Winter 2024

ArcUser

The Magazine for Esri Software Users

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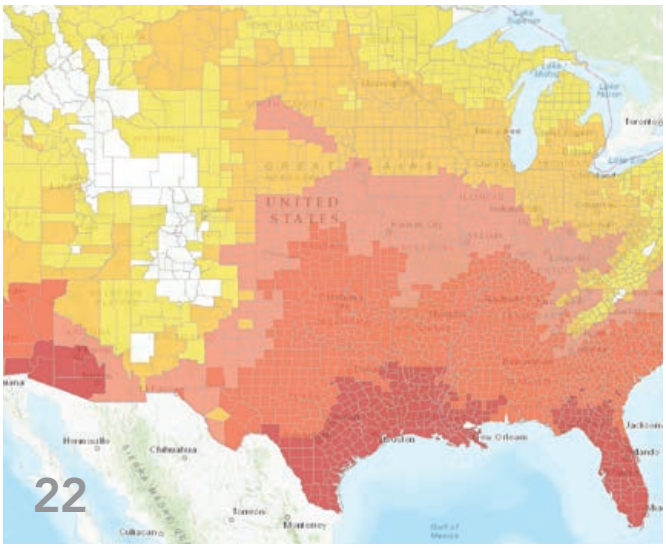

Focus

Special Section

End Notes

Meeting Climate Change Challenges with GIS

The increase in the intensity, frequency, and extent of fire events has become one of the most serious of the many adverse weather effects brought on by climate change. The United Nations reported in 2023, "As the increasing effects of climate change and land-use change make wildfires more frequent and intense, it is estimated that we could witness a global increase in the occurrence of extreme fires of up to 14 percent by 2030, 30 percent by 2050 and 50 percent by the end of this century."

The zone of transition between areas of wilderness and human settlement, known as the wildland-urban interface (WUI), is the fastest growing land-use type in the conterminous United States. This expansion means the millions who live in these areas are increasingly threatened by the economic, social, and environmental impacts of fire events that have been exacerbated by climate change.

This issue highlights the many ways that GIS is being used to address these challenges more comprehensively by identifying who will be affected; where they are located; and what can be done to mitigate, respond, and recover from fires. New GIS visualization and analysis capabilities that have been enhanced by the further incorporation of artificial intelligence (AI); additional data now captured by GIS on mobile devices; and the collaboration fostered by tools such as ArcGIS Dashboards, have been adopted by agencies around the world.

An article in this issue describes how deep learning models developed by Esri greatly decreased the time required to assess the damage caused by the 2023 wildfires in Lahaina, Hawaii, while increasing the accuracy of the assessment to 95 percent.

Another article highlights how GIS helps preserve and disseminate ancient knowledge. More than 700 Indigenous firefighters who work for a wildfire prevention agency in Brazil use smart maps and apps to record their traditional ecological knowledge and make it more widely available.

These examples illustrate the effectiveness of GIS in determining where impacts caused by climate change will be the greatest and identifying opportunities for adaptation, mitigation, and response.

Monica Pratt
ArcUser Editor

ArcUser

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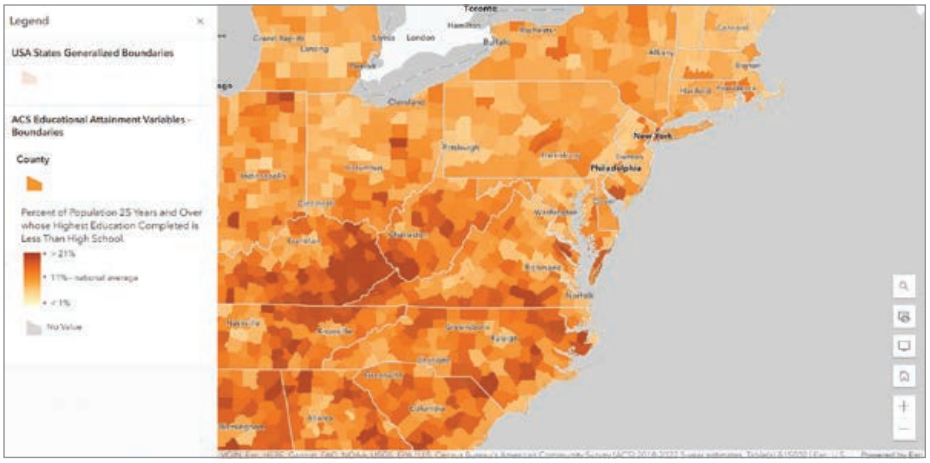
Departments

Briefly Noted

→ 2018–2022 Five-Year Census Estimates Available

ArcGIS Living Atlas of the World has been updated with the newly released US Census Bureau American Community Survey (ACS) 2018–2022 five-year estimates. Available for free, these hosted feature layers eliminate the need for users to spend time downloading and processing new census data. These 112 layers can be mapped and used in analysis of ACS data at state, county, and tract levels.



↑ The newly released US Census Bureau American Community Survey (ACS) 2018–2022 five-year estimates are available for free from ArcGIS Living Atlas of the World.

→ Microsoft Fabric Will Include ArcGIS Spatial Analytics

The long-standing strategic collaboration of Esri and Microsoft has been extended with the inclusion of 140 ArcGIS spatial analytics tools and functions into Microsoft Fabric. Fabric, an artificial intelligence (AI)-powered analytics platform that unites data and services, is slated to be available in the second quarter of 2024. This integration will allow data to flow across organizations, whether users are working in Microsoft OneLake, Microsoft Power BI, or the ArcGIS environment. With this collaboration, Fabric users can directly access sophisticated spatial analytics tools and functions and an extensive library of authoritative and curated spatial data to produce interactive and intuitive visualizations and maps. Learn more at links.esri.com/fabric.

→ Get Answers to Your Tech Support Questions with an AI-Powered Chatbot

A new AI-powered chatbot makes it easier to get answers to simple and complex questions about ArcGIS technology. The Esri Support app enables users to connect with Esri Support through their mobile devices. Users can ask it questions about Esri products ranging from general ones like, "How do I create a layer in ArcGIS Online?" to more specific queries such as, "What causes Error 001624 in ArcGIS Pro?" and get answers in seconds. It supports 40 languages and responds in the language in which the query was made. While anyone can use the chatbot, users on support can submit a technical support ticket, follow the progress of bug fixes, keep tabs on patch releases, and get product life cycle information from the app. The Esri Support app is available in the Apple and Google Play app stores.

→ Autodesk Adds ArcGIS Basemaps and ArcGIS Living Atlas Data to Its Software

Autodesk and Esri, which have been collaborating since 2018, enhanced their relationship to further the interoperability of GIS and building information modeling (BIM) data to reduce costs and boost efficiency across construction projects. This agreement will integrate ArcGIS basemaps and ArcGIS Living Atlas of the World layers into Autodesk products so that communities can build more connected, resilient cities and infrastructure by designing projects in a real-world context.

→ Updated Teaching Tool for Exploring the World through Geography

Esri and the National Geographic Society have launched a new version of the National Geographic MapMaker, an online interactive mapping tool that empowers students, teachers, and others to explore the world through geography. Updates to MapMaker 4.0 reach beyond the scope of a traditional map and provide users with interactive data on a variety of important topics. This 2D and 3D app employs the latest GIS software, allowing users to visually experience and interact with geospatial information about Earth's interconnected social and physical systems while also exploring the art of mapmaking.

↑↑ Now ArcGIS basemaps and ArcGIS Living Atlas of the World layers will be in Autodesk products.

↑ National Geographic MapMaker, an online interactive mapping tool, empowers students, teachers, and others to explore the world through geography.

Enhanced Interoperability: ArcGIS Pro Supports 3D Tiles

By Cliff Song

The power of 3D data extends beyond just delivering contextual visualization and spatial understanding. The 3D perspective, combined with GIS, enables users to understand and interpret high volumes of complex location data with greater accuracy and speed.

Advances in 3D data capture and creation, such as reality capture and feature extraction from point clouds, have led to the generation of extensive and distributed 3D datasets. Detailed meshes and citywide scale 3D objects are an integral part of 3D GIS workflows. In response, Open Geospatial Consortium (OGC) 3D data standards, such as Indexed 3D Scene Layer (I3S), and 3D Tiles, were designed to stream massive 3D content files on mobile and web applications.

With many Esri customers working with a variety of open 3D data standards, supporting 3D Tiles ensures critical interoperability within ArcGIS. ArcGIS enables organizations across diverse sectors to implement a multidimensional system of record by combining geospatial imagery, reality mapping, real-time data, and realistic 3D environments. Organizations in national, state, and local government; the architecture, engineering, and construction (AEC) sectors; and other industries are leveraging the tools in ArcGIS Pro to implement 3D workflows for

↑ A 3D mesh of the Haidhausen district in the Munich was processed with SURE using nFrames.

→ Viewshed analysis indicates the visibility of downtown Boston, within a defined radius from the peak of the Custom House Tower. Green indicates what can be seen and red indicates what is not visible.

everything from asset monitoring and mission planning to performing risk analysis.

With the latest release of ArcGIS Pro, users can consume the integrated mesh and 3D object elements of a 3D Tiles tileset from local directories or public services. Future integration of 3D Tiles in ArcGIS will include the ability to publish to ArcGIS Online and ArcGIS Enterprise as a tile-hosted service with added support throughout ArcGIS Platform for developers.

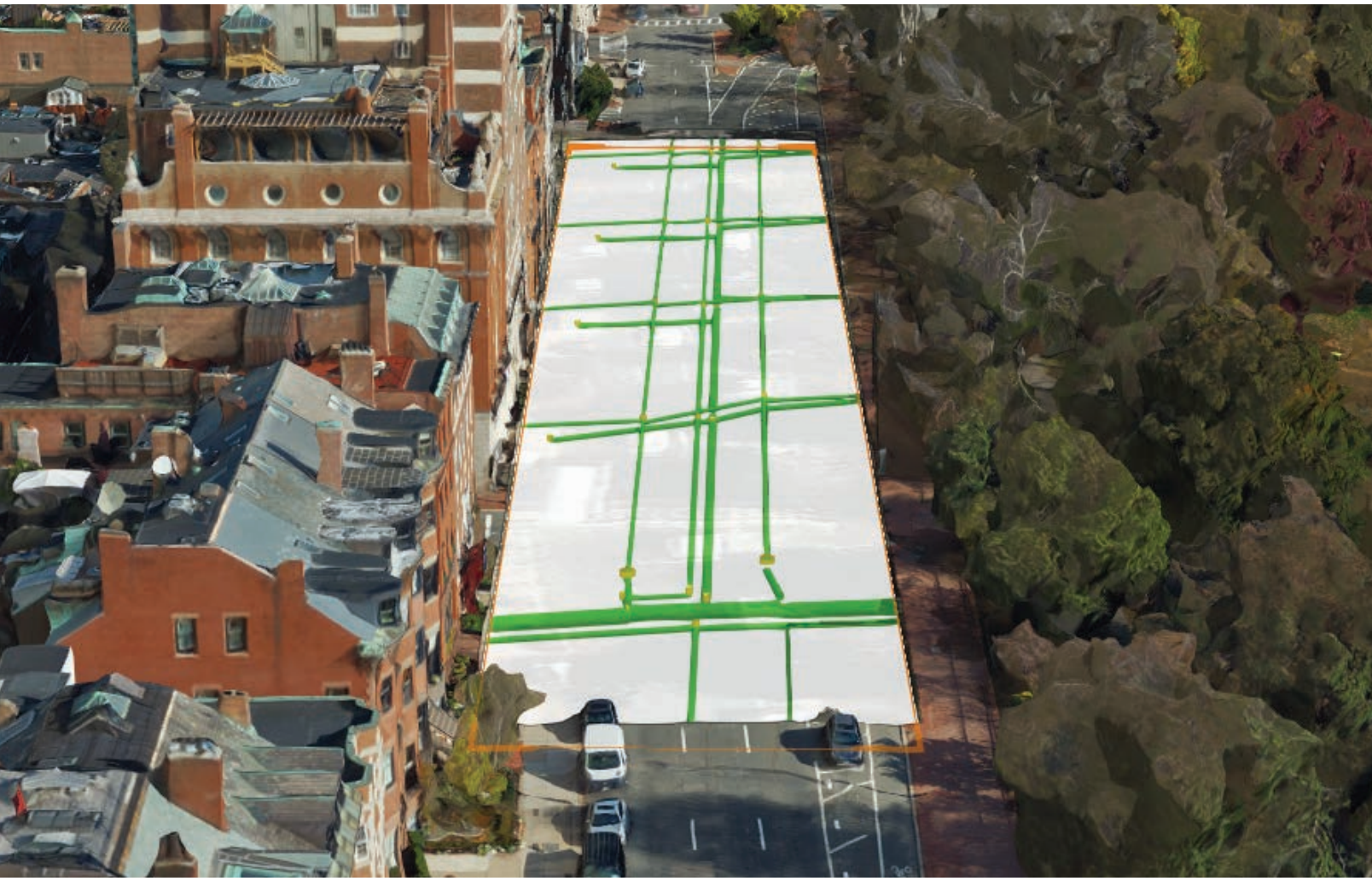
3D Tiles layers can be combined with other layers for use in exploratory analysis tools, animations, and layouts to reveal additional context and improve decision-making. This article explores how users can incorporate 3D Tiles into workflows, just like any other 3D layer in ArcGIS.

Working with 3D Exploratory Analysis Tools

Three-dimensional exploratory analysis workflows in ArcGIS Pro allow users to investigate their data interactively. Tools such as viewshed and view dome give users the ability to perform visibility analysis while also empowering them to make changes to parameters in real time. Not limited to visibility analysis, exploratory analysis workflows also allow users to dynamically peek inside or slice through terrain and 3D objects. For example, users can explore the spatial relationships between surface and subsurface infrastructure dynamically.

Interactive Viewshed

A viewshed analysis is a type of visibility analysis that calculates and displays the visibility of 3D elements in a scene from an observation perspective. It is calculated from an observer point, which can be a point location, a camera location, or a geoelement. (A geoelement is any element in a map or map view that can be identified by its location to return attribute information. Geoelements can be features from a feature



layer, graphics in a graphics overlay, or cells from a raster dataset.)

Viewshed analysis produces a viewshed layer that indicates what can be seen and what cannot be seen from the observer's location. This analysis is commonly used by telecommunication companies. When planning the placement of cell towers, these companies use viewshed analysis to optimize service coverage by identifying locations that have a minimal number of obstructions from natural elements (e.g., mountains or trees) and human-made elements (e.g., buildings) that can disrupt radio signals.

Interactive View Dome

Interactive view domes are used to determine the visible volumetric spaces in a direct 3D distance of a location. They are calculated against the currently displayed content in a scene, including the ground surface and symbolized features such as buildings and trees. They display which parts of the environment can and cannot be seen from the location of a specified point.

View domes are valuable tools for evaluating sky occlusion in urban areas. *Sky occlusion* refers to the view of the sky being obscured by an object such as a building. Used in urban planning, development, or construction applications for assessing future impacts of proposed buildings, view domes can assess the impact of proposed new building heights on the sky view factor (SVF).

SVF is a measure of how much sky is visible from a specific point. On an infinite plane, the full half dome of sky would be visible, and that location would have an SVF of 100 percent. Trees, buildings, or hills obscure the sky, which results in a lower SVF. Research has shown that trees and vegetation in urban areas that provide shade can help reduce heat. SVF is a tool for assessing the level of sky occlusion needed to optimize park design to mitigate climate change.

↑ The slice tool in Scene Viewer exposes the utility network under Beacon Street in Boston. (Data courtesy of Bluesky International Limited)

→ In this city scene, a view dome analysis illustrates the potential impact on the visibility of the sky from the central observer location.

Interactive Slice

Interactive slice is a tool that hides parts of a 3D scene to reveal content that would otherwise be hidden. This tool can be used on any element in a 3D scene to explore the inside of buildings, stacked volumes, or subsurface geology.

Utility companies efficiently track and monitor underground stormwater pipes using this powerful tool. By clipping away layers of roads and sidewalks, the intricate network of pipes is visible, which facilitates the development and implementation of effective maintenance and management strategies. Similarly, AEC firms derive significant benefits from the slice exploratory analysis feature, particularly when visualizing electrical wiring within a building. The process of slicing away obstructing elements, such as roofs, walls, or floors, provides valuable insights into the complex infrastructure and enables decisions to be made with greater precision.

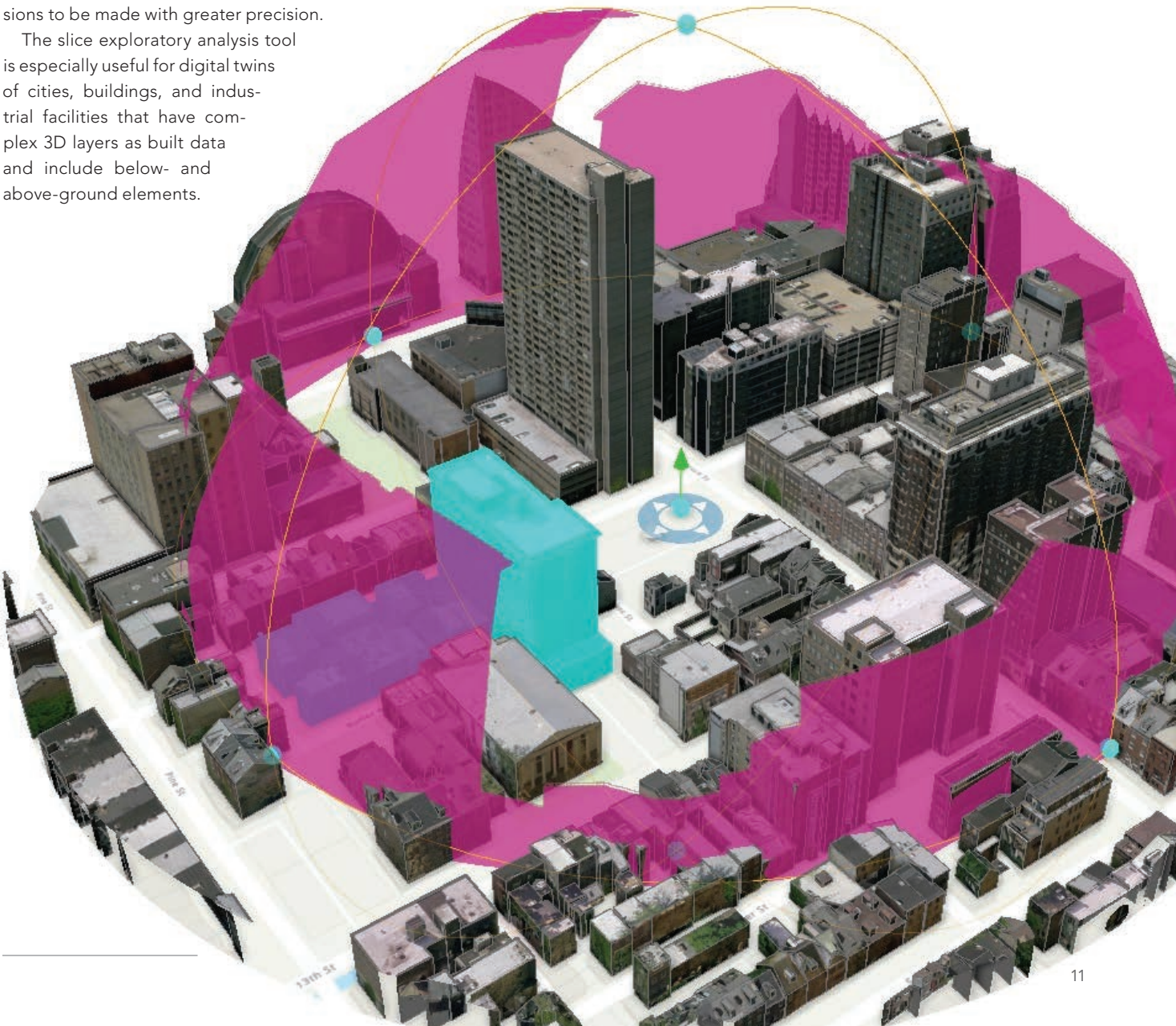
The slice exploratory analysis tool is especially useful for digital twins of cities, buildings, and industrial facilities that have complex 3D layers as built data and include below- and above-ground elements.

Learn about Related Topics

- **Interactive viewsheds**
  https://shorturl.at/ipFN4
- **Interactive view domes**
  https://shorturl.at/npJW1
- **Interactive slices**
  https://shorturl.at/tzEI2

About the Author

Cliff Song is the product marketing manager for 3D GIS. His professional experience includes leading marketing programs and managing projects within media and technology companies including HBO, *The Washington Post*, and Esri. He enjoys spending time with his wife and young children, pursuing his passion for cars, and exploring the great outdoors.



Make Geospatial Content More Usable with the Atlas Instant Apps Template

Within minutes GIS analysts can create lightweight, interactive web apps that enable stakeholders to explore collections of carefully curated geospatial content using a new app template in ArcGIS Instant Apps. Atlas allows GIS analysts to create a digital atlas that is easy to explore and presents layers of context that enable users to conduct simple analyses and allows for easy sharing.

Organizations of all types need to leverage geospatial data in ways that improve operations, support collaboration, and boost business outcomes. Being able to quickly implement solutions that make data more accessible to stakeholders across an organization is key to making this happen. There are several advantages to using Atlas to build simple apps of curated content to leverage organizational geospatial data.

It's Easy to Assemble a Relevant Data Collection

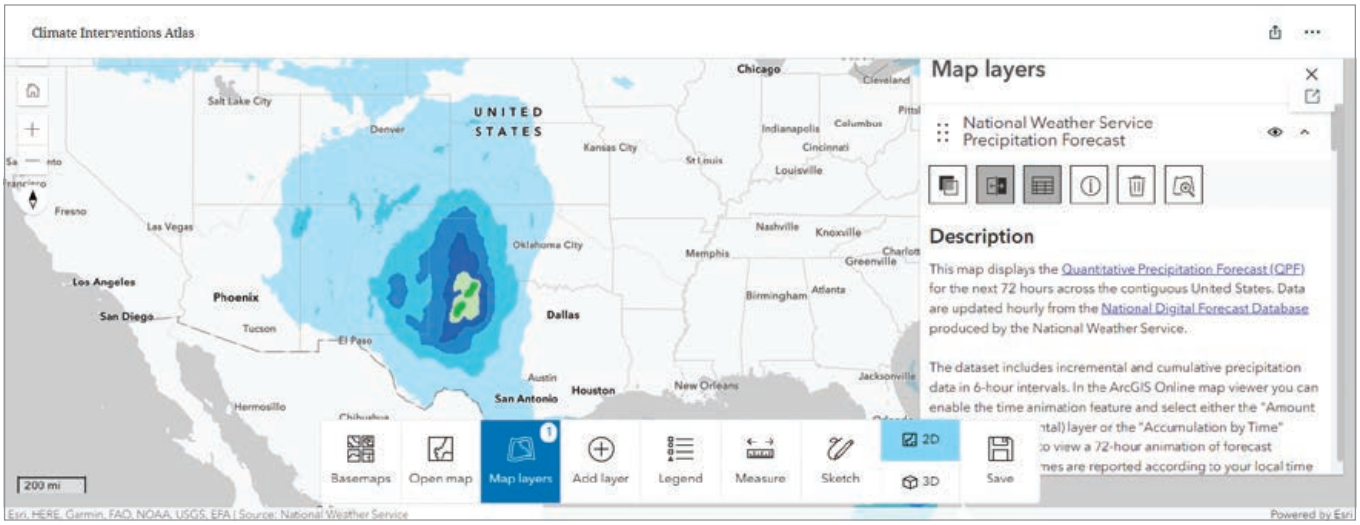
When GIS analysts first receive a request, they need to identify the relevant data and where it is located. Often, relevant data is stored privately on someone's computer, shared with a specific group in an organization, or saved within another organization's system.

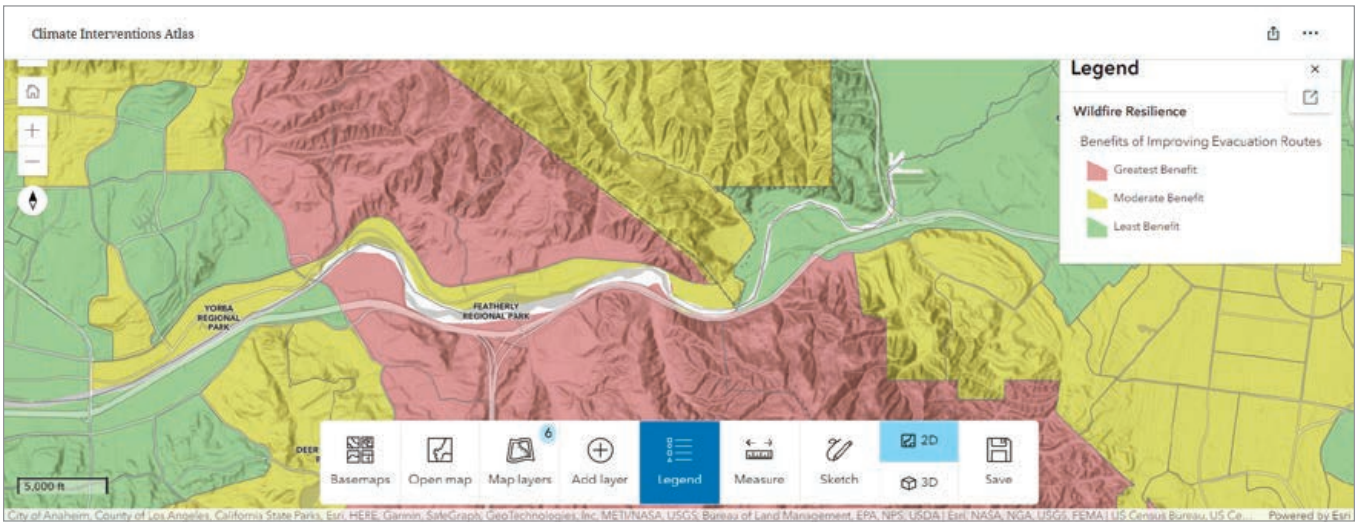
After the required data is located, GIS analysts must load that data into ArcGIS Online and organize it so that end users can access it. Commonly, this is done by creating a group in ArcGIS Online for gathering curated content and granting access to stakeholders—both inside and outside the organization—by making them members of the group. Another strategy used by GIS analysts is establishing a partnered collaboration between ArcGIS Online organization group members to view or retrieve content from other organizations. Implementing distributed collaboration between ArcGIS Online and ArcGIS Enterprise organizations is another way to make content accessible.

GIS analysts can use the Atlas template in ArcGIS Instant Apps to create an interactive app that allows users in a group to explore atlas content. All the maps and layers added by the group automatically populate the Atlas app, which puts them in one place where group members can access them. (Alternatively, GIS analysts who don't create a group in ArcGIS Online can manually pick and choose content to add to the app as they're configuring it.)

Atlas automatically pulls in each item's title, thumbnail image, and description and organizes the content into predefined categories that are relevant to the group. This lets users of apps built with the Atlas template easily browse the maps and layers or search for specific content using keywords.

To create a good user experience, GIS analysts should determine the content that is most relevant to the app's audience and double-check that those maps and layers have easy-to-read pop-ups and sufficient metadata. They should also organize the content into categories that are pertinent to group members and create bookmarks that users can employ to focus the map on certain areas of interest.





An Intuitive Map Exploration Experience

Since the users of an app may have limited or no experience with GIS, GIS analysts need to ensure that all members can effectively explore and interact with the data and discover the information they need without guidance.

Atlas enables GIS analysts to efficiently create a simple app that allows users to open various maps from a gallery and interact with different areas on a map by searching for a location, zooming to a spatial bookmark, opening the legend and pop-ups, using a swipe tool, and measuring distance and area. Users can also choose other basemaps and add or remove map layers to gain additional insight. The Atlas app-building template includes a large toolbar menu on the bottom that allows GIS analysts to add or remove tools to best suit the group for which they're building the app.

Stakeholders Can Save and Share Their Work

In many instances, stakeholders need an easy way to share the geospatial work they've done so that they can effectively collaborate with others. For example, after a hurricane, a city government GIS department might be asked to coordinate with numerous outside organizations: emergency medical teams to coordinate rescues; the media to keep members of the public updated; federal agencies to get aid; and insurance companies to report damaged areas.

Apps made using the Atlas template allow users to employ sketch tools to make notes and mark locations on a map. Users can explore a map, add notes and markups, and save this work as a new map in ArcGIS Online. They can also create an entirely new app with it, such as an ArcGIS StoryMaps story. Their work can be shared with other stakeholders by taking a screenshot of the map or exporting the map as a PDF.

Quickly Meet Deadlines and Organizational Requirements

Even when GIS analysts need to create solutions on a short timeline, those solutions often must meet their organizations' requirements for accessibility, mobile responsiveness, and even branding. GIS analysts and other app creators can build focused, interactive web apps from their maps in minutes using Instant Apps templates—including Atlas. All the theming tools in other Instant Apps templates are available in Atlas.

Default express setup options, such a preset theme and simple map tools like search and zoom control, let GIS analysts publish apps quickly by only including the essential settings in Atlas. For apps that require additional customization, they can use the full configuration options of Atlas to explore and add more map tools and change the app's appearance by including items such as adding a cover page, inserting a customized app title, or incorporating a logo.

Purpose-Driven App Templates

With 18 purpose-driven app templates—plus two in beta—Instant Apps enables GIS analysts to quickly build apps that can display an organization's collection of content (using Atlas, Portfolio, and Category Gallery); showcase 2D, 3D, and temporal data in a map (using Sidebar, Insets, Exhibit, 3D Viewer, Slider, and others); and deliver local information based on proximity to a certain location (using Nearby, Zone Lookup, and Public Notification). The resultant apps let users interact with different capabilities and features in a map, including attachments, charts, and bookmarks.

The apps perform well on both desktop computers and mobile devices, support accessibility, and include theming tools that help GIS analysts customize the look and style of their apps to conform to their organizations' branding requirements. Instant Apps is part of the essential apps bundle in both ArcGIS Online and ArcGIS Enterprise, and using these apps requires no additional licensing.

↑ This map from the *Climate Intervention Atlas* shows the areas that could most benefit from improvements in evacuation routes.

← Apps created with the Atlas template in Instant Apps allow GIS analysts to easily share data and maps in context that enable users to conduct simple analyses and allows for easy sharing. This map from the *Climate Intervention Atlas* shares data and maps from the National Weather Service Precipitation Forecast.

Learn more about ArcGIS Instant Apps and the Atlas template at links.esri.com/instant-apps/overview and links.esri.com/instant-apps-templates.

GIS and Deep Learning Make Damage Assessments More Timely and Precise

By Anthony Schultz and Jarell Perez

When wildfires ravaged Lahaina, Hawaii, in August 2023, the scars left behind weren't just physical but also emotional and societal. The subsequent challenges of conducting damage assessment underscored a pressing need for improved tools and methodologies. While traditional methods have their merits, the scale and severity of disasters such as the Lahaina wildfires demand something more efficient. In response, Esri developed a new damage assessment deep learning model.

Historically, conducting a damage assessment in the wake of a disaster has been a manual and time-consuming endeavor. Damage assessment teams need to cover vast areas—often under hazardous conditions—to document and assess damage. This not only elongates potential response times but also can sometimes result in inconsistencies due to the sheer scale of the disaster.

Esri's damage assessment deep learning model was designed with the primary goal of addressing these challenges. By processing high-resolution satellite and aerial imagery, the new model can identify patterns of destruction, differentiating between damaged and undamaged structures. This automation speeds up the assessment process with surprising accuracy. This article provides a high-level overview of the associated workflow and where you can locate the model so you can start using it.

Practical Application in Lahaina

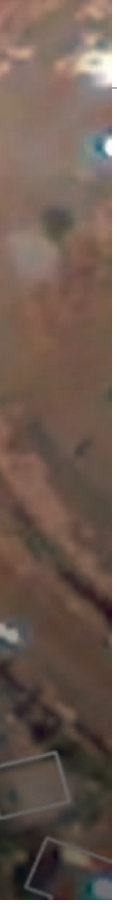
In the wake of the Lahaina wildfires, Esri developed and tested a new damage assessment model. The results were outstanding. What would traditionally take hours of labor and manual surveying was achieved in a fraction of the time with 95 percent accuracy. Rapid damage assessments with this level of accuracy revolutionize postdisaster assessment processes by providing access to previously unobtainable decision support information during initial response. For instance, with rapid and accurate damage assessments, authorities can prioritize areas for search and rescue and allocate resources to heavily affected areas immediately.

What would traditionally take hours of labor and manual surveying was achieved in a fraction of the time with 95 percent accuracy.

To classify damage, it is necessary to have building footprint information for the area of interest. This information allows the damage assessment model to classify buildings as damaged or undamaged by creating boundaries from which to reference and label.

The accuracy of the building footprint layer is also important and may vary depending on the method used to create the data. The building footprints should be accurate to the incident imagery that will be used to run the model.

If building footprints don't exist, predisaster imagery can be used with different artificial intelligence (AI) models to extract building footprints. Esri offers a high-resolution model, Deep



← FEMA Urban Search and Rescue, Washington State Task Force 1, participated in federal response efforts for the Lahaina wildfires. (FEMA photo)

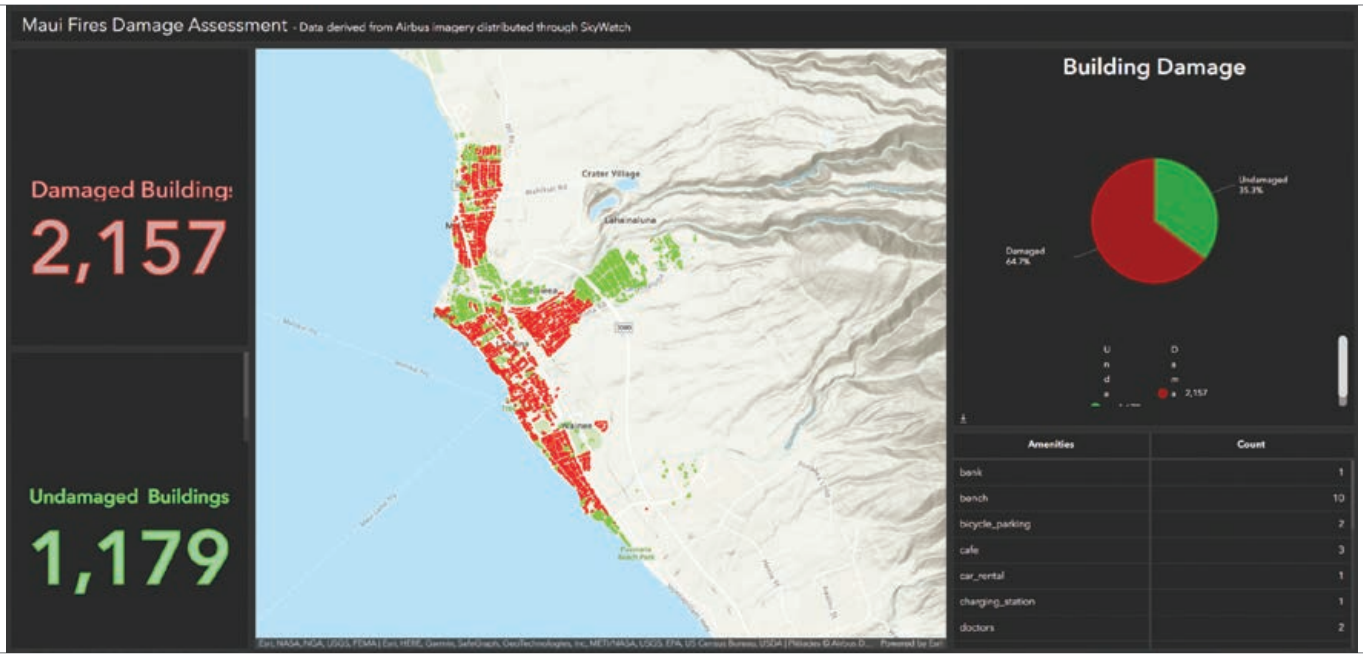
↓ The damage assessment model requires a building footprint layer to classify buildings as damaged or undamaged. If building footprint data is not available, the Deep Learning Model to Extract Building Footprints model can be used to extract the data from predisaster imagery.

Learning Model to Extract Building Footprints (https://shorturl.at/efsF5), which is available from ArcGIS Living Atlas of the World. To provide additional context for the buildings, the building footprint data that indicates building occupancy type allows the model to help quantify the number of homes and other types of infrastructure that may be damaged.

After obtaining building footprint information, the next step is to locate postdisaster imagery for the affected area. Postdisaster imagery can come from a variety of sources including satellites or unpiloted aerial vehicles (UAVs) or drones. While obtaining postdisaster satellite imagery sounds difficult or prohibitively expensive, it is actually neither. Visit the SkyWatch (https://shorturl.at/cdrFV) and SkyFi (www.skyfi.com/blog/what-is-skyfi) websites to learn how easy it is to task satellites. Another great resource for postdisaster imagery is Maxar's Open Data program (www.maxar.com/open-data). *[Both SkyWatch and Maxar are Esri partners.]*

Once postdisaster imagery is obtained, it is best to refine the deep learning model. For the Lahaina wildfire assessment, Esri manually inspected 500 buildings from the postdisaster imagery, classifying them as either damaged or undamaged. This helped refine the model for different geographies, account for differences in building size and shape, and incorporate different extents of damage into a model's output. A drive-by or windshield survey augmented the postdisaster imagery to help the model classify buildings.

Once the model is refined, users can run the deep learning model in ArcGIS Pro or ArcGIS Online and produce their own damage assessments. Esri published both the results of the analysis and the deep learning model in ArcGIS Online in hopes of spurring efficient collaboration, creating new tools for incident response, and democratizing geospatial artificial intelligence (GeoAI). The Esri Damage Assessment Model is publicly available at https://shorturl.at/mwy15.



The model's results can easily be placed into a web map, dashboard, or web app, depending on the user's need. In the case of the Lahaina fire, a dashboard was chosen so that the results could be visualized and organizations could use it to help guide response and recovery efforts as well as inform public outreach.

The Way Forward

The tragic wildfires in Lahaina served as a stark reminder of the vulnerabilities we face and the importance of timely and accurate postdisaster assessments. Like most AI applications to support wildland fire response, deep learning doesn't replace on-the-ground verification and expertise. It is a tool that augments human capabilities.

As wildland fire and disaster management continues to evolve, blending these models with traditional methods will only serve to improve disaster response mechanisms. As technology progresses, the goal remains steadfast: to support communities in their time of need, ensuring that they have the best tools at their disposal for disaster preparedness, mitigation, response, and recovery.

Additional Resources

- **Maui Fires Damage Assessment dashboard**
  https://shorturl.at/jHUXZ
- **Damage Classification Deep Learning Model for Airbus Imagery**
  https://shorturl.at/rzKV5
- **Deep Learning Model to Extract Building Footprints**
  https://shorturl.at/cejZ7
- **FEMA Geospatial Resources for Hawaii Wildfires**
  https://shorturl.at/yJW49

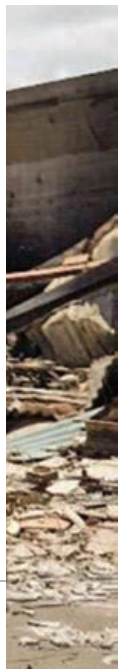
↑ The output of Esri's Damage Assessment Deep Learning Model was shared using the Maui Fires Damage Assessment dashboard.

↓ Additional training samples were used to refine the damage classification model.

About the Authors

Anthony Schultz is the director of wildland fire solutions at Esri. He has a background in wildland fire management and operations and has served in a variety of capacities. Most recently, he was the Fire Management Officer (FMO) for the State of Wyoming. During his tenure in Wyoming, he served as chair of Western State Fire Managers and was a Rocky Mountain Coordinating Group member. He has also served as an FMO with the State of North Dakota. Prior to becoming an FMO, he worked as a wildland firefighter the US Bureau of Land Management, the National Park Service, and the US Fish and Wildlife Service.

Jarell Perez is a solution engineer on the imagery and remote sensing team at Esri. He has a varied background in remote sensing, data visualization, and web development. Prior to joining Esri, Perez built geospatial solutions for many organizations.



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URBAN FIRES REQUIRE MORE INFORMATION AND COLLABORATION

By Anthony Schultz, Carrie Speranza, and Mike Cox

Firefighters are starting to see urban neighborhoods as overgrown forests. If homes are close together, made of wood, and surrounded by mature vegetation, there's a need for mitigation work. Homeowners are creating defensible space—a buffer that acts as a barrier to slow the progress of fire. Both efforts are guided by maps made with GIS.

GIS-powered maps help fire departments model risks to create wildfire protection plans, inspect homes, and pinpoint places to reduce vulnerability. The same type of map encourages homeowners to trim trees, remove wood chips, or add screens on chimneys and vents to halt embers from entering. In this way, firefighters and community members come together to harden assets and protect property from worsening conditions.

The growing number of urban conflagrations has also brought emergency managers, firefighters, and wildland firefighters closer together. They have a history of collaboration, but with the escalation in fire-related tragedies there's a need for more coordination.

Growing Pressure

Fast-moving fires, which were once considered unusual, have swept through a growing number of communities. These urban fires include the Santa Rosa and Paradise fires in Northern California; the Marshall Fire in Colorado; the Lytton in British Columbia; and in 2023, the Lahaina wildfires in Hawaii, which were the deadliest in more than a century.

Yet, tragic fires hold lessons. Catastrophic great fires, such as the Chicago fire of 1871 and the fire that followed the San Francisco earthquake of 1906, led to changes in building codes and firefighting methods.

Now, the distressing growth in urban conflagrations is calling for further reforms. Structures at the wildland-urban interface (WUI), the transition zone between wilderness and developed land, are at the greatest risk. Due to higher rates of property damage in these areas, homeowners must shoulder additional financial burdens and have a more difficult time obtaining insurance. Given warmer weather and more extreme weather events, devastating fires are

more likely to occur. These are conditions that cannot be ignored in the hopes that things will get better.

Data-Driven Assessments

Places known to be vulnerable to wildfire have started to get more serious. Many leaders have proactively applied GIS technology for a holistic approach to climate resilience. They make community-wide plans to drive on-the-ground actions. They look to forecasts to mitigate future hazards. They conduct traffic studies to improve evacuation routes and inform roadway reengineering.

A recent report, *ON FIRE: The Report of the Wildland Fire Mitigation and Management Commission,* recognized that "mapping and analytical tools, which enable the geospatial identification of wildfire hazard or risk, are foundations for locally relevant, well-informed decision-making." The commission recommended measures to better coordinate, integrate, and strategically align fire-related science, data, and technology. The report also suggested new performance standards for wildfire response. It cited the need for wildland fire efforts to align closer to emergency management and called for better federal coordination and support for local communities.

The federal government has provided preparedness funds furnished by initiatives such as the US Department of Housing and Urban Development's Strong Cities, Strong Communities program and the US Forest Service's Community Wildfire Defense Grants. A report from The Brookings Institute suggested that federal funds should do more to enhance local capacity.

More Integration and Coordination

With increasing pressures from climate hazards, all communities must prepare, and many require technical assistance. Wildfires are now threatening new areas and striking in all seasons. No community can afford to be complacent.

Major cities are using modern management information systems such as GIS to prepare and plan, coordinate actions, check the progress on efforts, and communicate conditions. The Federal Emergency Management Agency (FEMA) has mandated that states address social vulnerability alongside climate predictions. GIS solutions help even the smallest communities prioritize efforts.

Continuing innovations in remote sensing, modeling, and real-time decision support promise to enhance awareness of incidents and speed response. As in planning, modern tools enable more open sharing of data and coordination across jurisdictions.

The progress is in line with the need for more effective use and adoption of science, data, and technology for wildfire mitigation and management noted in a recent Wildland Fire Mitigation and Management Commission report. The report recognized that "much of the science and technology needed to help mitigate, manage, and recover from wildfire likely already exists." What's important now is stronger coordination and alignment between the cadres of fire and emergency management professionals and within and among communities.

← The Lahaina wildfires in Hawaii in 2023 were the deadliest in more than a century.

↓ The growing number of fires on the wildland-urban interface have brought emergency managers, firefighters, and wildland firefighters closer together.

↓ This is a satellite view of the Paradise, California wildfire. (Image: NASA)

→ This Currier & Ives lithograph shows people fleeing across the Randolph Street Bridge during the Great Chicago Fire of 1871. Catastrophic fires led to changes in building codes and firefighting methods. (Wikimedia Commons/US work that is in the public domain in the US.)

Learn more about the tools firefighters use to better understand and suppress wildland fire, how GIS provides real-time solutions to enhance emergency management operations, and how communities reduce fire risk with GIS.

About the Authors

Anthony Schultz is the director of wildland fire solutions at Esri. He has a background in wildland fire management and operations and has served in a variety of capacities. Most recently, he was the Fire Management Officer (FMO) for the State of Wyoming. During his tenure in Wyoming, he served as chair of the Western State Fire Managers and was a Rocky Mountain Coordinating Group member. He has also served as an FMO with the State of North Dakota. Prior to becoming an FMO, he worked as a wildland firefighter the US Bureau of Land Management, the National Park Service, and the US Fish and Wildlife Service.

Carrie Speranza, director of emergency management solutions at Esri, is responsible for cross-cutting industry-wide strategic initiatives. Previously, she worked at the District of Columbia Homeland Security and Emergency Management Agency, where she served as deputy director. Currently, she is the vice chair of the FEMA National Advisory Council, where she has served as an administrator's appointee since 2019. She is the second vice president of the International Association of Emergency Managers (IAEM) and was selected for inclusion in the Top 40 Under 40 list in 2021 by IAEM-USA Region 3. Speranza is a graduate of the National Emergency Management Executive Academy and hold a Certified Emergency Manager (CEM) designation.

Mike Cox is director of fire and emergency medical services (EMS) solutions at Esri, where he helps for fire and EMS agencies leverage geospatial information and technology to achieve their response and recovery goals. As a member of the public safety industry marketing team at Esri, he works collaboratively with GIS professionals to promote the broad use of Esri's ArcGIS platform within fire and EMS. Cox recently retired from the Henrico County, Virginia, Fire Department after 27 years of service. He served as the deputy chief with responsibilities including operations, emergency management, planning, accreditation, budget, and human resources. He was also a member of the Central Virginia All-Hazards Incident Management Team, was the technical rescue team leader, and served as a HAZMAT specialist on the Virginia Department of Emergency Management's regional hazardous materials team.

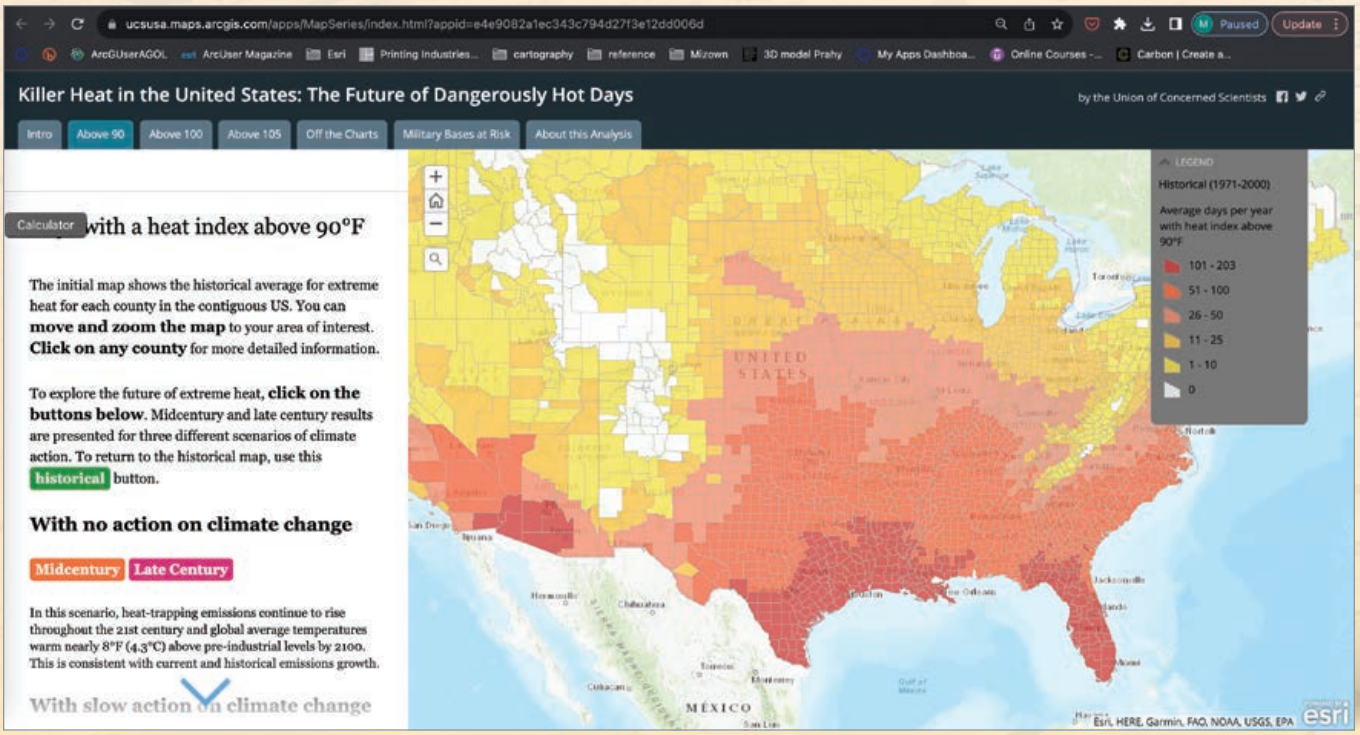
Cities Save Lives by Mapping Communities Most at Risk from Extreme Heat

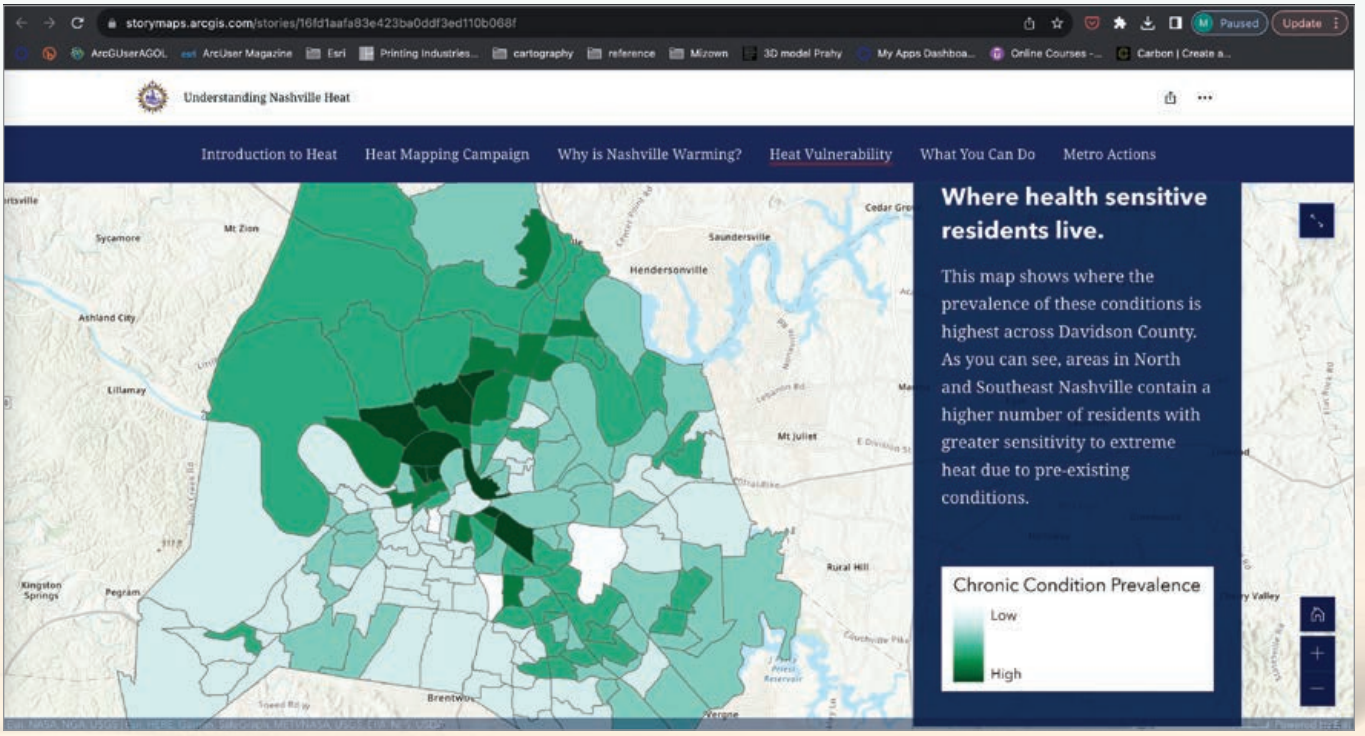
By Karen Sullivan

Deaths from extreme summer heat are preventable. As temperatures climb, public health officials are using maps to find the communities that are most threatened. In Tennessee, Oregon, New York, and other areas, public health teams are featuring online maps that highlight neighborhoods most likely to experience extreme heat.

On average, more than 650 people across the US perish in grim circumstances each year because of heat, the Centers for Disease Control and Prevention (CDC) has reported. Extreme heat during summer is now the deadliest weather-related threat in the US, even though most heat-related deaths are preventable.

The maps, created using GIS, show who is affected as temperatures rise because of climate change. In all locales, the maps reveal that extreme heat has the greatest impact on communities that have already been ravaged by the effects of past discrimination in land-use policies. Public health groups across the US are using GIS analysis to identify the most vulnerable neighborhoods and recommend interventions—such as





tree planting to increase the tree canopy with its cooling properties—that could prevent the worst outcomes.

Maps Uncover Hidden Dangers

As leaders and communities awaken to the dangers of extreme heat, attention is shifting to the prevention of heat-related deaths and illnesses at home and on the job. Education programs about the dangers of extreme heat and self-protective measures for staying cool have become a priority.

Protecting communities from extreme heat starts with making online maps that help locate the hottest neighborhoods and streets. In the summer of 2022, the National Oceanic and Atmospheric Administration (NOAA) and local scientists used GIS to map and monitor temperatures and humidity in the hottest parts of 14 communities across the US that are recognized as urban heat islands. *[Urban heat islands are areas characterized by temperature differences between cities and the surrounding nonurban area, caused by the degree to which surfaces absorb and hold heat.]* Temperatures in intraurban heat islands can be from one to seven degrees higher than in outlying areas, according to the US Environmental Protection Agency.

NOAA's Climate Program Office worked with the interagency National Integrated Heat Health Information System (NIHHIS) and CAPA Strategies, LLC, to collect and analyze the data. *[NIHHIS is an information system created by NOAA and CDC to help protect people from heat. CAPA Strategies helps communities plan for heat management, mitigation, and adaption.]* Volunteers drove around the city in August 2022 to record temperature and humidity readings, using sensors attached to their cars.

Nashville, the state capital located in Davidson County, is one of the 14 cities chosen for the program. A history of discriminatory housing practices and state highway construction has aided the decline of Black communities here and across the US. These neighborhoods became economically fragile, racially segregated, and often isolated as lenders denied mortgage applications for properties in Black neighborhoods. Other forms of private and public investment were also mostly absent.

Communities that are marginalized in these ways tend to have aging, less energy-efficient housing. This makes those residences more dangerous as temperatures rise. From 2010 to 2021, there were 3,009 documented heat-related hospitalizations and emergency department visits in Davidson County, according to the

Protecting communities from extreme heat starts with making digital maps that help locate the hottest neighborhoods and streets.

↑ In Nashville, climate change is predicted to worsen extreme heat more than any other weather threat. By 2053, the number of extreme heat days is expected to increase to 45, according to First Street Foundation, a nonprofit 501(c)(3) research and technology group.

← The Union of Concerned Scientists has mapped killer heat in the US, showing the growing number of days above 90 degrees if action on climate change is not taken.

As heat waves become more of a threat, city leaders are making maps to save lives.

Tennessee Department of Health.

Sensor data allowed researchers develop temperature and heat index maps that highlighted heat hazard zones. Targeting these areas for additional support and resources can save lives and help control the cost of caring for those who otherwise might become sick.

Communities Act to Save Lives

In Multnomah County, Oregon, which includes the city of Portland, the community has spent millions of dollars to create emergency cooling centers, provide air conditioners, and respond to heat-related illnesses. Billions more could be needed to prepare for more severe public health emergencies related to extreme heat in the future. Residents and government officials there are taking steps to save lives and reduce public health risks.

In July 2023, more than 100 volunteers used sensors to gather data along 41 routes in three counties. The temperature data will be used in a heat risk assessment tool built using GIS technology. This resource will also include data about the type and age of buildings, the likelihood that air conditioning is available inside, and details about the density or scarcity of the community's tree canopy. Location-based analysis will help pinpoint where interventions are most needed to protect people at greater risk.

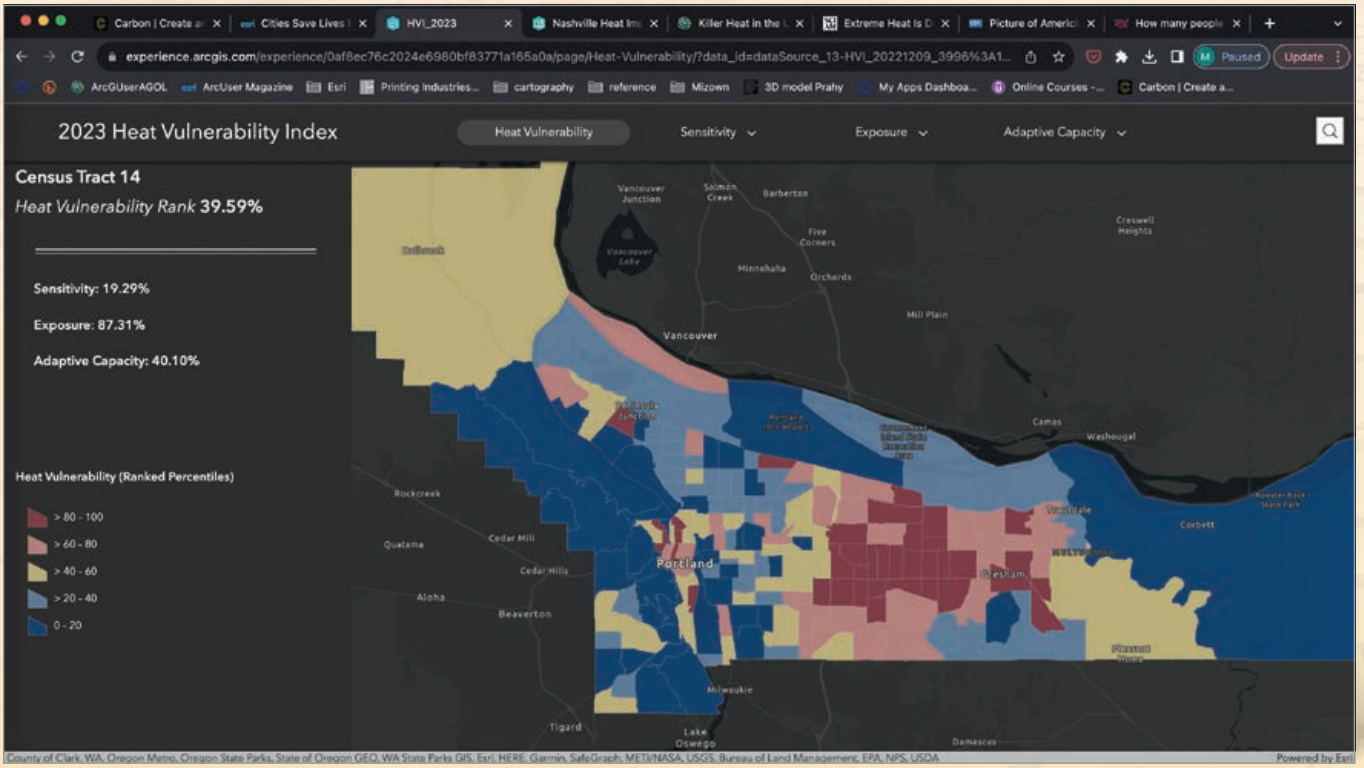
Developing statistical models on the risks from extreme heat is also important for identifying the range of factors that can contribute to heat illness or death, Vivek Shandas told *Oregon.Live.com [the online newsite for* The Oregonian *newspaper]*. A professor in the geography department at Portland State University, Shandas led the heat mapping effort with an eye on identifying policies that might restrict residents from protecting themselves.

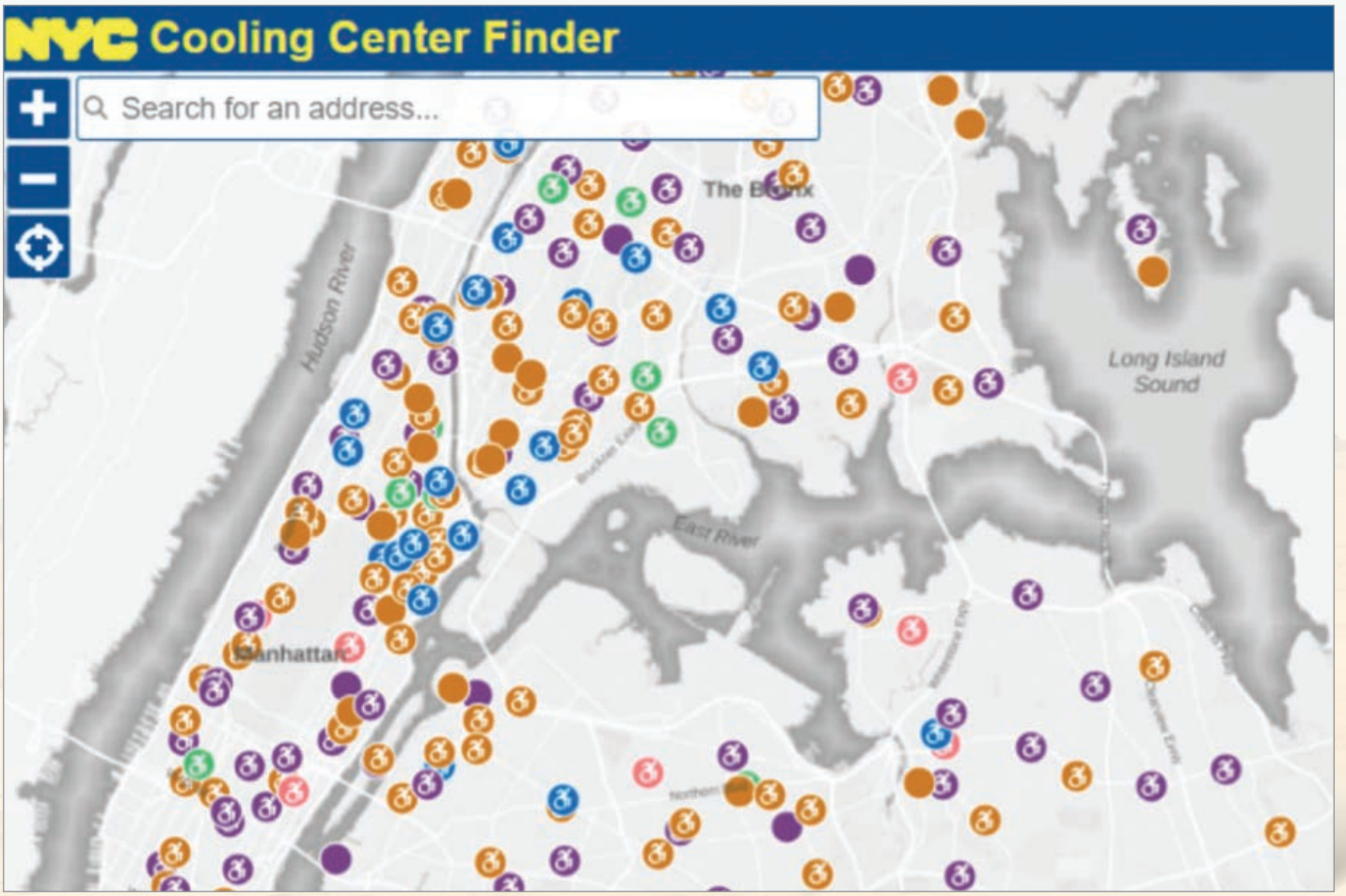
Data collected will be added to Multnomah County's *Heat Vulnerability Index*. This interactive map illustrates variations in how populations throughout the area adapt to extreme heat based on heat vulnerability, sensitivity, and exposure. New data from the heat mapping campaign will be used to recalculate the exposure score of the heat index. Ultimately, the *Heat Vulnerability Index* map will be useful in shaping policies in land-use planning, transportation, public housing, and tree planting.

A Formula Emerges for Calculating Risk

About 350 people die prematurely in New York City every summer because of hot weather. The death rate is two times higher for Black residents compared to white residents. Disparities in economic opportunities, health care, housing, energy, and other areas double the risks for Black residents in some neighborhoods, according to the New York City Health Department.

Today, the city's outreach efforts aim to





prevent deaths in those communities that are most at risk. In its outreach efforts, the city relies on a Heat Vulnerability Index, or HVI. This resource includes an interactive digital map that identifies and ranks neighborhoods most at risk. The rankings consider surface temperatures, green space, access to home air conditioning, and other factors.

With this data available to locate neighborhoods where temperatures are most intense, the city has issued heat warnings and opened cooling centers. The city also helps with summer utility costs, works to ensure that windows operate properly inside homes, and prohibits the disconnection of electricity during the hottest months.

As heat waves become more of a threat, city leaders are making maps to save lives. These maps have proved essential for locating communities in need of help, whether to protect against extreme heat or other weather-related threats. While every local government has a responsibility to identify and support those most at risk, climate-related events make that assignment much more urgent.

↑ When heat reaches dangerous levels, this CoolIt! NYC map shows residents where they can go to cool off.

← Multnomah County Environmental Health Services has developed a Heat Vulnerability Index (HVI) to help prioritize and guide extreme heat response and long-term planning.

About the Author

Karen Sullivan writes about technology's power to integrate the digital and physical worlds—and how that integration is reshaping modern life and business operations. She also examines technology's role in helping individuals and organizations address some of the most complex challenges of our time. Before joining Esri, she was a longtime editor, reporter, and columnist for *The Charlotte Observer.*

USING GIS TO BRIDGE ASSET MANAGEMENT AND CUSTOMER CARE

By Ioannis Kavouras

UTILITY COMPANIES, especially water utility companies, face challenges such as implementing environmental policies, developing cost- and time-effective procedures, fostering responsive asset management, and providing personalized customer care. Water utility companies traditionally have technical teams that leverage asset management procedures, and administrative personnel for customer care, two seemingly distant worlds that provide information within the same workflow.

This was true at Water and Sewer Company of Thessaloniki S.A. (EYATH). A disconnect between teams created procedural bottlenecks, which increased response time and diminished the quality of customer service. EYATH needed to bridge this gap to provide a holistic view of water and sewer systems. By doing this, staff would streamline daily workflows, improve efficiency, and eliminate delays that impact customer service.

A NEED FOR SHARED DATA

EYATH, a utility company located in the northern part of Greece, provides fresh water and sanitation to 1.2 million residential customers. The company has used GIS technology for the past two decades. Recently, it focused on connecting its GIS infrastructure to other information systems within the company to provide GIS services, exchange data, add spatial perspective to most of the processes, and embed geographic awareness into its operations for better understanding and implementation. An enterprise resource planning (ERP) data warehouse stores all customer-related data, ranging from financial data for billing to hydraulic data that measures consumption and encompasses service sectors such as personalized customer care, customer profile policies, and billing strategies.

GIS and ERP constitute the two main pillars of EYATH procedures: the system infrastructure and data warehouses. The technical warehouse containing GIS data and the customer database that manages financial and ERP customer data together embody most of the company's procedures and data. They provide access and a holistic view of the entire water and sewer life cycle of assets, personnel, customers, and activities.

Traditionally, EYATH handled asset management via interaction between administrative and technical personnel, which was time-consuming. By connecting asset and customer data, EYATH expected to increase asset management efficiency by addressing more failures in less time, minimizing the response time to customer care requests by substituting paperwork with automated information flow, and improving hydraulic modeling workflow by granting direct access to consumption data.

INTEGRATING GIS AND ERP

Connecting the GIS and ERP databases proved to be a very complicated and time-consuming process because there was no direct joining point between the two systems. ERP had been storing data since the 1990s. The system uniquely identified customers and customer activity but also allowed users to input data without restrictions or editing rules, which resulted in nonstandardized addresses. In addition, interrelated processes—such as construction of a new water service line following an application submitted by a customer—were directed to ERP and GIS as separate procedures, without documented information within the systems that could allow future connection between the asset and the customer.

To achieve the bilateral connection of the databases, the GIS department needed to identify a common denominator between GIS data and customer data. This common denominator would be used to link procedures, serve both water and sewer networks, and function as a unique point of reference. After thoroughly scrutinizing the issue, staff recognized that the only link that would work was the asset address (such as a water meter) in the GIS database and the customer address in the ERP database.

The initial connection based on address was rather disappointing. Based on corresponding ERP addresses, only 9.4 percent of the 515,000 customers matched the meters in the GIS database. The cause: Address input in ERP had been unrestricted for almost three decades. A half million customer addresses in the GIS database had not been standardized when the database was populated.

DATA STANDARDIZATION AND VALIDATION

It was clear that the address structure for both systems needed to be standardized. Because EYATH's GIS department had experience that could support the project, it was executed in-house. In addition, the project would require constant internal feedback to succeed, so using an outside consultant would be challenging.

The project was led by the GIS manager, Ioannis Kavouras, in cooperation with the IT department (including an external contractor supporting the ERP infrastructure) and staff in the Division of Consumers who used the ERP system. These parties held meetings to define the scope, set milestones, and address issues that came up throughout the process. The project lasted more than a year and was undertaken exclusively by GIS department personnel.

The methodology employed was categorized into three major phases:

1. Standardizing address data
2. Correcting asset and customer addresses based on standardized address data
3. Ensuring that future customer address input complies with standardized address data

STANDARDIZING ADDRESS DATA

Standardizing address data was labor-intensive and time-consuming and required detailed correction of a high percentage of database records. This phase was undertaken by the GIS department. Four GIS staff members were dedicated to this process and spent approximately 3,000 working hours on it. Basemaps and address information were overlaid in ArcGIS Pro, which combined street information from different sources into a unique cartographic environment and eliminated ambiguities and cross-checked data sources.

In the case of missing or contradictory information, GIS personnel visited authorities responsible for street names and collected data in the field with the use of tablets and the ArcGIS Server web

mapping application. This work resulted in a table of address rules as well as a complete, homogeneous, updated, and standardized address table.

CORRECTING ADDRESS DATA

Using the standardized address data developed, the GIS team corrected data in the GIS database that stored address information such as water meter locations, geocoding data, and annotation. In addition, the GIS department created an SQL procedure to correct customer records coming from the ERP database. This procedure is used during the export of information to comply with restrictions on making large corrections to the database. Correcting data in this way preserves data integrity and limits the impact on crucial sectors such as billing.

ENSURING THAT ADDRESSES ARE STANDARDIZED

Although the ERP database was corrected, permanent correction of the ERP database remained a challenge. The cost for outsourcing holistic address correction was too high and did not ensure data integrity for massive data correction. Instead, it was decided that this step should be done gradually by ERP users as well as customers via the customer portal. The final goal was to ensure that future ERP transactions would both correct existing addresses and ensure that future addresses would comply with the standardized address table.

For that purpose, a procedure within ERP was established that forced every future change in customer data (e.g., new applications, meter changes) to comply with the standardized address table and—at the same time—ensuring that mapping functionality was provided for address validation.

The GIS department provided support to ERP users, empowering customer care personnel with geographic awareness. This process is daily and ongoing, both for the employee-user of the ERP database and for the customer-user of the portal. It has been approximately six years since the project began, and EYATH has succeeded in matching more than 400,000 of 515,000 customers in the ERP database with GIS assets. Within the next two years, EYATH expects the project will be completed. At that time, most of the customer data will be connected to the corresponding asset data, providing a holistic and complete solution to satisfy the need for shared data within the company.

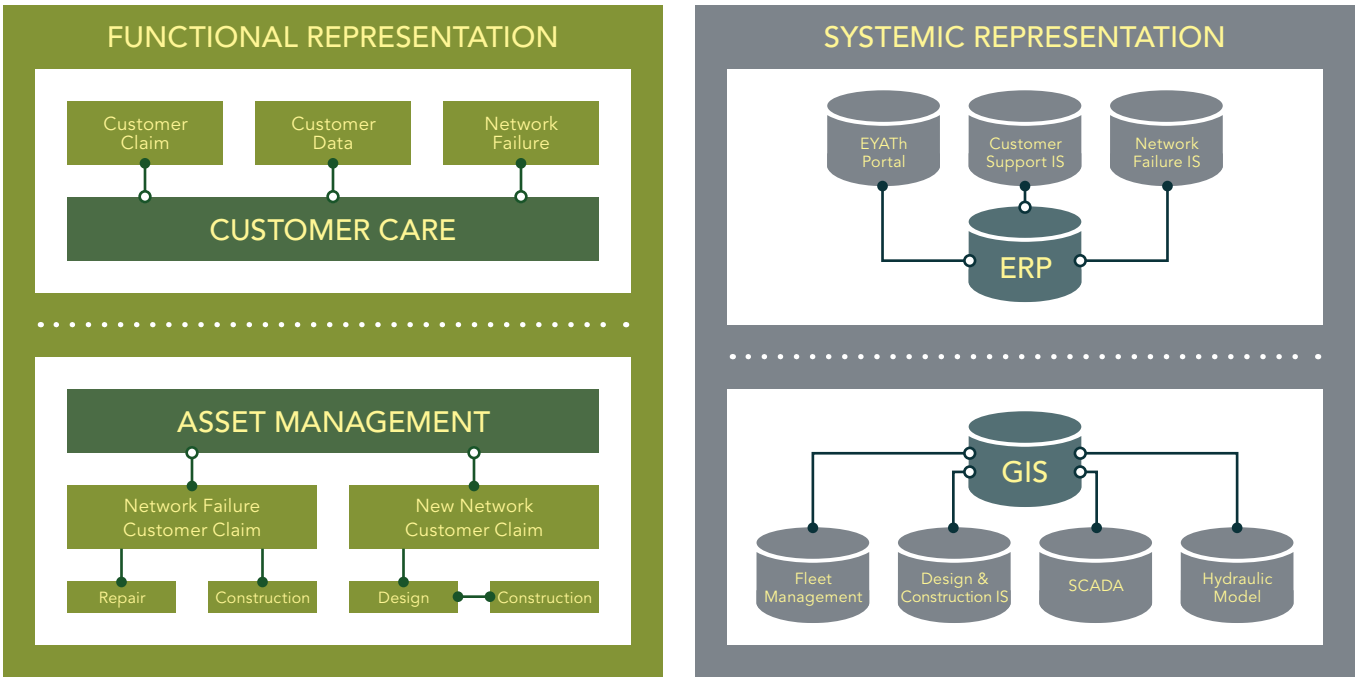
REALIZING THE BENEFITS OF INTEGRATING CRITICAL SYSTEMS

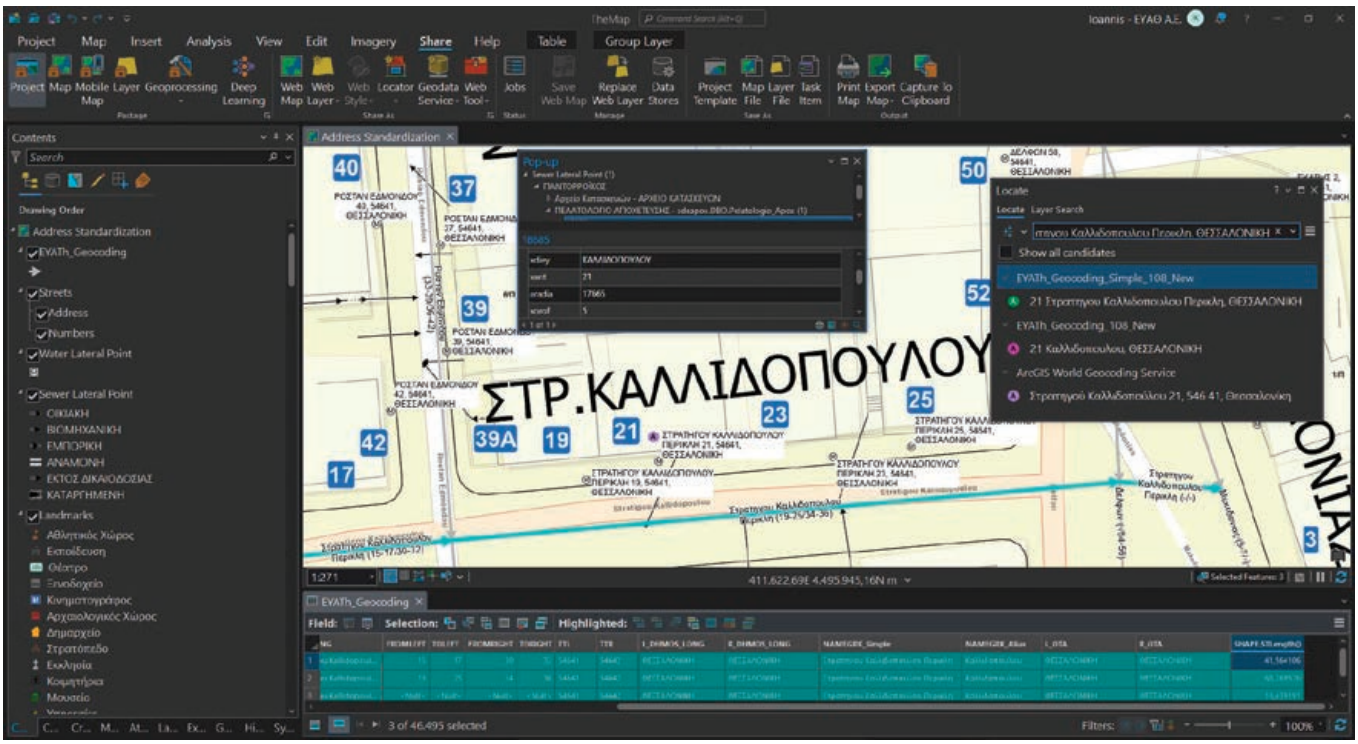
The project benefits are numerous and multidimensional: interconnecting processes; unifying activities; dissolving traditional business silos; and provisioning updated and holistic information to all involved parties regardless of their involvement sector.

Integrating the GIS and ERP data has provided field crews, engineers, and administrative and customer care personnel with continuous access to updated information on the life cycle of each business task. This makes customer care and asset management workflows more efficient and cost-effective.

Customer care personnel now have a geographic perspective on customer locations, which minimizes service time. The billing department saves an average of one working hour per day by geolocating consumers more quickly. Improved efficiency equals

↓ Customer Care and Asset Management Procedures Translated into Information Systems





↑ Different data sources were combined in ArcGIS Pro during the address standardization process.

money saved for EYATH. Field crews have instant access to asset- and customer-related data, which improves response time. These improvements minimize workload and overtime expenses and have resulted in an average saving of seven working hours per day for all sewer and water network field crews.

"Now we have all the information we need with one click, out in the field, speeding up our work *[and]* making our life easier," said Hatzisarrou Panagiotis, who is responsible for water network maintenance of the center of Thessaloniki.

There have been additional project benefits. Because asset data and a geographic perspective are embedded in the ERP environment, GIS services can run in the background to enhance customer support procedures and improve the customer experience.

Historic consumption data—essential for modeling, performing geographic analysis of consumption patterns, tracing water losses in combination with SCADA data, or identifying customers affected by a network failure—is now easily available to hydraulic engineers. This functionality has eliminated ad hoc exports and imports of data between systems and reduced staff time by an average of two hours per week.

EYATH customers are also benefiting from this systems integration. Customer claims triggered in the ERP environment, such as applications for a new connection, are linked to the physical asset (connection line) via the interconnected systems, allowing the recording of the full life cycle of the request (e.g., application for a new connection, construction of the connection line, and future asset management of the connection line).

Conversely, a customer request to fix a network failure is triggered in the call center environment, which is linked to the ERP system. The request is connected to asset management procedures, which are linked via GIS with the physical asset. This ensures the full life cycle of the request is recorded. This improved process has reduced the amount of time to complete customer requests. On average, the customer service department is saving one working hour per day.

In addition to the benefits already realized, the processes and capabilities that the project has added to EYATH's working environment will be utilized by upcoming projects and technologies, such as streamlining the workflows needed to replace traditional water meters with smart meters. The project also provides the foundation for digital twin creation by providing EYATH with accurate and robust asset data.

"By aligning the location of water meters with customer data, we have minimized cases of unfound or misplaced meter location for meter indication reading, meter replacement, or meter installation, minimizing significantly office workload on a daily basis," said Lefkas Aspasios, the head of the Meter Reading Office.

Through the project, GIS has provided the business framework for better services and optimization of procedures, minimizing the cost and response time for asset management, and improving the customer care experience.

ABOUT THE AUTHOR

Ioannis Kavouras is the head of the GIS—Surveying and Hydraulic Modelling Department at Thessaloniki Water Supply and Sewage Company. He is a surveying engineer who holds a master of science degree in GIS and a master's degree in business administration. As a geospatial service professional for more than two decades, Kavouras is a subject matter expert for GIS software, specifically Esri products and technologies, and spatial databases.

Designing a Fiscally Resilient City with ArcGIS Urban

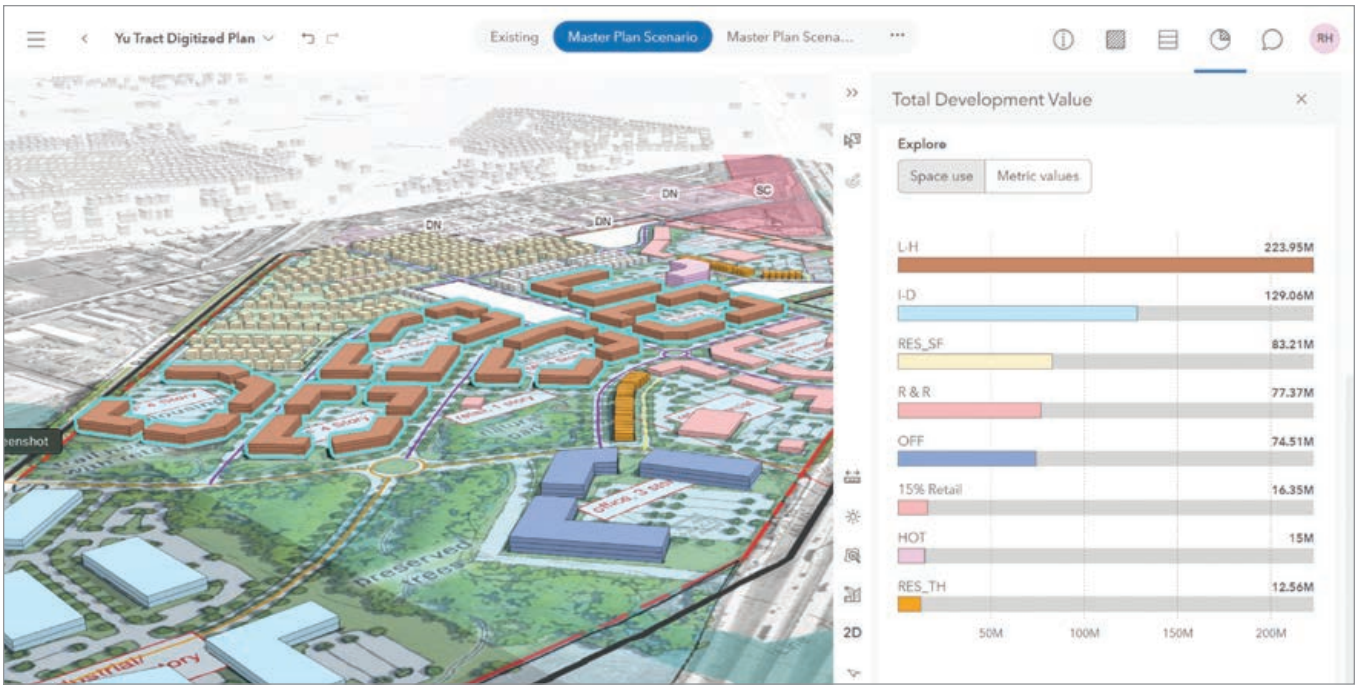
By Keith Cooke

The city of Fate, Texas, is a growing community on the eastern edge of the Dallas-Fort Worth metroplex. Like many suburban communities, its growth has been driven by several large residential planned developments. Also, like many suburban towns, these developments were changing Fate into a bedroom community—a community in which people lived but traveled outside town to work and shop.

Ryan Wells, director of planning and development at the city, recognized the long-term problem this created. "That really sets up a condition where a city has a hard time being fiscally sustainable or fiscally resilient. Single-family detached neighborhoods, while an important ingredient in any community, don't really pay the bills when it comes to the cost of serving those communities."

In the mid-2010s, city leadership became aware of this dangerous financial condition and decided to act to protect the future of the city of Fate. That decision included diversifying the way that the city develops. Part of this process included measuring the fiscal impact of every new development

↓ The new city hall for Fate, Texas, was completed in 2017. (Photo courtesy of JLarson, used under the Creative Commons Attribution-Share Alike 4.0 International license)



↑ Scenarios were created in ArcGIS Urban to test a plan for an undeveloped tract in Fate. The plan tracks space use for selected properties.

that was proposed in the city.

"This feeds into a citywide understanding of what development patterns tend to be more fiscally productive and which of those require more fiscal resources to support," said Wells.

The city has recently acquired a 267-acre tract and is using ArcGIS Urban to carry out both the scenario planning and fiscal analysis to determine the best path forward for the city. This has put GIS technology in the hands of non-GIS staff so that the planning director, city leadership, stakeholders, and the public can view and analyze multiple scenarios. With everyone in agreement, it will be easier to establish buy-in across the city.

To learn more about how that project in the city of Fate has developed, listen to episode 3 of the Reinventing Planning podcast, *Performing Fiscal Impact Analysis with GIS*. The podcast is available on Spotify (https://shorturl.at/esJRS) and wherever you download podcasts.

About the Author

Keith Cooke is the global industry manager for community development at Esri. A graduate of Auburn University, he has been a GIS professional since 1994 and has worked for planning and community development agencies at the regional and municipal levels in Alabama and North Carolina. Prior to this role, he was an account executive at Esri for 15 years, who worked with more than 100 local governments.

Is Digital Transformation Still a Thing?

By Matthew Lewin

Yes, digital transformation is still a thing.

It always will be.

If digital transformation talk has faded, then I think it's due to lingering confusion about the term itself. Many people treat and discuss digital transformation as a single tech-driven initiative—an IT undertaking primarily focused on replacing or upgrading an organization's core technology stack.

This is off in my book.

Digital transformation is about business transformation. I think of it as business transformation through digital means. That means that as technology evolves, the opportunity to transform digitally persists. The problem with thinking that digital transformation is a one-time event or even a multiyear initiative is that it implies that a digital transformation can somehow be complete, as though it's a project with a start and end date.

In fact, digital transformation is a process—an ongoing, continuous evolution in how an organization leverages digital technology to run its business, interact with customers and deliver its products and services. And, as long as technology keeps advancing the minute you finish one

transformation effort, you're presented with a new world of digitally driven opportunities.

To quote Jeff Bezos, "It's always day one for digital transformation." Sadly, success with digital transformation has been modest. While digital transformation is never dead (and results may vary), transformation successes have unfortunately been few and far between.

In a recent study, the global management consulting firm McKinsey took a fresh look at digital transformation in the banking sector to determine who's succeeding in their efforts and who isn't. *[The study, a Finalta benchmarking study by McKinsey, tracked the performance of 80 global banks from 2018 to 2022 against a set of normalized metrics.]*

The results were disappointing. While 89 percent of organizations surveyed indicated they actively pursue digital transformation, only 31 percent indicated that they've realized a significant return on their investment—not exactly a resounding success.

Much of this shortfall gets back to the problem of perception. Many of the organizations surveyed focused their digital transformation efforts on keeping up with technology rather than leaping ahead in their business. And lagging organizations, in particular, were focused on implementing "table-stakes" digital tools—tools such as a customer-facing mobile banking app. Ten years ago, this might have been transformational, but not anymore, especially from a competitive standpoint.

As the study noted, "As soon as one bank introduces a mobile feature, others see it and follow suit relatively quickly." Organizations that play a perpetual game of catch-up never truly transform anything about their businesses relative to the rest of the industry. What was once innovative quickly becomes just the cost of doing business.

So, what do those leading the way with digital transformation do differently? In short, they focus on creating value that's hard to copy. According to the study, organizations enjoying the greatest benefits from their digital transformation efforts go beyond table-stakes apps and focus on transforming core functions of their business. They focus on reengineering or optimizing complex processes and workflows. This involves integrating dozens of use cases, multiple stakeholders, volumes of data and numerous external systems.

In the banking sector, leaders go far beyond customer-facing mobile apps and transform the entire digital sales process. They leverage foundational digital technologies (such as cloud, mobile, analytics and social) to optimize the entire customer journey. This includes developing personalization analytics to improve marketing campaign uptakes, providing omnichannel customer contact center access, enabling real-time financial product approval, and offering extensive customer self-service tools to support day-to-day banking.

Digital leaders don't just change technology; they fundamentally change how business is done. Technology that enables and optimizes complex integration will drive the next wave of digital transformation.

What stands out from the trends in digital transformation identified by McKinsey is how central the concepts of integration and connectivity have become. Reengineering complex business processes is essentially an exercise in integration, where you undergo a deep rewiring of systems, workflows, and behaviors.

Modern digital transformation rests heavily on achieving broader and tighter integration inside and outside an organization, and the technologies that enable and accelerate this deep connectivity will compete for mindshare. That's why conversations around digital twins, generative AI and geospatial technology have reached a fever pitch.

Digital twins are virtual replicas of physical systems and are, in essence, the ultimate integrative concept. Whether it's a digital twin of a manufacturing production line, a transportation network, or a river basin, implementing a digital twin involves integrating numerous datasets, systems, and processes to model a real-life functioning system. That includes how humans interact with and maintain these systems, often in real time and in 3D, depending on the degree of sophistication.

Maturity Level	Level 0: Static Twin	Level 1: Design Twin	Level 2: Connected Twin
Defining characteristics	A compiled dataset composed primarily of existing landscape features and physical asset geometries	Augments a static twin (level 0) with design capabilities enabling a user to create and add new asset elements to an existing static twin	Augments a design twin (level 1) with embedded metadata or linked datasets stored in external systems
Major benefits	Provides a visual snapshot of a landscape or physical system at a given point in time	Enables a user to modify the digital snapshot of the physical system and generate designs that are ready for real-world implementation	Supports scenario planning, enabling a user to analyze how changes to the physical system impact the attributes of related phenomena (and vice versa)
Role of geospatial technology	**Reality capture and map production** • Acquire, process, and integrate imagery and spatial features into the compiled data model. • Create 2D/3D maps from the static data	**Model creation and design** Design new spatial features that respect the topological rules of the digital twin and incorporate them into the static data model.	**Spatial analysis and static data integration** Connect metadata or external attribute data to associated spatial features and conduct cross-factor impact analysis (a change in x, impacts y).
Key technologies	• Remote sensing • Satellite/UAV imagery • Mobile data collection • Map production tools	• 2D/3D map authoring tools • GeoBIM	• Geo enrichment • Spatial ETL, virtualization • Spatial analytics • Geodata exchanges

↑ Table 1: Maturity levels derived from "Digital twins for the built environment" by Atkins.

Digital Twins and Geospatial Technology

A twin with a high degree of integration and richness provides the basis for complex digital transformation. Managers can confidently model scenarios across complex workflows and identify process improvements. Essentially, digital twins are a vehicle for modern digital transformation.

Underpinning digital twins are two critical technologies: generative AI and geospatial technology. These are central to digital twin systems, as they provide the means to generate, simulate, and adapt digital representations that closely mirror real-world systems. Generative AI delivers predictive and prescriptive powers. Geospatial technology provides the spatial context. Put them together, and you get an integrated, intelligent digital twin that can tell you where, when, and why to take action or make changes.

Geospatial technology is a foundational component of digital twins and plays a vital role at each level of maturity. Table 1 summarizes a general digital twin maturity model.

Generative AI and Geospatial Technology

Generative AI has the potential to accelerate outcomes at every stage of the geospatial data life cycle, shifting human involvement toward data-driven interpretation, decision-making, and innovation.

How do I see the digital twin-driven transformation era unfolding? It is hard to say overall, but here are a couple of examples from city government organizations that are already underway:

Infrastructure Development and Investment

- Uses generative AI to assess economic indicators, demographic trends, and urban growth projections to recommend strategic infrastructure investments
- Uses geospatial technology to map existing infrastructure and growth areas
- Integrates both technologies to create a planning twin to guide city officials in making informed decisions about where and when to invest in new infrastructure projects

Citizen Engagement and Services

- Uses generative AI to analyze residents' feedback, service requests, and sentiment analysis data to identify trends and improve service delivery
- Uses geospatial technology to provide

Level 3: **Real-time Twin**	Level 4: **Two-way Twin**	Level 5: **Autonomous Twin**
Augments a connected twin (level 2) with real-time asset data updates delivered by sensors, connected devices, and IoT	Augments a real-time twin (level 3) by enabling updates to the state or condition of the physical asset from the digital twin	Augments a two-way twin (level4) with machine intelligence enabling the twin to sense and adapt to changing conditions and take corrective action
Enables a user to monitor the changing state and behavior of the physical system as it happens and take timely and accurate corrective action	Allows a user to manipulate the state of the physical system without the cost or difficulty associated with interacting with the physical environment directly	Reduces required human intervention and increases the predictive and prescriptive power of the digital twin
Real-time data integration (one way) Ingest spatial data into the twin in real-time from external sources and process massive volumes into spatial features and associated attributes	**Real-time data integration (two way)** Update components of the physical system at accurate locations/areas according to instrucitons sent from the twin	**Geospatial AI** Predict changes in spatial phenomena, evaluate the impact on the physical system, and generate corrective response in the twin
• Real-time data integration • Real-time dashboards	• Big data location analytics	• Image classification • Forecasting/prediction • Intelligent routing • Computer vision

location-based insights into service demand
- Combines these technologies to enhance resident engagement, tailor services to specific needs and optimize resource allocation for improved public satisfaction

The Bottom Line

Digital transformation is not dead; it's thriving, evolving, and adapting to the changing times. The integration of digital twins, generative AI, and geospatial technology (and other innovations) into business operations is a testament to its continued relevance. Organizations that embrace these technologies are better equipped to innovate, stay competitive, and meet the demands of an increasingly digital world.

So, let's not bury digital transformation prematurely. Instead, let's recognize its enduring importance and harness modern digital advances to shape a more efficient, creative, and sustainable future for businesses and societies alike.

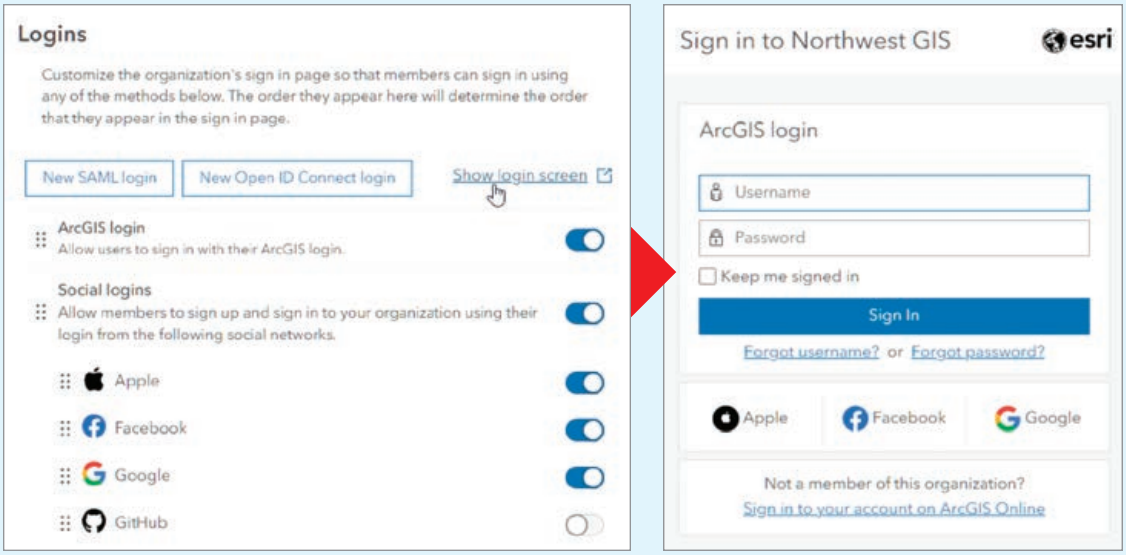
About the Author

Matthew Lewin is the director of management consulting for Esri Canada. His efforts are focused on helping management teams optimize and transform their businesses through GIS and location-based strategies. As a seasoned consultant, Lewin has provided organizations in the public and private sectors with practical strategies that enable GIS as an enterprise business capability. His interests lie at the intersection of business and technology, and he thrives on helping organizations bridge the gap between the two to achieve their most challenging GIS ambitions.

Digital transformation is not dead; it's thriving, evolving, and adapting to the changing times.

Configure Multifactor Authentication for ArcGIS Logins

By Bern Szukalski and Mehul Choksey



← Organization settings for multifactor authentication are only for ArcGIS logins and can only be configured by administrators or others with sufficient privileges.

Multifactor authentication (MFA) is a security measure that is highly recommended to protect your accounts and sensitive information. MFA provides increased security by requesting additional verification information when members sign in, such as a code obtained from an authenticator app.

By configuring MFA, you can significantly enhance your organization's security by preventing unauthorized access even if someone manages to obtain login credentials. Multifactor authentication is an essential, often mandatory, part of your organization's security needs.

This article focuses on configuring MFA for ArcGIS logins only. For other supported login methods, please check with your identity provider.

About Organization Logins

Your organization can be configured to allow members to sign in using a variety of methods, such as ArcGIS logins, Security Assertion Markup Language (SAML) logins, OpenID Connect logins, and social logins.

In the Logins section on the Security tab of your organization settings, you can set login options and reorder them. Click Show login screen to view the current settings.

Organization settings for MFA are only for ArcGIS logins and can only be configured by administrators or others with sufficient privileges. MFA for other methods other than ArcGIS logins must be configured via their respective identity providers.

For more information, see Configure security settings: Logins at https://shorturl.at/eiKV7.

Enable MFA

You can enable MFA for your organization by choosing the Organization tab > Settings > Security. Scroll down to Multifactor authentication. If you have not done so already, when you toggle MFA, you will be prompted to designate at least two administrators who will receive email requests to troubleshoot members' MFA issues. You can designate as many administrators as desired. This ensures that at larger organizations, especially those covering multiple time zones, administrative help will be available if needed.

Once MFA has been enabled, you can optionally allow the use of recovery codes for organization members. Recovery codes are one-time-use codes that provide second-step verification when members lose access to their authenticator app or security keys.

Without these recovery codes, members must contact organization administrators to sign in if their configured authenticator app or security keys are unavailable. Members using recovery codes are responsible for properly storing the information.

Once Enable multifactor authentication for organization is toggled on, MFA is optional for members using ArcGIS logins unless enforced (see section below). MFA can be configured by individual organization members if they choose to do so. This setting can be found on the Security tab in the member profile settings. Members can

click Enable to set up MFA for their account.

Once MFA has been enabled, administrators will see an MFA adoption status chart, showing how many members have set up multifactor authentication. This provides useful metrics for adoption and for moving forward with enforcement.

Enforcing Multifactor Authentication

MFA provides the highest level of security when it is enforced throughout your organization. Enforcement will require all members with ArcGIS logins to adopt MFA when signing in. Once you enable MFA you will see an option to enforce it, as well as an option to create a member exemption list that removes listed members from enforcement.

Click Enforce MFA to enforce MFA for ArcGIS logins. An information pane will display that underscores the considerations and immediate implications of MFA enforcement.

Things to Consider

All currently signed-in members using ArcGIS logins that have not configured MFA—whether they are administrators, field data collectors, or other members of your organization—will be forced out and will need to sign in again using MFA.

When members sign in again, they will be required to use a Time-based One-Time Password (TOTP) authenticator app, such as Okta Authenticator, Google Authenticator, Microsoft Authenticator, or another app to set up MFA. If an exemption list has been configured, additional charts will be displayed that let you track MFA adoption and show the status of required and exempt members.

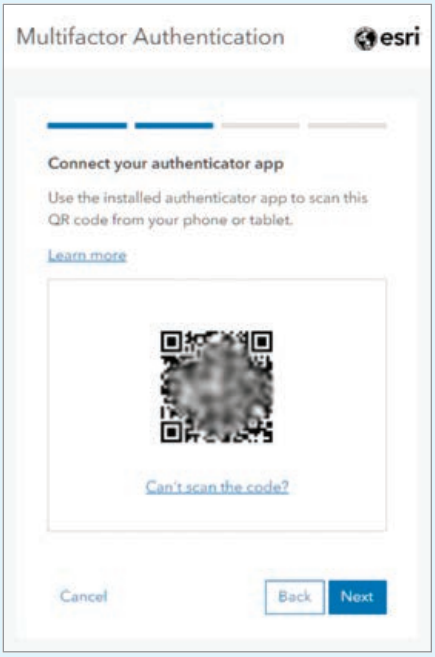
Since this option circumvents multifactor authentication, it should be used only when special circumstances exist—for example, when a member needs additional time to procure and set up a device, is out in the field and does not have the means to set up MFA, or other similar situations.

Member Experience When MFA Is Enforced

When MFA is enforced, all members using ArcGIS logins will need to use MFA to sign in to the organization. Members currently signed in with ArcGIS logins who have not set up MFA will be signed out immediately. All members using ArcGIS logins who have not set up MFA will be guided through the setup process the next time they sign in and will need to have access to a TOTP authenticator app for completion.

Note that current activities, such as field data collection, map authoring, or analysis, may be interrupted. Best practices for ensuring minimal disruption of organization activities are listed in the best practices and considerations section below.

Those signing in for the first time after enforced MFA will be presented with a QR Code, used to configure the authenticator application. Use your camera via the authenticator app to complete the configuration. Once configured, the authenticator application can be used to generate the required code, providing secure sign-in access. After successfully entering the security code, if the option Allow use of recovery codes for members in the organization has been enabled, members signing in for the first time will be prompted to save the recovery codes (which they must acknowledge) and optionally register a security key.



↑ Those signing in for the first time after enforced multifactor authentication will be presented with a QR Code, used to configure the authenticator application.

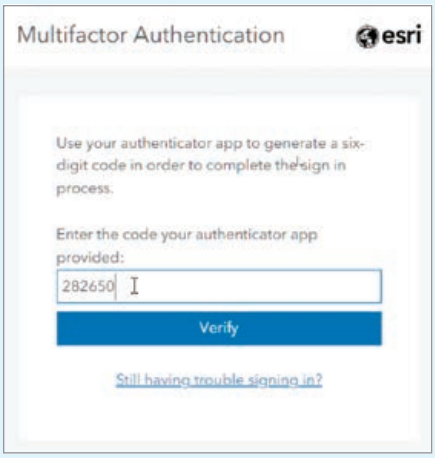
Security keys can include USB devices, face recognition, a fingerprint, or other options. Security keys can be used as a second factor during authentication, following the first factor of a valid username and password. Members are highly encouraged to configure one or more security keys. Security keys are considered the best choice for preventing phishing attacks, while reducing the time for members to authenticate their idenities.

Members can also go to the MFA section of their Security tab in their member profile settings to obtain recovery codes or register security keys for the second factor.

Best Practices and Considerations

When implementing MFA, test the waters. If you are unsure about the impacts of MFA across your organization, you can set it up without enforcing it. This gives members

↓ If an exemption list has been configured, additional charts will be displayed, enabling you to track MFA adoption and see the current status for required and exempt members.



↑ Once configured, the authenticator application can be used to generate the required code, providing secure sign-in access.

the option to try it out and the ability to provide feedback. You can gauge adoption via the MFA adoption chart. Once you've reached a threshold of adoption, you can move forward with enforcing multifactor authentication.

Plan ahead for multifactor authentication, especially if you will enforce it. Enforcing MFA will automatically sign out any members with ArcGIS logins who have not yet enabled multifactor authentication, which will interrupt ongoing work and processes including field data workflows and analysis workflows.

To avoid unwanted disruptions, you can temporarily add members to the MFA exemption list. Members may also be unfamiliar with how MFA works and need some time to install an authenticator app. Forward planning will minimize any confusion and interruptions.

Communicate Your Plans

Communicate in advance your intention to implement MFA and provide a target date. You can leverage the Information banner and Access notice settings to get the word out to members using ArcGIS logins. These settings are found on the Security tab of your organization settings.

Note that information banners are visible to anyone, including visitors to your site, so they may not be the best way to communicate these changes. Access notices, which are only shown when members sign in, may be the better choice. For more information on how to use both banners and access notices, read the blog post "Get the word out: Use information banners and access notices in your ArcGIS organization" (https://shorturl.at/gkIIX).

Offer TOTP App Suggestions

A wide variety of TOTP authenticator apps are available. Organization members may be unfamiliar with the options, so coming up with suggestions (perhaps with guidance from your IT department) will ease the confusion.

Ensure the Highest Level of Security

Your reasons for implementing MFA are based on a need or the requirement to increase the security of your organization. With that in mind, enforcing MFA is the logical choice and so is encouraging members to use security keys. Ensuring compliance and best practices for members is a worthy goal when it comes to security. Adopting MFA is a significant step toward increased security, benefiting both users and organizations.

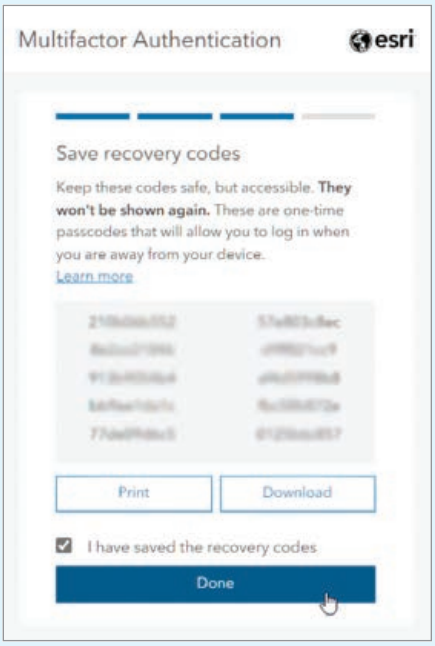
For more information, see these sections of the help documentation:

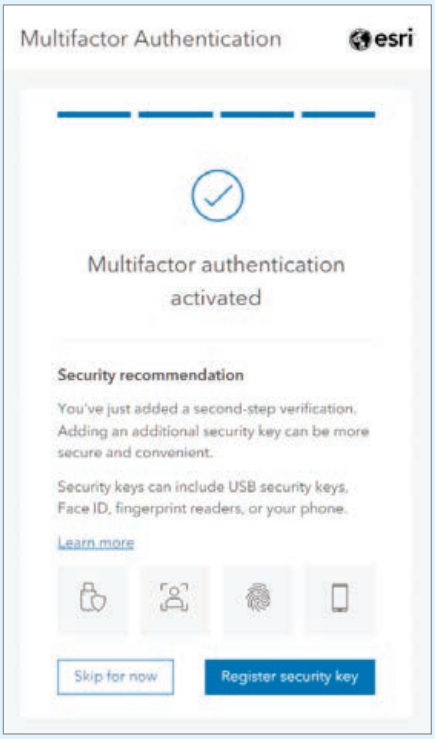
- Sign in (https://shorturl.at/LSX28)
- Configure security settings (https://shorturl.at/uHK78)
- View your settings (https://shorturl.at/gKNT4)

About the Authors

Bern Szukalski is a corporate technology evangelist and advocate at Esri who focuses on ways to broadening access to geographic information and helping customers succeed with the ArcGIS system. On a good day he is making a map; on a great day he is on one. Email bszukalski@esri.com or connect on LinkedIn (www.linkedin.com/in/bernszukalski/).

Mehul Choksey is a senior principal product engineer on the ArcGIS Online development team who focuses on security, licensing, and the ArcGIS Marketplace.





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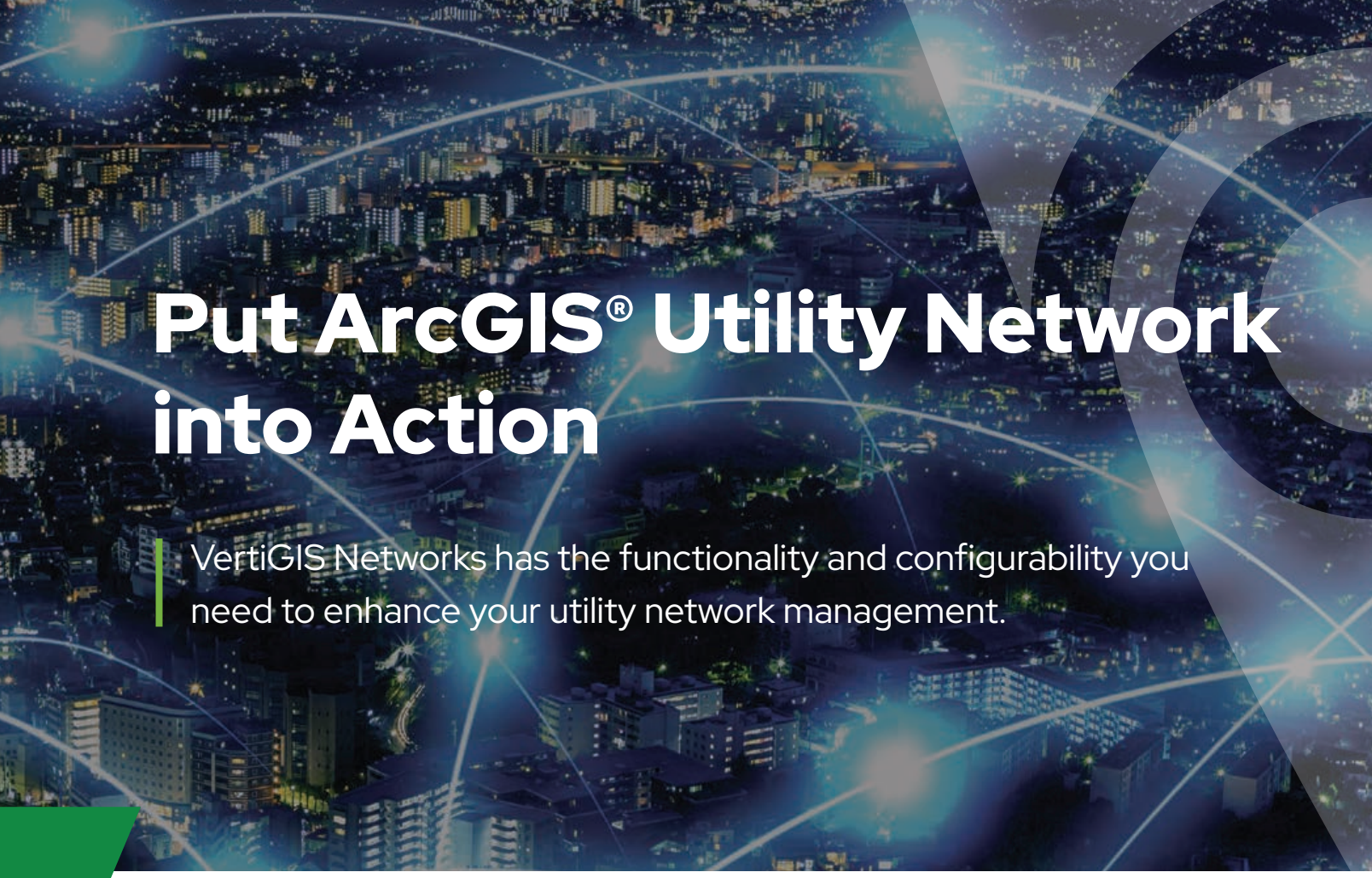

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New ArcGIS Platform Places Service Brings Places Data into Your Apps

By Tony Howser

Places service is a new ArcGIS Platform capability that provides developers with a ready-to-use option for incorporating richly attributed global points of interest (POI) data into their custom applications and solutions.

↑ Places data can be a valuable source of location-based context for users in applications that support mapping, analysis, and decision-making.

Places service provides regularly updated data that describes more than 1,000 types of places and has global coverage. Places service supports applications for users across industries and has flexible query capabilities and attractive pricing. Clear documentation and samples will help you get started quickly.

Places Data and Its Applications

POI are a type of places data that describes specific point-based locations on a map. Places data can be a valuable source of location-based context for users in applications that support mapping, analysis, and decision-making.

For mapping and local searches, Places service can help your users locate and understand what's nearby. For example, users of consumer travel apps may want information on restaurants, parks, and other amenities near lodging options.

In apps using market analytics, Places service can describe potential customers, competitors, suppliers, and distributors for retail site selection solutions.

In data science apps, Places data can provide context for modeling and analysis workflows. Places data can be used in analytic modeling and artificial intelligence (AI) applications along with other context to describe, explain, predict, or even make recommendations based on the models/inferences. For example, in property insurance underwriting, this information could be used to predict future claims based on

and specific categories (e.g., "Szechuan Restaurants"). Each place can be associated with more than one category, which can be very useful when working with collocated businesses, such as coffee shops within supermarkets or public restaurants in hotels.

These valuable characteristics represent additional business value because they contribute to the flexibility of the service to address a wider variety of your customers' needs and opportunities. To see what categories are supported, check out the online Places category finder (https://shorturl.at/DJPWZ).

Data Sources

ArcGIS Platform Places is a service primarily based on supplier data from Esri partner Foursquare. This data is derived from various sources including more than 14 billion monthly check-ins from Foursquare's consumer-facing apps, SDK partners, feedback from businesses, web crawls, and other third-party data sources.

Dedicated Esri data engineering and testing teams handle data intake, quality assurance (QA), production, and releases so you can focus more of your valuable time and resources on creating impactful applications rather than worrying about sourcing, licensing, processing, and hosting data. Esri currently supports quarterly global data updates and is ramping up to support more frequent releases.

Querying Places Service

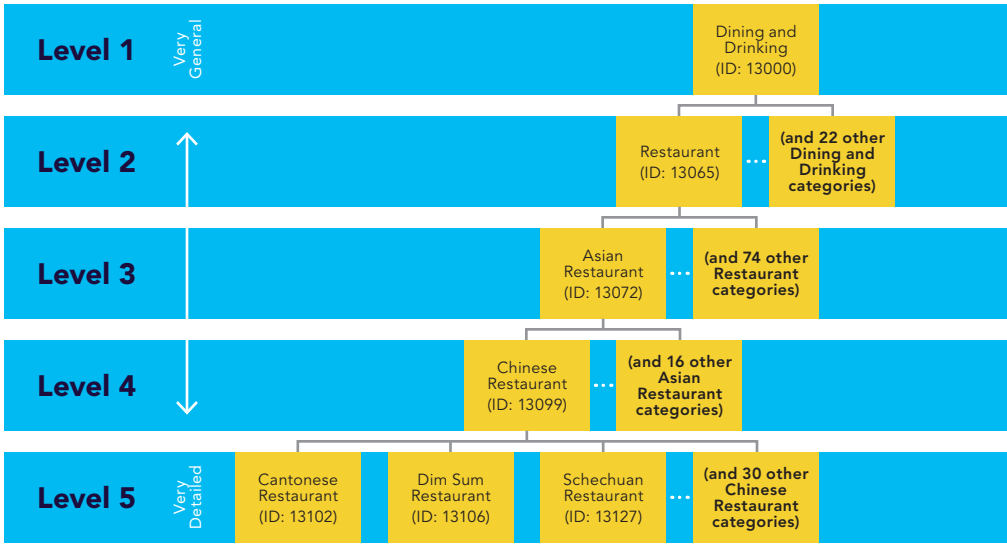
Places service supports simple and flexible query options for searching for and getting details about places. The first search option, near-point endpoint, queries places within a ring-based search area around a point location on a map. You can also include a ring radius, a list of place categories, and search text as optional filtering criteria.

The second search option, within-extent endpoint, queries places within a rectangular search extent. For this search option, you can include a list of place categories and search text as optional filtering criteria.

Any records matching your query criteria—using either search option and up to 20 records and their standard fields—can be returned with each request. You will be metered for a single search transaction.

Your users can easily obtain additional information about a place, beyond the information provided by search responses using the Esri Place ID (PlaceId). Each returned record includes a persistent identifier—PlaceId—that can be submitted, along with the list of desired fields

↓ Places uses a hierarchical category system. Each place can be associated with more than one category.



previous claims history and proximity to certain types of places.

ArcGIS Platform Places service supports coverage for more than 170 countries and regions, so you can create applications for areas of interest around the world. The service currently supports more than 1,000 categories of places. While other POI offerings may focus only on commercial or retail places, Places also supports public places such as courthouses and transportation hubs, and places in the natural landscape such as mountains and lakes.

With a hierarchical category system, you have flexibility on how you target your searches—from general categories (e.g., all "Dining and Drinking" places) to detailed

(requestedFields), to the places endpoint to obtain additional place details, if they are available. Additional information can include:

- Map coordinates for drop-off location
- Detailed address information
- Description, opening hours, and contact info

Pricing

You will be metered once for each of parent groups containing your requested fields. *[Note: You will only be metered once for each group whether you request 1 or more than 10 fields from that group.]* Due to the many characteristics of places data, including the plethora of underlying sources that support global coverage, not every field may be available for every place returned from your search requests.

If all your requested fields from a group are not available, you will not get metered for that group. These options give you more control and help manage costs by giving you the flexibility to request only the fields you need, when you need them.

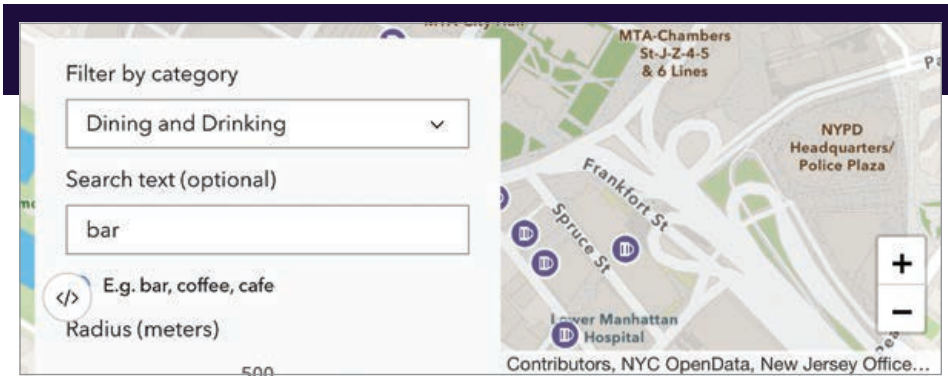
Pricing for Places service is simple, and transaction based, with a monthly free tier. Current licensing terms prohibit storage and reuse. For additional pricing questions, contact your Esri account manager or the Esri data and location services team at data_and_location_services@esri.com.

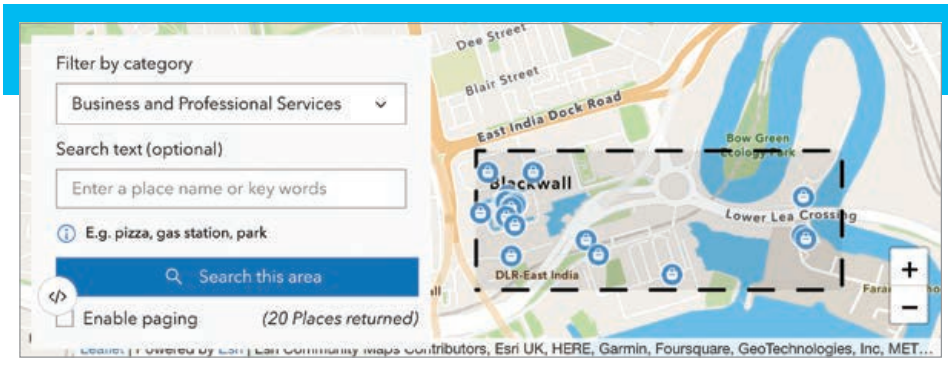
Next Steps

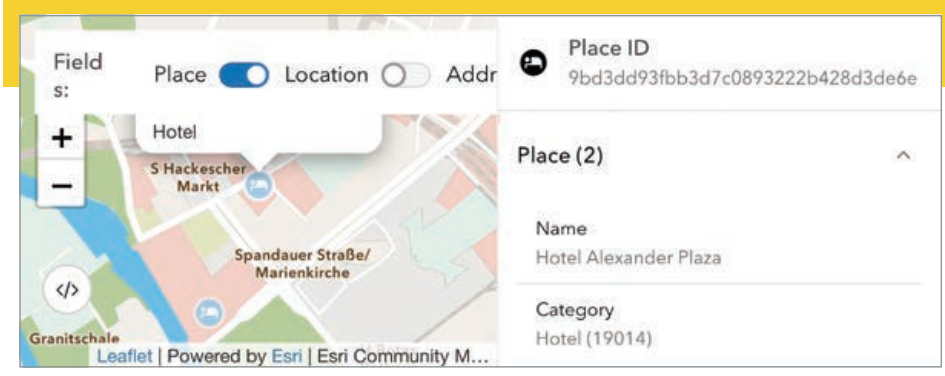
Empower your users with on-demand location-based context by integrating the Places service into your custom applications and solutions today.

Getting Started

- Sign up for a free ArcGIS Developer account at https://developers.arcgis.com/dashboard/.
- Create and manage an API key and configure it with the Places location services scope. See https://shorturl.at/fijr1 for information.
- Review the Places service topic and tutorials (https://shorturl.at/gopsI) and REST docs (https://shorturl.at/izHVX) and start creating valuable apps and solutions for your users.







↑↑↑ Places supports simple and flexible query options for searching for and getting details about places.

↑↑ Places can be queried using a rectangular search extent.

↑ To provide your users with more information about a place, additional place details can be obtained using the Esri Place ID (PlaceId).

Additional Resources

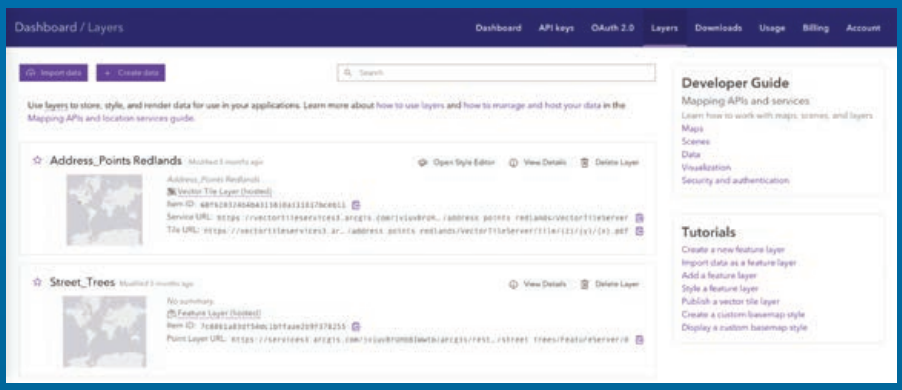
- Location services pricing is listed on https://developers.arcgis.com/pricing/.
- Various support resources including community support, product support, knowledge base, tech support, blogs, videos, and training and can be accessed at https://developers.arcgis.com/support/.

About the Author

Tony Howser is a product manager on the data and location services team. His work is focused on Esri's ArcGIS GeoEnrichment and Places offerings, and his primary goal is to empower users and developers with valuable location-based context to support their mapping, analysis, and decision support needs.

Unlock the Power of Spatial Data with ArcGIS Platform's Data Hosting Service

By Alan Cassidy



↑ ArcGIS Platform Data Hosting is available globally.

Developers need options to store and access their authoritative location data so users can view, edit, and analyze it through their applications. In addition, they need to ensure that their data is securely stored, be certain they retain complete ownership, and have confidence their data is not going to be leveraged by vendors or third parties. Developers are also looking for hosting services that can scale with the growth of their applications and don't have hidden costs.

The ArcGIS Platform Data Hosting service is available and ready to be leveraged by you and organizations of all types. This versatile and powerful solution offers key capabilities centered around spatial data expertise, quality, cost efficiency, and privacy.

This hosting service lets you securely store, manage, and access location-based data. However, this isn't simple data storage in the cloud. Esri converts your data into services that can be seamlessly added to applications and scaled up as needed. Esri supports tiles (both raster and vector), data files, attachments, and feature services.

The ArcGIS Platform Data Hosting service also gives you seamless access to powerful data visualization options, such as point, line and polygon styling, as well as options for data-driven visualizations. You can count on increased productivity and reduced costs because the amount of code needed is minimal.

The service provides additional benefits:

- A generous free tier and consumption-based business model
- Transparent, cost-effective pricing and e-commerce options
- A developer dashboard that makes it easy to understand usage and costs
- A robust service level agreement (SLA)

ArcGIS Platform Data Hosting is available globally. The business model combines storage and usage fees, so you are only charged for what you use. Free tier allocations are replenished every month. If you need more storage and capacity or need your data hosted in a specific geographic region, contact Esri at https://shorturl.at/elKWY.

During the public beta period, thousands of developers and businesses of all sizes leveraged the capabilities of ArcGIS Platform Data Hosting. Whether you are a government agency, a commercial entity, or a nonprofit organization, this service equips you with tools and infrastructure you can count on.

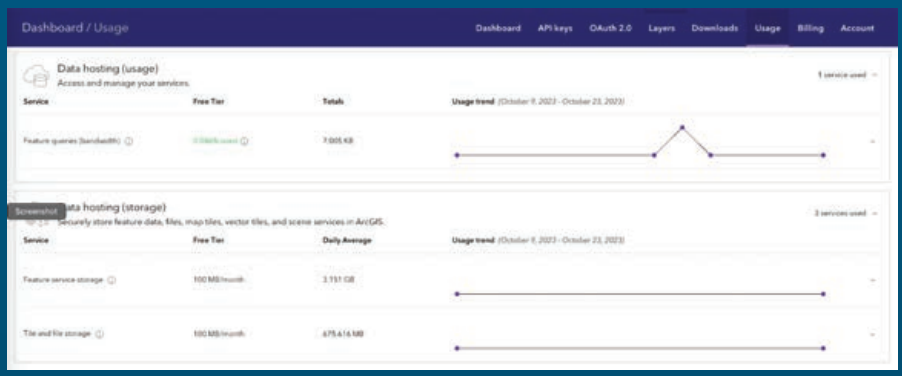
Get started today by signing up for a free ArcGIS Developer account (https://developers.arcgis.com/sign-up/). Once you've signed up, read the best practices documentation (https://shorturl.at/fptAX), and try a tutorial (https://shorturl.at/jGIJU).

Ask questions or share enhancement ideas by posting in the ArcGIS Platform section of Esri Community (https://shorturl.at/lGU45).

About the Author

Alan Cassidy is the lead product manager and partner strategist for ArcGIS. He works directly with developers, product leaders, governments, and businesses around the world to ensure that Esri's developer communities have access to the most comprehensive and high-quality set of location services, data, and mapping tools available. In addition, he leads the Esri Partner CTO Council and is a member of Esri's Distributor CTO Council steering group focused on emerging technologies.

↓ This is an example of the usage details for ArcGIS Platform that are available.



WHAT IF THE URBAN UTOPIA WAS SOMETHING WE COULD ACTUALLY BUILD?

By Greg Milner

→ The favela was created as a test of landscape-scale modeling capability with ArcGIS CityEngine and was used to demonstrate seamless data export to the Unreal gaming engine. (Screenshot courtesy of vrbn)

↓ The overall effect is a city that is both utopian and rooted in the everyday reality of existing cities. (Screenshot courtesy of vrbn)

Anca Badut and Ulrich Gehmann built a utopian city.

It only took a couple of weeks.

The city was brought to life by advanced 3D visualization and modeling tools, along with a 3D content library, using GIS technology. Swiss 3D urban modeling firm and Esri partner vrbn teamed with Ideal Spaces Working Group (ISWG) on a project to design an ideal contemporary utopian city.

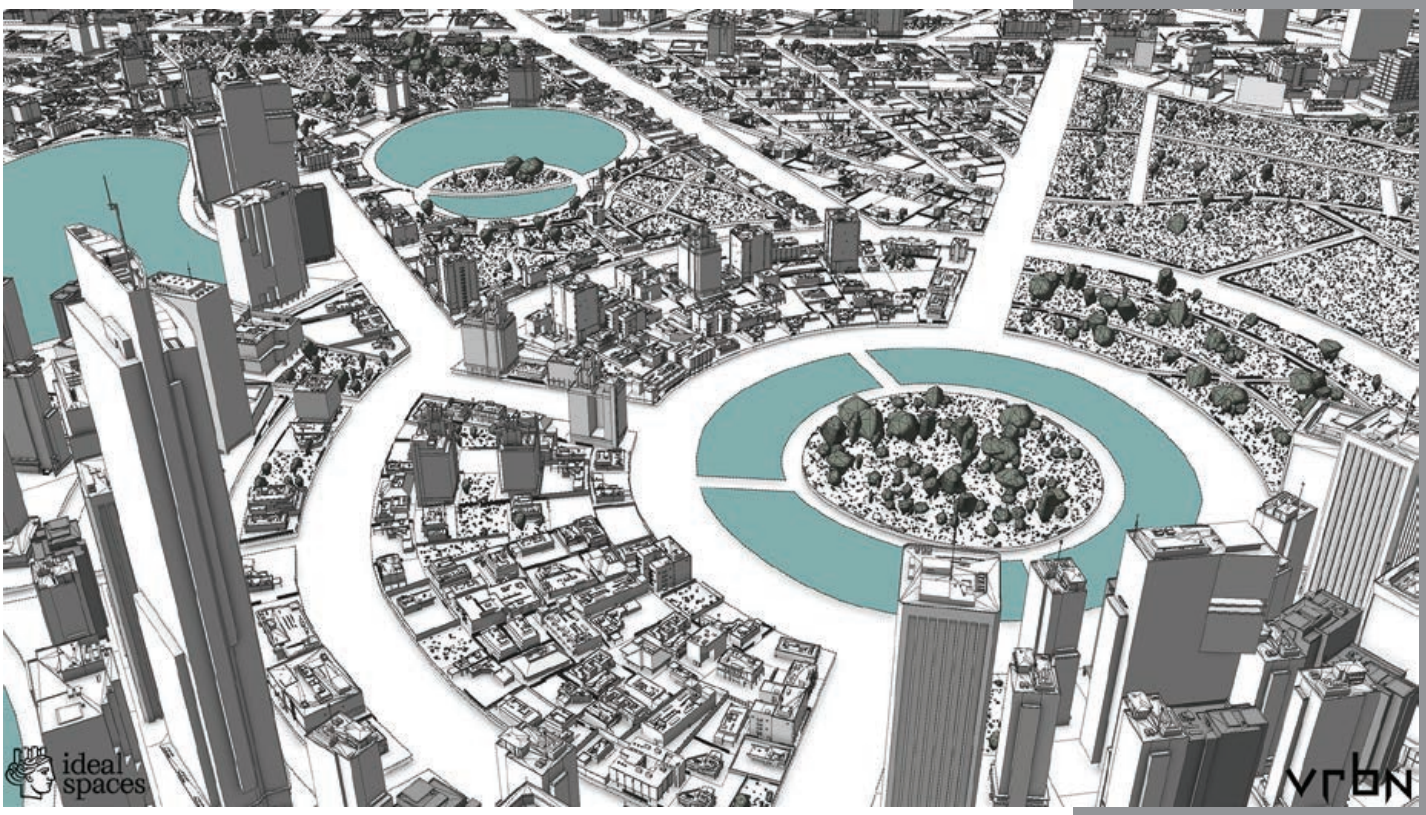
The goal was to create a digital reality that reflected the tradition of utopian architecture, while minimizing the grandiose elements typical of depictions of ideal cities. It had to somehow integrate the elements of European cities that enhance quality of life. Badut and Gehmann presented their creation, called Utopian Disruption, at Esri's 2023 Geodesign Summit.

Badut is an architect by training. She works as a technical director at vrbn (pronounced "urban"), a Zurich-based firm that designs detailed computer-generated environments. *[Vrbn is an Esri partner.]* Vrbn's clients include video game designers, Hollywood filmmakers, and advertising agencies.

Gehmann, an urban theorist and academic, is the founder and director of ISWG, a German nonprofit foundation. With an interdisciplinary team that includes engineers, digital modelers, architects, and historians, ISWG conducts research and develops projects that explore how architecture is perceived. The foundation focuses on optimizing the built environment to best serve the needs of people. As ISWG's manifesto explains, "The ideal space is a mythic theme, but at the same time, very practical."

Exploring the Concept of Ideal Spaces

ISWG's most recent exhibition, The Heavenly City and Paradise, displayed at the central church in the German town of Karlsruhe in 2022, foreshadowed Utopian Disruption. Through



images and text, it traced the evolution of ideas of paradise, from ancient images to contemporary futurism concepts.

Vrbn and ISWG have had a working relationship since 2015. Vrbn helped build 3D models that were part of ISWG's display at Biennale Architettura 2016 in Venice, Italy.

Two years later, as part of ISWG's *Artificial Natures* exhibition at Biennale, vrbn constructed multiple interactive 3D models of cities. Some were based on real planning projects, such as Patrick Geddes's 1935 plan for Tel Aviv, which is an exemplar of the movement. Others were imagined or imaginary. These included Sforzinda, a never-realized Renaissance utopian city imagined by Italian architect Filarete in the 15th century.

Gehmann was intrigued by vrbn's model of a Brazilian favela, or shantytown, displayed as part of the 2016 Biennale.

Matthias Buehler, vrbn's founder and chief technology officer, had studied the architecture of favelas, knowledge he used to begin constructing the 3D model in 2012. This initial project, done in collaboration with Cyrill Oberhaensil (who is now the software developer lead at vrbn), began as a hobbyist project. It was a way to test and showcase the technical capabilities of ArcGIS CityEngine. As with all vrbn work, the visualizations reflect an attention to realism, achieving a lived-in look rather than the gleaming architectural renderings typically made by most firms.

In 2015, an ISWG member learned of the project and asked Buehler if parts could be repurposed for the group's 2016 Biennale exhibition project. The idea was for the favela model to serve as a counterpoint to the other examples on display, which followed a more conventional model of ideal worlds. It facilitated a deeper discussion of the urban and spatial qualities of ideal worlds, a core focus of ISWG.

The dialogue helped Buehler realize that although favelas embody spatial chaos, they also reveal something profound about modern cities.

"A favela certainly doesn't provide anything close to ideal living conditions, of course, but there are certain interesting spatial qualities of its urban fabric that modern cities lack or have lost over time," Buehler said. "Having seen a favela myself, I know that people who live there have a strong influence on the design, function, and construction of their spaces. You can interact in these spaces socially and develop connections with your neighbors and the community. In the Global North, building codes and regulations often make that virtually impossible."

Applying these concepts to a modern

↑ At the sketching phase, the Utopian Disruption design took form to look like a modern city, rather than a fantasy utopia. (Screenshot courtesy of vrbn)

→ The canals are designed to be scalable as the city grows and expands. (Screenshot courtesy of vrbn)

utopian ideal became a driving force of the Utopian Disruption project. "Since the dawn of time, deep connections in communities have been an essential aspect of supporting meaningful social life, a sense of place, and a kind of spiritual home," Buehler said.

Buehler offered a comparison with Brasilia, Brazil's capital city. Built according to a master plan between 1956 and 1960, Brasilia has since become an urban planning cautionary tale.

"Brasilia was designed as an ideal city, and it is ideal in the geometric sense," Buehler said. "It has broad highways that reflect a transport-centric philosophy, but with too little thought on social space for actual living. Brasilia was designed more like a sculpture. It's not a truly livable space if function follows form and the form is unchangeable."

Buehler proposed the *Ideal City project* to Gehmann, as a way to collaborate again and explore these concepts. Although Buehler did not have time to devote himself personally to the project, he deputized Badut to be vrbn's representative.

Modeling Tools Bring Ideas to Life

One of the primary tools Badut used to create Utopian Disruption is ArcGIS CityEngine, advanced 3D modeling software for massive, interactive, and immersive urban environments. Urban planners and architects use CityEngine for realistic visualizations of their projects.

Badut had first encountered the tool during her studies at Ion Mincu University of Architecture and Urban Planning in Romania, where she used it to examine real spaces. "So, I already knew that it's a super powerful tool, not only for doing a conceptual project from scratch, but also for analyzing existing areas of a city," she said.

CityEngine employs an approach that makes the challenge of creating an entire realistic city more manageable. It involves a set of rules that can be applied and easily altered for individual sites or across whole landscapes.

The basic dimensions of one building or street, for example, can form a template for others. Parameters of one element, such as curb heights or centerlines, can be tweaked to make another one rather than starting from scratch. Small differences in a facade, such as windows with sashes or without, can all be modified together to save time. Using such procedural rules and tapping into a large internal library, vrbn can create many

Brasilia was designed more like a sculpture.

↑ The plan follows a pattern of high-rise development for convenient access to a range of services. (Screenshot courtesy of vrbn)

variations to avoid cookie-cutter sameness, while keeping control on design for very large areas.

As an engineer, Buehler had helped build early versions of ArcGIS CityEngine. He felt the time was right to push the tools and internal production workflows toward a utopian direction.

"At vrbn, the tools we use to create our 3D visualizations had progressed far enough that we could do one of those collaborative projects relatively efficiently," he said.

What most intrigued Badut about the project was the chance to diverge from "the old way of designing a utopian or ideal city, in which everything would have a kind of opulent vibe, with lots of piazzas and super intricate buildings," she said.

Utopian Disruption shares some characteristics with classic approaches to utopian cities. Like Sforzinda, it has a geometric symmetry with an emphasis on waterways. In Utopian Disruption, four canals meet at the city's center. These canals extend outward throughout the city and are designed to be scalable as the city expands. As the city moves away from the center, open space increases. The architecture becomes more integrated into the "organicity of green areas," Badut wrote in the project notes.

There is a futuristic quality to Utopian Disruption, an almost mythic, garden-like quality. At the same time, it looks like a city, with skyscrapers and parks and recognizable infrastructure.

One of the project's guiding principles was to avoid using architectural styles, such as baroque, that have historically been used to depict utopian cities throughout history.

"It's not about luxurious spaces or castles or fountains," Badut said. "It was more like we wanted to use contemporary and affordable architecture that people can interact with, including beautiful public spaces, parks, and waterways. It's very conceptual, but when you look at the buildings and how they're placed next to one another, it's basically North American-inspired architecture. We wanted to take what's existing yet propose a design approach that could scale from very small plot-scale interventions to vast cities."

The team also didn't hold back on one of its strengths: realistic visualization.

"The way the project's concept also includes the necessary industrial parts, with pipes and gas tanks, that's something you typically wouldn't see in the planning of an ideal city," Buehler said.

Buehler hopes Utopian Disruption will inspire professional urban planners to plan ideal cities, despite the inherent limitations of contemporary construction principles. These cities would stress the inclusion of public space, parks, and other places where nature and culture meet.

Ideal Futures in the Present

Utopian Disruption is not a detailed blueprint of a city. It doesn't confront the gritty planning realities of sprawl, traffic, walkability, and pollution. Yet, it's not obsessively ideal. Instead, it shows what can be achieved in reality.

"It's not just aqueducts and green ponds and lush gardens," Buehler said. "Reality is a bit messier, and it's OK to see industrial infrastructure. But if we could just push ourselves a little, we could do this."

Badut and Gehmann were careful to make the ultimate borders of the city invisible, something for the reader to fill in. Badut compares it to a puzzle piece, a place in flux where the viewer can imagine how the city might expand, perhaps eventually meshing with similar cities. "A boundary is no sharp line, but a transition zone where something different begins," she wrote.

This echoes the democratic ideal Buehler noticed in favelas, where the lack of rigid urban planning gives residents an opportunity to sculpt their neighborhood's contours.

"This idea of letting a story have an impact on the viewer was really important to me, which is why I didn't want to have any boundaries," Badut said. "So, it wasn't only about making it beautiful or functional. It was also about what stories the viewer can generate. It can be like a book without an ending."

Yet, it's not obsessively ideal.

Instead, it shows what can be achieved in reality.

About the Author

Greg Milner is a writer in the strategic content group at Esri, where he tells stories about how location intelligence is transforming our world and how we perceive it. A former magazine editor and political speechwriter, he is the author of the books *Perfecting Sound Forever: An Aural History of Recorded Music* (a finalist for the National Book Critics Circle Award) and *Pinpoint: How GPS Is Changing Technology, Culture, and Our Minds*.

A Better Way to Build and Maintain Feature Layers

By Rich Nauman

Do you have layers that occasionally need to be updated?

The workflow described in this article uses layer views to make updates quick and easy, and efficiently manage important feature layers.

What Is a Layer View?

A hosted feature layer view looks and acts like a hosted feature layer but doesn't have its own data. As the name implies, layer views are simply a second view of a hosted feature layer that lets you maintain a public-facing view while keeping its feature layer hidden.

This simple architecture—a shared layer view and a hidden feature layer—enables you to do updates out of sight of your users and make updates with minimal impact. ArcGIS Online provides a simple process for switching which feature layer a layer view uses. Layer swapping is a powerful technique that will make your work easier.

The Benefits of Layer Swapping

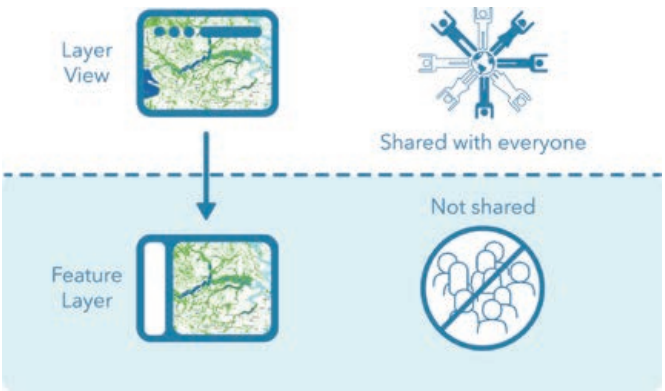
In addition to letting you perform seamless and instantaneous data updates, using layer swaps hides the lengthy publishing process, while giving you time to check the layer prior to changing a public-facing layer. If something in your updated layer doesn't look right, you can quickly and easily swap back to the old layer. Symbology, pop-up configuration, and other properties can be saved in the layer view and will be maintained after the swap. Maintaining old feature layers leaves an archive of past versions.

Layer swap architecture is particularly useful when working with large layers. Updating a very large feature service can take some time—from minutes to hours—and a layer swap enables you to hide that layer while it publishes. This means you can take your time and check your work before sharing it with your users.

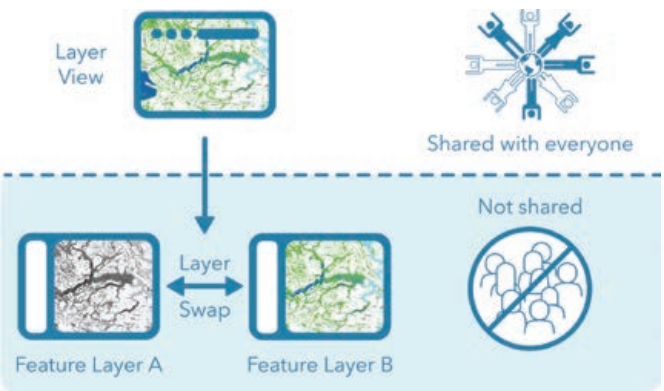
Performing a Layer Swap Is Quick and Easy

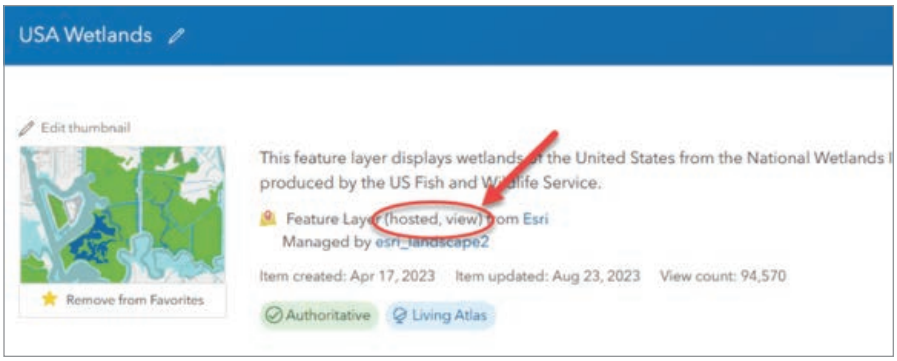
Start with a view layer. If you need help creating a view layer, read "Introducing the new create and update view layer experiences" (https://shorturl.at/gDGZ6) to get started. *Note that you must be the owner or administrator of a hosted feature layer to create and manage layer views from it.*

↓ The simple architecture of shared layer view and a hidden feature layer will let you do updates out of sight of your users.



↓ ArcGIS Online provides a simple process to switch which feature layer a layer view uses.





↗ Using layer swapping begins with a view layer. You must be the owner or administrator of a hosted feature layer to create and manage layer view. The item page indicates whether it is a layer view.

↓ In the Update View window, select Swap source at the bottom of the window.

From the layer view's item page, click the Settings tab and scroll down to the bottom of the window and click Update View. After the Update View window opens, click Swap source at the bottom of the window. After reviewing the source layer requirements, click Browse for a layer. Locate the replacement layer and click the arrows to swap layers. You can confirm that the layers swapped by looking at the source layer on the item page for the layer view.

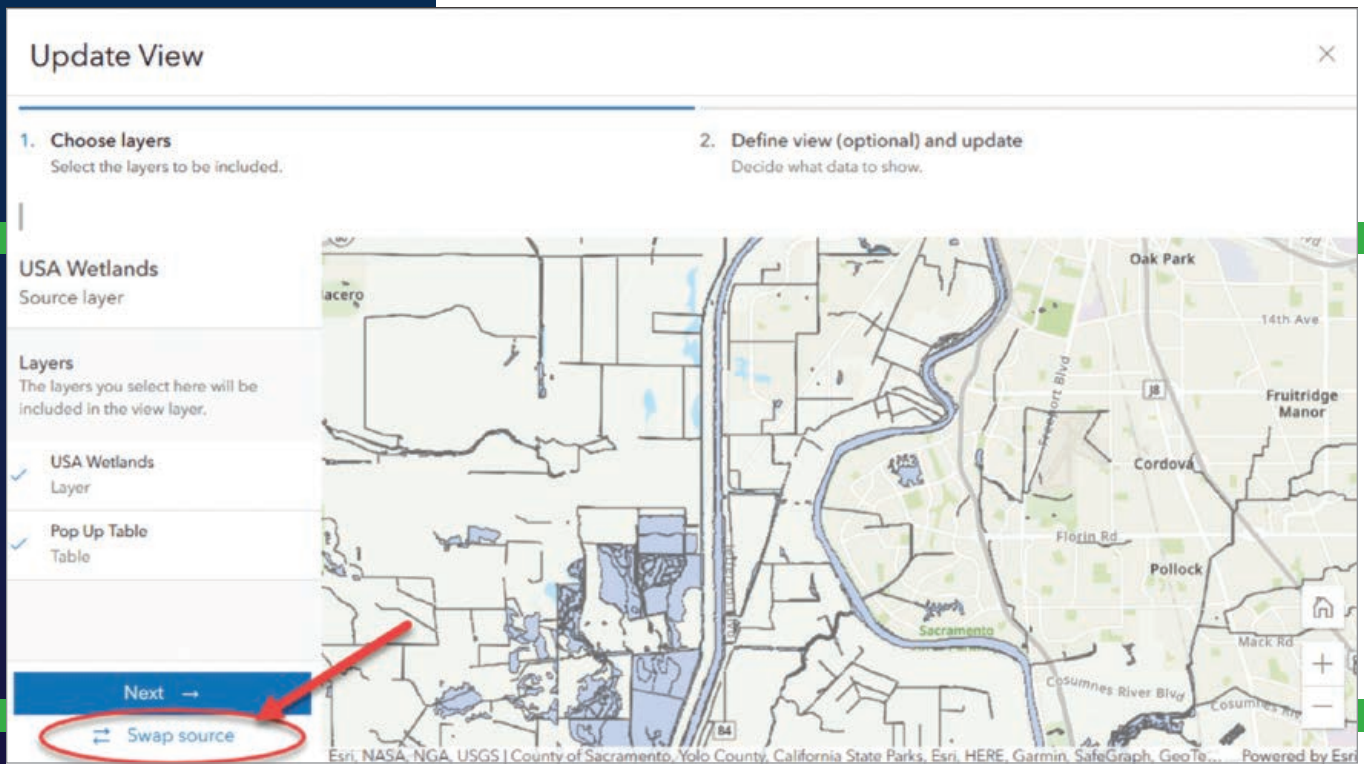
Things to Know

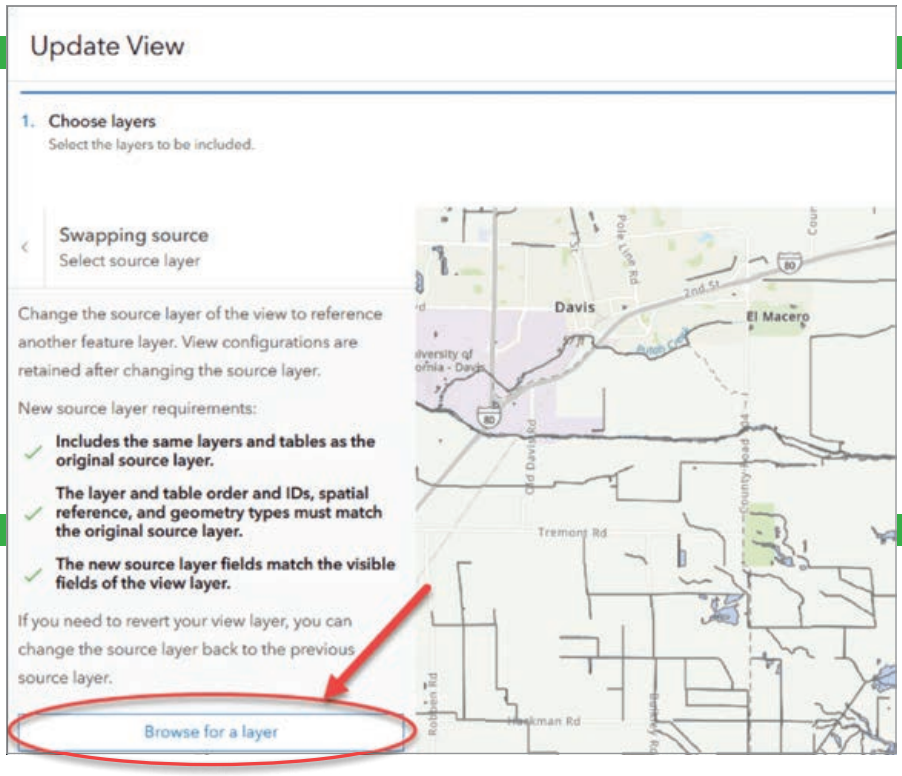
While the layer swap is straightforward, there are a couple of things to keep in mind. The most important is that the schemas of the new and old feature layers should match. The new layer must include the same layers and tables as the original source. If you run into issues, make sure these things are the same in both layers:

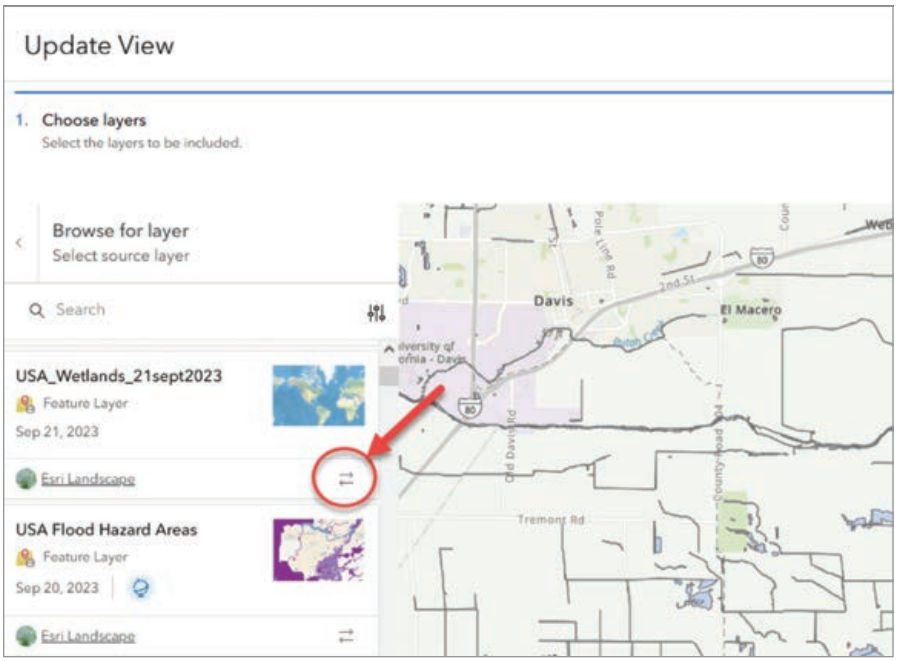
- Coordinate system
- Spatial reference
- Geometry type
- Layer and table order must match
- Fields in the new attribute table must match the visible fields of the old layer
- Layer ID numbers must match

Use Layer Swaps in Your Work

Taking the time to set up a layer view will allow you to work behind the scenes and







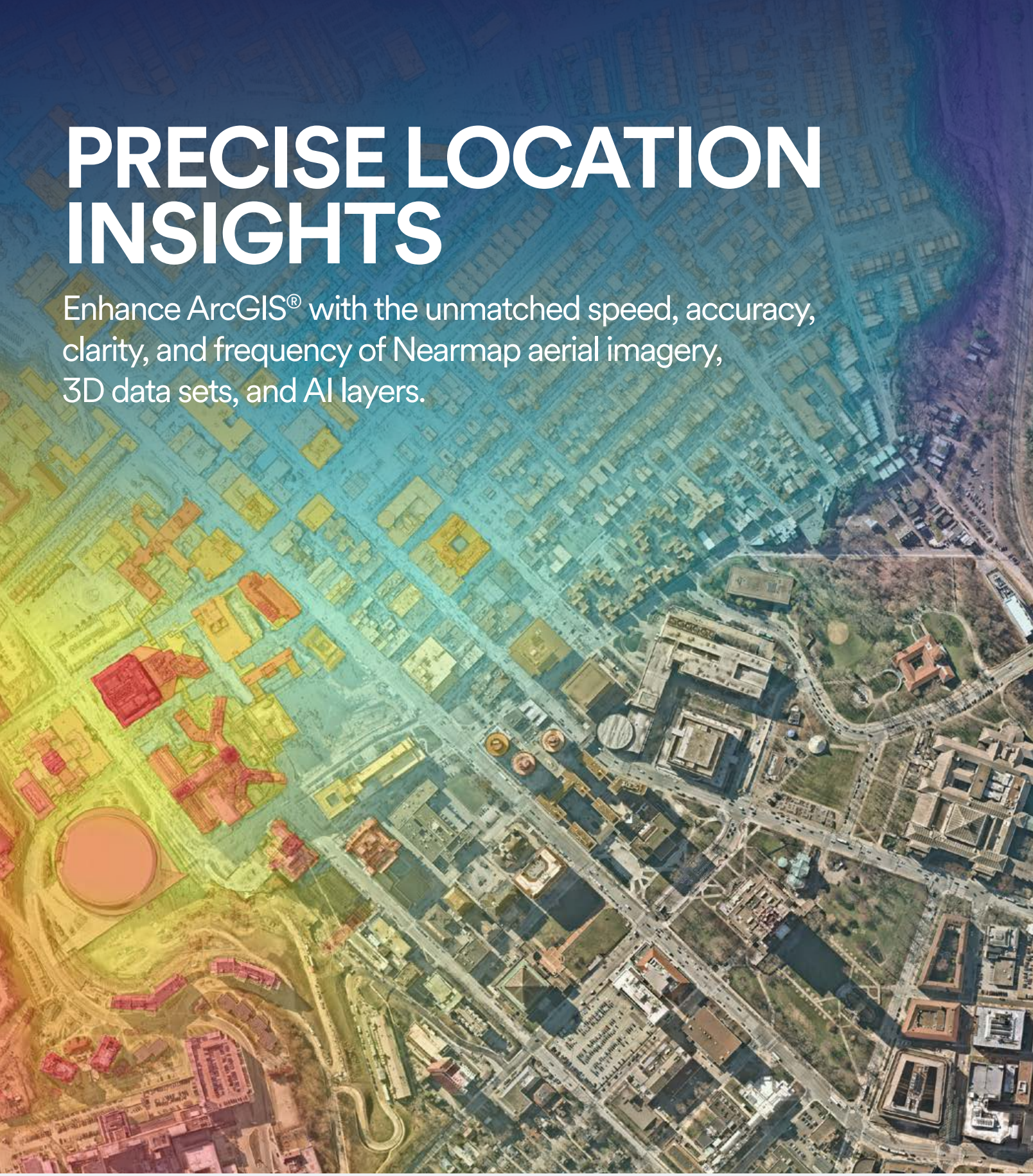
↖ After the verifying that the view layer meets the requirements for swapping, click Browse for the layer.

← Find the replacement layer you will use and click the arrows to swap layers.

give your maps the professional edge that users expect from a top-quality product. Keep your data up-to-date with seamless transitions to give your users confidence that your layer will be there when they need it.

About the Author

Rich Nauman is a member of the ArcGIS Living Atlas of the World environment team at Esri. He works with a wide variety of natural resource datasets ranging from rare species and habitats to soils and hydrology. With 30 years' experience in both the field and office, Nauman uses his skills to help others understand the world. When not making maps, he is using them to find new rivers to fish and places to visit. Contact him at rnauman@esri.com.



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Five Tips for Easier Editing in Map Viewer

By Emily Garding

If you're familiar with editing data using ArcGIS Online, you may already know that Map Viewer offers out-of-the-box tools that allow you to do things like update attribute values or add new features to the map. This article will make you aware of the latest capabilities that make editing and managing data even easier by exploring five tips you can use right away to improve your editing experience in Map Viewer.

1. Enable Editing at the Map Level
2. Create Views
3. Author Forms
4. Save Forms
5. Save Group Layers

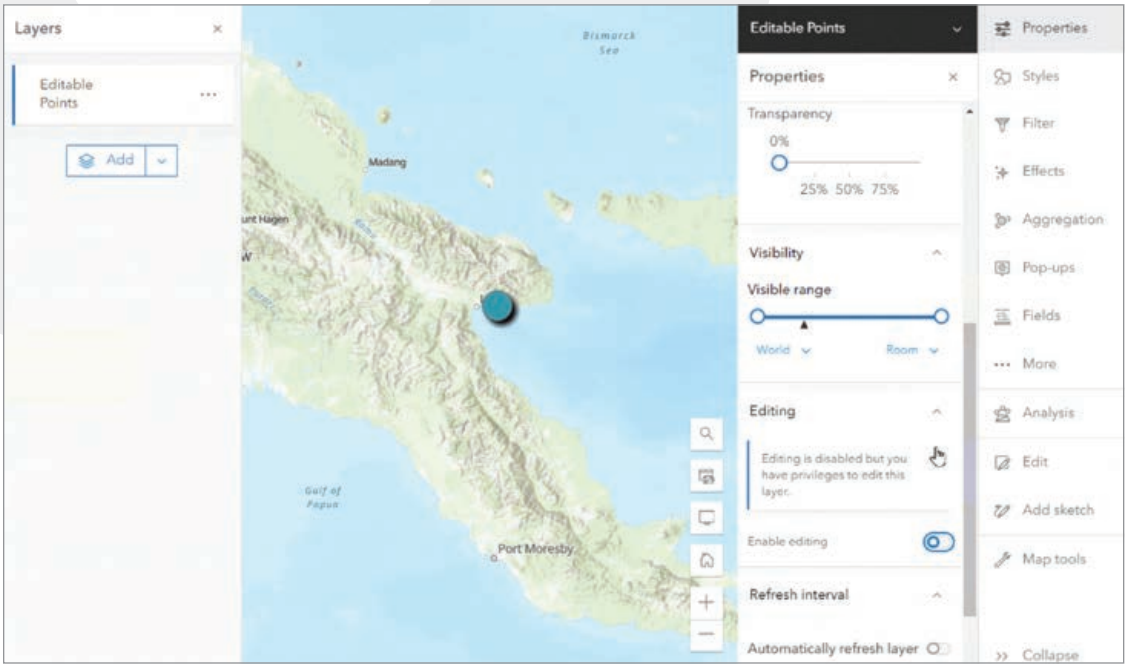
1 Enable Layer Editing at the Map Level

As a data manager, you know you can enable editing for a layer on the Settings tab of the layer item details page. But did you know that you can enable editing for layers at the map level? For each editable layer in a map, you can disable editing for that layer in that map. This is especially useful when your map includes editable layers that you want to use to provide context, such as roads or addresses, but you don't want map users to edit those layers.

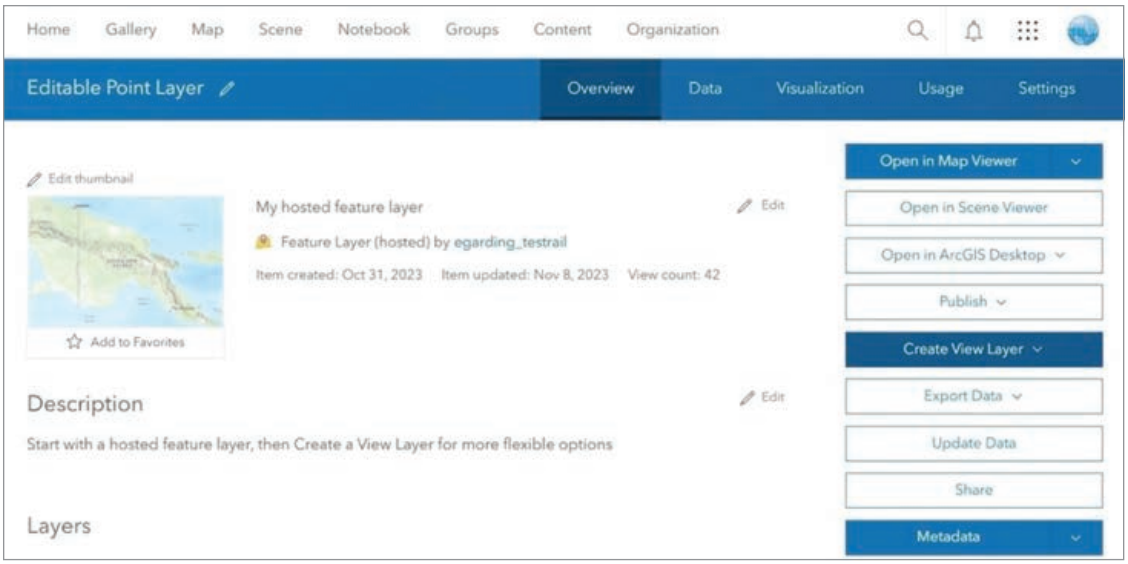
To enable editing for a layer in the map, follow these steps:

1. Click to select the layer. The Properties panel will open in the pane on the right side of the screen.
2. Scroll down in the Properties panel until you reach the Editing section.
3. In the Editing section, find a toggle switch to enable or disable editing for the selected layer.
4. Toggle the switch to the desired position. If the switch is turned on, editing is enabled. If the switch is turned off, editing is disabled.

Note: Disabling editing in the map doesn't affect the editing settings for the layer itself; it only applies to the layer in this map.



← You can disable editing for a map without affecting the editing settings of an individual layer.



← Using hosted feature layer views allows you to create separate views of the same layer for different purposes. When creating views, you can define the sharing level and editing settings independently from the hosted feature layer.

2 Create Views for More Flexibility

Data can serve many purposes. In some cases, you create a dataset for editing, while in other cases, you simply want people to view or interact with the data on a map. There are times when you may want a single dataset to fulfill both purposes. That's when you can use hosted feature layer views.

Using views gives you options. They allow you to create separate views of the same layer for different purposes. For example, you can create a public-facing dashboard for viewing data that uses a view that's not editable and create a separate map for editing that uses an editable view. Both views point to the same layer, so there is no need to reconcile edits or manage multiple versions of the same dataset.

When creating views, you define the sharing level and editing settings independently from the settings of the hosted feature layer. You can create view layers on the layer's item details page. Read the "Introducing the new create and update view layer experiences" blog post (https://shorturl.at/exKOW) for detailed information on creating views.

3 Author Forms for Intuitive Editing Workflows

Creating a form tailored to fit a specific workflow can help make editing data easier and more efficient. You probably know Field Maps Designer provides a user-friendly form authoring experience with Form Builder. What you may not know is that Form Builder is also part of Map Viewer.

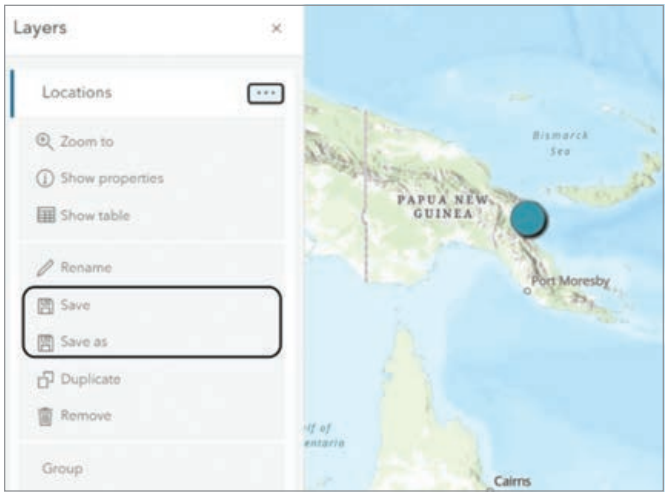
To get started creating your own custom forms in Map Viewer, follow these steps:

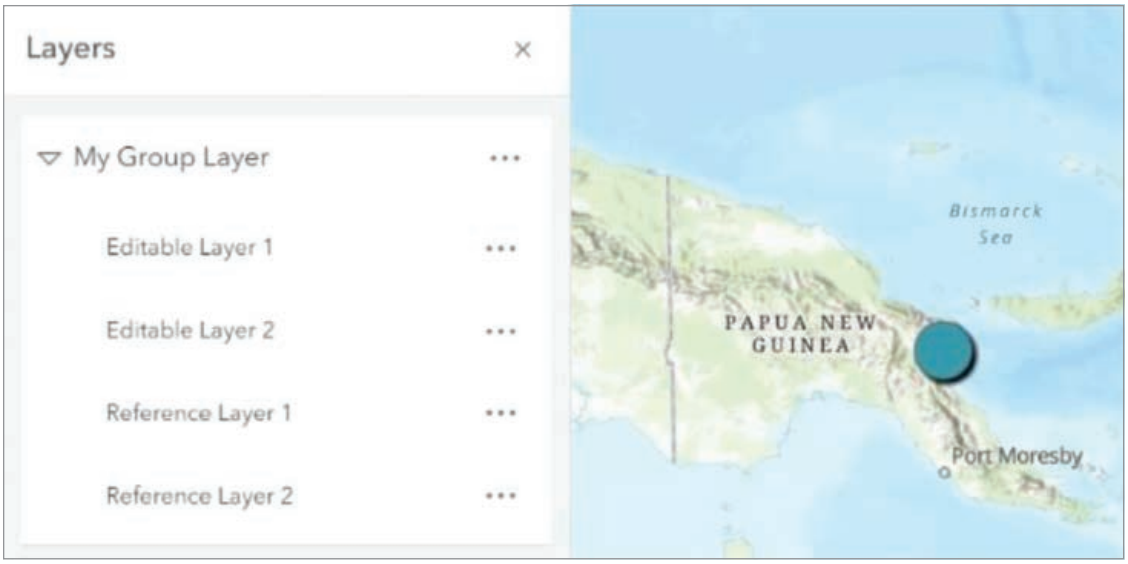
1. Select your editable layer in the table of contents.
2. Click Forms, located on the Settings (light) toolbar.
3. Form Builder opens in a new window. This is where you can customize the form for your layer.

You can customize forms as much or as little as you like. You can order fields; format fields with tips or different input types; calculate values using ArcGIS Arcade expressions; and control the requirements, visibility, and editability of fields. Using forms ensures that the necessary data is organized and presented in a logical manner. This reduces the time and effort required to complete editing tasks. Simply put, a well-designed form can make editing easier.

See these blog posts, "Forms aren't just for ArcGIS Field Maps anymore" (https://shorturl.at/adwOR) and "From the Smart Editor to Smart Forms" (https://shorturl.at/ioZ16), to learn more ways to use forms.

↓ When you author a form in a map, it is saved with the map. You can save the layer and the form will be ready to be reused.





← You can preserve a set of layers that work together as a group layer and you can easily reuse the set.

4 Save and Reuse Forms

When you author a form in a map and save the map, the form is saved within the map. If you plan to use the same layer in a different map, you can reuse the form you already created. When you add the layer to a new or existing map, the form is ready to go, saving you valuable time.

To save a layer,

1. Click the Options menu (three dots) next to the layer name.
2. From the drop-down menu, click Save or Save As—depending on your needs. The layer will be saved along with all the properties you configured in the map, including pop-ups, symbology, and labels as well as forms.

5 Save and Reuse Group Layers

When you're managing an editing project with multiple maps, those maps may require some of the same layers. In an editing workflow, you could have a set of editable layers and helpful reference layers to provide context. How do you avoid adding and configuring each of these layers in new maps? One option is to save this set of layers as a group layer. With the October 2023 update of Map Viewer, you can create, save, and reuse your own group layers.

When you save a group layer, it preserves the properties you configured on each layer, including forms, pop-ups, symbols, and editing settings. Everything is in place when you add the group layer to new or existing maps. This saves you loads of time when creating new maps using the same set of layers.

Summary

The time-saving tips in this article will help you create more streamlined editing workflows and make editing in Map Viewer even easier. Visit Esri Community (community.esri.com) to provide feedback.

Note: Some tips mentioned in this article—such as enabling editing for a layer or authoring forms—require appropriate permissions and privileges.

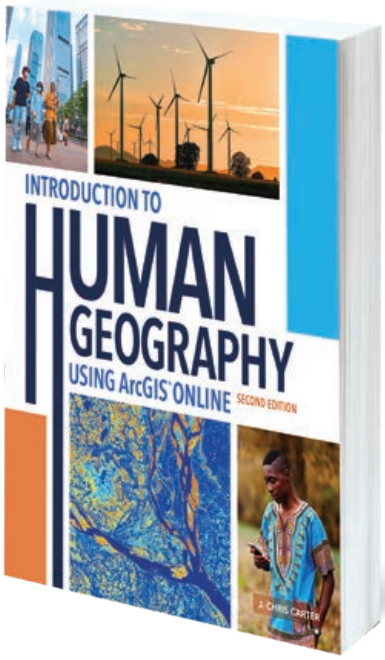
About the Author

Emily Garding is a senior product engineer on the ArcGIS Online team. She joined Esri in 2022, bringing expertise in mapping, app creation, and data management. She is passionate about the outdoors, nature, and hiking. She often seeks refuge in wild areas and acoustic guitars.

Bookshelf

Introduction to Human Geography Using ArcGIS Online, Second Edition

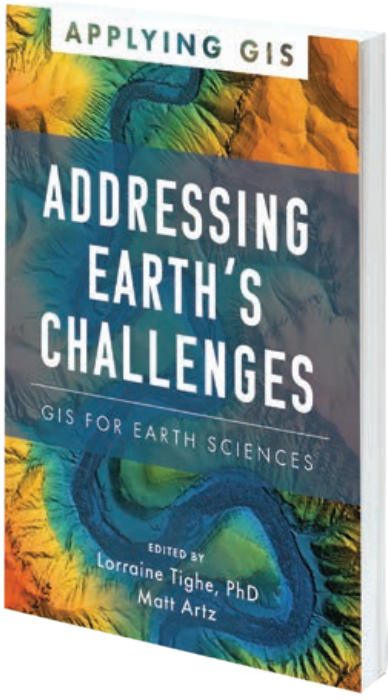
By Dr. J. Chris Carter



Introduction to Human Geography Using ArcGIS Online, Second Edition, uses an approach to teaching the essential concepts and theories of human geography that integrates interactive web maps. It is designed as a textbook for undergraduate college students or AP high school students. Exercises use ArcGIS Online to explore topics such as migration, food and agriculture, manufacturing and services, and cultural geography. This second edition features updated maps, figures, and charts reflecting the latest data and includes new text on contemporary issues, ranging from race, ethnicity, and political geography to pollution and climate change. Esri Press, 2023, 384 pp., print ISBN: 9781589487468, ebook ISBN: 9781589487475.

Addressing Earth's Challenges: GIS for Earth Sciences

Edited by Dr. Lorraine Tighe and Matt Artz



In *Addressing Earth's Challenges: GIS for Earth Sciences,* find out how organizations that work in geoscience, sustainable energy, environmental monitoring, climate science, meteorology, and marine science use GIS to streamline workflows, make decisions, boost operational efficiency, and foster civic inclusion. This book contains a collection of real-life stories that describe how earth science organizations in six fields—geoscience, sustainable energy, environmental monitoring, climate science, weather, and marine science—use GIS to visualize and analyze data to improve workflows, drive decision-making, and operate more efficiently. Ideas, strategies, tools, and actions are provided to help readers incorporate GIS into their work. Online resources, including additional stories, videos, concepts, and downloadable tools, are also available. Esri Press, November 2023, 160 pp., print ISBN: 9781589487529, ebook ISBN: 9781589487536.

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

Sustaining Public Lands with Location Data

By Jesse Cloutier

Preparing for an eight-day excursion into some of the most remote areas in the world takes time and careful planning under any circumstances. For the Bureau of Land Management's (BLM) Assessment Inventory Monitoring (AIM) team, this task comes with added challenges that include preparing and packing the host of equipment needed to assess natural resource conditions across the 245 million acres of US public lands that BLM manages.

The enormity of the area being monitored—10 percent of the entire land base of the United States—presents no small challenge. Every year, crews of three to five AIM team members gear up and head into the field to collect large samples of data that will later be used to inform policy and decision-making in the BLM's mission: "to sustain the health, diversity, and productivity of public lands for the use and enjoyment of present and future generations."

Doug Browning, a geospatial systems architect with the Sanborn Map Company who is a BLM contractor, relies on a foundation of ArcGIS technology in his work to support the AIM team. He is also an Esri Community MVP, who has contributed thousands of posts and hundreds of solutions helping other users with GIS challenges over the years.

Browning designs and manages large integrated workflows that combine ArcGIS Online, ArcGIS Field Maps, and ArcGIS Survey123. His ArcGIS-enabled applications provides navigation to isolated survey sites, capture massive datasets over repeated day-long assessments, and convert that data into useful information that's linked to location.

↑ Doug Browning

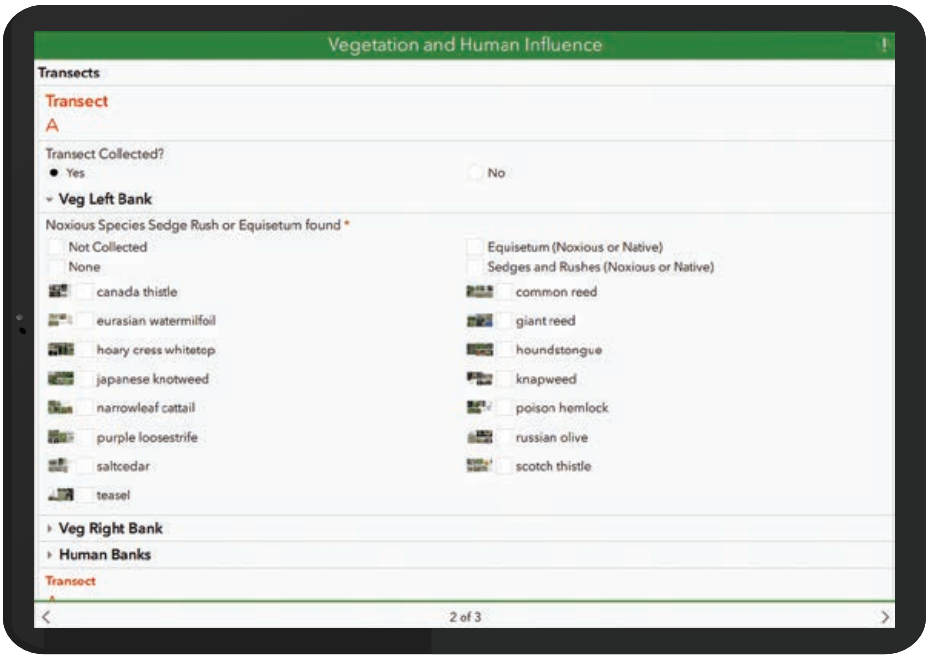
↓ AIM team members take measurements and collect field samples for input into ArcGIS Survey123.

Forms Built for a Huge Task

Browning concentrates on building the ArcGIS Survey123 forms that AIM team members will use in the field to enter data at each location they visit. He's designed this suite of forms so that they remain applicable regardless of the area and environment they're being used in, while leveraging the ability of ArcGIS Survey123 to account for key differences across locations.

Once AIM team members are on-site, ArcGIS Field Maps is used to launch ArcGIS Survey123 and pass configuration variables and other parameters, which allows forms to adjust on the fly. This means that the team needs just one form for the entire nation. While forms *don't have* to be adjusted by state, they *can* be adjusted by state.

Each form can have its own species list and that list can vary from from 20 to 30,000 species. Plants classified as native in one state can be classified as invasive in another



↑ Team members collect and enter data on their visits to approximately 8,000 sites. They collect 100,000 images per season and use ArcGIS Survey123 to input data on those sites.

state, so categories must be dynamic.

Team members work one of the three AIM programs that collect and enter data. They visit approximately 8,000 sites and collect 100,000 images per season. At each location, they complete a series of 10 to 15 surveys. Breaking up the surveys this way is intentional. It enables team members to enter data on their own tablets simultaneously, while filling in the 1,700 fields that must be completed by each program for each site visited. These forms represent some of the most complex and intricate examples that Esri's ArcGIS Survey123 team has seen put into action.

Collaborating with the ArcGIS Survey123 Team

ArcGIS Field Maps, ArcGIS Survey123, and ArcGIS Dashboards aren't the only Esri products in Browning's toolkit. If you are a member of Esri Community, you may have benefited from his expertise.

When asked how he first started using Esri Community, Browning described himself as having been someone who always reads through official help documentation and scours message boards to help him learn and solve challenges. While both resources are valuable, he finds differences in what the two resources offer users, and that's what makes Esri Community particularly valuable to him.

"I think the Community is that window into what's going to work in real-life situations or might work in a kind of a funky situation," he said.

He's also seized the chance to collaborate with Esri staff directly in the platform, particularly when it comes to exchanging ideas and insights with the ArcGIS Survey123 team. He did a lot of back-and-forth with the team.

"In my 30 years of software development, I've never had that kind of interaction, and that all came from Esri Community," Browning noted.

The benefits flow both ways. Browning has shared his own hands-on experience with Esri product teams through the ArcGIS Ideas (https://shorturl.at/jlUV0) and improve ArcGIS Survey123. In some cases, this has helped fuel new features that are then available to all users.

A Team of Peers and Pros in Esri Community

Browning has published thousands of posts over the 10 years he has been using Esri Community. Nearly 400 of his posts have become Accepted Solutions that have helped other users overcome difficulties and solve problems. Due to his high degree of engagement and contributions, Browning became an Esri Community MVP in 2021.

"I always learn a lot. It improves what I do," he said as he reflected on what it's meant to not just receive help in Esri Community, but to also spend time offering help back to others. "It gives me problems that I might not normally have and encourages me to work with techniques that I might not have used before."

He describes Esri Community as "almost like living documentation." It deals with real work problems. "Esri Community is giving story problems; continuously testing your skills to really branch out your knowledge."

To ArcGIS users who haven't yet joined Esri Community, Browning encourages them to get involved. He observed, "We're going alone. I mean, why wouldn't you want a whole team of real experts there to help you?"

Watch This Interview of Doug Browning (5:47)

mediaspace.esri.com/media/t/1_vlsvww22

About the Author

Jesse Cloutier is the Esri Community manager for engagement and content.

Join Your Peers on Esri Community

Esri Community (community.esri.com/) is a global community of Esri users where you can find solutions, share ideas, and collaborate to solve problems with GIS. Communities are organized around products, industries, developers, learning, user groups, networks, services, events, Esri communities outside the United States, and GIS life, so you can more easily find people who share your interests. Find out what others are doing in your area of interest. Get help from others and share your expertise.

K–12 Program Receives Alex Trebek Medal for Geographic Literacy

Canada's vast size is reflected in the country's varied ecosystems, wildlife, natural resources, and cultural diversity. Yet with a population of just over 40 million people, Canada accounts for only 0.5 percent of the world's population. In other words, Canada has a lot of land- and water-based resources to develop and manage, with relatively few people to do it.

This is one reason why the Royal Canadian Geographical Society (RCGS) and its Canadian Geographic Education program, better known as Can Geo Education, place such great importance on geographic literacy—to help ensure that tomorrow's Canadian leaders understand and appreciate their country's land and resources.

"Having a fundamental understanding of the basic principles of geography is essential to being an engaged citizen and better understanding the world around us," said Michelle Chaput, director of research and education for Can Geo Education. "That's why we offer programs that aim to strengthen geographic education in the classroom."

GIS Is a Key Part of This Effort

"More and more jobs in the next decade and beyond are going to involve GIS or geographic technology in general to address issues such as food supply, the environmental impacts of globalization, extreme events like fires, even our economic and political environment," she said. "This is why GIS is essential to future careers for Canadian students."

Esri Canada, Canada's leading provider of GIS solutions, is a key partner in this effort. Last November, the RCGS recognized Esri Canada's K–12 *[kindergarten through 12th grade]* Education Program for significantly contributing to advancing geographic literacy in Canada.

At the annual RCGS Geographica Dinner in Ottawa, four members of the Esri Canada K–12 team—Arabelle Sauvé, Angela Alexander, Jean Tong, and Susie Saliola—were awarded the Alex Trebek Medal for Geographic Literacy. Tong is the manager for the Esri Canada Education Program.

In 2019, the award was renamed for Alex Trebek, the late Canadian-American television personality, *Jeopardy!* game show host, and friend to the RCGS. A passionate advocate of geography and education in Canada, Trebek hosted the first Canadian

↓ Esri Canada and the Royal Canadian Geographical Society's Can Geo Education program provide geographic educational resources to students across Canada. (Photo courtesy of Tanya Kirnishni/Canadian Geographic Education)

↑ Arabelle Sauvé, Angela Alexander, Jean Tong, and Susie Saliola, members of the Esri Canada K–12 team, received the Alex Trebek Medal for Geographic Literacy at the Royal Canadian Geographical Society annual awards gala in November 2023.

Geographic Challenge in the 1990s, supported the opening of Canada's Centre for Geography and Exploration, and served as honorary president of the RCGS.

Raising GIS Awareness in Canada's Schools

Launched in 1987, Esri Canada's K–12 Education Program has transformed how geography is taught in Canada by raising awareness of GIS as a powerful problem-solving tool for students and teachers. Through this initiative, teachers across Canada can access real-world tools that provide students with skills they can use throughout their lives. The program supports inquiry-based learning, helping students develop skills such as geographic literacy, spatial awareness, critical thinking, and analytical reasoning. "Through our K–12 Education Program, we aim to inspire the next generation of geospatial thinkers and problem-solvers," said Jon Salter, Esri Canada's director of education and research.

This effort supports Can Geo Education's work by allowing access to cutting-edge technologies and accessible tools that are easily implemented in the classroom. Can Geo Education provides free geographic educational resources to more than 27,000 educators across Canada. The country's largest geographical education nonprofit, Can Geo Education creates and supports student programs for its K–12 teachers, students, and parents. Using products such as ArcGIS Online, ArcGIS Pro, and ArcGIS StoryMaps, the Esri Canada K–12 Education Program provides hundreds of software tutorials and teaching resources with titles such as "Think Local, Eat Local," "Locating a New Airport in Manitoba," and "Woodland Caribou."

Esri Canada's K–12 Education Program has worked closely with Can Geo Education for more than 10 years, said Tong, noting that her team and Can Geo Education have very similar missions. "They have such amazing stories to tell, and we can help them tell those stories on an educational level, such as highlighting Indigenous knowledge using *[ArcGIS]* StoryMaps."

A former classroom teacher, Tong said that although she loved having a direct connection with her students, "In my current role, I am inspired by being able to bring my passion for geography to teachers across Canada's provinces. Teachers are often amazed when they find out that Esri GIS tools are available to use in their teaching, while students benefit from understanding how GIS can be used to solve *where*-based problems. We're helping to bring geospatial awareness and excitement to schools across the country."

Paul VanZant, chair of the Canadian Geographic Education Committee, confirmed the group's contribution to geographic literacy in Canadian schools. "As a former classroom teacher, I've had experience with the Esri Canada K–12 team since the 1990s," he said. "Many of my students went into GIS careers, and that was directly related to the teaching resources provided by this group. They've also been great supporters of Can Geo Education's summer institutes and conferences. For example, they've adapted their work to fit our conference themes."

"I can't express how proud I am of these four brilliant women. They are tireless advocates for GIS in K–12 education," said Alex Miller, president and founder of Esri Canada.

For more information, contact Jean Tong at jtong@esri.ca.

PROGRAM COMBINES THEORY AND HANDS-ON LEARNING

AT North Carolina State University's (NCSU) Center for Geospatial Analytics, graduate students benefit from an innovative curriculum that integrates geospatial theory, hands-on applications, and client-based instruction. Students completing the NCSU's Master of Geospatial Information Science and Technology (MGIST) program capstone project work with community partners to build custom solutions using modern GIS technology and geospatial analysis.

While the capstone project is designed to be challenging, Eric Money, associate director of educational innovation at North Carolina State University, finds that students ultimately regard it as rewarding.

Money is also an associate teaching professor and instructs the MGIST capstone course. "The capstone project is set up so that the partner organization—or community partner—is the client, and the student is the expert. Students build a relationship and develop a fully functional solution in the span of about 15 to 16 weeks. We call it experiential learning."

Students are paired with government, industry, academic, or nonprofit organizations across the country. Although some organizations have experience with GIS, others might be testing a geospatial solution for the first time. Money tries to frame the experience as a pilot project for the partners.

"Perhaps you don't have the staff at your current organization to test out some new technologies or use the data you have lying around," he said. "That's where our master's students come in. And for the most part, our students have been successful at creating practical products that the partners really want to use even after the project is over." Nearly 200 organizations have been partnered with MGIST students since the program began over 12 years ago.

Final projects vary widely in both scope and application—a testament to the broad utility of modern GIS. Collaborative projects between students and partner organizations have improved railways, tracked city infrastructure, and georeferenced imagery.

As an intern for the North Carolina Department of Transportation (NCDOT), MGIST student Summer Faircloth helped the Rail Division analyze its investments. "Railroads are commonly referred to as the 'first and last mile'" for transporting goods, Faircloth explained. "They play a critical role in North Carolina's economy by ensuring the efficient and safe transport of freight." Through Faircloth's efforts, Rail Division will be able to determine the impact of NCDOT grants.

MGIST student David Kist helped the City of Oxford, North Carolina, prioritize the maintenance of its utility infrastructure. He developed a web mapping application that calculates and spatially displays the risk of water and sewer pipe failure that helps city staff members more efficiently manage inspections, repairs, and replacements.

Working with Durham County Stormwater and Erosion Division, MGIST student Andrew Freeland helped more effectively collect stormwater utility fees by using remotely sensed imagery to more accurately calculate fees charged to property owners. Fees are based on the square footage of impervious surface.

Money determines the pairing of students and community partners. He has found that matching students based on their initial enthusiasm about a project leads to the best engagement and outcomes. One project he oversaw involved a former teacher who had entered the MGIST program. She was ultimately paired with a local school district in Wake County, North Carolina.

"The client was looking at doing some indoor mapping of schools related to safety measures," Money said. "She was able to explore new technologies, such as ArcGIS Indoors, and help the district build a dashboard and analyze data related to its schools. This was something really novel at the time.

→ Each semester, students present their capstone projects at the MGIST Digital Symposium.

"For many students, this is the first time they've really had to work through a project from beginning to end. You start with something on a piece of paper, and you end up with a working product," he said. During their final semester, students collaborate with organizations to build practical, custom solutions using modern GIS technology and geospatial analysis.

CLEAR EXPECTATIONS AND DIRECTION LEAD TO COLLABORATIVE SUCCESS

It's crucial to set clear expectations from the onset of every MGIST capstone project, for both community partners and students. Money wants to ensure that partners and students work together as collaborators, not employer and intern. He also reiterates that projects are subject to certain requirements and guidelines.

Money is responsible for enlisting potential community partners. Prior to each semester, he sends out an open call for proposals. NCSU Center for Geospatial Analytics faculty have cultivated a list of organizations and GIS professionals, whom Money reaches out to.

"The way we frame these projects for our community partners is, 'What tools can our students develop for your organization to help you better analyze your spatial data?' That's the overarching goal of the capstone project," said Money.

"Since it's the capstone *[project]*, the idea is to bring together all of the knowledge we've tried to teach our students across the master's program", said Money.

Students can help steer the direction of projects to develop a GIS solution that demonstrates the required skills. Organizations interested in applying complete a capstone project partner form. This gives Money important background information about the organizations' possible project ideas and expectations, as well as the data that will be available to the students.

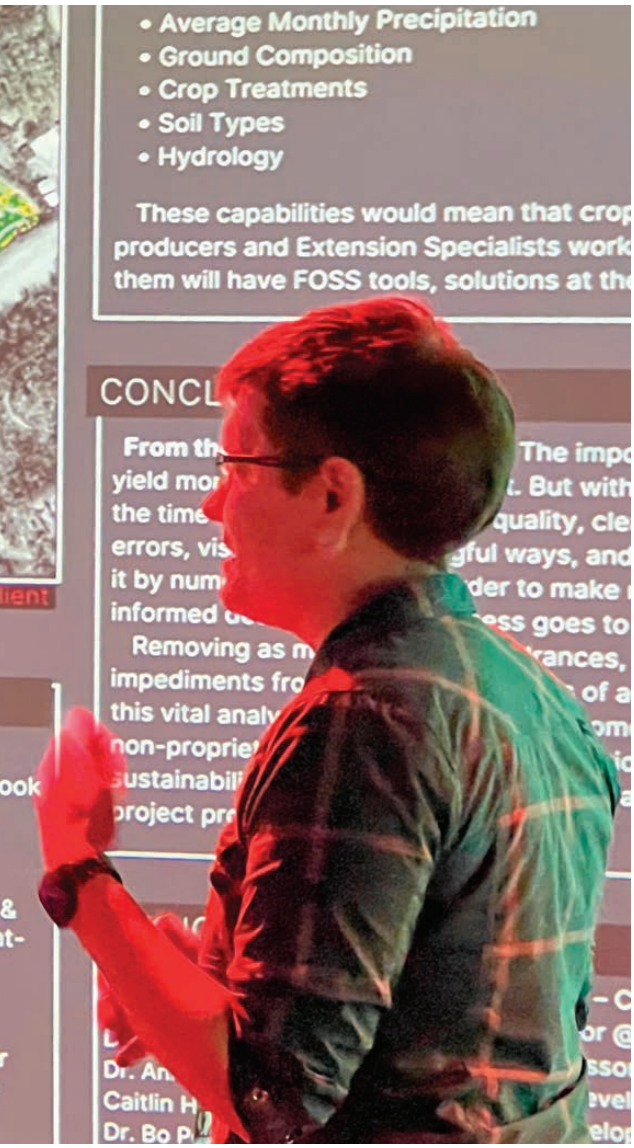
Using these initial forms, Money compiles a request-for-proposal packet that his students review during the first week of class. Each student then writes three short preproposals for the projects that have captured their interest. Money then assigns students to their final community partners—typically, a single student to a single organization.

Once paired with a partner organization, students must meet with the client to assess the project. This entails defining its scope, learning more about data access, and understanding the expected final deliverable materials. Students may use a variety of tools while developing their solution, including ArcGIS Online, ArcGIS Pro, and Esri apps such as ArcGIS Experience Builder, as well as links to open-source solutions like PostgreSQL.

"One of the big components that's required for the capstone project is *[that]* each student has to set up a stand-alone GIS server," said Money. "They're implementing the IT side of GIS, using ArcGIS Enterprise and associated applications."

Students also submit a professional proposal about the project to Money and his teaching assistant for feedback to guide them on what is achievable during the project time frame.

After these initial tasks, students are expected to complete milestone assignments. These include a formal data management plan and a



modeling and analytical summary of their technical approach prior to submitting their final documents. "We try to provide students some formal deadlines throughout the semester to keep them as on track as possible, given that these are real-world projects," said Money.

MEETING A GROWING DEMAND FOR HIGHER GIS EDUCATION

Over the past few decades, the number of students pursuing advanced degrees in geographic information science has soared. When Money began working at the university in 2014, the Center for Geospatial Analytics had recently added the MGIST program. "NCSU faculty had seen quick growth in the GIS certificate program," he said. "There was a lot of interest from current working professionals and students to get a better education credential related to GIS and geospatial technologies." From its onset, the MGIST program was designed as a fully online program to help attract new learners and accommodate nontraditional students.

Money notes that many students who receive a GIS certificate end up entering the master's program. Credits earned for the certificate can be applied toward an MGIST. Today, there are about 200 students active across the two programs every year.

Initially, the MGIST program primarily attracted working professionals already proficient in GIS and eager to advance their skill set. The composition of geospatial technology classes has shifted over the years. More GIS courses have been added to the undergraduate curriculum and students are being exposed to geospatial science earlier in their academic journeys.

"Now, we have students that are coming straight from their undergrad studies to get their master's degree," said Money. "Students are seeing GIS as a viable pathway for a career."

Graduate students at NCSU who complete the MGIST program receive the Professional Science Master's (PSM) designation. PSM programs are designed to hone the skills of science professionals via real-world experiences and prepare them for evolving workplace demands. Students complete the semester-long capstone project instead of doing a research thesis.

In addition, the master's program requires students to incorporate their capstone work into a professional digital portfolio. Documenting the development of their GIS solution and their collaborative efforts with community partners gives students an advantage with employers. "For students who don't have a lot of existing work experience, this gives them something they can put on their résumé that is real-world demonstration of their skill sets," Money said.

At the conclusion of the course, students must create a detailed user guide and operations manual to ensure that the solution can be supported even after the student moves on. Students also submit a final resource-oriented report that summarizes the project. The experiential learning, provided by the capstone project, gives students valuable insight that can't always be surfaced in the classroom.

"For many students, this is the first time they've really had to work through a project from beginning to end," he said. "You start with something on a piece of paper, and you end up with a working product," said Money.

> "Now, we have students that are coming straight from their undergrad studies to get their master's degree."

Tribes in Brazil Fight Wildfires with Indigenous Knowledge

By Anthony Schultz and Adam Reedy

The Indigenous people of Brazil have managed their fire-prone landscapes for millennia using controlled burns. Rainforests managed by Indigenous peoples have a lower presence of fire and lower fire temperatures.

Now, more than 700 Indigenous firefighters who work for Brazil's National Center for Wildfire Prevention and Suppression (Prevfogo) are starting to use smart maps and apps to share their knowledge of the forest to protect it from destructive wildfires. Indigenous fire brigades record their traditional ecological knowledge via map-based apps.

"The true owners of the knowledge, with field experience about the way fire behaves, are the Indigenous people in those areas," said Talita Oliveira Tarlei De Freitas, an environmental analyst at Prevfogo, which is part of the larger Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA).

Prevfogo's fire brigade training includes the use of an app called the National Wildfire Information System (Sisfogo), which was built using GIS technology. Sisfogo makes it simple for firefighters to collect wildfire information and incident details, which are displayed on a dashboard for decision-makers.

Firefighters use Sisfogo on their phones and tablets to see the fuel load maps of green and dry vegetation and coordinate the suppression of unwanted fires. This information helps manage controlled burns during the wet season and contributes to a greater understanding of the land.

Reinforcing Indigenous Rights

Brazil is also taking measures to prevent illegal fires along the Amazon—those started by settlers who burn the forest to clear land for farming and grazing. When Brazilian president Luiz Inácio Lula da Silva won reelection in 2022, he pledged increased protections and support for the rainforest and Indigenous stewards of the land.

← Indigenous firefighters are part of a broader effort in Brazil to raise environmental awareness and train locals to monitor, prevent, and combat forest fires. (Image courtesy of Prevfogo)

Since then, thousands of non-Indigenous people have been removed from the two native territories that had seen the greatest amount of deforestation. The removal of illegal settlers reduces environmental stress on the land Prevfogo manages and eliminates a persistent source of fires.

Prevfogo works within Indigenous territories called *quilombos* and land reform settlements in integrated fire management activities. *[*Quilombos *are settlements dating from Brazilian colonial times that were organized by fugitive slaves.]* Of the 99 fire brigades Prevfogo has trained and maintained since 2009, more than half are composed of Indigenous people and one is composed entirely of women.

Each tribe has a unique cultural connection to fire, using it in various ways for rituals, land management, and hunting. The Indigenous fire brigades spread their fire knowledge through the Sisfogo app so that all can learn what elders have passed down through generations.

"Indigenous firefighters work in their own territory, which is very important for us because they have a natural relationship of protection," Freitas said.

Depleting Fuels Before the Dry Season

To reduce fuels, brigades conduct prescribed burns in May at the beginning of the driest season, which typically lasts through October. The areas considered most vulnerable to fire are carefully evaluated, and

↓ An Indigenous firefighter with Prevfogo sets a controlled burn to reduce fuel loads. (Image courtesy of Prevfogo)

↑ An all-women fire brigade has been trained to strengthen the Indigenous firefighting effort in Brazil. (Image courtesy of Prevfogo)

> "We use maps to explain where we plan to burn and to demonstrate how and why we will conduct the operation in a certain way."

burning only occurs where authorized. For this work, the center's GIS tools help with public awareness.

"We need to inform the community and gain approval," Freitas said. "Maps and imagery help us show the risk and convince them that we're there to partner and work with them. They may need to sacrifice a small piece of their land as part of a prescribed burn for the bigger picture of reduced wildfire risk in the future."

For a short period that began in 2001, Brazil's government banned controlled burning by tribes but soon reversed the policy. Researchers have learned that many of Brazil's biomes depend on fire and controlled burns reduce fire intensity and damage. Controlled burns that spread slowly—called *cold fires* because they naturally die out in the early evening when temperatures decrease—give animals and insects time to flee. The flames don't reach the treetops and are not intense enough to destroy mature trees or shrubs.

GIS maps visually communicate the brigade's strategy for its controlled burns. "We use maps to explain where we plan to burn and to demonstrate how and why we will conduct the operation in a certain way," said Luiz Pacheco Motta, an environmental analyst and developer at Prevfogo who is working on Sisfogo.

Stopping Destructive Fires

When faced with wildfire, tribes in the affected region share maps to communicate and take strategic actions. Within the Sisfogo app, they can adjust data capture forms and dashboards as needed. "They can share their thoughts, their feelings,

their perceptions of the world using GIS tools and maps," Freitas said.

The value of collecting and sharing tribal knowledge extends beyond the immediate needs of firefighters. Government ministries, agencies, and academics benefit from the data and shared awareness.

"One of Sisfogo's biggest challenges is to adapt the traditional use of fire to climate change," Motta said. "To this end, GIS technology with spatiotemporal data and Indigenous land-use records provides the right way to respond to this challenge."

Prevfogo can now visualize and analyze wildfire data to see patterns, compare incidents in space and time, and monitor hot spots. The insights could provide answers about wildfire conditions and incidents, which can inform global efforts to reduce disasters.

"Everyone is watching Brazil for environmental issues, deforestation, and wildfires right now," Freitas said. "It's important for us to show the world what we're doing, how we prevent wildfires, and how we manage them."

Prevfogo's monitoring and combat division (DMC), where Sisfogo developers work, relies on global GIS collaborators who share knowledge and techniques to better face the challenges of global warming. Motta reflected on the urgent need to help one another during a talk at the 2023 Esri User Conference, "We do not have another planet Earth; there is no second chance."

↓ Drones have proved effective to gain a top-down view of conditions and the progress of wildfires. (Image courtesy of Prevfogo)

↑ Women firefighters pass along knowledge to young people, extending their important role as educators in their communities. (Image courtesy of Prevfogo)

About the Authors

Anthony Schultz is the director of wildland fire solutions at Esri. He has a background in wildland fire management and operations and has served in a variety of capacities. Most recently, he was the Fire Management Officer (FMO) for the State of Wyoming. During his tenure in Wyoming, he served as chair of the Western State Fire Managers and was a Rocky Mountain Coordinating Group member. He has also served as an FMO for the State of North Dakota. Prior to becoming an FMO, he worked as a wildland firefighter at the US Bureau of Land Management, the National Park Service, and the US Fish and Wildlife Service.

Adam Reedy is the national government business manager for the Americas at Esri, covering Canada, the Caribbean, and Latin America. He has more than 20 years of experience guiding US and international clients in the development and implementation of enterprise geospatial systems for defense, intelligence, public safety, and emergency management solutions. Reedy graduated from the US Air Force Academy with a bachelor's of science degree in engineering and political science and received a master's degree in aeronautical science from Embry-Riddle Aeronautical University. As a US Air Force officer and pilot, he flew C-21 jets and provided operational airlift support for senior military and federal officials, and flew time-sensitive medical evacuations out of Randolph Air Force Base in Texas.

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"I truly believe GIS currently is and will be one of the most effective forms of communication in the coming years. Intuitively, humans have an innate sense of looking at a map and understanding what story it is trying to tell. Regarding whatever realm of work, there is always a place where GIS can be utilized effectively. Without the GIS knowledge that I acquired from the program at Redlands, the experience I received, and the Redlands Alumni Network, I would not have this position or unbelievable lifestyle I have today."

—J. Keaton Thompson '21
GIS Engineer
Naval Facilities Engineering Systems Command of Hawaii

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