri Story Map App

Every community has vacant or unused properties that are the result of abandonment, foreclosure, a death in the family, or out-of-state owners who chose to stop maintaining them. Those buildings are the property of the city or county in which they are situated—though they no longer yield tax revenues and often end up being quite costly. That is because the city or county has to maintain the property by cutting the grass, clearing garbage off the lot, or even razing uninhabitable buildings. What's more, these lots are typically eyesores and a detriment to economic development—especially if they are located in low-income neighborhoods.

Although cities are not generally in the real estate business, they encourage development, growth, and prosperity in all sectors of their jurisdictions. To this end, the City of New Bern, North Carolina, created a website that, with the help of GIS and an Esri Story Map app, informed small developers, first-time home buyers, and lower-income populations about affordable city-owned properties for sale.

Vacant Properties Spur Economic Development

In 2013, New Bern received a Choice Neighborhood Initiative (CNI) grant from the US Department of Housing and Urban Development to revitalize a commercial district and some adjacent, lower-income residential neighborhoods. The purpose of the grant is to bring together residents, businesses, nonprofits, and service organizations to plan how to improve an area in ways that enhance residents' lives.

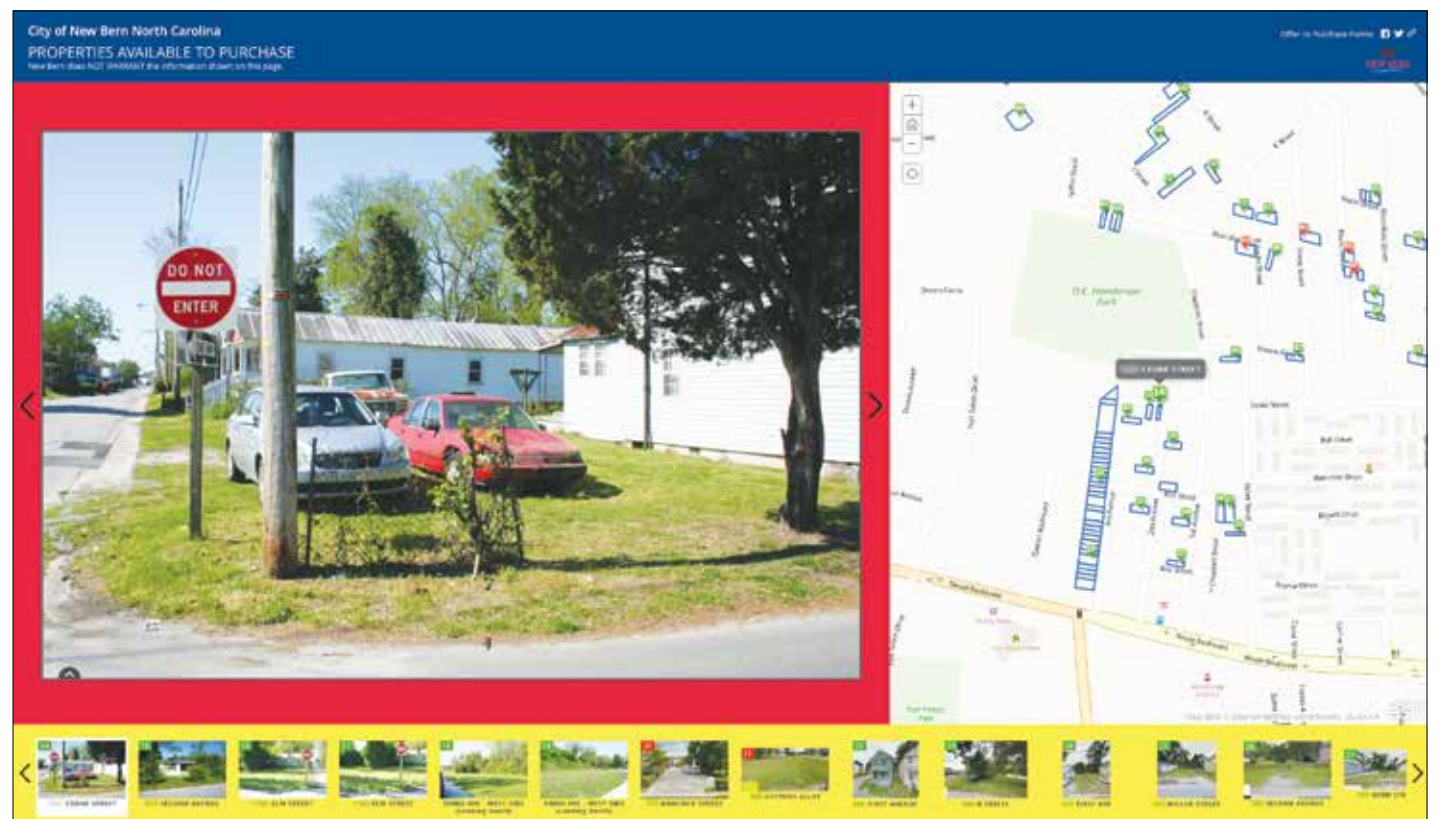
Among the key indicators that the city used to determine the state of the area were vacant properties and abandoned buildings. In early 2015, New Bern reexamined the neighborhoods that would benefit from the grant to figure out what to do about this all-too-common and constant issue.

The city had GIS data and information on ownership, which showed that many of the vacant properties were already city owned. This sparked discussion about how New Bern could use these properties to promote development by others or in conjunction with the city.

From a long-term planning perspective, the city was determined to provide better affordable housing, encourage economic progress, and help people feel more of a sense of place in these neighborhoods. While this would be challenging due to shrinking budgets and a relatively tenuous economy, those involved in the CNI grant realized that the unused properties could play a key role.

Making City-Owned Property Data Available

New Bern's primary plan was to build up the area to better provide for the community. The city wanted to work with small developers and housing organizations to establish community spaces and construct affordable housing on some of the unused lots. It also wanted to encourage first-time home buyers and



↑ New Bern's GIS team released a website in October 2015 called Properties Available to Purchase, which uses the Story Map Tour template as its foundation.

lower-income populations to transform these abandoned houses into homes.

To begin to put this idea into action, New Bern's GIS department was tasked with seeing whether GIS tools could play a role in making information about these properties available to the public—not just in and around the CNI grant area but also across the entire city.

GIS staff members met with various city departments to weed out properties that New Bern could use for future parks, green spaces, storage areas, or utility needs. That left more than 150 available properties. Their total tax value—which the city was not receiving—was deemed to be more than \$2.4 million. What's more, the city was spending, on average, \$120,000 each year to maintain these properties—mowing the lawns, clearing junk, and boarding up and demolishing uninhabitable buildings.

With all this information in hand, New Bern's GIS staff saw an opportunity to use Esri Story Map apps to reach out to the public. The staff had never used these before, so they had to learn some HTML code on the fly to link county tax information with images of the properties. But after that—plus some database construction and photography work—New Bern's GIS team released a website in October 2015 called Properties Available to Purchase, which uses the Esri Story Map Tour template as its foundation.

Property Ownership Within Reach

After just a few months, the work has paid off. The City of New Bern has sold or transferred ownership of eight lots, and seven more are in the process of being signed over to new owners. Because the city received multiple offers on some lots, for the first time in its 305-year history, New



↑ Using the story map, small developers have located and purchased properties—including abandoned lots and unoccupied buildings—and are improving them.

Bern has had to exploit the upset bid process, wherein people have 10 days to put a higher bid on a property that has already been sold.

Small developers have purchased some of these lots and are putting people to work, renovating the unoccupied buildings or constructing new homes there. The city's housing authority is also negotiating to purchase a handful of other vacant lots to use for low-income housing. One goal is to have tenants from older public housing apartments move into detached homes to help them achieve more of a sense of ownership in where they live.

The lots are generally being sold for significantly less than their assessed value, which makes home ownership in the area affordable. And in addition to being absolved of having to take care of the sold lots, the City of New Bern is finally receiving tax revenues on these formerly fruitless properties.

Impoverished neighborhoods in the area are striving for economic growth by planning new

housing projects and working with various organizations—such as Habitat for Humanity and Veterans' Community Gardens—to fix up some smaller lots and support infill development, which advocates cultivating existing buildings and lots rather than championing further sprawl.

New Bern's GIS staff is still amazed at how easy it was to start with a simple concept and develop a robust website that uses a clear, comprehensible story map to do exactly what the city wanted to do: raise awareness about available vacant properties and sell them to foster economic development in decrepit areas. The website averages more than 20 visitors per day, and elected officials and neighborhood leaders keep receiving positive feedback from citizens who are anxious to purchase properties that previously seemed out of reach.

To see New Bern's Properties Available to Purchase story map, visit www.newbern-nc.org/departments/development/ed/city-owned-property-sale.



Navigator for ArcGIS works with Pima County's custom data, which gets inspectors to the right address with just one click.

The Route to More Efficient Inspections

Pima County's Green Building Manager Shares Advantages of Using Navigator for ArcGIS

Every morning in Pima County, Arizona, six inspectors from the building and site development division leave their homes to visit 5 to 16 houses or buildings to make sure construction is up to code. The agency is committed to helping property owners and professionals complete projects economically, safely, and sustainably.

The inspectors' coverage zone includes all of Pima County, an area that encompasses more than 9,000 square miles and is home to about 1 million people. A little more than half of Pima County residents live in the city of Tucson, while the rest are spread out across rural stretches of the Sonoran Desert and nearby mountain ranges.

That means county inspectors have to do quite a bit of driving. But before they start their day, each inspector downloads a route that has been strategically designed to account for the time it will take to drive to each site and perform an inspection.

That route is made using Navigator for ArcGIS, a new mobile app from Esri that is part of ArcGIS Online. The app is designed to get fieldworkers where they need to be in the most efficient and reliable way possible. It can read Esri data or custom data, and it allows field crew members to search for and navigate directly to the organization's assets—even if those assets are located off commercial street networks.

Like many other Esri apps, Navigator is fully integrated with the ArcGIS platform. It works offline and has seamless interactions with Collector for ArcGIS, an app designed to help crews collect information and images in the field and sync them with the office. Navigator can also receive stop assignments directly from other apps, and its travel modes calculate the most efficient routes possible based on the type of vehicle being used.

Pima County's green building manager, Rich Franz-Ünder, recently shared some details about his experience with Navigator. This is an edited account of his interview.

Q: How does being able to use custom data in your navigation app help you out?

A: There are two different fundamental problems with other mapping software products. First, they are not current. Our inspectors work in brand-new housing divisions. Without our custom map layers, we can't route inspectors to those areas. Second, sometimes mapping software has an address that is different from the official address, and the program may send us to the wrong place. The county has the official address data we use for our records.

The Navigator app works with our custom data. Before, we would have to convert

addresses to latitude and longitude and then upload multiple stops. That takes up a lot of time every morning. With Navigator, it's one click and they're ready to go.

Q: What back-office analysis have you been able to integrate into the app?

A: We analyzed how much time our staff spends performing inspections so we can determine their estimated times of arrival for clients. We used to spend about four staff hours every day answering the question, when is my inspector going to be here? Soon, homeowners will receive an email the afternoon prior to the inspection that contains the inspector's estimated time of arrival. Homeowners will be able to manage their time better because they will have better information.

We use our analysis to create routes that better balance workloads, and we push out those routes to the Navigator app. Now inspectors are traveling an average of 34 percent fewer miles each day and saving 18 percent of drive time. And we are saving \$197,000 per year on mileage and inspectors' time.

Q: How does the ability to work offline change things for you and for the inspectors?

A: That is key. Pima County is a big, rural county, and there are areas without cell phone service. Inspectors need to be able to receive routing and directions in these areas. Staff also use a tool in the permitting system that has to work offline. When the inspectors get back online, the app has to be able to adjust to what happened, to sync with other systems. That is huge for us.

To learn more about Navigator for ArcGIS, visit esri.com/navigator.

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ArcGIS 10.4 for Server: Ready for the Enterprise

Many organizations have explicit requirements for keeping their GIS implementations up and running. They need to protect critical information assets, limit data loss, and minimize downtime during a crisis. That is why Esri's goal with ArcGIS is to develop better ways to support business continuity and increase GIS server resiliency across all deployment patterns.

ArcGIS 10.4 for Server is a more resilient platform that makes it possible to respond quickly when something goes wrong. It includes new tools and capabilities to help users protect GIS investments running on their own infrastructure.

Maintaining High Performance

When large numbers of people require access to an IT system all at the same time, performance can slow down considerably and sites and applications can be hard to maintain. ArcGIS 10.4 for Server includes a new, simplified high-availability configuration that makes it much easier to sustain continuous operations and maintain performance during periods of peak user load.

By default, sites on ArcGIS 10.4 for Server work with a load balancer—either ArcGIS Web Adaptor (which is included with ArcGIS for

Server) or a third-party load balancer—to support multiple GIS servers. This high-availability experience gives administrators the capacity to detect site failures and mitigate single points of failure, minimizing downtime.

To keep network chatter to a minimum, GIS server machines configured to work with an ArcGIS Server site can be organized into groups, called clusters. New and updated installations of ArcGIS 10.4 for Server default to single cluster mode. This decreases network traffic between machines, cuts back the load on the network, and improves monitoring of GIS servers in the site. Single cluster mode does not include load balancing between machines in the cluster. Customers who already use single cluster mode, as well as sites with multiple clusters from earlier releases, will have their settings preserved when upgrading.

Ingesting, archiving, and displaying data just got faster too. The improved ArcGIS 10.4 GeoEvent Extension for Server now works with high-velocity and high-volume observation data via the new spatiotemporal big data store. The spatiotemporal big data store can archive high-volume observation data (including both moving objects and stationary sensors with change attributes) at a rate of tens of thousands of writes

per second. It can also archive across multiple machines, or *nodes*. Additionally, users can visualize observation data on dynamic maps that are aggregated and rendered by the server, as well as through features queried from a feature service that is rendered on the client side.

Protecting Site Integrity

Accidental changes to GIS services can be detrimental. That is why, with ArcGIS 10.4, an ArcGIS Server site can now be set to read-only mode.

When a production site is read-only, most administrative operations—including publishing new services—are disabled so any inadvertent or ad hoc changes that are made to layers and services can't impact the applications and data that staff and customers use on a daily basis. Existing services on the site continue to function, and administrators can still add machines to the site or remove them.

Beyond protecting against unintended changes, read-only mode is useful for upgrading software, since it protects against publishing new services and blocks most administrative operations. Additionally, if multimachine sites fail to connect to the underlying configuration information, read-only mode enhances the server's ability to continue functioning.

If an ArcGIS Server site or web GIS deployment goes down completely, a single tool in ArcGIS 10.4—called *webgisdr*—can now bring it back online quickly. The tool, which is located in the Portal for ArcGIS tools directory, allows users to back up all the related parts of a web GIS deployment—including Portal for ArcGIS, ArcGIS for Server, and ArcGIS Data Store, as well as all their items and settings—and export the whole system as a single file.

Users can store the exported file in a secure place (a separate machine is the best practice) and use it to restore the ArcGIS Server site or web GIS deployment. They can also use the file to replicate the implementation on a standby deployment that can be brought online promptly if the primary deployment fails.

Ensuring Enhanced Security

For ArcGIS for Server users, security is generally a primary concern. ArcGIS 10.4 presents a new security option—fine-grained access control—for federated servers. With this, administrators can update a federated GIS server to control which portal members have administrative and publisher access to the server.

To ensure tighter security, administrators can also now scan their organization's portals for best security practices. A new Python script tool in Portal for ArcGIS scans for common security issues by checking for problems based on the best practices for configuring a secure portal environment.

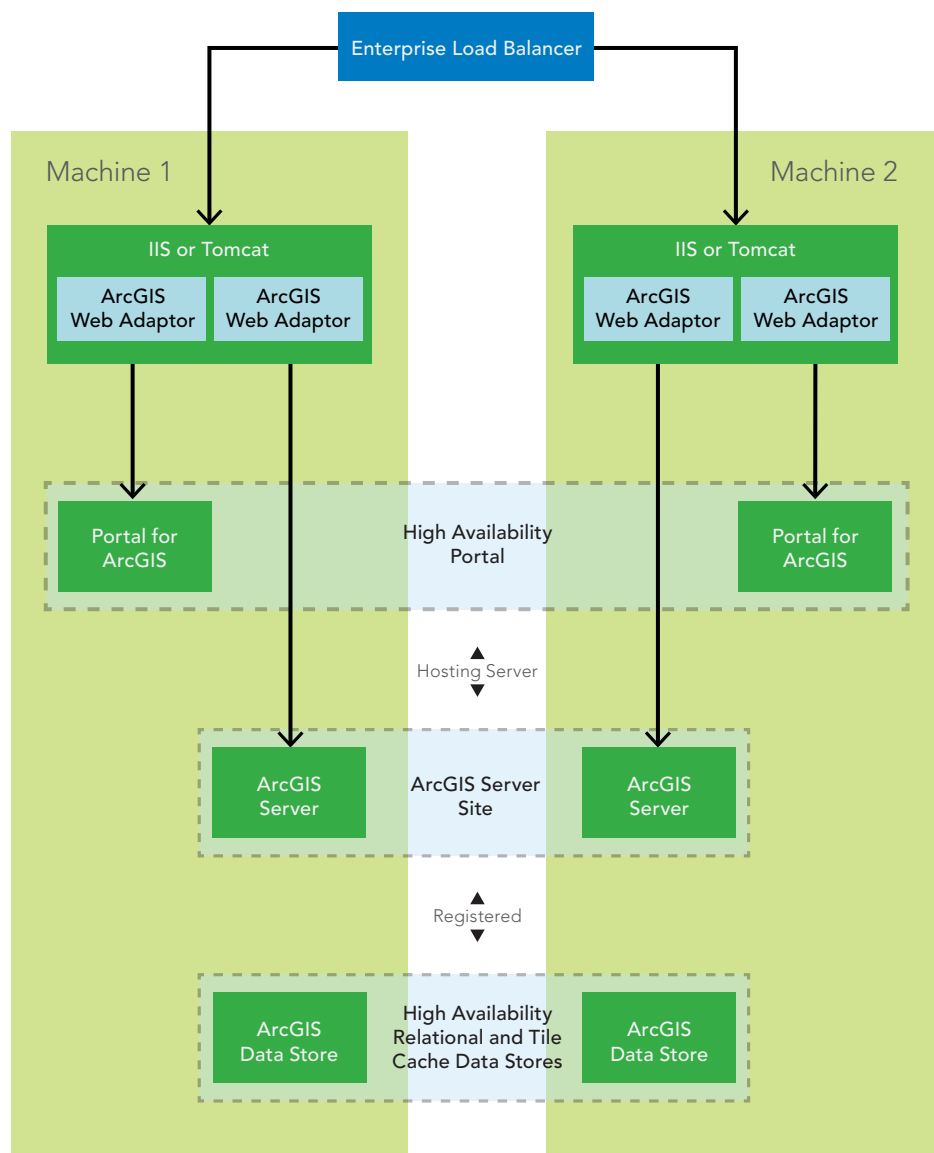
To strengthen security, many organizations require their users to regularly change their passwords and database credentials. Previously, this impacted apps that used GIS services with connections to specific databases, forcing all affected services to be republished. Now, administrators can use the ArcGIS Server Manager or ArcGIS for Desktop to put the new credentials into the data store connection file, making it unnecessary to republish the impacted services. ArcGIS Pro publishers can also connect to registered data stores and share new maps and layers that directly reference the enterprise data without having to copy data or republish layers.

Taking Big Steps Forward

ArcGIS 10.4 is a major step forward for customers running ArcGIS on their infrastructure. Users will find a stronger, more resilient GIS server and on-premises portal, with built-in tools to implement high-availability sites and protect deployments for better business continuity. ArcGIS 10.4 also sets the stage for specialized enterprise GIS implementations coming later in 2016.

For more details on ArcGIS 10.4 for Server, visit its What's New page.

How the New High-Availability Configuration Works



Deploying ArcGIS 10.4 for Server

Customers can deploy ArcGIS for Server in a variety of ways, depending on their business needs. They can implement it on their own on-premises infrastructure or in third-party cloud platforms—or both.

Cloud Deployments

Esri provides ready-to-use images (virtual computers running in the cloud) of ArcGIS for Server on Amazon Web Services (AWS) and Microsoft Azure. Customers can use ArcGIS Server Cloud Builder on Amazon Web Services, a free desktop application, or ArcGIS Server on Microsoft Azure to quickly get ArcGIS for Server software up and running in AWS or Azure.

Installation with Chef Cookbook

Customers looking to automate on-premises installation using multiple GIS servers in a single site configuration, a real-time GIS configuration, or a full web GIS configuration can use ArcGIS Cookbook. Designed for users who are familiar with the Chef configuration management tool, Cookbook includes a variety of Chef recipes. It is available on the Esri GitHub repository and via Chef Supermarket.



ArcGIS Online Runs Security at Boston Marathon

500 People from 60 Agencies
Connect with One Real-Time Map

Almost 30,000 people braved 40-degree weather and rain to compete in the Boston Marathon on April 20, 2015. Half a million more spectators lined the legendary course, which passes through eight Massachusetts cities and towns, to cheer on friends, family members, and strangers.

Just two years after a pair of bombs went off near the finish line, killing three and injuring more than 260 racers and spectators, city and state officials focused on making the event as secure as it is festive. For that to work, they needed to give hundreds of people real-time data and maps that could be accessed on any device. ArcGIS Online—a secure, software-as-a-service solution that comes with apps and app builders for the office, the field, and the community—was the clear choice to run security behind the scenes.

A Dashboard That Goes the Distance

Desiree Kocis moved to the Boston area in early 2015 to work for the Massachusetts Emergency Management Agency. Although new to the city and to marathons, Kocis is a highly skilled GIS professional, adept at working with maps and data.

As the agency's GIS coordinator, she set out to build an online operations dashboard that could track everything—including runners, weather, traffic, emergency vehicles, and medical situations—and be accessible on desktop computers, tablets, and smartphones.

"The Boston Marathon bombing in 2013 showed us what data we needed to have online and not just on paper," said Kocis. "I had never used ArcGIS Online, but I knew it was the only way to build the dashboard and push out all that information to so many different people."

In just six weeks, Kocis learned how to use ArcGIS Online to build what turned out to be the highly successful 2015 Boston Marathon Dashboard. Using Operations Dashboard for ArcGIS (one of the apps included with ArcGIS Online), Kocis was able to provide security personnel and emergency responders with a real-time view and common operating picture, complete with live data feeds and widgets for maps, charts, gauges, and histograms.

The 2015 Boston Marathon Dashboard featured dynamic web map layers, including live weather and traffic, real-time tracking of runners and emergency vehicles, and information about emergency operations. It hosted 20 static layers that could be turned on or off as needed to show helicopter landing pads, National Guard staging areas, or medical facilities. In case of an emergency, all responders involved could quickly zoom in to emergency shelters to see their status changes, capacities, key contacts, and phone numbers.

← The bomb squad used the maps displayed in the Tactical Operations Room to identify the locations of suspicious or unattended packages.





On the day of the race, 300 people from 60 different agencies, including state and local police and the Federal Emergency Management Agency, used the dashboard at the Multi-Agency Coordination Center (MACC). An additional 200 people in the field and around the country accessed the dashboard using ArcGIS Online. Everyone could follow the runners, weather, and emergency operations; tune in for race updates; and zoom in for more specific information.

"I was truly in awe," Kocis said. "The teamwork from the public safety side was like nothing I've ever experienced. People at the MACC weren't just doing their jobs; they genuinely cared and were passionate in their duties. I've never felt so proud to be a part of something."

Tracking More than Just Race Times

For the dashboard to work that Marathon Monday, a considerable amount of data had to be recorded on the ground and shared with all 500 people charged with keeping racers and spectators safe.

Each marathon participant was given a bib to wear that contained a race number and a chip. The chip registered each competitor's time and location at mats placed every five kilometers along the course. That data was pushed into a feature service using ArcGIS GeoEvent Extension for Server, which processed incoming data in real time. This helped keep track of how many runners, wheelchair racers, and handcyclists crossed each mat and how many of them were in each section of the course, enabling security and medical resources to shift accordingly along the route.

Crews on the ground used Collector for ArcGIS on their iPhones to respond to falls and other injuries. With the app (which is also included with ArcGIS Online), they tracked police cars, ambulances, and other emergency vehicles in real time. So when a runner needed medical attention, the app—working online or offline—could locate the nearest ambulance or medical station.

Every hour throughout the race, Kocis updated the map's weather layer in ArcGIS Online

as well. For maximum accuracy, she built the weather widget to include three different weather hot spots along the 26.2-mile route. Her hourly updates were automatically fed into the widget and shown on the dashboard map.

GIS Crosses the Finish Line

ArcGIS ended up being central to the security efforts of the 2015 Boston Marathon, and Kocis was thrilled with the results.

"I felt such an amazing sense of accomplishment that I was able to contribute to the safety of the runners and spectators, of the cities along the course, and of the infrastructure of the commonwealth," she said.

The winner of the men's race, Lelisa Desisa of Ethiopia, who had also won in 2013—about two hours before the bombs went off—has said that "sport holds the power to unify people and to connect people from all over the world with one another, allowing them the opportunity to share in their common humanity and to celebrate the richness of our world's cultural diversity."

↑ The dashboard featured dynamic web map layers, including live weather and traffic and real-time tracking of runners and emergency vehicles.

As Kocis and everyone who was part of the MACC learned, that same ethos can hold true for technology. During the 2015 Boston Marathon, GIS connected people to essential information and each other in the spirit of safety and goodwill.

This historic marathon, which unites a region and attracts runners from around the globe, has long been a way to celebrate the good things in life. In 2015, GIS was one of those things.

Kocis compared the work of those who planned and secured the Boston Marathon to the work of the runners, who spent months training and preparing.

"We all crossed the finish line that day," she said, "proudly and safely."

ArcGIS Improves Vermont's Flood Resiliency

By Heather Kennedy, Vermont Department of Environmental Conservation

On August 28, 2011, Tropical Storm Irene lashed the Vermont landscape, dumping more than eight inches of rain in 24 hours in some communities. Spring flooding at Lake Champlain had already broken lake level records that year, and Irene's devastation rivaled that of Vermont's historic 1927 flood, which took out miles of roads and railroad tracks, more than 1,200 bridges, and numerous homes and buildings.

Irene caused an estimated \$800 million in damages. While the wreckage of homes, farms, businesses, roads, bridges, and the natural environment was enormous, it was nothing new. Catastrophic floods have occurred many times in Vermont in the last 100 years, requiring repeated flood recovery efforts throughout the state. And the surprising finding from postflood damage surveys is that most of the destruction comes from fluvial erosion, not floodwater inundation.

Since 2004, the Vermont Rivers Program, housed within the state's Agency of Natural Resources' Department of Environmental Conservation, has assessed the geomorphology (the evolution of the physical condition) of more than 8,000 stream miles in the state. The assessments show that Vermont's streams have been greatly altered since the 1800s. People have straightened rivers to protect roads, used dams to divert river water, and armored stream beds with rock and concrete—all of which change a stream's width, depth, slope, and sinuosity.

The data indicates that almost 75 percent of the rivers assessed are unstable. After three

major floods in 2011, the State of Vermont passed legislation mandating that the Agency of Natural Resources conduct sensitivity analyses of vulnerable infrastructure in river corridors, develop new state flood hazard area rules, and implement a flood-resilient communities program.

To this end, the Rivers Program undertook the task of augmenting existing field maps with a uniform, statewide GIS model of Vermont's river corridors. The department used several Esri software products and extensions to do this, including ArcGIS for Desktop (Basic and Advanced), the ArcGIS Spatial Analyst and ArcGIS 3D Analyst extensions, and Arc Hydro tools.

A River Corridor: More than Water

No river is static. Rivers migrate across valleys over decades and centuries, changing the land as they meander. A stable river, however, is one in a state of dynamic equilibrium—that is, it is able to adjust its width, depth, and slope to efficiently store, transport, and discharge water, sediment, and debris without raising or decreasing the height of its riverbed.

Because of this natural movement, the State of Vermont specifies that a river corridor include not only the channel through which the river travels but also the adjacent land required to restore or maintain the river's dynamic equilibrium. Interpreting river corridors this way takes into account the meandering of a river in its least erosive form. River corridors that include intact floodplains and wetlands give

rivers room to meander and release energy from a flood flow.

The Vermont Rivers Program delineates river corridors based on both existing and estimated meander belt width. River scientists use a custom ArcGIS extension, called the Stream Geomorphic Assessment tool, to evaluate river geomorphology within a specific project area. The tool partially automates the creation of river corridors in ArcGIS, though scientists still have to manually digitize features such as tributary entry points, breaks in relatively consistent stretches of a stream, and valley walls.

Communities where the Rivers Program had done river corridor delineation studies had access to relevant maps of that area, but often they only showed a small area of interest—where, for example, the town might be trying to get a development permit.

"We had river corridor maps, but they were spotty," said Mike Kline, program manager for the Rivers Program. "Having only ad hoc maps created uncertainty when it came to policy making and development planning."

As of 2011, most communities still did not have access to river corridor maps—hence the River Program's mapping project.

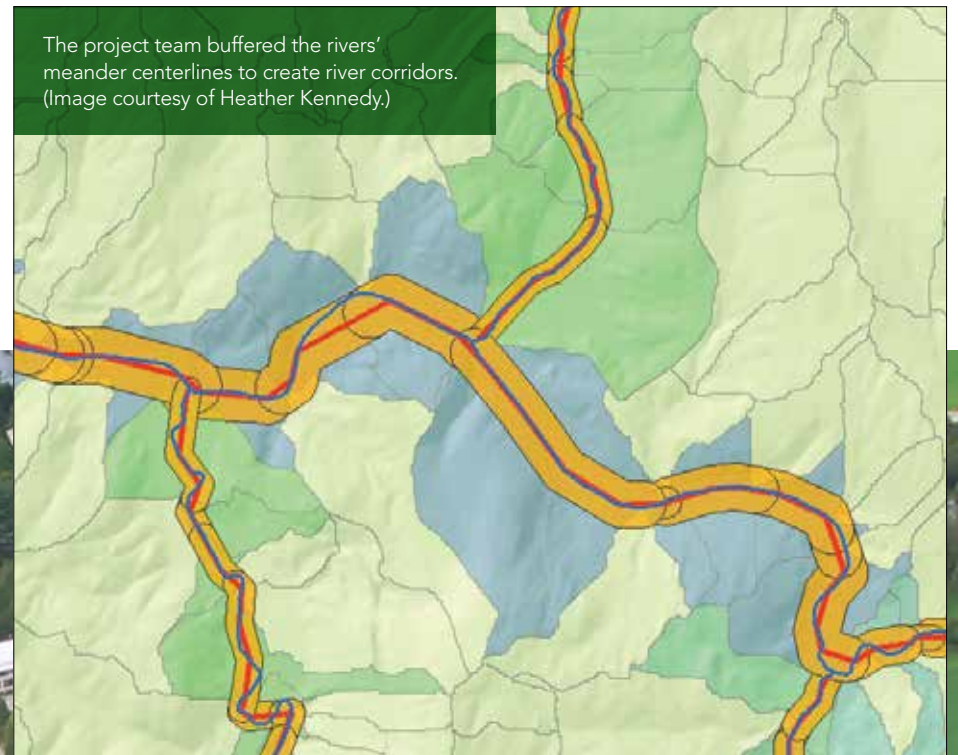
Developing the Vermont River Corridor

The Rivers Program limited river corridor development to streams that drain water from more than two square miles of land—or about 5,500 of Vermont's 23,000 stream miles. Smaller streams were simply assigned a conventional 50-foot riparian buffer starting at the top of the stream bank.

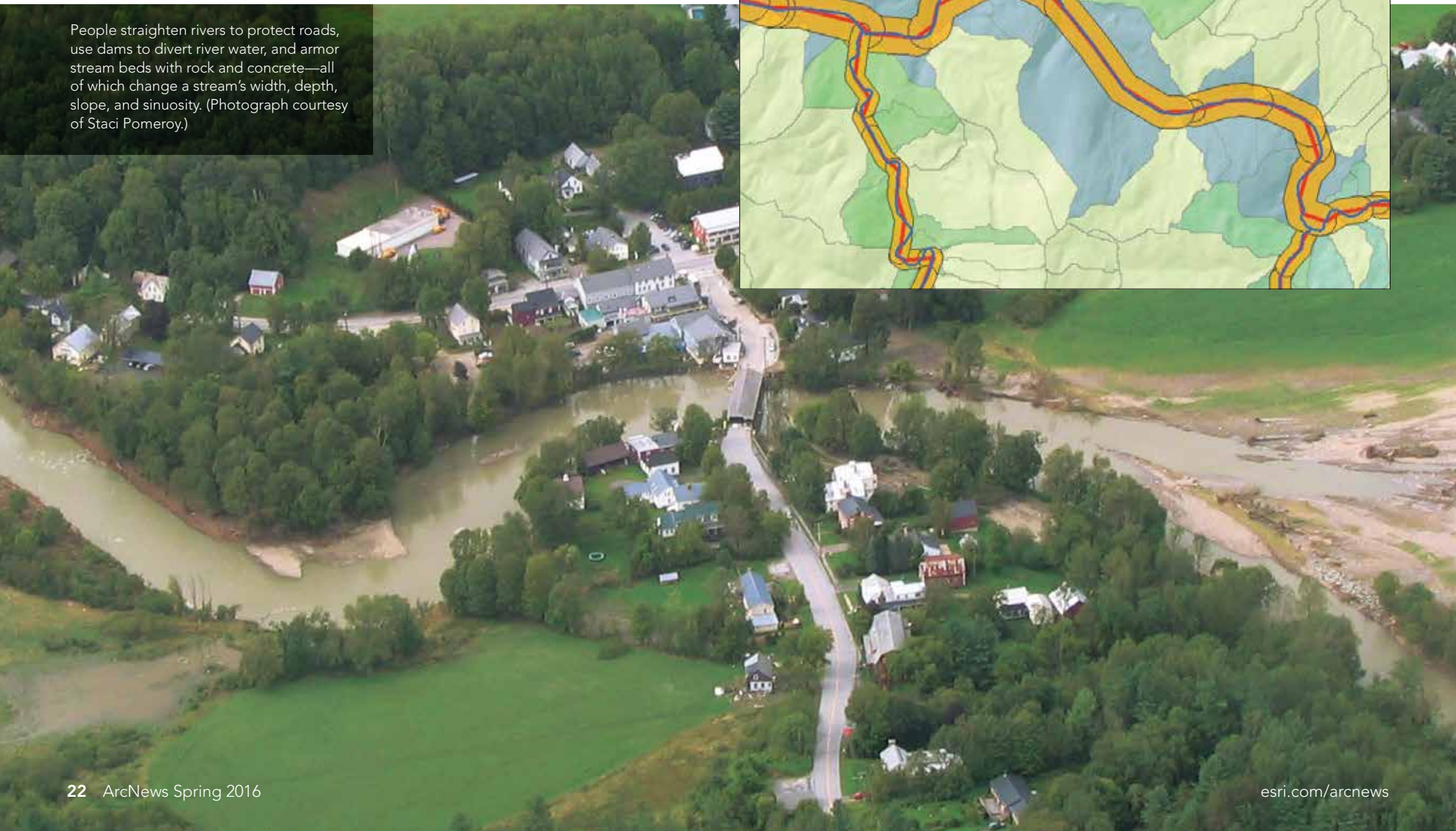
For geoprocessing, the Rivers Program used several statewide datasets, including a stream centerline shapefile; a 10-meter digital elevation model; a 10-meter hydro-enforced digital elevation model (which allowed the team to simulate river flow under bridges and through culverts); road and railroad centerlines; and a shapefile of Hydrologic Unit Codes for subbasins (HUC-8) from the US Geological Survey, which identified the drainage basins in the area.

First, members of the team created valley walls. They followed The Nature Conservancy's

The project team buffered the rivers' meander centerlines to create river corridors. (Image courtesy of Heather Kennedy.)

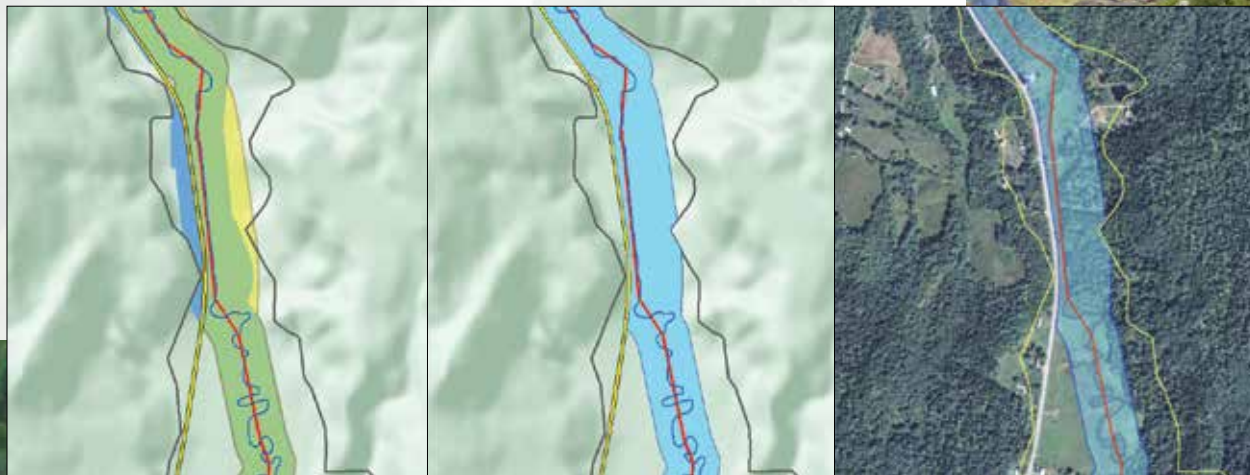


People straighten rivers to protect roads, use dams to divert river water, and armor stream beds with rock and concrete—all of which change a stream's width, depth, slope, and sinuosity. (Photograph courtesy of Staci Pomeroy.)



↓ In places where there might be some room between the meander centerline buffer and the valley walls, the team bumped buffer polygons over to discourage development in spaces where the river might meander in the future. (Image courtesy of Heather Kennedy.)

→ After assessing more than 8,000 stream miles in Vermont, the state's Rivers Program determined that almost 75 percent of the rivers assessed were unstable. (Photograph courtesy of Mike Kline.)



For 24 hours in August 2011, Tropical Storm Irene dumped buckets of rain on Vermont, causing nearly \$800 million in damages. (Photo courtesy of Staci Pomeroy.)

method for developing an active river area, which includes not only the channels that a river travels through but also the surrounding lands that aid the ecological processes of a river system. Using the Path Distance function on stream centerlines and the Vermont digital elevation model, the team members created a raster of the relative cost to travel on a surface upslope from the stream bed. They used an arbitrary cost limit of 1,000 first, as a test; but after the river scientists evaluated the layer against aerial photos and contour lines of the area, plus evaluations from field sites, the team found that a cost value of 550 worked to delineate valley walls along rivers throughout the state. The team then converted the raster to vector format to create polygons of the valley walls.

Next, the team defined catchment areas (where water collects and then flows into a waterway) for the length of each stream. The researchers used Arc Hydro tools on stream centerlines and the hydro-enforced digital elevation model to create accumulation rasters for the streams' basins and catchment areas, as well as to assign the correct drainage area to every segment of each stream.

Although river scientists had already digitized most of the basins' meander centerlines (approximations of the meander patterns of

each river), some still needed to be done. To expedite the process, the team took the stream centerlines in ArcGIS for Desktop and used the Simplify Line command to remove extraneous curves from the rivers' shapes.

The meander centerlines serve as the basis for the initial river corridor polygon layer, but they have to be buffered by values calculated from fields in the stream centerline shapefile. To do this, the team needed to assign each meander centerline the attributes—such as slope and drainage area values—of the stream segment it represents. But while the meander centerline polylines run near the stream centerlines, they only intersect occasionally. So the group used the Functional Surface toolset in 3D Analyst with the hydro-enforced digital elevation model to assign slope values to the streams. They then assigned slope and drainage area attributes to the stream segments' corresponding catchment polygons. From there, they intersected the catchment areas with the meander centerlines, which divided the meander centerlines into sections that are geomorphically similar (called reach-break lengths) and gave them the slope and drainage area attributes of the stream centerlines.

Finally, team members calculated the bankfull width—the width of a stream at the point

where it spills out of the channel and into the floodplain. They did these calculations for each river segment using Vermont's hydraulic geometry curve formula, which relates a stream's channel dimensions to its average annual discharge, and a slope-based channel multiplier, which indicates how many channels wide the full meander belt needs to be for the stream to attain dynamic equilibrium.

The appropriate channel multipliers buffered the meander centerlines, creating buffer polygons around them. This formed the initial river corridor. Where the valley walls pinched the corridor, the team clipped the corridor polygons. But in places where the valley walls pinched one side but left room on the other between the corridor and the valley walls, the team made additional buffers to maintain the corridor polygon width—thus discouraging development in spaces where the river might meander in the future.

With this, a natural river corridor—clipped only by valley walls—was delineated for each basin. Additionally, the team created an administrative river corridor that took into account major roads and railroads that will always be protected before and rebuilt after a flood or catastrophic erosion event.

Working Together to Avoid Erosion and Flood Hazards

The Agency of Natural Resources published the Vermont River Corridor layer on its Natural Resources Atlas website in January 2015. Now communities and their partners—including watershed groups, conservation districts, and land trusts—can map the areas that are most vulnerable to erosion and flood hazards.

“By developing and publishing a river corridor map that uniformly covers all streams and rivers, we avoid ad hoc decision making and allow the state and municipalities to move forward with certainty in adopting consistent statewide regulations,” said Kline.

The map is now the base GIS layer for regulatory actions under Vermont's Flood Hazard Area and River Corridor Rule, which ensures that construction in flood hazard zones is safe and does not impair a stream's natural flow. Additionally, municipalities that regulate land use in river corridors are eligible for increased state disaster assistance, so many of them are beginning to use the layer for flood resilience planning.

For more information, contact Heather Kennedy, GIS data analyst and information coordinator for the Vermont Department of Environmental Conservation's Rivers Program, at heather.kennedy@vermont.gov.

Cadastral Cooperation Along Bulgaria's Black Sea Coast

How a GIS-Enabled Map Allowed One Organization to Deliver Administrative Services Online

The Bulgarian Black Sea Coast blankets the country's entire eastern side, extending more than 230 miles (almost 380 kilometers) from Romania in the north to Turkey in the south. The area—known for its sand dunes, riverside forests, wildlife conservation parks, and protected plant and animal species—draws millions of foreign and local tourists each year.

Ensuring that tourism is sustainable and doesn't interfere with the management of protected areas—whether public or private—requires enhanced cooperation and concrete partnerships among government, the tourism industry, local communities, managers of protected areas, and planners. It is crucial that all parties have access to good-quality cadastral and specialized data for the Bulgarian Black Sea Coast.

Centralizing the Cadastre

Bulgaria's Geodesy, Cartography, and Cadastre Agency (GCCA), within the Ministry of Regional Development and Public Works, is responsible for creating and maintaining cadastral maps and registers for the whole country. The agency's priorities include providing administrative and technical services to citizens, organizations, municipalities, and others who use cadastral information, as well as maintaining the national geodetic, mapping, and cadastral registers.

In carrying out these responsibilities, GCCA faces many challenges. There is no single, centralized database for the cadastre (a register of property showing ownership, boundaries, and real estate values) or the main features of the Black Sea Coast, such as beaches, dunes, lakes, lagoons, infrastructure, and buildings. Different contractors from various agencies collect data and create specialized maps and registers in distinct ways. The resultant data is heterogeneous and often inconsistent. This hinders effective land management and slows down the delivery of technical and administrative services to governmental organizations, municipalities, and citizens.

So in 2014, GCCA launched a project to develop a GIS for a specialized map of the Black Sea Coast that could aid in delivering administrative services online. The project was funded under the Operational Programme Administrative Capacity. Esri Bulgaria Ltd., Esri's distributor in Bulgaria, was selected as a leading partner to develop and implement the system.

GIS for the Black Sea Coast

The development of GIS for the Black Sea Coast cadastre was an IT project of national importance. On one hand, it aimed to support the municipal and state organizations that govern ownership, construction, and environmental

preservation. On the other hand, it also needed to provide for citizens and private companies with investment interests in the area.

To achieve these two objectives, Esri Bulgaria's team first analyzed how objects in the specialized map and registers were regulated and classified in accordance with the Black Sea Coast Spatial Development Act, which seeks to protect the coastline while allowing for its sustainable, integrated development. The team also analyzed GCCA's processes and studied all of its available data, including the organization's IT systems.

Based on this analysis, Esri Bulgaria designed a GIS for the Black Sea Coast map that employs ArcGIS for Server and ArcGIS for Desktop to create and maintain one centralized database with powerful functionality. Esri Bulgaria developed seven functional modules as part of the system: a central GIS module, an e-services component, a reports module, integration with two of GCCA's IT systems, an import/export function, and an administrative component.

Esri Bulgaria processed, validated, verified, and incorporated more than 500 types of objects into more than 50 layers in the geodatabase. The objects included coast protection systems and equipment, sea lakes, lagoons, estuaries and wetlands, islands, the Black Sea's water area, infrastructure, and buildings.

With this, the GIS module enables GCCA's experts to identify all the Black Sea Coast objects on a dynamic map, as well as edit the associated spatial and attribute data, perform analysis, and review relevant documents. Additionally, the module automatically performs quality control on the data—assessing the information's completeness and making sure objects have logical relationships, for example—to ensure that the content and structure of the geodetic measurements coming in from third parties are

consistent and can be easily analyzed. This is again in line with the Black Sea Coast Spatial Development Act.

The integration with GCCA's two IT systems was essential. One of them, KAIS, is an Internet portal for searching and accessing cadastral map and register information. It handles administrative service requests and provides users with sketches of cadastral map data combined with information from the specialized map of the Black Sea Coast, samples of objects from the map along with their technical characteristics, and a list of coordinates (including altitude) for detailed points on the map.

A Project of National Significance

With streamlined cadastre data and the improved ability to deliver administrative services online, the GIS for the Black Sea Coast map was deemed a success. In fact, in a competition organized by the Bulgarian Association of Information Technologies, it was ranked among the top three IT projects for 2014 in the state administration category. Computerworld Bulgaria also nominated it to be recognized as IT project of the year, in the category for national government administration IT projects.

"The GIS for the specialized map of the Black Sea Coast is an IT project of national importance, as it allows us to provide high-quality online services to governmental organizations, municipalities, and citizens," GCCA's then-executive director, Valentin Yovev, noted during the nomination process. "Moreover, it helps us to meet a number of regulatory requirements in this area."

For more information, email Violeta Koritarova, project manager at the Geodesy, Cartography, and Cadastre Agency, at koritarova.v@cadastre.bg or Miglena Kuzmanova, account manager at Esri Bulgaria, at marketing@esribulgaria.com.



↑ Until 2014, there was no centralized database with information about the main features of Bulgaria's Black Sea Coast, like this estuary on the Veleka River in the country's southeast.



→ The Geodesy, Cartography, and Cadastre Agency (GCCA) can now use the specialized map of the Black Sea Coast to provide online administrative services, such as sending a requester this map and object information for the central beach in the village of Kranevo.



"I have been able to apply my new expertise to projects back home in Nigeria, and I am working on my Ph.D. in hydrology, looking at more water management issues."

– Damilola Eyelade '12

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ArcGIS Helps Charity Feed Singapore's Needy

Food from the Heart (FFTH) is a voluntary food distribution program that has a clear mission: to feed Singapore's citizens in need.

Since 2003, the nonprofit has collected good, unsold bread and buns every day and delivered them to welfare homes, senior activity facilities, distribution centers, and self-collection centers around the island. Now, around 1,700 volunteers make these deliveries to more than 14,500 impoverished families and individuals at over 150 locations.

Last year, FFTH's collection network expanded thanks to a partnership with Singapore's largest supermarket chain, NTUC FairPrice. This new alliance allows the nonprofit to pick up unsold (but still nutritious) canned food products and nonperishable items from FairPrice's 128 stores within a specified time frame every month. But FFTH only has one truck and two vans in its fleet that can be used to collect the donated supermarket goods.

To make this work, the charity needed to streamline its collection and delivery routes

and improve resource allocation. So it turned to GIS.

Driving Smarter Approaches

FFTH needed to ensure that the right vehicles arrived at the right pickup points at the right time—all while keeping operations as cost efficient as possible.

"This is a problem faced by many small- and mid-sized organizations," noted FFTH executive director Anson Quek. "In our case, we had to make sure we were utilizing our resources responsibly while continuing to fulfill our obligations to partners and beneficiaries."

In addition to getting the appropriate vehicle to a precise place at the correct time, the charity needed to optimize the capacity of its collection vehicles. Sometimes, FFTH's truck and two vans were being only partially filled up during a collection run, resulting in unnecessary multiple trips, added labor, and increased fuel costs.

Quek decided to put ArcGIS into play to help streamline logistics planning and allow the charity

to efficiently collect and distribute food to as many needy families and individuals as possible.

Uncovering Operational Patterns

Working with Esri Singapore, Quek and his team identified and gathered key data that was crucial to FFTH's everyday operations, including the average collection load at each FairPrice location, the collection vehicles' capacities, and the most efficient collection routes. Esri Singapore then analyzed the information using ArcGIS for Desktop and ArcGIS Online. Based on the findings, FFTH adjusted how it collected and distributed food.

Instead of devising routes around whoever offered food donations, FFTH used GIS to map out all of its collection spots so it could make the most of its collection journeys. The result was a measurable improvement in FFTH's overall productivity. It led to faster, more responsive service that maximized its new partnership with FairPrice.

Esri Singapore also built FFTH a customized version of Operations Dashboard for ArcGIS, which provides the organization with a real-time,

synchronized, map-based view of its operations. The dashboard displays all FFTH's collection points plus the amount of bread and goods gathered so far in the day. This helps the organization better allocate its vehicles and volunteers.

"Our work entails a lot of logistics planning, and using ArcGIS Online allows us to streamline our workflows," said Quek. "Beyond plotting the location of collection points, [Operations Dashboard] also helps us uncover operational patterns, allowing us to better plan how we can best work with our volunteers, partners, and citizens, given our limited resources."

More Appreciation, Less Food Waste

Since adopting a GIS-based solution, FFTH's operational efficiency has improved immensely—mostly because the organization can now commit to precise collection and delivery times.

"In the past, we would spend a significant amount of time planning our routes and schedules while also trying to accommodate ad hoc requests for collections," Quek pointed out. "Now we are able to make quick, well-informed decisions on how we can mobilize our resources."

Members of FFTH's distribution network can now prepare their donations ahead of time because they know when to expect volunteers, and the organization's beneficiaries get to enjoy punctual food deliveries. Additionally, FFTH has added 40 more welfare organizations to its beneficiary list, enabling it to provide food to a thousand more people than before.

Quek added that the recipients of food donations "are also able to better appreciate the truly collective effort of our volunteers and many businesses throughout the community."

Together, they all ensure that good food in Singapore does not go to waste.

To learn more about Food from the Heart, which was founded by Singapore-based Austrian couple Henry and Christine Laimer, visit foodheart.org.



↑ Food from the Heart (FFTH) volunteers pack deliveries for more than 14,500 needy individuals and families around Singapore.



↑ Using ArcGIS for Desktop, FFTH can see the location of each NTUC FairPrice store and determine how the organization's one truck and two vans can pick up donations in the most cost-effective way.

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Fighting Social Disparities Across the Map

Researchers Use ArcGIS to Evaluate Impact of On-Site Social Programs on Affordable Housing Residents

By Alyssa Vergara and Juan Carlos Araque, University of Southern California School of Social Work

California is in an affordable housing crisis. The Golden State has the second-lowest home ownership rate and the second-highest median property value in the United States. Although the fiscal challenges of home ownership drive more than 40 percent of the state's residents to rent, California's average monthly rent is 50 percent higher than the rest of the country.

Take Orange County, for example. This county of 3.1 million residents is one of the most expensive rental markets in the United States, with 90 percent of very low-income households reportedly spending at least one-third of their income on rent each month.

Building affordable, multifamily housing could provide many socioeconomic benefits to Orange County's low-income residents, though, according to a 2014 report commissioned by state housing authorities. Affordable housing has been shown to decrease residential instability and enhance educational outcomes for children. It also reduces pressure on household budgets so that families have more discretionary income to spend on food, health care, and other basic living expenses.

Even so, securing stable housing is only half the battle, given that more than 4 million US families living in government-assisted rental units earn less than 30 percent of their area's median income, according to the National Resident Services Collaborative. Thus health and education challenges abound for many low-income families in affordable housing.

That is why researchers at the University of Southern California (USC) School of Social Work recently applied geography to examine whether a service-enriched housing model—which provides on-site social services to residents—could minimize socioeconomic, educational, and health disparities for children and families living in affordable housing communities.

Can On-Site Social Services Narrow the Rift?

To see if providing hyperlocal educational, nutritional, and health assistance to low-income residents would make a difference, the research team sought out three affordable housing sites in Orange County to test the model.

The team used data available through Esri's ArcGIS platform to identify three sites that were comparable in location and composed of similar populations: predominantly low-income, Hispanic residents. Once the three apartment complexes were selected, researchers employed ArcGIS for Desktop to map the key assets and risks within a one-mile radius of each location. Assets included the number of neighboring parks, schools, grocery stores, and recreational centers, while risks comprised the quantity of nearby liquor stores and local crime rates (taken from the total number of police reports made during the month of June 2014).

Teaming up with Project Access, a nonprofit that specializes in residential services for low-income families, the researchers decided to administer different doses of adult nutrition classes and after-school youth programming to each of the three housing complexes. The experimental site received full-time services, the comparison site received part-time programming, and the control location was given no services at all.

The team's ArcGIS maps displayed the sites' tallies of assets and risks. For the sites that received full-time and no services, results were comparable: they each had more than 100 criminal activities with varying degrees of severity reported to local authorities throughout the one-month time frame. The part-time site, however, only had one criminal activity reported for the month—non-aggravated assault. Moreover, the part-time site had few risk factors altogether. This data on the sites' sociogeographic variations proved to be vital when analyzing the study's outcomes.

Connecting Location with Program Performance

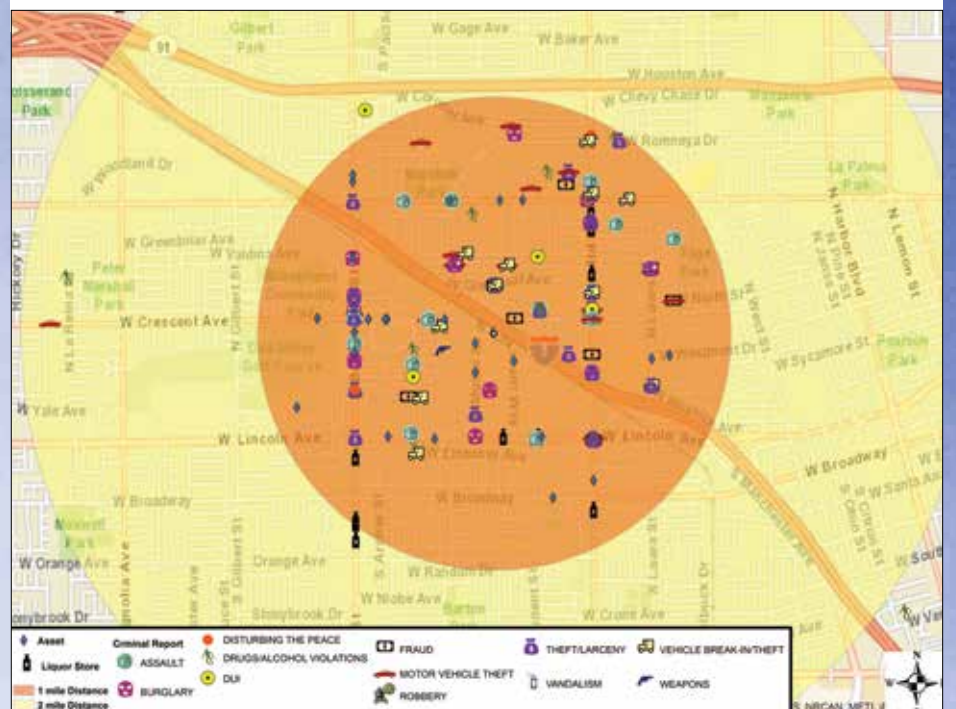
Although the three-year study is ongoing and researchers are continuing to collect data, results for the first year revealed stark differences among the three locations.

Researchers discovered that residents at the full-time programming site strongly outperformed the other two sites, achieving more considerable gains in developing and maintaining positive relationships, contributing to community integration, and working toward healthier lifestyles.

Tenants in the full-time group also experienced higher satisfaction rates with their programs. Residents from the other two sites voiced concern about the lack of services and support systems in their complexes. At the part-time site, participants said they wanted more program hours and better scheduling flexibility. Residents who received no programming at all expressed a strong desire to participate in social programs but cited lack of transportation, long waiting lists, and high costs as reasons why they could not take advantage of similar services being offered elsewhere.

According to the first-year investigation, full-time social services do have a significant impact on the lives of low-income families—especially when it comes to their sense of community; making better lifestyle choices, such as eating well and exercising regularly; and perceptions as to whether their needs are being met. However, part-time and no-services participants had much lower—and nearly identical—perceptions of their quality of life and respective communities. This is

Community Risks & Community Assets—Sea Wind South



↑ Sea Wind South, the control group that received no services, had 146 crimes reported during the study time frame. Both Sea Wind South and Warwick Square have higher crime rates than middle- to upper-class socioeconomic communities in Southern California.

especially telling considering that the part-time site is situated in an area with a much lower crime rate than the other two sites.

Geospatial Analysis Confers Credibility

Social science studies conducted in the field differ from those done inside a laboratory because researchers cannot control every variable. In these instances, it is pertinent to consider any influencing factors that might alter the study's outcome.

For this research project, it would have been ideal—albeit unrealistic—to have comparable crime rates across all three sites at the outset. However, employing geospatial analysis lent credence to the researchers' conclusion that part-time services may be less impactful on residents' quality of life than full-time services.

Because the full-time group appears to have received greater benefits from its social services, researchers determined that the number of community risks identified in ArcGIS at the outset of the project did not impact the on-site programming. It was revealing, too, that although low-income communities have to combat multiple risk factors—including poverty, crime, lack of resources, navigation of public

services, and language—full-time, on-site services appear to go a long way toward improving educational and health outcomes.

In the long run, researchers hope that this study can advocate policy changes for affordable housing. It has important implications for social policy, as the California Tax Credit Allocation Committee, part of the state treasurer's office, awards tax credit points to housing developers that provide different levels of social programming. Since GIS helped illustrate that full-time services may have more substantial impact than part-time services—despite sociogeographic variables—the research team recommends that the committee reconsider the quantity of award points given for supplying part-time programming.

For more information on this study, contact USC professor and researcher Dr. Juan Araque at araque@usc.edu.

Bridging the Gap Between Local Acts and Global Effects

The Importance of Global Understanding for Sustainable Living

By Benno Werlen, International Year of Global Understanding

Dealing successfully with social and climate changes on a worldwide level requires people to understand their own lives in a global context.

With globalization, everyday actions operate within and generate new geographic conditions in which things that are spatially distant are no longer temporally isolated but are instead very close. Communication technologies allow information to be transmitted and exchanged in real time. Because of this, everyone is directly or indirectly part of a globalized geographic reality.

This new *conditio humana*, or human condition, requires people to have a more wide-reaching awareness of their own lives. It necessitates bridging the gap between local acts and global effects—because thinking globally and acting appropriately on a local level presuppose global understanding.

The International Year of Global Understanding (IYGU), which was launched at the beginning of February and runs through the remainder of 2016, centers on the idea that the local and the global are intertwined in manifold ways. For a year, IYGU will foster research, education, and debate about both local and global processes, with the goal of developing a blueprint for a new geographic view of a radically changing world.

But what defines this new geographic view?

New Conditions Demand Change

Humans can't keep trying to solve twenty-first-century ecological problems using strategies derived from nineteenth-century issues. The digital revolution has set in motion a process of globalization that is radically transforming spatial and natural relations.

One basic, core assumption of most environmental approaches, for example, is that living spaces exist prior to human action. This conceptualization began with biology

and was then applied to countless spatial formations—especially the social ones typical of nineteenth-century nation-states and their distinct boundaries.

For many aspects of everyday life in the twenty-first century, however, this notion is more historical than anything else. Globalization is demonstrating that actions can precede spaces. In other words, spaces are constituted by actions, not the other way around.

Humans experience daily how globalization is bringing far-flung places and people into ever-closer contact. New kinds of supranational communities—such as the European Union and the Caribbean Community and Common Market (CARICOM)—are emerging at an accelerated pace. Even globally shared lifestyles that revolve around music, sports, or nutrition, for example, are growing in importance.

That is not to say, however, that these supranational trends efface the local. Globalization also accentuates places and regions as distinctive forums of human action. All human actions remain, in one way or another, regionally and locally contextualized.

Thus spatial information—which is a particularly accurate precondition for carrying out analyses and making decisions—is still crucial. But with ongoing digitalization and the continued individualization of lifestyle choices, sustainability research needs to advance from a space-centered focus to an emphasis on spatially contextualized day-to-day conduct.

This research should provide insight into the logic of everyday actions and their global consequences. By helping researchers understand how humans act, it should also assist people in understanding the repercussions of their actions. Thus information is needed about spatially and globally contextualized conduct—especially the

intended, unintended, and condoned negative consequences of all kinds of actions in the social, economic, biological, and physical worlds.

Only Understanding Can Transform Habits

Research on global climate change has produced unambiguous scientific insight into complex terrestrial processes. But so far, these revelations are too rarely translated into effective policies.

Knowledge alone about the existence and severity of a problem too rarely results in changes in actions—especially with regard to everyday activities that, more often than not, represent deeply ingrained habitual routines. Awareness does not change habits or routines. Only understanding can.

Understanding enables improved social and cultural acceptance of scientific knowledge and helps establish culturally distinct paths to global sustainability. To think globally and act locally, the local and the global have to become one. For this to occur, people need to better understand how their local, daily activities have global impacts.

How the Local Shapes the Global

Humans' future on earth depends on being able to establish sustainable everyday actions that are backed by scientific insight. Societies and cultures need widespread awareness of how their daily endeavors have created—and continue to shape—the challenges that humanity now faces. Seemingly disconnected actions and thoughts need to be unified across time and space.

If current ecological problems are indeed caused by human actions, the reasons for changing habits and implementing new routines lie outside the realm of natural science. Although, increasingly, people understand that some practices are not sustainable they still have a hard time changing their behavior.

Defining a healthy relationship between nature and society remains challenging—principally when it comes to designing environmental policies that are informed by sound science.

For people to attain global understanding, they must first comprehend the circumstances of their own sociocultural living conditions—and grasp the consequences. In what is now being called the Anthropocene age, people have to understand that the most vital parts of the lifeworld (the subjective world that people experience in their everyday lives) are man-made. That means they are humans' responsibility.

Additionally, people must realize that their corporeal, biophysical way of existence is part of nature, just as the human body is, in itself, nature. Thus nature is not the environment; nature is the contemporary world.

Instituting Global Awareness

Although it is clear that local and global issues are intimately related, fostering an understanding of the cumulative global effects of individual local actions remains a challenging task.

People need to open up to a new geographic worldview that takes into account, above all, four things:

- The diversity of sociocultural ways of interpreting natural conditions
- The creativity of different ways of living
- The plurality of pathways to global sustainability
- The local and regional particularities of globalized living conditions

Only then can humans establish the necessary setting for this bridge-building exercise.

A New Geographic Imagination

A precondition of global sustainability is achieving sustainable, ordinary practices. Citizens need to change their actions, habits, and routines so that they become more endurable in culturally and regionally specific ways that keep global conditions top of mind. This entails not just knowing about sustainability but also living it.

In the long run, sustainable living depends on global understanding. This means that people's habit modifications need to be based on a new geographic imagination of the world—one that puts their everyday actions at its core. That way, people transform not only their day-to-day practices but also their living spaces and the earth's environment. And that is exactly what IYGU seeks to do.

About the Author

Benno Werlen, a professor of social geography at the Friedrich Schiller University of Jena in Germany, is also the executive director of the 2016 International Year of Global Understanding. The initiative is supported by the International Council for Science, the International Social Science Council, and the International Council for Philosophy and Human Sciences.



Weaving a Tapestry of Hope for Climate Change

Amid the milieu of fierce deliberation and uncertainty that defined much of the 21st Conference of the Parties (COP21) in Paris in late 2015, primatologist, conservationist, and UN messenger of peace Dr. Jane Goodall offered a message of hope. Along with renowned marine biologist Dr. Sylvia Earle, Goodall launched the Tapestry of Hope, an interactive online map that documents thousands of projects around the world that young people are establishing to benefit communities and animals who share the earth.

The map, released December 7, tracks the on-the-ground impact of Roots & Shoots, a youth-led community action program from the Jane Goodall Institute (JGI) that inspires young people the globe over to do projects that protect the environment. The Tapestry of Hope, a customized Esri Story Map, pinpoints youth-focused projects on a world map and lets users click on individual points to explore them in greater depth.

In Mashhad, Iran, for example, kids, teenagers, and other volunteers founded the Kavikonj Nature School—the first of its kind in the country—where urban youth, who otherwise have little access to nature and wildlife, plant trees, manage a small farm, and learn to care for the environment. Community members in Iida, Japan, are trying to set up an ecology learning park in the city and are working with the local government to acquire land for their park. In Nairobi, Kenya, students from Eastleigh High School's Clean Up Young Youth Club are removing trash from a 300-meter section of the Nairobi River. And in Crete, Nebraska, members of the community are operating a thriving community garden.

"The launch of Tapestry of Hope reflects just a snapshot of the projects young leaders have led in the past several years through Roots & Shoots," said Erin Viera, associate vice president of Roots & Shoots. "Moving forward, the map will be a critical tool to document,

manage, visualize, and share the actions and impacts of Roots & Shoots projects that are making a positive difference for the environment, animals, and people. The map will continue to grow and populate with the launch of each new Roots & Shoots community project that young people continue to pioneer around the world."

The Tapestry of Hope also highlights Hope Spots—areas of the ocean that are either already protected or that Earle and the Mission Blue initiative are seeking to preserve. With less than 4 percent of the ocean sanctioned for preservation, the pinpoints in the story map not only spotlight marine protected areas but also single out locations that, without formal safeguarding, will remain seriously threatened.

Esri technology, which powers the mapping behind JGI's conservation work, forms the basis of the Tapestry of Hope.

"It really couldn't be simpler," said Esri application programmer Lee Bock, who built the story map. "You click on icons and you get to see projects that happen in that location...and you'll see anywhere from one to many projects that occurred at that location."

Bock added, "It's nice to showcase people, and particularly young people, who are striving to make the world a better place."

"Esri and [JGI] have collaborated on conservation programs across Africa for more than 10 years now," said Lilian Pinteá, JGI's vice president of conservation science. "These projects have included applications ranging from using geospatial technologies for chimpanzee behavior research in Gombe to supporting the development and implementation of conservation action plans and improving village land use, using geodesign and community mapping across East Africa and Congo basin."

And now, the collaboration includes illustrating how all actions, big or small, can truly impact the natural world.

The historic 2015 Paris Climate Conference resulted in 195 nations committing to taking concrete steps toward permanently reducing greenhouse gas emissions. As countries seek to implement their plans in the face of myriad challenges and ongoing disagreements, the Tapestry of Hope will continue to let people visualize all the conservation work that global youth—who care deeply about the world they will inherit—are bringing to fruition.



↑ The Tapestry of Hope, a customized Esri Story Map, pinpoints youth-focused projects on a world map.

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Startups Tackle Traffic Issues Using Esri Technology

Transportation technologies are making mobility more efficient and economical. Consumers' increasing adoption of ride sharing services is shaping the future of transit, as is the Internet of Things. The mobility business is booming, and transportation startups are using Esri technology in their apps to connect people to one another and keep traffic moving.

The Esri Startup Program gives emerging businesses an edge by helping them integrate spatial functionality into their products and services. Program participants receive ArcGIS platform technology, training, support, and marketing opportunities to help them succeed. To learn more about the Esri Startup Program, visit developers.arcgis.com/en/startups.

Convenient Carpooling

German startup Match Rider designed an app that matches people with a car pool heading in the direction they need to go. And drivers don't have to go out of their way to pick up passengers.

Participants can search for car pools within a 100-kilometer range. The app shows users a map with Match Points where drivers will stop to pick up passengers. The Match Rider system works like public transportation, with Match Points functioning like bus stops: A passenger clicks a blue Match Point dot on the map and sees a picture and description of the pickup spot. He or she then walks to that location to get a ride.

Participants can use the app spontaneously or for routine rides. Passengers and drivers can rate each other after the ride, building trust and transparency among users. The service is currently free to use, and passengers pay their drivers the set fee for each ride in cash.

The Match Rider platform, which runs on the web and on iOS and Android devices, is hosted



↑ Match Rider shows a map with Match Points where drivers will pick up passengers.

in ArcGIS Online. Esri's network analysis capabilities improve routing. By mapping population data, Match Rider can place Match Points where they are more likely to be used.

In partnership with the University of Stuttgart, Match Rider is currently testing its service on busy commuter routes in the German city of Stuttgart.

Learn more at matchrider.de.

Fixing Traffic Flow

Cameras and sensors monitor traffic throughout the United States. Startup company MetroTech is aiming to improve traffic flow by putting this real-time data onto maps.

Working with Esri, MetroTech is creating better datasets from this information and incorporating analytics into it. The company is enhancing traffic signal timing and communication with drivers—leading to improvements in people's daily commutes.

By employing ArcGIS Marketplace and technology from Esri partner OSIsoft, MetroTech can map real-time activity on roads and highways. The company uses the PI Integrator for ArcGIS to stream sensor data to the Esri platform—specifically to ArcGIS GeoEvent Extension for Server. GeoEvent Extension sends those updates to a standard Esri feature service hosted in ArcGIS Online. The live-updating feature service can be analyzed and manipulated using powerful tools from Esri, including custom dashboards and live map editing. The data can be visualized as a live



↑ Using MetroTech's technology, Santa Clara County has reduced stop-and-go traffic.

traffic web map, which helps immensely with orchestrating traffic management. MetroTech also uses Web AppBuilder for ArcGIS to create web applications that customers can use to access live maps and do traffic flow calculations on any device.

Santa Clara County, just south of San Francisco, has implemented MetroTech analytics for more than 100 of its intersections. In just two years, MetroTech tracked 3.1 million turning movements (the number of vehicles going straight or turning left or right at an intersection) per day. Using this information, the county has altered its traffic lights so they change more efficiently. The first year that MetroTech's technology was put into action, Santa Clara County eliminated 18,000 stops per day. Considering that the United Parcel Service could reportedly save \$100 million per year if each truck cut one minute off of its drive time, this is a huge cost savings for businesses, governments, and commuters.

Learn more at metrotech-net.com.

Esri Partners Implement Web GIS in Diverse Industries

Esri partners around the world are implementing web GIS in their organizations to help users be more effective and make smart decisions faster. These are just a few examples of the solutions Esri partners offer across various industries.

Esri's more than 2,000 global partners provide customer-focused, geoenabled solutions that span dozens of industries. Products and services range from configured apps and custom-built solutions to complete ArcGIS system implementations and content. To search and discover partners, solutions, and services that meet your needs, visit esri.com/partners.

For additional information about the partners in this article, view their E380 interviews from the 2015 Esri User Conference at video.esri.com.

A Better View of Electricity and Gas Assets

Utilities rely on field operations to manage their essential networks. Giving field crews timely information about a network and its assets is vital. EpochField, a mobile app from Epoch Solutions Group, helps fieldworkers in the electric and gas industries visualize their network's asset and pipeline data. The app's synchronization capabilities allow fieldworkers to see maps and data whether or not they are connected to the Internet, enabling field crews to do better asset inspections and damage assessments. The app's sharing capabilities—made possible by Esri's portal and server architecture—also provide the head office with more timely information, empowering everyone to make better decisions. Learn more at epochsg.com.



↑ EpochField allows fieldworkers to see their network's asset data while on the go.

A Spatial Framework for Pipelines

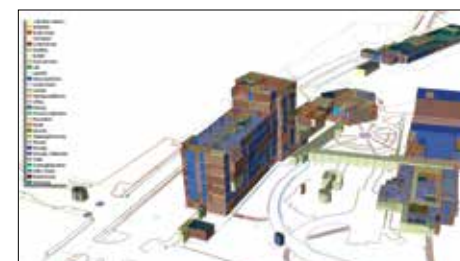
Pipeline organizations often find it challenging to gain access to reliable asset information. That is why Intrepid 4.0 Pipeline Management, from Novara GeoSolutions, makes it easy to store, organize, and manage vital pipeline information in a spatial framework. Intrepid provides mapping presentations, extensions, templates, mobile solutions, and interfaces that can be configured to meet a range of needs. With the ArcGIS platform at its core, Intrepid helps users maintain and analyze data at an enterprise level, as well as access information from any industry database, including the Pipeline Open Data Standard (PODS), the Utility and Pipeline Data Model (UPDM), and the ArcGIS Pipeline Data Model (APDM). Learn more at novarageo.com.



↑ Intrepid makes it easy to store, organize, and manage critical pipeline data.

Validating Critical Facility Decisions

Facility teams have to make accurate decisions quickly, and those decisions need to be based on precise information about buildings, assets, people, events, and infrastructure. With this in mind, PenBay Solutions developed the InVision software suite, which brings GIS to facilities management and public safety. Using InVision, facility managers and safety and security teams can leverage their data spatially to find answers fast and validate critical decisions. Built on the ArcGIS platform, InVision is an integrated, scalable solution that helps users resolve key facility life cycle issues—from maintenance, security, and daily tactical operations to space management and move planning. Learn more at penbaysolutions.com.



↑ InVision helps users solve facility life cycle issues such as security and space management.

Hartford Saves Time, Resources with ArcGIS Open Data

ArcGIS Open Data helps more than 2,800 organizations around the world share their authoritative data in multiple open formats. The solution, hosted and managed by Esri, comes free with ArcGIS Online. It enables users to set up public-facing websites where members of the community can search for and download open data.

Hartford Data

The City of Hartford, which is the capital of Connecticut and the state's fourth-largest city, uses ArcGIS Open Data to streamline the process of releasing its geospatial data. Using ArcGIS Open Data has helped the city respond to data requests from the public and improved the ArcGIS Online experience for its internal users.

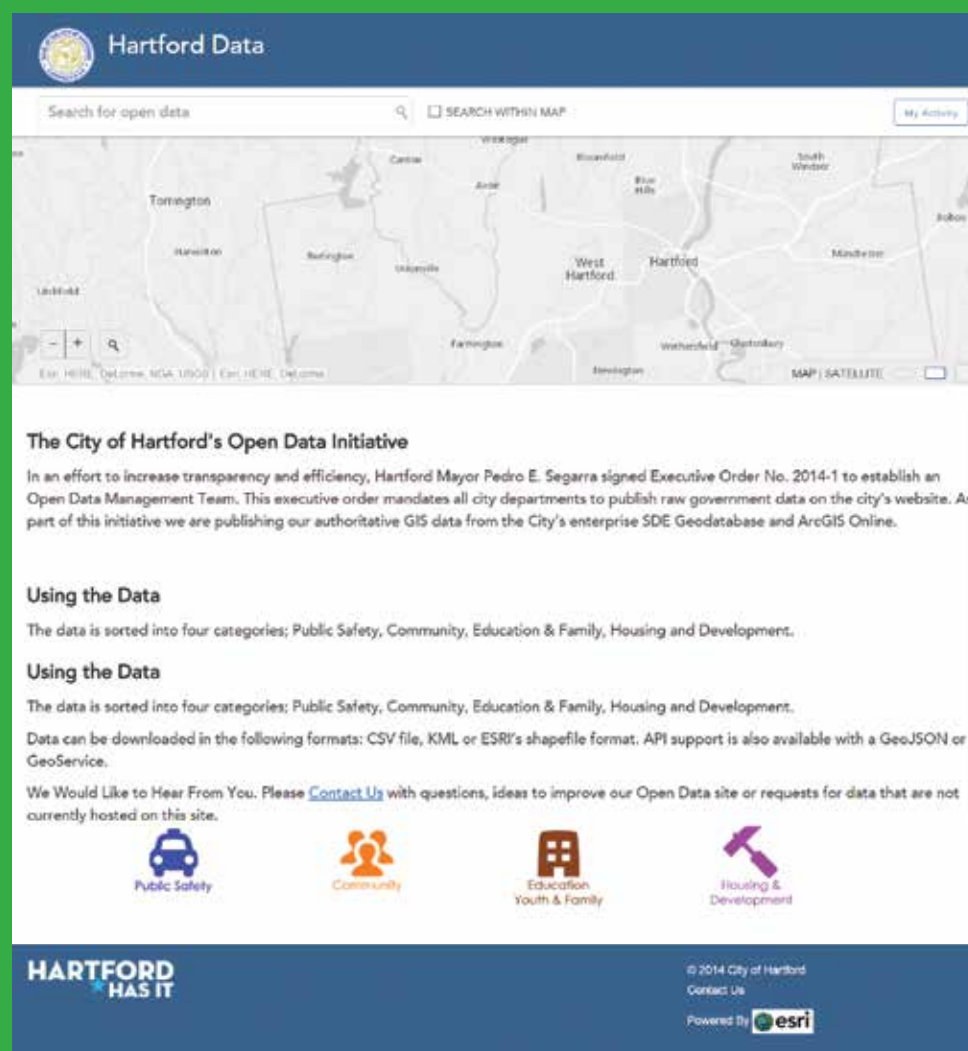
Hartford has released more than 70 datasets on its ArcGIS Open Data site, saving the city a significant amount of time and money.

Employees in Hartford's GIS Services division receive countless requests for geospatial information from engineering companies, graduate students, and other organizations. Before launching its ArcGIS Open Data site, these GIS specialists had to endure a complicated, time-consuming process for each request. They had to locate the data; clip and format it to meet the requester's specifications; export the data from Hartford's internal GIS system; and, finally, upload the data to a publicly accessible FTP site for downloading. Now all they have to do is point people to the city's ArcGIS Open Data site.

Many internal users from departments across the city also access Hartford's open data, including the mayor's office; the planning division; the police department; the Department of Families, Children, Youth, and Recreation; and the Department of Public Works. All these divisions are linked via ArcGIS Online, and Hartford's ArcGIS Open Data site is always at hand. When employees in these departments create a new map in ArcGIS Online, they can easily add the city's open data to it. This ensures that everyone in every department is using the latest and most authoritative city data.

ArcGIS Open Data has made the City of Hartford's GIS workflows much more efficient and effective. And its GIS staff continue to look for new opportunities to expand Hartford's open data offerings, including the Living Atlas of the World.

Explore Hartford Data at openhartfordct.hartfordgis.opendata.arcgis.com/.



↑ The City of Hartford has released more than 70 datasets on its ArcGIS Open Data site.

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The Relevance of Cartography

A Cartographer's Perspective

A column by Menno-Jan Kraak

President of the International Cartographic Association



Blurry Borders

Borders and maps are inseparable. These simple boundary lines might even be the reason cartographers exist, since many of the very early maps delineated territory. But, actually, borders aren't simple at all. They change constantly.

If there are no prominent border conflicts happening in the world, a cartographer might hear, "What do you do? Everything has been mapped." When territorial disputes do make headlines, though, people will exclaim to cartographers, "Wow, you must be very busy with all these new borders."

The desire to continue conversations about topics that constantly change—such as urban growth; long- and short-term weather dynamics; or, of course, borders—might depend on the crowd. And sometimes it makes more sense to just change the topic to something easier to talk

about, like that new shop downtown or how good the desserts look. But there is no shortage of cartographic discussion material because borders on maps exist in an abundance of different forms.

People are probably most familiar with administrative borders for countries, states, or municipalities. On many maps, such as those from National Geographic, a band of color along the border enhances the boundaries. On other maps, each area is given a different color—and, as Robin Wilson argues in *Four Colors Suffice: How the Map Problem Was Solved*, only four colors are needed to indicate different areas on a map with no color ending up next to itself.

Even nonadministrative maps have borders. Geologic and soil maps, for example, delineate different entities by using borders. The same is

true for maps that show contour lines, plans, and even weather patterns.

Borders of all kinds are often disputed though. Looking at the world map, there are many countries that do not agree on the exact location of the border. In fact, one might find several maps that depict the same border in different places, depending on which country the map comes from.

Which map should be created, then? A map with a neutral view seems logical, but that might be the most challenging map to make from a design perspective due to the complexity of all parties' territorial claims. Take, for instance, the South China Sea, where China, Vietnam, Malaysia, Indonesia, Brunei, and the Philippines have conflicting territorial claims. Those are complicated boundaries.

Perhaps a de facto map that illustrates the situation on the ground could be created. Or maybe an official map—one that shows how the United Nations recognizes the situation—would work best.

Some international map providers have even offered localized maps of areas with ambiguous boundaries, such as the eastern border between India and China. So the Indian version of the map portrays the disputed territory of Arunachal Pradesh as part of India, while the Chinese version envelops the area inside the country's own borders, indicating that it is South Tibet.

In discussions among disagreeing countries, this kind of mapping can be viewed as cartographic aggression, wherein a country uses a map to claim territory. Accordingly, borders in geopolitics can be dangerous.

Sometimes territorial fights are executed on the square centimeter—on postage stamps. For example, several countries have issued stamps with maps that claim parts of Antarctica. If we were to overlay these stamps from the United Kingdom, Chile, and Argentina, the resultant map of Antarctica would have interesting overlaps.

These weird situations aren't always so far away from home though. On the Belgium-Netherlands border, there is a Belgian municipality called Baarle-Hertog that is scattered within the Dutch

municipality of Baarle-Nassau. And even within the Belgian territory in the Netherlands, one again finds Dutch parcels. This particular situation—having borders within borders—results in a perfect dataset on which to practice the validity of your topological algorithms.

Another interesting situation is when only geographic names are used to identify an area. Amazonia in South America and the Sahara in North Africa are notable regional examples. These types of toponymic delineations also exist at the local level within cities or states. Little Havana in Miami is one such place, as is Skid Row in Los Angeles. It might be interesting, actually, to define these fuzzy borders via crowd-sourcing, asking locals whether or not they think they belong to such a region or neighborhood.

Borders on most physical maps, such as soil maps, look very authoritative. But one has to realize that those maps are mostly interpretations based on a relatively small set of observations. Sometimes borders on soil maps are hard, like when bedrock bounds sand. But sometimes they're not. Along a riverbank, for example, sand melds with clay, and we end up with a transition zone rather than a sharp boundary—though a line is still drawn.

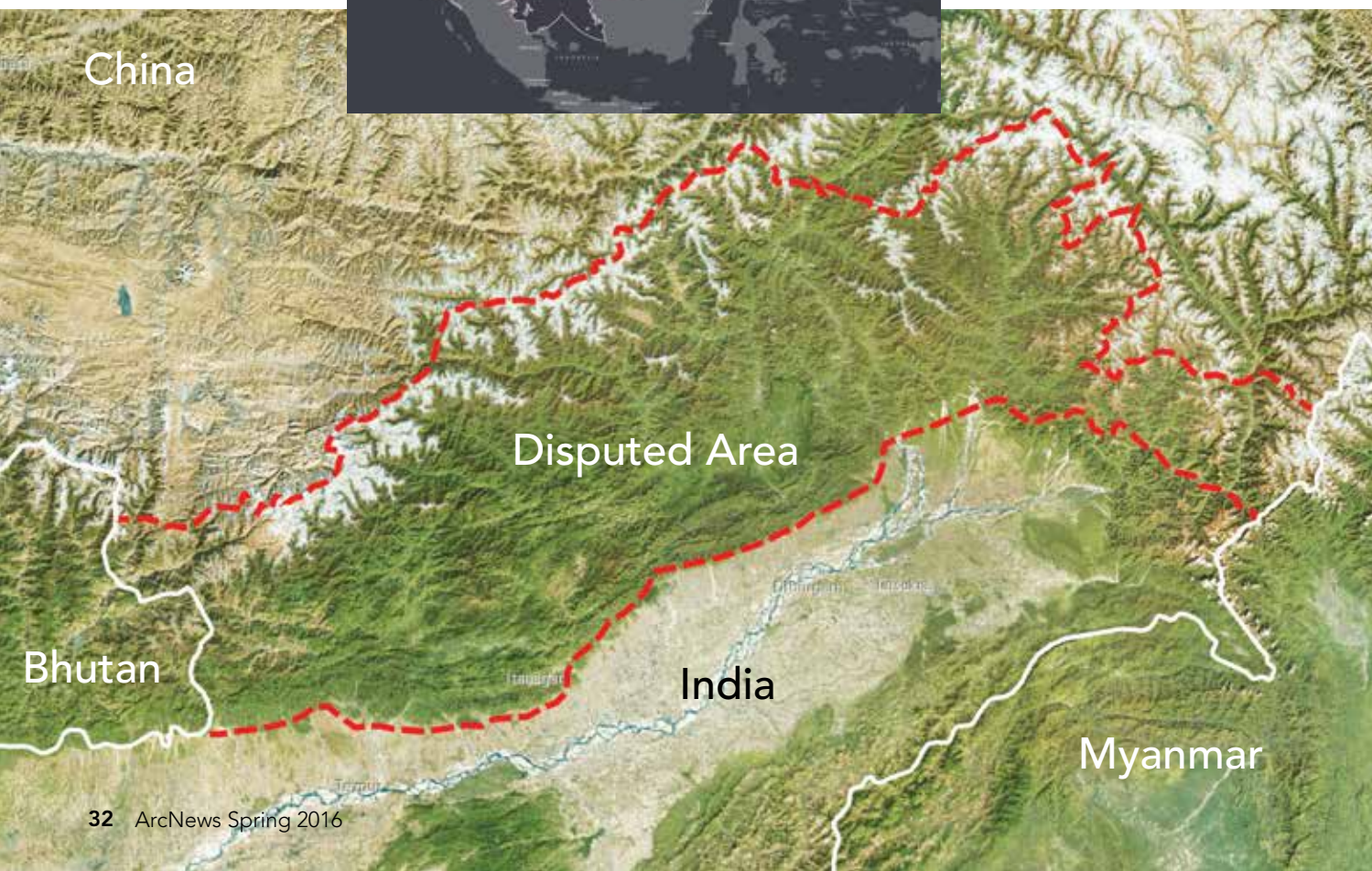
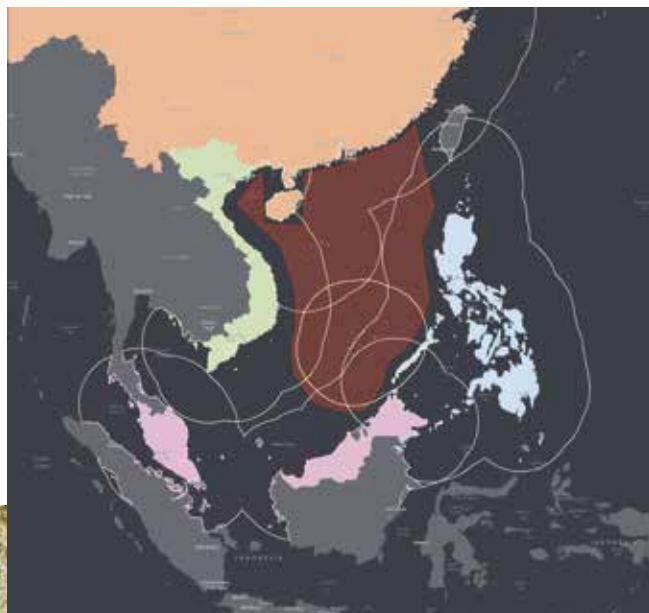
This is similar for maps of noise zones around airports or those that depict flood risks. The borders we see on these maps are the result of interpolation and interpretation. Planning maps sometimes even have blurred borders on purpose—to try to keep commercial businesses at a distance from residential areas, for example.

Borders are found on all maps, and they are a challenge for cartography in many ways. Nevertheless, map design should inform properly so that map readers can accurately shape their opinions of a situation. To ensure this, the mapmaker should indicate the discipline (interpretation, interpolation, or measurement) or the political viewpoint by which the borders were defined.

Many decisions—good and bad—are made based on the borders drawn on maps. The more information map readers have about these borders, the more likely they are to make good decisions.

→ In the South China Sea, multiple countries have conflicting territorial claims, making for complicated borders.

↓ Indian maps portray the disputed territory of Arunachal Pradesh as part of India, while Chinese maps envelop the area inside China's own borders, calling it South Tibet.



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 Technical University. 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.



Crossing Borders

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

Geography Helps Every Student Succeed

The American Association of Geographers (AAG), together with others, has been working for more than a decade to reauthorize the No Child Left Behind Act. On December 10, US president Barack Obama signed the new Every Student Succeeds Act (ESSA) into law. The ESSA is the successor to No Child Left Behind and is now the primary federal law dealing with K-12 education policy.

The ESSA took effect immediately, but it will take several months for the US Department of Education to fully implement the new programs established by the law. The AAG has been monitoring the 2015 congressional reauthorization process closely and advocating for new programs to be included that support geography education. We are pleased with several programs in the law that advance K-12 geography.

These include the following:

- A new grant program for history, civics, and geography is being created as part of a larger series of grant programs that includes teacher incentives and literacy education funding.
- States are authorized to use certain funds to support school districts in developing activities that foster a well-rounded education, and those activities include geography.
- School districts, in turn, are required to use some grant funds to foster opportunities for a well-rounded education, and geography is one of the subjects specified for these expenditures.
- Grants to magnet schools must be related to a series of activities, including improving students' knowledge of various subjects—one of which is geography.

- Grants to aid in educating Native American students are focused on raising achievement in various subjects, including geography.
- The law defines a "well-rounded education" for K-12 students, and it incorporates instruction in geography.
- The law identifies geography as a core subject.

Just before he signed the bill, Obama said, "Now the hard work begins." And he is right.

As the federal government works to enact the law and states and districts adjust to their newfound flexibility, it will be incumbent on the geographic and GIS communities to engage with educational leaders across the nation to stress the importance of geography as a science, technology, engineering, and mathematics (STEM) discipline that is critical to job growth. The recent report from the US Government Accountability Office on American students' dearth of geography knowledge will help in conveying this message. So will the widely endorsed AAG Resolution Supporting K-12 Geography Education, which urged the US government to include geography and geospatial learning in its education reform proposals.

The US Department of Labor has repeatedly indicated that geographic technologies are among the most important emerging and evolving fields in the technology industry for job creation. Public and private sector entities are increasingly turning to GIS, GPS, and related technologies to handle complex problems and assist in organizational planning and

operations. Additionally, a heightened focus on global affairs has made understanding the economic, political, cultural, and geographic components of globalization increasingly important to all students and policy makers.

While the ESSA is not perfect, it does provide promising new pathways for geography teachers (and other educators who are interested in geographic learning at the K-12 level) to work with states and local education agencies to seek and receive federal grant funding for geography-focused activities.

Efforts to strengthen geography education across the nation also received a major boost when Esri president Jack Dangermond offered free ArcGIS Online accounts to all K-12 schools in the United States. This pledge, which was made in connection with the Obama administration's ConnectED initiative, has the potential to greatly improve geography and GIS education in K-12 classrooms and is synergistic with the new ESSA. The AAG is working closely with Esri to build a national network of GeoMentors as well to support GIS implementation in classrooms. So far, more than 1,000 participants have joined these efforts.

We at the AAG look forward to working with the Esri user community to strengthen geography and GIS education in all US schools.

For questions about the new law or geography education policy in general, reach out to John Wertman at jwertman@aag.org or Doug Richardson at drichardson@aag.org.

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California State University, Long Beach

Dutch Teacher Enriches National Geography Curriculum with ArcGIS

The Dutch education system recognizes that students need to have a fundamental understanding of physical geography. That is why topography, the study of the earth's physical features, is part of the national curriculum for secondary school education.

Dutch students are required to learn the locations of 300 specified cities, bodies of water, and mountain ranges throughout the world. This helps them understand the dynamics that drive political power, international trade, industrialization, climate change, national alliances, and many other important occurrences related to geography.

Although there is standardized curriculum to get students prepared for their topography examinations, one teacher, Dennis Hunink, didn't think this was enough. So he used ArcGIS Online to create more contemporary, web-based course materials for his students.

Adapting ArcGIS Online to Course Requirements

Hunink began teaching geography eight years ago at DevelsteinCollege in Zwijndrecht, a town located in the suburbs of the port city of Rotterdam.

"Initially, I just used the same materials that my fellow geography teachers were using for my topography classes," he said. "After a few years, though, I began to wonder if there were better materials available on the web to help my students master the designated worldwide locations for their exams."

He soon discovered that despite the vast resources available on the Internet, he was unable to find the exact materials his students needed.

"I found some websites that provided good information, but they weren't particularly easy for the students to use because the displayed maps were not the same as those they used in their exams," he said. "More importantly, though, I found that the vast majority of the

educational mapping materials available on the web lacked a real didactic vision; nor were they cartographically correct."

Hunink had taken several courses on GIS and cartography while studying social geography at Utrecht University, so he decided to explore the possibility of creating the online mapping resources he was seeking.

He spoke with some Dutch experts on geography education and determined that an integrated method to teaching topography was needed. Commercial publishers of educational materials just weren't providing this.

"I have some web development skills and thought it would be useful for my students if I created a website that allowed them to easily find the materials they needed for my topography course and prepare for their examination," said Hunink. "I got in contact with Esri Nederland B.V. [Esri's distributor in the Netherlands], and they were enthusiastic about my project. They provided me with an ArcGIS Online organization account, which allowed me to use the available APIs to develop the maps for the class and server space for file storage."

After several months of work, Hunink released Topografie in de Klas (topografieindeklas.nl) in January 2012. The program is driven by ArcGIS API for JavaScript and uses hosted content from ArcGIS Online to provide students with an interactive experience for their topography coursework.

Students pick specific features, such as rivers or cities and then engage in a series of questions about them. The instructor reviews the results online, and the student can save all materials for future reference. Students can also share their results with friends via Facebook and Twitter.

By the end of 2012, more than 100 schools (about 15 percent of all secondary schools in the Netherlands) were using the Topografie in de Klas website. Today more than half of the students taking topography classes use the website.

Although Hunink indicates that it is difficult to say with absolute certainty that Topografie in de Klas has boosted learning outcomes, he has a wealth of anecdotal evidence that this

↓ In 2015, Hunink completed Veldwerk 2.0, a program that uses Collector for ArcGIS to get students more engaged in their required fieldwork exercises.



↑ Hunink's students say they prefer using the Topografie in de Klas website for studying topography.

is his students' preferred method for studying topography.

"I found indications suggesting that the website makes a positive impact on the students' work," said Hunink. "But, more importantly, the students keep telling me that learning topography is much more effective and supportive using the website. Many of them became very frustrated when they had to learn the course materials with low-quality printed maps, and some even felt like giving up."

Taking ArcGIS Online into the Field

After seeing that ArcGIS Online worked for Topografie in de Klas, Hunink explored options for his students to use the program in the field.

"I had been using the Collector app with ArcGIS Online for two to three years in my classes but wanted to set up a formal program that could be used by other teachers," said Hunink.

In early 2015, he completed Veldwerk 2.0, a program that uses Collector for ArcGIS to get students more engaged in their required fieldwork exercises. Taking their smart devices outside, students follow a displayed map that includes markers at specified locations. With Collector loaded onto their smartphones or tablets, students can answer all the questions displayed on the map, whether they are connected to the Internet or not (thanks to the app's offline mode). The teacher tracks their progress.

Like Topografie in de Klas, Veldwerk 2.0 provides a digital version of an existing course requirement in Dutch schools.

"Implementing GIS this way works well in our educational system here in the Netherlands," said Hunink. "The teachers are familiar with the

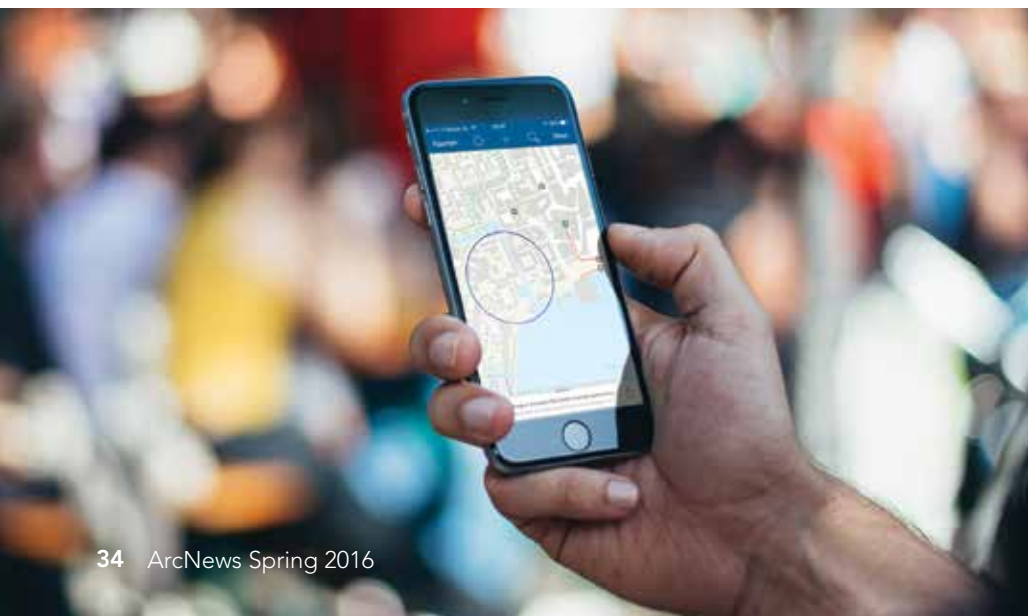
existing coursework, and it is an easy step for them to use digital maps rather than printed ones. They don't feel intimidated by a GIS program. Hopefully, by building their confidence in this way, both the teachers and students will begin to create their own content with ArcGIS Online."

To expand the use of Veldwerk 2.0, Hunink and Esri Nederland began to collaborate. Hunink teaches the Veldwerk 2.0 workshops in a classroom provided by Esri Nederland. The company also publicizes the workshops as an official course. Today approximately 40 teachers from 20 different schools have completed the workshop and are using Veldwerk 2.0 in their classes.

"We started this project with Dennis during the spring of 2015," said Dene Mastwijk, part of the educational team at Esri Nederland. "We host Veldwerk 2.0 workshops throughout the year so that teachers can learn how to use ArcGIS Online and implement it into their students' fieldwork exercises. After a teacher has completed the workshop, their school receives free access to their own ArcGIS Online organizational account for a year."

On a recent visit to DevelsteinCollege, Hunink's students gave a demonstration of Veldwerk 2.0 to Alida Oppers, director general of primary and secondary education in the Ministry of Education, Culture, and Science.

"This is a great example [of] how innovative technology can be used in education," Oppers observed. "It makes classwork more visual and allows students to experiment. This type of education is effective because the students remember the lessons much better and they get the opportunity to reinforce their lessons outside of the classroom."



Visit Distant Worlds with the Solar System Atlas

New Esri Story Map App Brings Planetary Maps Down to Earth

For decades, scientists on Earth have sent a plethora of probes into nearly every corner of our solar system to explore planets, moons, comets, and asteroids. What comes back is stunning imagery, startling scientific discoveries, and comprehensive maps of worlds many millions and even billions of miles away.

But where on earth can the average person find a sampling of these maps and use them to explore the universe? One place is Esri's new interactive Solar System Atlas.

Built using the Esri Story Map Journal app, the atlas gathers more than 50 maps into a single app. Starting with the sun, the Solar System Atlas takes users on an interactive journey to the outward reaches of our solar system to examine many of the most detailed maps available for planets, moons, asteroids, and comets.

An Unexpected Venture

The Solar System Atlas consists of more than 60 maps of different areas of the solar system. Some are from US Geological Survey cartographer Trent Hare, who loaded a number of planetary basemaps into ArcGIS Online, and some come directly from NASA's website.

Exploring the atlas is like taking an interplanetary ride from Earth all around the solar system

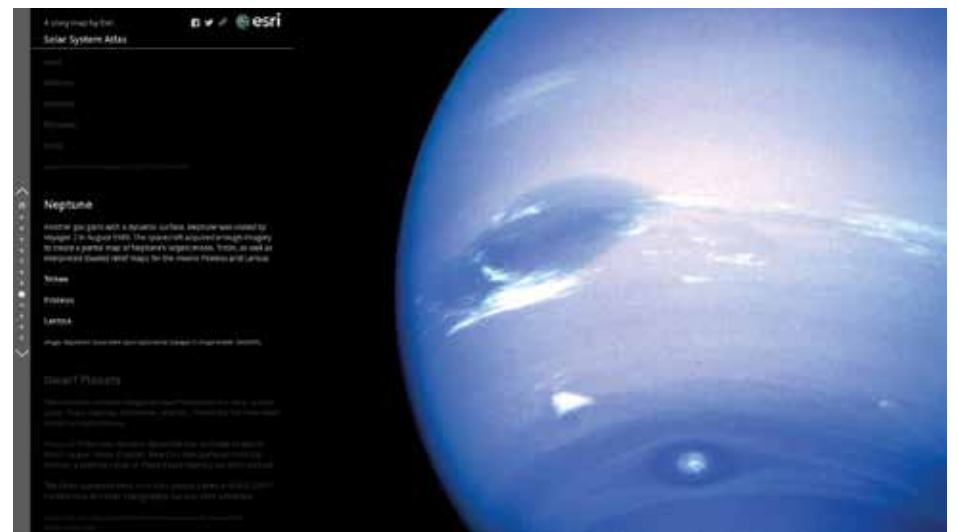
to see faraway places like the gas giant Jupiter and its moons, dwarf planets such as Pluto and Ceres, and even comets and asteroids.

While the maps themselves are mostly simple images at varying resolutions—without attribute data or georeferencing—they are not merely displayed as images in the story map. To allow users to really explore planetary bodies, the creator of the Solar System Atlas, Matt Artz (GIS and science manager and a content strategist for software products at Esri), made interactivity a priority.

He put each map into ArcMap in ArcGIS for Desktop and published every one of them as an image service in ArcGIS Online before displaying them in the atlas as interactive maps. Because of the different resolutions of the source maps, the user experience varies from map to map. But this is just the beginning of pulling all this information together into a single app.

More to Come from the GIS Community

The Solar System Atlas operates as a powerful educational tool that both teachers and students could use. Even members of the general public find it interesting, as it allows them to find out more about space, science, and



↑ Exploring the atlas is like taking an interplanetary ride from Earth all around the solar system to see faraway places like Neptune or Uranus.

discovery, in addition to learning about returns on investment for space exploration programs.

"There really is a lot of overlap between 'space geeks' and 'GIS geeks,'" said Artz, "but I'm not sure the average GIS/space geek is aware of how many different bodies in the solar system we've mapped. I certainly wasn't aware of all the mapping that has been done by NASA, the European Space Agency, and other organizations."

Additionally, it is intriguing to see technology that was created for Planet Earth starting to be used on other planets.

"I know that more detailed maps are being developed for some planets and other objects in the solar system using new, remotely sensed data," said Artz. "And, of course, new exploration of our solar system will continue, such as the Juno probe, which is slated to arrive at Jupiter on July 4, 2016."

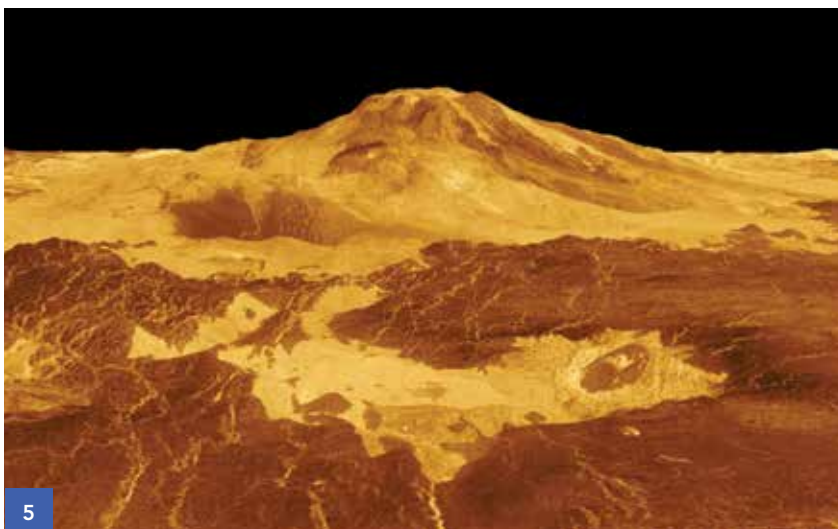
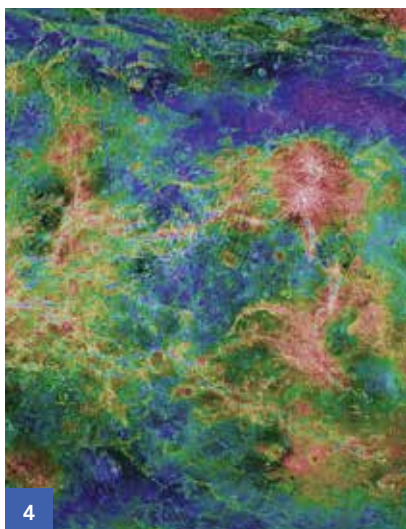
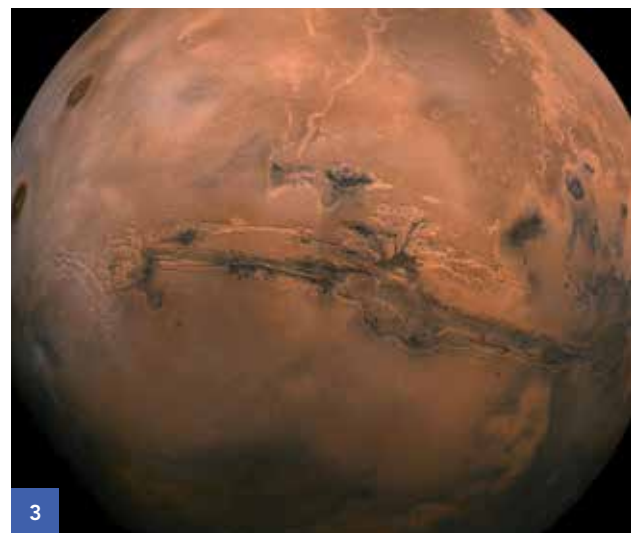
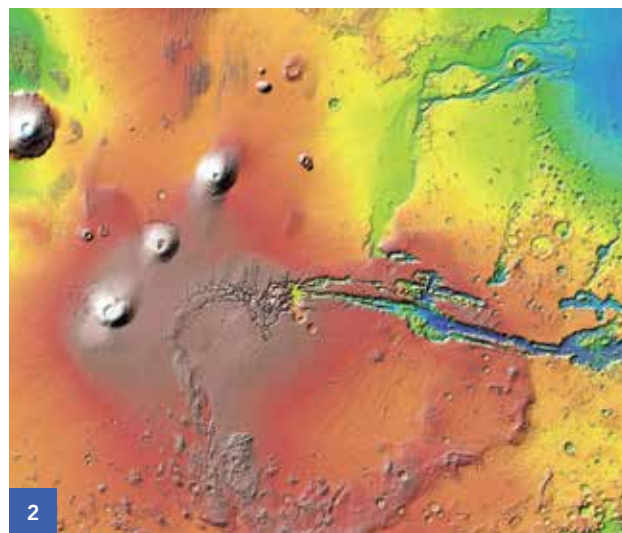
With new information coming in frequently, many of the maps published as simple image services will be enhanced over time.

"This atlas really just serves as a starting point for something much more robust and comprehensive that could be developed in the future," said Artz.

All maps featured in the Solar System Atlas are in ArcGIS Online and available for public use in a variety of applications. Links to the maps and more information about them can be found at the end of the story map.

"It's going to be fun to see the creative uses that people in the GIS community find for these maps," added Artz.

To explore the Solar System Atlas, visit arcgis.com/IRTPGCM.



- 1 The probes scientists have sent into nearly every corner of our solar system return stunning imagery, startling scientific discoveries, and comprehensive maps.
- 2 This map of the topography of Mars was generated by the Mars Orbiter Laser Altimeter instrument aboard NASA's Mars Global Surveyor spacecraft.
- 3 With the Solar System Atlas, users can take an interactive journey to planets such as Mars.
- 4 This colorized topographic global mosaic of Venus was created using images from the Magellan mission, with gaps in coverage filled with images from Earth-based radar, the Soviet Venera spacecraft, and the United States' Pioneer Venus missions.
- 5 The Solar System Atlas is a starting point for something much more robust and comprehensive to be developed.

A Management Perspective on GIS Professional Certification

By Rebecca Somers, Somers-St. Claire GIS Management Consultants

Managing GIS

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



Since the GIS Certification Institute (GISCI) restructured the GIS Professional (GISP) certification process and added an exam to it in 2015, discussions about the value of the GIS professional certification have reignited.

Most of the talk has revolved around the certification's value to individuals, focusing on how it can improve people's job prospects and salaries. But a larger discussion needs to be had about how the professional certification affects organizations.

The purpose of professional certifications is to protect the public by ensuring that competency standards have been met. Therefore, the matter is not just an individual consideration; it is a management one as well.

So how does having certified GIS professionals involved in an organization's GIS operations improve its effectiveness and quality? Answering this question requires considering several key aspects of management.

How Critical Is It to Ensure Work via Certification?

Good quality GIS work can certainly be performed by competent yet uncertified GIS professionals. But reliable work is not just about the quality of the product; it also involves the ability to ensure that quality, as well as the professionalism applied to the work. That is where professional certification comes in.

The most important area of concern is the caliber of geospatial data produced by a GIS team for its organization, clients, and the public. Doubtless, it is desirable to have all data be developed

and maintained in a skilled and reliable way, according to GIS professional standards. But organizations need to determine how important it is to assure this via the involvement of certified GIS professionals.

To do this, they need to consider which aspects of data development, management, and output require assurance that professional standards and expertise have been applied. For example, are there certain data collection, data conversion, database construction, database management, or map creation activities that require certified expertise?

Appropriate GIS knowledge and competence are also required to effectively develop and deploy GIS apps. Many aspects of these processes—from understanding user requirements and interpreting how an app will be employed to grasping technical processes—involve professional GIS approaches and judgments. Thus an organization would need to determine how these considerations arise in the types of apps it builds and uses—and to what extent they would need to be backed by professional certification.

When decisions are made using geospatial data, those choices are only as good as the data and apps from which they stem. The capabilities of the data and apps are commensurate with the degree of professionalism applied while developing them. So, ultimately, an organization's decisions and operations are dependent on the strength of the GIS professional standards applied to the geospatial information it uses.

In addition to geospatial data, apps, and products, GIS operations themselves are affected by professionalism. The selection, design, integration, and administration of databases, software, and technology require professional GIS capabilities to ensure that the tools and operations enable and maintain the spatial data's reliability and accessibility. Organizations need to determine their key operational components and whether they require certified GIS expertise.

Having certified GIS professionals on staff can assert the dependability of an organization's data, products, and services more concretely, raising the GIS team's level of professionalism and increasing its credibility within an organization.

Do Contractual Needs Warrant Certified Professionals?

Credibility with business partners and clients outside the organization is critical too. If an organization provides GIS products and services on a contractual basis, it needs to assure its customers of the quality of its deliverables. While experience, adherence to standards, and past performance furnish such proof, having certified professionals involved in contract assignments provides another level of certainty that professional standards will be met.

Many contracts include requirements that staff members hold specific professional certifications, and the GISP certification is starting to appear in some of them. Even if it is not a standard requirement yet, providing certified staff not only demonstrates an added level of commitment to professionalism, but it also could yield a competitive advantage.

Likewise, if an organization acquires GIS products and services from a contractor, the same concerns apply. The organization needs to determine if it is important that certified GIS professionals produce the products and services—and that may depend on whether its end users require it.

Where Would Certified GIS Professionals Fit In?

Managers should consider their organization's profile and professional needs and determine how those affect their GIS operations and products. Questions to ask include the following:

- Where and why would my organization need certified GIS professionals?
- Would all GIS positions require professional certification or only select ones?
- How could certification benefit operations?
- Where would technical- or application-specific certifications be appropriate?
- How critical are geospatial data and activities to my organization's overall objectives, and where are reliable quality assurances needed?
- What are my organization's vulnerabilities and liabilities?
- What are customer or end-user expectations?

Answering these questions helps managers determine if hiring certified GIS professionals and encouraging staff to attain and maintain certifications would increase the reliability and credibility of their data, products, and services and boost the GIS team's profile both inside and outside the organization.

What Should the Level and Timing of Certification Be?

GIS professional certification is voluntary. Managers and clients can directly review individuals' and companies' qualifications and judge their suitability for specific jobs and contracts without requiring certification credentials.

That said, professional certification provides a recognized, authoritative, third-party review and verification of competency and professionalism. What's more, another key component of certification is a code of ethics. Someone who has a professional certification not only meets the required level of competence but also follows recognized ethical standards.

Even if an organization's needs do not require this degree of outside professional assessment at this time, professional certifications are becoming expected and more reliable. Certification standards, development practices, and accreditation are growing rapidly, as are the prevalence and nature of professional certifications. That is, in part, why organizations and states are increasingly encouraging and endorsing professional certification—particularly GISCI's GISP certification.

Improving GIS Operations Now and in the Future

Supporting professional certification helps to build the GIS profession, benefiting those who work in it, as well as those they serve. Certification defines and strengthens the profession and increases public protection and trust.

While professional certification remains an important individual choice, many of the considerations that will have the largest impact on the intended beneficiaries of certification—the public—are actually management decisions. So managers should increasingly consider how incorporating certified GIS professionals could improve the effectiveness of their GIS operations now and in the future.

About the Author

Rebecca Somers, GISP, has been a GIS management consultant and GIS manager for more than 25 years. She was a member of the initial URISA GIS Professional Certification Committee and the GISCI board and led the recent development of the GISCI Geospatial Core Technical Knowledge Exam. She is currently president of URISA. She can be reached at rsomers@somers-stclaire.com.

Well-Traveled, and Trodden, Esri T-shirts



Kathryn Scott and Brian Hall, GIS analysts from Washington State, let a leaf-tailed gecko walk all over their Esri T-shirts in Mount Windsor National Park in Queensland, Australia. The two were there volunteering for a research project that was studying the distribution of species in western tropical rain forests, and the gecko was found during a nighttime spotlighting transect.

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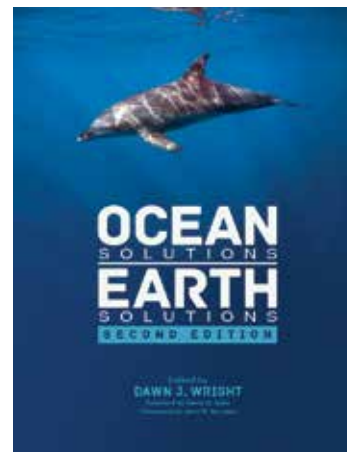
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Ocean Solutions, Earth Solutions, Second Edition

Edited by Dawn J. Wright

The ocean covers more than 70 percent of the earth's surface. What happens in our oceans affects land and vice versa. In the second edition of *Ocean Solutions, Earth Solutions*, more than 90 ocean and coastal science researchers express their insights by exploring the components of our oceans, as well as their relationships, patterns, and trends over time and space. The new edition includes the book's original 16 chapters (four of which have been updated) plus seven new chapters that feature GIS best practices and additional online resources. Edited by oceanographer and Esri chief scientist Dawn J. Wright, *Ocean Solutions, Earth Solutions*, Second Edition, includes a new afterword by Jerry R. Schubel, president and CEO of the Aquarium of the Pacific. June 2016, 500 pp. Paperback ISBN: 9781589484603 and e-book ISBN: 9781589484658.



Mapping the Nation:

Building Smart Government with GIS

By Esri

Mapping the Nation: Building Smart Government with GIS is a collection of maps that illustrates the many ways federal government agencies use GIS to build stronger, more resilient nations and help make the world a better place. Pulled from a broad range of departments, the maps included in the book demonstrate how GIS can be used to evaluate, plan, and respond to social, economic, and environmental concerns at the local, regional, national, and global levels. Examples on topics such as safe nations, public policy, health, and climate resiliency show how government agencies use GIS to facilitate initiatives, improve transparency, and deliver strong business models. February 2016, 154 pp. Paperback ISBN: 9781589484528.



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Luis Bermudez, Ph.D., leverages his experience as Director of the Interoperability Certification, Open Geospatial Consortium (OGC) to empower UMBC students. By sharing his expertise on how to design databases, publish data via **web services**, and use **cloud computing**, Dr. Bermudez help students advance in the GIS community.

At OGC, Dr. Bermudez leads the planning and execution of Compliance and Testing Program activities, serves as system architect in interoperability program initiatives, and gives talks, tutorials and workshops worldwide about OGC technologies, **geospatial interoperability, sensor networks and geo-semantics**.

His work continues to help GIS professionals share data, leverage advanced technology, prototype situations, and establish critical requirements all while working within a given framework and structure of rules.

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