Summer 2013

ArcUser

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Contents

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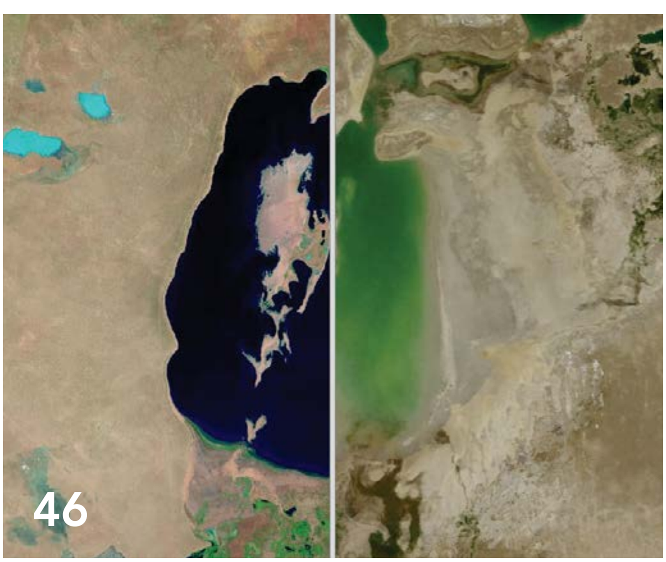
Focus

Feature



Special Section: ArcGIS Online

On the Cover:
This WorldView-2 image of Alang, India, was provided by DigitalGlobe. ArcGIS can visualize all types of imagery, perform a wide range of processes on imagery, and extract information to make informed decisions.

Pervasively Enabling

The new generation of ArcGIS technology is light, agile, and interoperable. It is profoundly changing organizations by making GIS knowledge pervasive and is helping overcome the limitations in time, money, and staffing that many organizations face. With ArcGIS Online, anyone can use and benefit from geospatial information without knowing anything about the underlying GIS technology.

Web maps and apps made available through ArcGIS Online eliminate information silos by promoting collaboration and communication. By simply pointing to data in a variety of formats—existing GIS data, imagery, tabular data, and social media—and integrating it without reformatting it, web maps make data more usable and information more accessible.

"Build It and Make Sure They Come: Seven Steps to Success with ArcGIS Online," an article in this issue, outlines a strategy for taking advantage of ArcGIS Online to improve processes, communication, and efficiency. With hosted services through ArcGIS Online, making these resources available inside or outside an organization no longer requires installing and maintaining a server.

A companion article, "What Can You Do with a Story Map?," highlights the ways agencies and organizations have used story maps. Based on web maps, story maps can inform the public, communicate policy, enhance transparency, demonstrate benefits, educate, or promote a cause.

Esri is also coevolving the ArcGIS platform so GIS professionals can take advantage of general IT trends. With full release of the Runtime APIs this summer, GIS developers will have even more robust tools for building focused, native applications on many platforms and devices. Esri has also released GIS Tools for Hadoop. These tools use cooperative processing between Hadoop and ArcMap to spatially analyze, visualize, and interactively query billions of records. ArcGIS GeoEvent Processor for Server, a new ArcGIS for Server extension that will be available at ArcGIS 10.2, connects with real-time data streams from a wide variety of sensors, performs continuous processing and analysis of that data, and sends relevant information to users or other systems. As the ArcGIS platform continues to expand, it extends the value of GIS and helps make organizations more successful.

Monica Pratt
ArcUser Editor

editor's page

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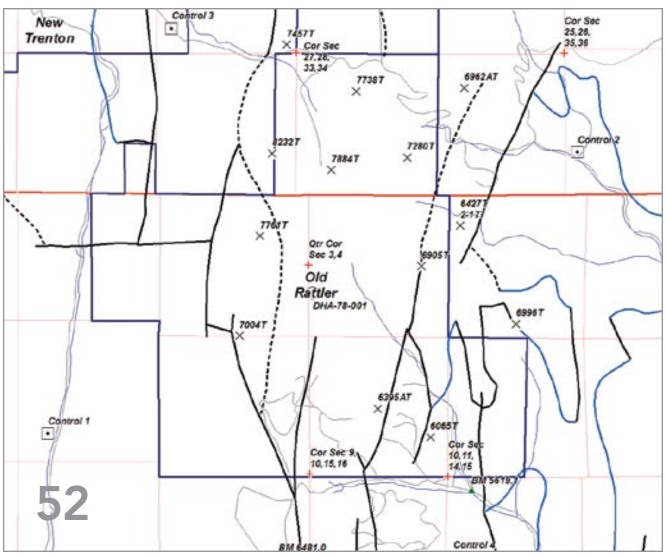
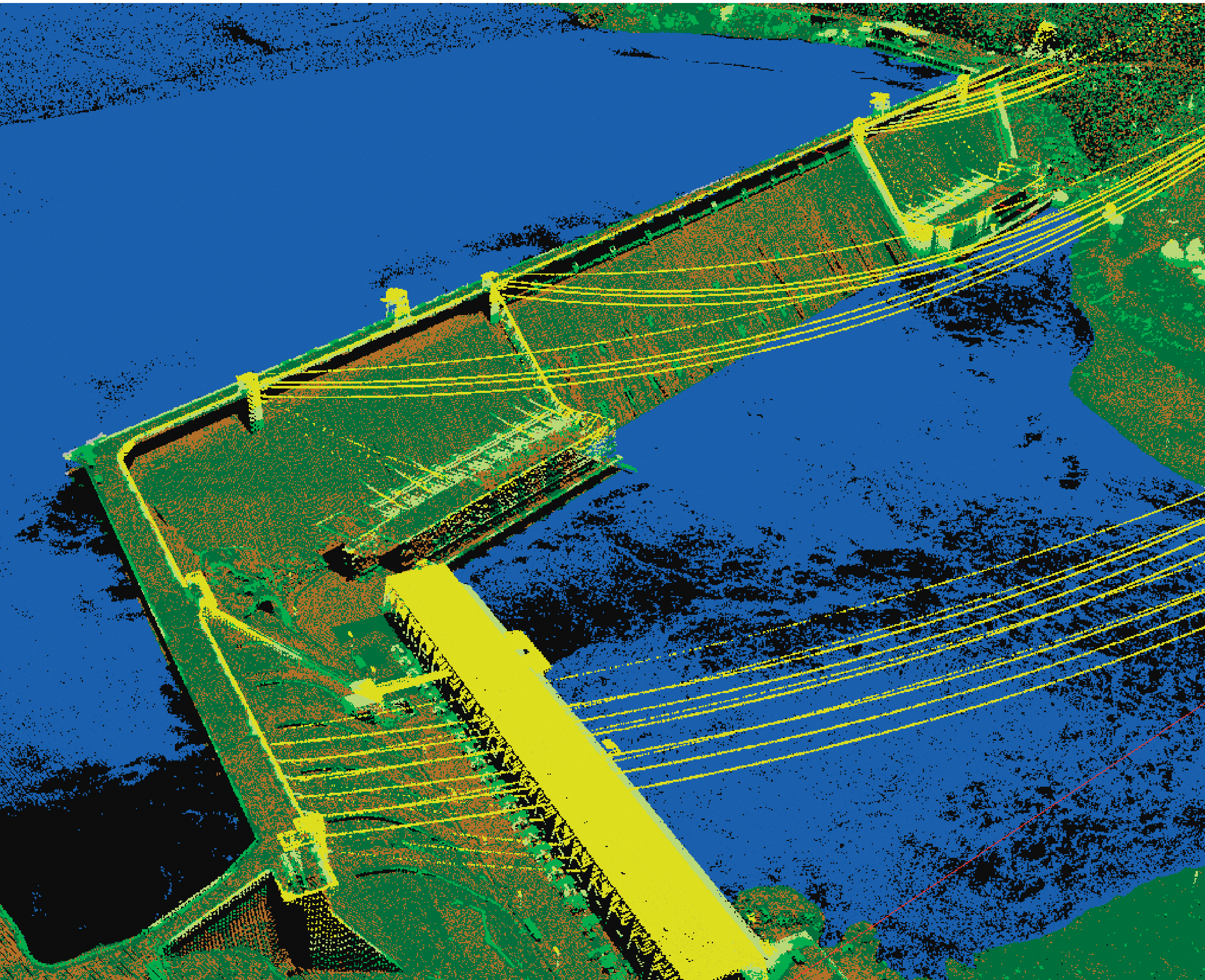
Departments



5 Ways to Use Lidar More Efficiently

By Clayton Crawford, Esri Lidar and 3D Analysis Product Lead, and Raghav Vemula, Esri Lidar and 3D Analysis Product Engineer

↓ Point cloud of the Grand Coulee Dam symbolized by LAS class code. Source lidar made available by the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center.



The use of lidar has exploded in recent years, and for good reason. The technology can produce higher-quality results than traditional photogrammetric techniques for lower cost. This is accomplished, to a large degree, by the automated collection of measurements that are sampled very densely. The progress in laser scanning hardware has been astounding. A major side effect of switching to lidar-based technology has been the challenges associated with increasing data volume and the expansion of software processing capabilities needed. Fortunately, ArcGIS offers many tools for managing lidar point clouds and deriving useful products from them to aid scientific research and decision making. Here are five tips that enable ArcGIS to take best advantage of this data.

1 Have Lidar in LAS Format

Having lidar in LAS format may be obvious to the initiated but not to those new to using lidar data. LAS, short for LASer, is the industry standard format for lidar. The specification is maintained and published by the American Society of Photogrammetry and Remote Sensing (ASPRS). It was intended primarily for airborne applications but is also commonly used for terrestrial and mobile lidar. It's binary, efficient, widely supported, and the format ArcGIS works best with. See the Additional Resources section at the end of this article for information on currently supported versions. Note that ArcGIS works with LAS format lidar of all kinds: airborne, terrestrial, and mobile. The latter two are most useful when viewed in 3D, while airborne is useful in both 2D and 3D and can be processed with numerous surface analysis tools.

2 Make Sure the LAS Files Are "Baked" for Use in GIS

There are many flavors of LAS. Some are better than others for use in GIS. LAS was originally intended as an exchange format for laser hardware vendors. A lot goes on between initial data collection of a raw LAS file and its delivery to a client as a ready-to-use file. A few critical items in LAS processing are projection, tiling, and classification.

All the LAS files for a project should be placed into a projected coordinate system (PCS). The PCS should be the dominant one needed by most of the intended users of the data so on-the-fly projection is not required when it is used. On-the-fly projection is expensive in terms of performance and should be avoided. Note: It's not uncommon for LAS files to have been projected but to be missing the projection metadata that's supposed to be included in their header records. Files missing projection metadata are noncompliant with the specification and should be rejected or repaired. ArcGIS allows use of .prj files that can remedy this situation easily if going back to the data vendor is not an option.

Tiling should be performed on the LAS files. This avoids having relatively few swath-based files with overlapping extents that can be gigabytes in size. It's better to have many smaller files that don't overlap. Huge files are hard to manage, period. Smaller files are better. Also, LAS has no inherent spatial indexing, so retrieving points for subareas requires scanning the entire file to locate them. Scanning a 3 GB file for every spatial query is not workable. Files of 200 MB or less are more appropriate. (Note that spatial indexing support for LAS will be added to ArcGIS 10.2 through the addition of ancillary files. This will allow more efficient use of larger files and access to files on a network, though the non-GIS related practical constraints of huge files remain.)

Classified lidar is more useful. The majority of GIS applications related to lidar have at least some need for bare earth elevation models, which require properly classified data. Classification is nontrivial and usually performed by the data provider.

Some users believe that last returns (i.e., the last strike of a laser pulse) are sufficient to isolate the ground. This is incorrect. Last returns can occur on rooftops and in tree canopies. At a minimum, airborne lidar should be classified into ground versus nonground. Often, model key (thinned ground), water, noise, and overlap points are also categorized. There are other possible classes such as buildings and vegetation height. The greater the degree of classification (generally), the more useful the data. However, this can become prohibitively expensive because more classification means more processing and more human intervention. For a comprehensive list of guidelines, see the National Geospatial Program Lidar Base Specification 1.0, listed under the Additional Resources section.

3 Consider Your Options

ArcGIS provides several complimentary options for accessing lidar. There are three primary data access mechanisms: the LAS dataset, the terrain dataset, and the mosaic dataset. Knowing about these data types will let you determine which type to use.

The LAS dataset, introduced in ArcGIS 10.1, provides a simple way to access LAS files directly without importing or converting to some other format so you can start working with lidar data immediately. Using a simple toggle on a toolbar seamlessly switches between points and surfaces in both 2D and 3D viewing environments. Points can be symbolized using standard LAS attributes such as class code and return number. Points can be queried and used as a backdrop for measurements. Point class codes can be edited to fix misclassified points (which always manage to sneak through and get discovered when using the data). Surface analysis, with support for breakline constraints, and point metrics can be performed via geoprocessing tools.

The terrain dataset is a geodatabase-based solution for airborne lidar. Terrains can efficiently store and retrieve lidar surfaces from a database based on area of interest and level of detail queries. If only the lidar point geometry is needed—without the other attributes—bringing points into a terrain and shelving the LAS files can save a lot of storage space.

↑ A digital surface model (DSM) near Plant City, Florida, made from first return airborne lidar, which includes the building roofs and treetops. Hydro-flattening of the water features is accomplished through the addition of breaklines that are incorporated into the surface model.

Along with other GIS data layers, terrain datasets can be stored in a geodatabase and benefit from support for multiuser access and versioned editing. Because they are spatially indexed and pyramided into multiple levels of detail, they are also efficient and network-friendly.

The mosaic dataset is used to catalog, analyze, display, and serve massive image collections. In ArcGIS 10.1, it was enhanced to support LAS files, LAS datasets, and terrain datasets as imagery. The mosaic dataset performs on-demand rasterization, presents a map-like view of the lidar, and can be used as input to analytic functions as well as be the basis for sharing via elevation services. Essentially, the benefits mosaic datasets offer for imagery have been extended to include lidar.

4 Stage Data Appropriately

Lidar data is notoriously large. Careful planning is required to avoid bringing a network to its knees or making users wait too long for data to display. To determine the best overall approach, identify workflows by asking questions such as How big is the dataset? and Will the entire lidar collection be processed in order or will it be subject to ad hoc queries?

For example, look at a large statewide lidar program. Ultimately it may provide the public with ad hoc access to the data, but initially, all holdings will go through a standard process of review, cleanup, and derivative creation. Consequently, it could make sense to house all data on a large central server and bring pieces of it (in ordered sequence) to a local machine for review and processing. Moderate-size solid-state drives are now affordable so the local machine, where many reads and writes will take place during processing, can work off a fast solid-state drive. Once the work is done, the processed data can be moved back to the server.

Data moves off and back onto the server once but allows local processing of the data, which is very fast. Depending on workflows, there are many options. The moral of this story is that with lidar, I/O tends to be very expensive, so minimize it to keep that cost down.

5 Pick the Right Points for the Job

The expression "lidar paints the surface with measurements" is another way of saying it is super dense. This density can be beneficial for capturing the detail of a rough or complex topography or creating a decent bare earth model for an area covered by forest. However, for open ground that's gently sloped, the data is invariably oversampled.

Fortunately, point filtering can help. The filtering process includes just the points needed while excluding the others. The LAS specification has support for a point type called model key, which is a subset of ground points. This thinned set will create a surface within a given vertical accuracy of the full resolution point set. Using just model key points to construct a ground surface may reduce the point count significantly. An 80 percent reduction rate is not uncommon. This benefit comes with just a small hit in vertical accuracy. Often, the accuracy is still sufficient for many engineering applications. The presence of these points requires the data to have been explicitly processed to flag or code them. Fortunately, it's common practice.

People often make the mistake of including all lidar return points when constructing a digital surface model (DSM). This kind of elevation model, which includes tree tops and building roofs, is also called a highest hit surface. Modern lidar is capable of processing multiple returns from individual laser pulses. In vegetation, returns greater than one represent either intercanopy points or ground beneath the vegetation. Including these points is unnecessary and wasteful when making a DSM. Include them and the results will tend to look correct, but these unnecessary points can skew the results and will add to the cost of processing. All ArcGIS tools offer a way to filter on return. Use the first return, which will be the highest.

Additional Resources

ArcGIS 10.1 supports versions 1.0–1.3 of LAS plus subversions of 1.4 that are 1.3 compliant. See the ASPRS LAS 1.4 Specification at asprs.org. The US Geological Survey's National Geospatial Program Lidar Base Specification 1.0 (the official published version of the v13 draft) is available at pubs.usgs.gov/tm/11b4/. For specific information on using lidar with ArcGIS, see ArcGIS 10.1 Help under the LAS format topic and visit the ArcGIS 3D Resource Center at resources.arcgis.com/en/communities/3d/.

↓ A high-resolution DEM of Rock Island, located along the Georgia coast next to the Deboy sound, created in ArcGIS from airborne lidar and collected as part of the 2010 Coastal Georgia Elevation Project. Source lidar made available by the NOAA Coastal Services Center.

New Capabilities in ArcGIS

↑ With dynamic image services, users can set properties on image services within web maps and further mine the information content of image services.

Easy to use and easy to understand, web maps have emerged to communicate geographic understanding across enterprises, businesses, and constituencies. New capabilities in ArcGIS make web maps even more useful.

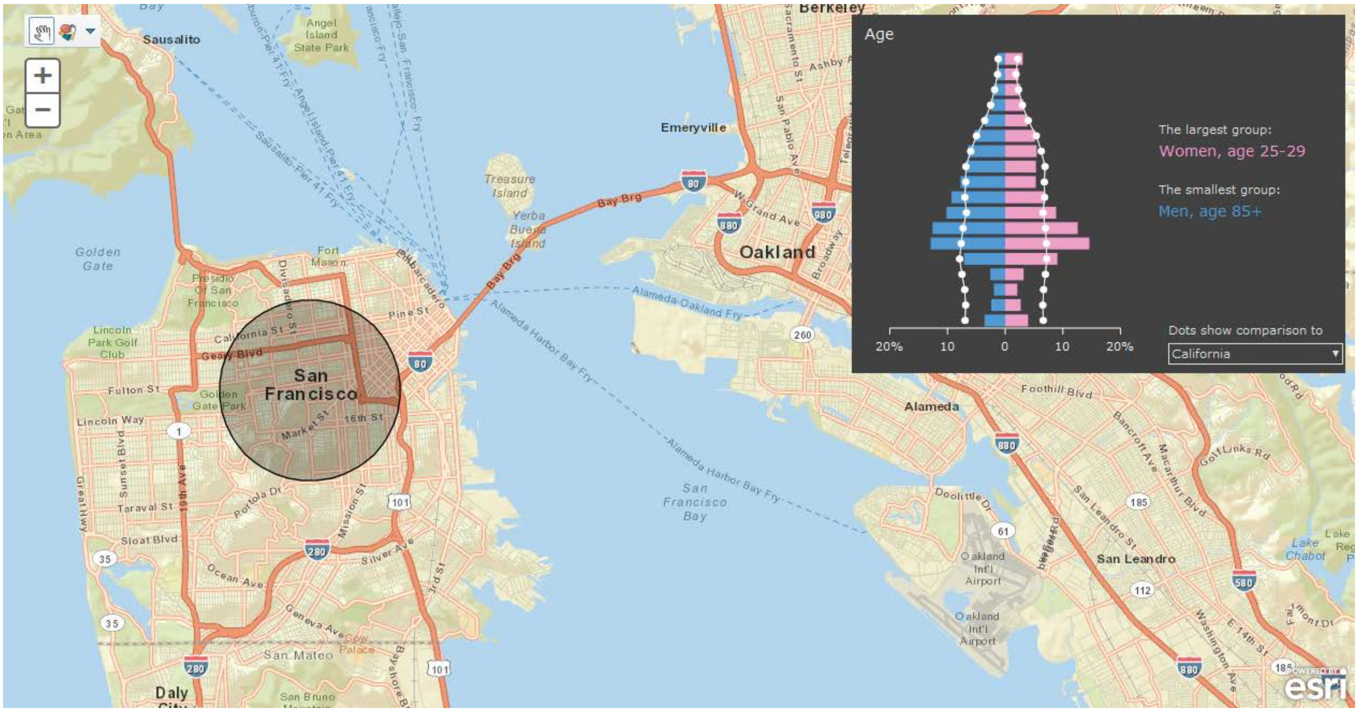
A set of online tools lets users perform analysis against layers hosted in ArcGIS Online, as well as any other layers they can access. Geographic analysis, the foundation of GIS, is more readily available online. Users can create new hosted layers and tables. Familiarity with ArcGIS for Desktop geoprocessing tools, models, or services is not required. These online analytics are also available as services that developers can use to build custom, workflow-specific apps for use within any organization.

↓ Esri CityEngine Web Viewer makes web scenes available for 3D presentations.

Advanced analysis tools have been added to ArcGIS Online for analyzing and measuring geographic relationships to uncover hidden patterns, assess trends, and make more informed decisions. These new tools include overlay and hot-spot analysis as well as search by attribute and proximity. Data enrichment makes information on people, places, and businesses for a specific area or within certain distance or drive time available.

With new premium content services, users can aggregate demographic data at various levels of geography, from existing administrative, political, or postal boundaries to areas the user defines. These demographic capabilities are available for more than 100 countries through the geoenrichment API. Ready-to-use, dynamic web maps bring demographic data directly into web, desktop, and mobile applications.

The new landscape services gives users access to incredibly rich biogeographic data that can be used to support natural resource management efforts, as well as land-use and conservation planning at regional and national scales. Landscape services include



↑ Data enrichment makes information on people, places, and businesses for a specific area or within certain distance or drive time available.

dozens of ready-to-use image services to support analytical tasks, feature services, web maps, and geoenrichment services.

With dynamic image services, users can set properties on image services within web maps and further mine the information content of image services—particularly for very large collections of imagery. Configurable web map pop-up windows for dynamic image services provide not only metadata about the specified image but also information about the specific pixel or data values for any location on the map.

Esri CityEngine Web Viewer makes web scenes available for 3D presentations. Users can explore locations, compare side-by-side views, and create fly-throughs of city models using any WebGL-enabled browser.

Organizations that use MicroStrategy BI and Microsoft Dynamics Customer Relationship Management can analyze data in a geographic context without leaving these applications.

With enterprise authentication, organizational account administrators can configure ArcGIS Online so that users can sign in using their existing enterprise user names and passwords, eliminating the need for multiple user credentials. This provides improved security for an organization's digital resources and users' personal information. Administrators don't have to replicate databases containing user credentials for separate applications and systems.

A new pricing and licensing model offers scalable plans based on anticipated volume of use per month. Developers can use their ArcGIS Online subscription to take advantage of hosted services, including geocoding and place search, directions and routing, data query, and a wide selection of ready-to-use basemaps.

Geotrigger, also available with ArcGIS, allows developers to build smart location-aware apps that are ideal for mobile advertising. Geotrigger can be used in combination with other ArcGIS Online services, such as geocoding, routing, basemaps, and geoenrichment.

These capabilities are making ArcGIS a part of everyday work life for many more people and empowering them to respond effectively to issues that affect their communities and the environment.

A Serious Game for Measuring Disaster Response Spatial Thinking

By Kevin Blochel, Amanda Geniviva, Zachary Miller, Matthew Nadareski, Alexa Dengos, Emily Feeney, Alyssa Mathews, Jonathan Nelson, Jonathan Uihlein, Michael Floeser, Jörg Szarzynski, and Brian Tomaszewski, Rochester Institute of Technology

"Serious" games are games with a nonentertainment purpose. Spatial thinking is the idea of using the property's space to structure and solve problems. It is critical to decision making in response to a disaster.

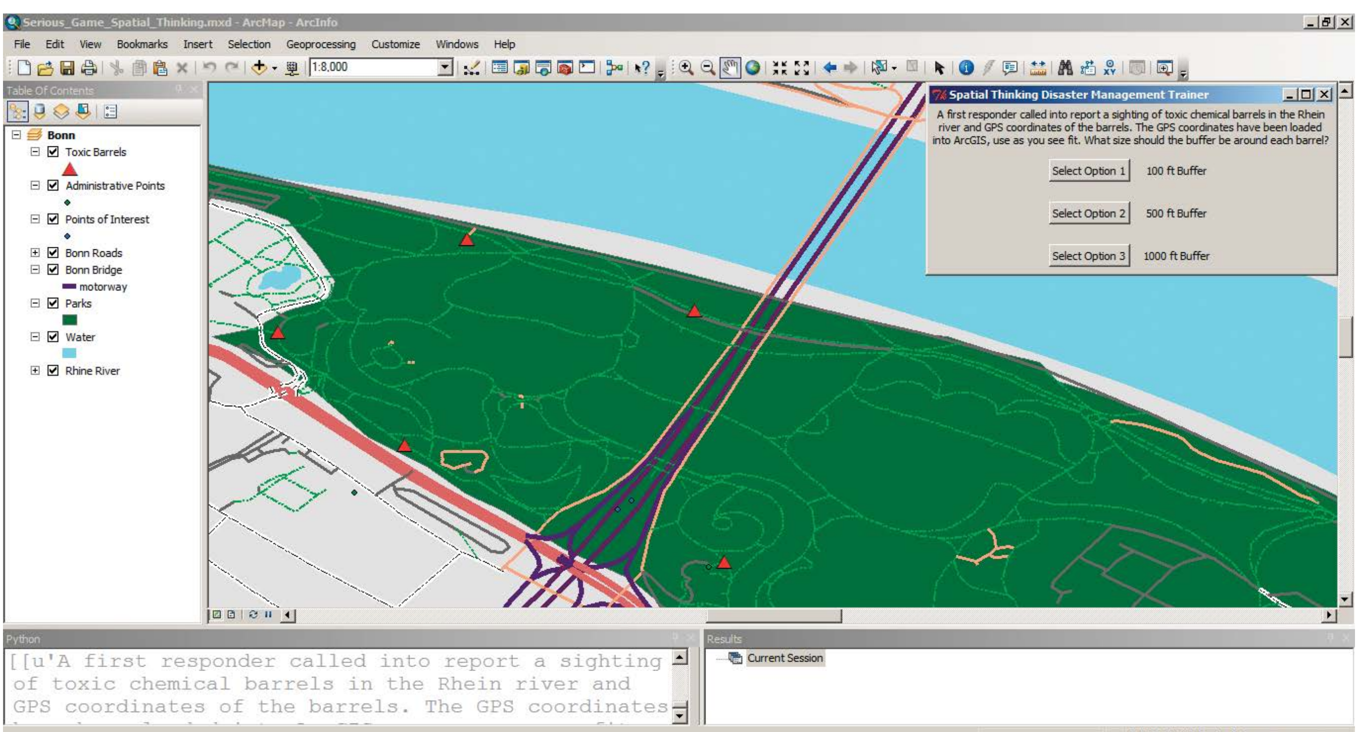
A team of student researchers at the Rochester Institute of Technology (RIT), working in partnership with the United Nations University Institute for Environment and Human Security (UNU-EHS) in Bonn, Germany, have developed a serious game in ArcGIS designed to measure the spatial thinking ability of disaster responders.

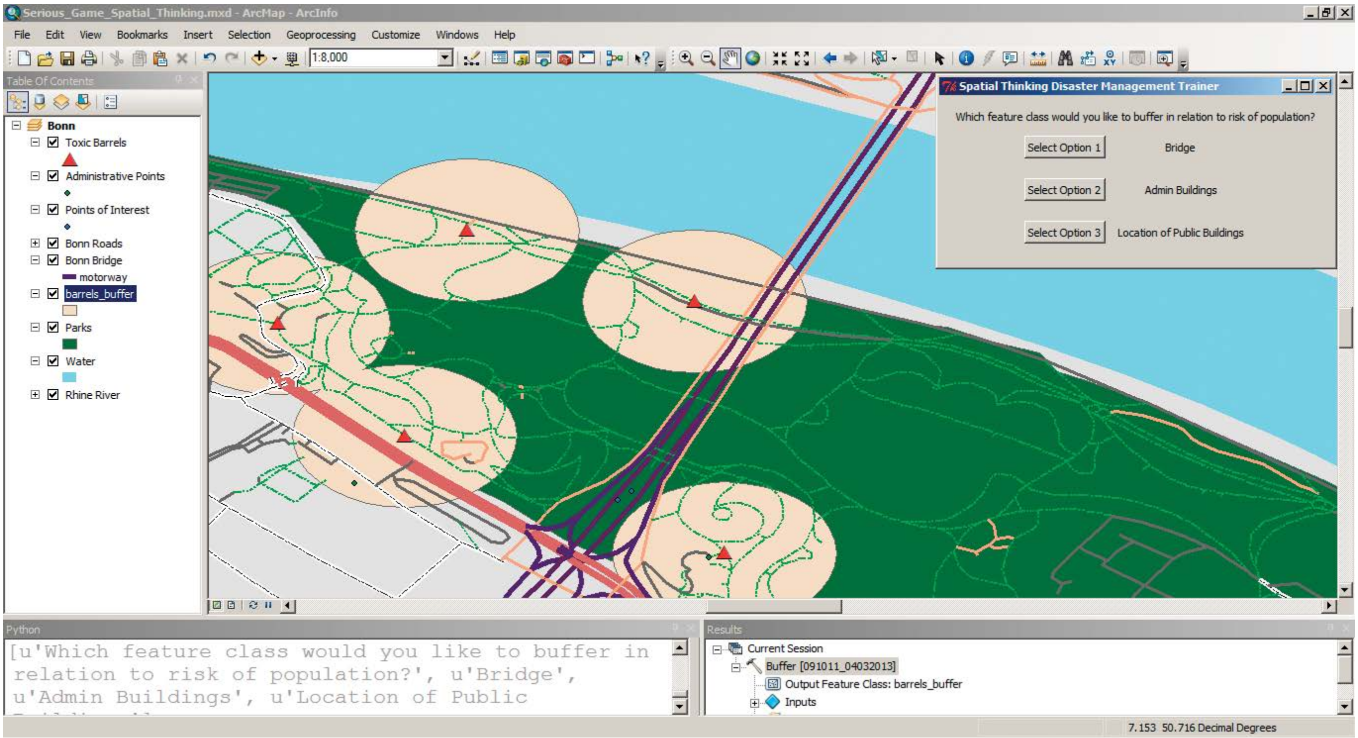
The game uses a disaster response scenario where toxic substances have washed up on the shore of the Rhine River in Bonn, Germany, after a flood. The game player is given a series of questions designed to measure spatial thinking abilities based on which ArcGIS tools they would use to respond to the disaster. Using real GIS data and tools in the game makes it particularly useful for realistic disaster management training. The following sections discuss the game in further detail and provide ideas for future work.

Using ArcGIS as a Serious Gaming Environment

The team developed the game's graphic user interface (GUI) and functionality using the ArcPy Python library to handle the game's interactions with ArcMap. The front-end system uses the Tkinter library *[Python's standard GUI package]*, which launches the gaming interface from the ArcMap Python window. When the game begins, it loads game questions specific to a given scenario, which are stored in JavaScript Object Notation (JSON) format. Because no two disasters are alike, a gaming framework was needed that could theoretically be expanded to work with any training scenario and keep all the data regarding the scenario separate from the gaming software itself. Thus, the JSON data format was an excellent choice for providing the flexibility needed to accommodate these factors.

Upon starting the game, the user is presented with a representation of the affected area in ArcMap. The map includes features such as parks, roads, public buildings, general points of interest, as well as the location of the toxic barrels along the Rhine River. The scenario data for the game was obtained from OpenStreetMap, but any data





↑ Pressing the button for Option 2 runs the underlying Python code, uses ArcMap functions, creates a 500-foot buffer around the toxic waste barrels, and updates the map. Next, the player is presented with options for determining risk to populations using buffers.

↙ At the start of the Spatial Thinking Game, the player can choose one of three buffer distances around the toxic waste barrels (shown as red triangles). The GIS tool choices selected by the game player are used to score the game player's spatial thinking ability. The Python window displays the code, which incorporates the ArcPy library, used to create the game and an external JSON file.

that ArcMap can import can be used in the game.

Beginning with the first game question, the gaming interface displays information taken from the JSON file for the current scenario that provides from one to five possible choices for the game player to select. When the user selects one of the choices, the gaming interface repopulates with new information based on that choice. Also, if a particular GIS operation is required (say, creating a buffer around a bridge), the appropriate ArcMap tool or model is called using the ArcPy library. Results of the selected choice are then displayed in ArcMap.

By using this approach, game players do not focus on technical details of using various ArcMap tools. Instead, they focus on spatial thinking and decision-making tasks. Furthermore, this approach allows game players who are not familiar with the capabilities of GIS to see how a real GIS environment operates.

Spatial Thinking Abilities as a Score

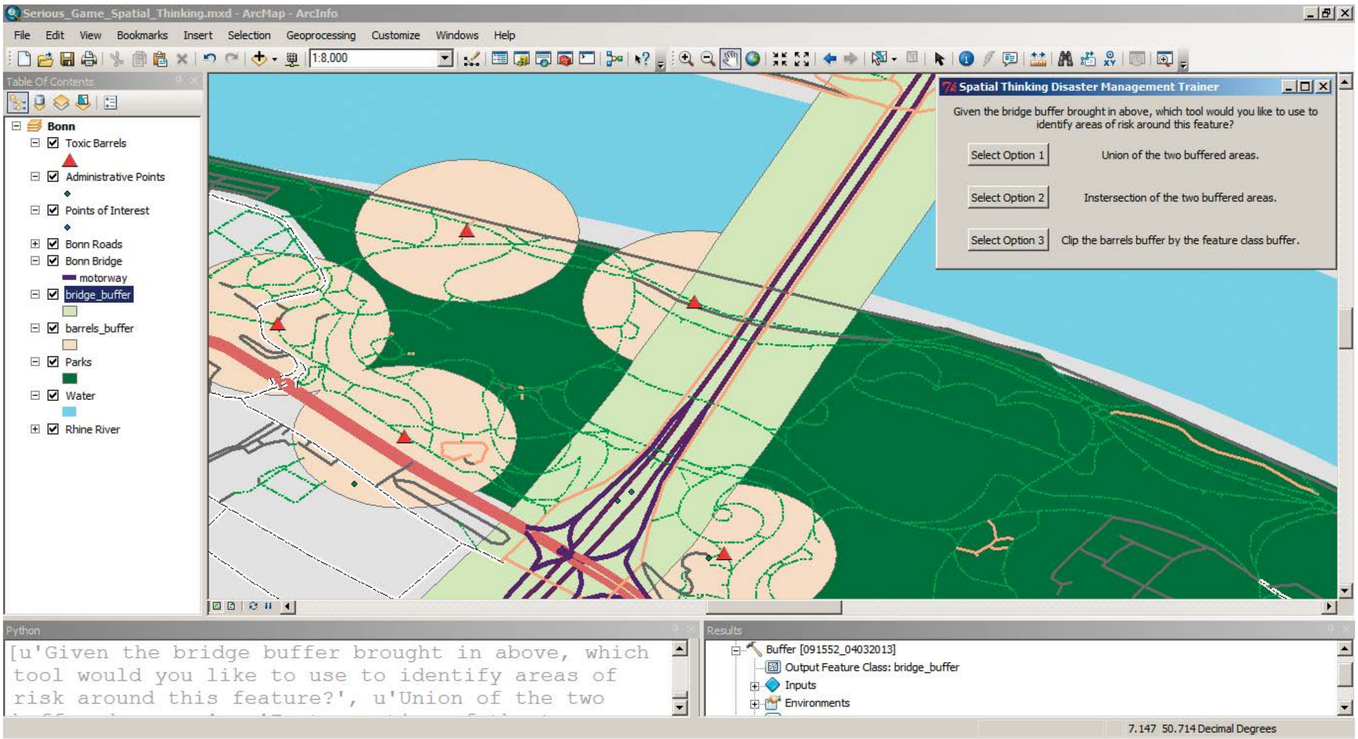
The goal in developing the game was to measure spatial thinking. To do this, each decision the user makes is associated with a given score. For example, a user who chose the buffer tool to create multiple buffers around the chemical barrels would receive a lower score for that particular question, while a user who correctly selected the Multiple Ring Buffer tool would receive a higher score.

In addition, timing was incorporated into the game to simulate a sense of urgency to replicate the tense, stressful situations emergency responders face in real disaster response situations. Users who need more than the allotted time to make a decision receive a reduced score, even if they make the correct decision.

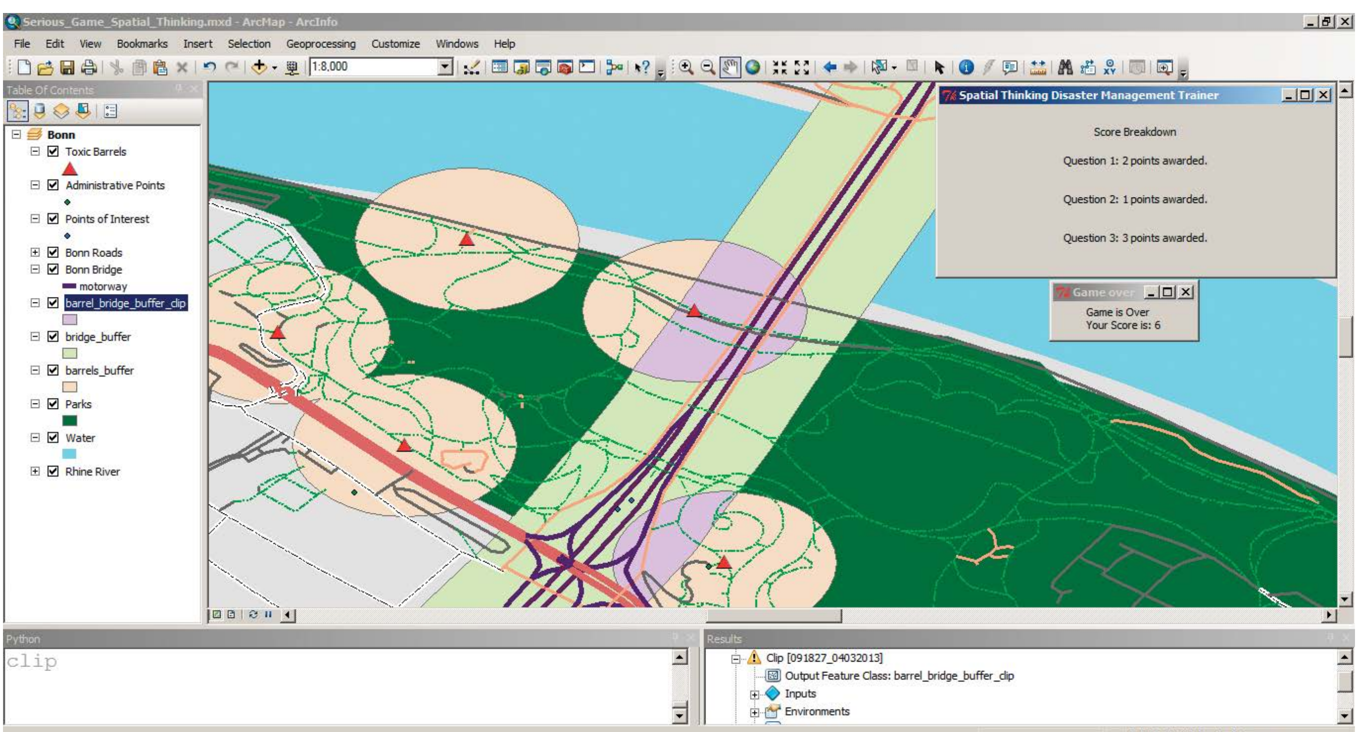
Upon completion of the game, the points for each question are added to present the user with an overall score that represents their grasp of the spatial thinking ability required in the game. The program also reports any discrepancies between the user's selections and the ideal choices and discusses what the user could have done better and why another choice may have been the better option.

Conclusions and Future Work

ArcGIS compatibility with Python programming was essential in the development of a serious game aimed at measuring spatial thinking abilities using ArcGIS. Future work includes expanding the game for other types of disaster response scenarios and formal testing of the game with emergency management practitioners. Serious games like this one may find a place in testing the knowledge and abilities of emergency responders prior to disaster situations without incurring many of the costs associated with developing more realistic, hands-on scenarios. Furthermore, the game can be expanded beyond specific applications like emergency response to use as a general approach for teaching spatial thinking and GIS concepts.



↑ The options available to the player are adjusted based on the initial choice. Selecting Option 1 creates a buffer around the bridge. The question prompt asks the player to choose a geoprocessing tool to identify risk areas in relation to the bridge buffer that was previously selected. The player is now presented with one last set of options.



↑ Selecting Option 3 clips the buffer around the bridge and the toxic barrel buffer and outputs them, concluding the game. The player's final score is based on the specific choices made during the game. Scores range from 1 for limited spatial thinking to 10 for good spatial thinking ability. A breakdown of points earned for each response is also provided so players can learn to make better choices.

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Improving Disaster Assessment

Disconnected mobile app uses ArcGIS Online

By Matt Sheehan, WebMapSolutions

To cope with increasing demand and decreasing resources, a Michigan county is moving from a paper-based to a tablet-based system for collecting damage assessments.

Response to natural disasters needs to be both rapid and carefully coordinated. Saving lives and providing shelter for those displaced are two key priorities for first responders. Assessing damage is another key task. Damage assessment measures and quantifies a disaster's impact on the community.

Jeffrey Boudrie, a GIS specialist who works in the County Planning Department for Monroe County, Michigan, performs disaster assessment. Floods and tornadoes, in particular, have become more frequent in the state over the last decade. At one time, Boudrie was one of six staff members dedicated to damage assessment. Today that number has been halved. Sometimes Monroe County has received assistance from Wayne County, its neighbor to the north. Red Cross volunteers have also helped. Though this help was welcome, it has also presented unexpected challenges.

Although Red Cross volunteers receive training in damage assessment, this training differs slightly from the training state personnel receive, primarily with regard to the level of damage. Boudrie's team assesses damage through field observation and by interviewing property owners. Data is collected on paper forms and photographs used to catalog and illustrate the extent of the damage. Teams are organized in shifts, and each team focuses on one area of an affected community.

When this process is completed, the finalized data is tabulated and interpolated. This can be a very time-consuming process. Syncing up photographs with the data in the paper forms can be very challenging, especially if the person performing the data tabulation is not the same person who did the assessment.

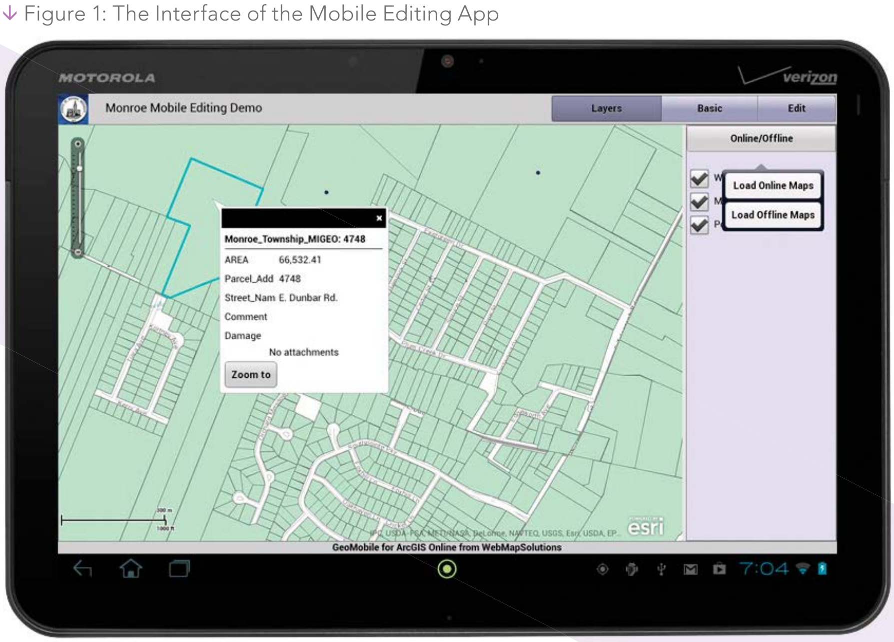
The final output from all this work is a concise report written according to the state's guidelines. This report is provided to state officials for review and guides the final decision on disaster declaration.

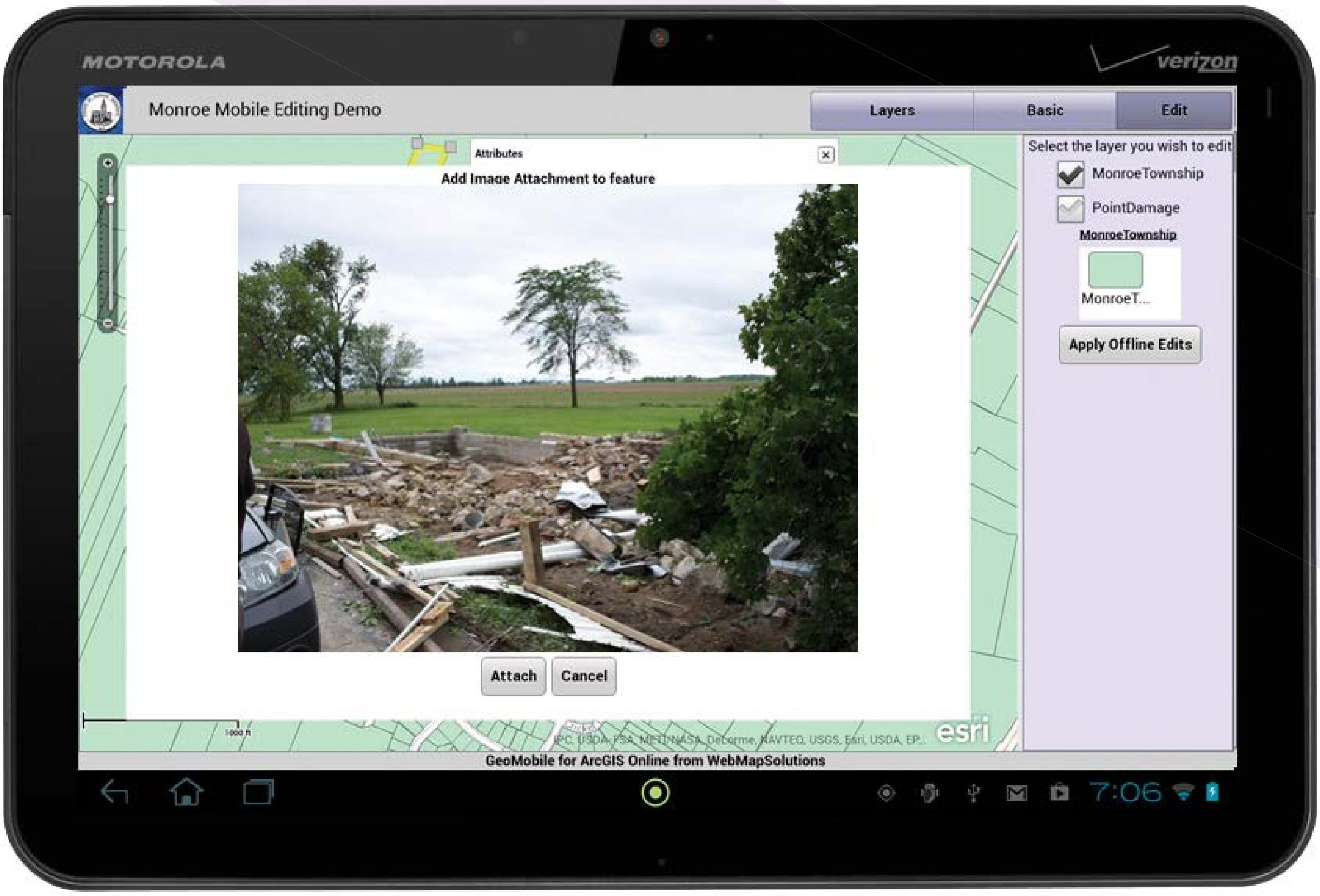
A Better Way

In early 2013, Boudrie began investigating methods for improving the county's damage assessment processes. He discovered and began working with WebMapSolutions. The company's developers were already working closely with Esri on a connected/disconnected mobile editing solution based on ArcGIS Online.

Esri partner WebMapSolutions is a GIS software development company based

↓ Figure 1: The Interface of the Mobile Editing App





↑ Figure 2: Attaching Images to a Selected Parcel

in Salt Lake City, Utah. Much of the company focus is now on ArcGIS Online and mobile development. WebMapSolutions recognized the many advantages of ArcGIS Online and was an early adopter of the technology. ArcGIS Online allows for a more holistic approach to GIS, marrying web, mobile, and desktop technologies, which has allowed the company to extend its GIS client solutions.

Monroe County needed to replace its paper-based process with mobile technology. Data collected needed to be stored and accessed from a single platform that would allow data analysis by GIS experts and visualization by state officials. Given the greater screen real estate available, tablets were seen as preferable to smartphones.

The ideal app would be intuitive and easy to use and not require staff training. As one team finished a shift, the next team could take the same devices into the field and see where previous teams had already recorded data to avoid duplicating efforts.

Team members visiting individual affected parcels should be able to tap a representation of that parcel as an overlay on the basemap in the mobile app and invoke an attribute box containing two key fields: damage level measured on a scale of 0 (damaged) to 3 (destroyed) and a comments field. The app should also let the assessor attach images to individual parcels.

Because Wi-Fi or cellular access may have been destroyed by the disaster, offline capabilities would also be important. Data visualization and collection should be available in disconnected mode. Once back in Wi-Fi range, collected data can be uploaded to a map layer hosted centrally.

The Perfect Platform

ArcGIS Online proved the perfect platform for this work. WebMapSolutions began by publishing parcel shapefiles, supplied by Monroe County, to its ArcGIS Online account as hosted feature services. These editable feature layers were included in a single web map, the core mapping unit of ArcGIS Online. The mobile application itself was built around this web map.

Time was spent up-front thinking through the interface and how to simplify workflows. Taking a single focused approach that avoided littering the app with too many tools greatly helped. Full extent, geolocation (zoom to current location), and online/offline editing were the key elements built into the app. The mobile app also reads from a configuration file on loading. This made the application highly configurable.

Manufactured home communities posed an additional data collection challenge. Typically in these communities, many structures are located on a single parcel. Adding a point hosted feature service allows the damage to individual mobile homes to be accurately recorded.

Strategy for Offline Editing

The key to offline editing involves

reading and writing data to and from the mobile device itself rather than ArcGIS Online. There are two key parts to this process. First, in ArcMap 10.1, a tile package was generated. This archive file, containing tiled images for each basemap zoom level, is copied to the tablet, either manually for Android devices or using iTunes for iPads.

Next, after starting in online mode, the offline option is selected, and the feature layers are serialized or copied to the mobile device storage. In offline mode, the application only references these local layers. When it is back online, any edits—adds, attribute edits, deletions, or attachments—are uploaded to the server by selecting an Edits Upload button.

For attachments, the tablet's camera was integrated into the app. Users can, after taking a picture of a parcel, attach the image to the feature or take a new photo. An ArcGIS Online hosted feature layer can store images, video, and audio files with an individual feature, and all attachments are visible seamlessly in ArcGIS 10.1 for Desktop.

By employing technologies such as Mobile Flex and PhoneGap, developers built installable apps that could be used on either an iPad or an Android tablet using just one code base. This approach potentially halves the cost of building the app as a native mobile app. These installable mobile apps can be distributed through various mobile app stores.

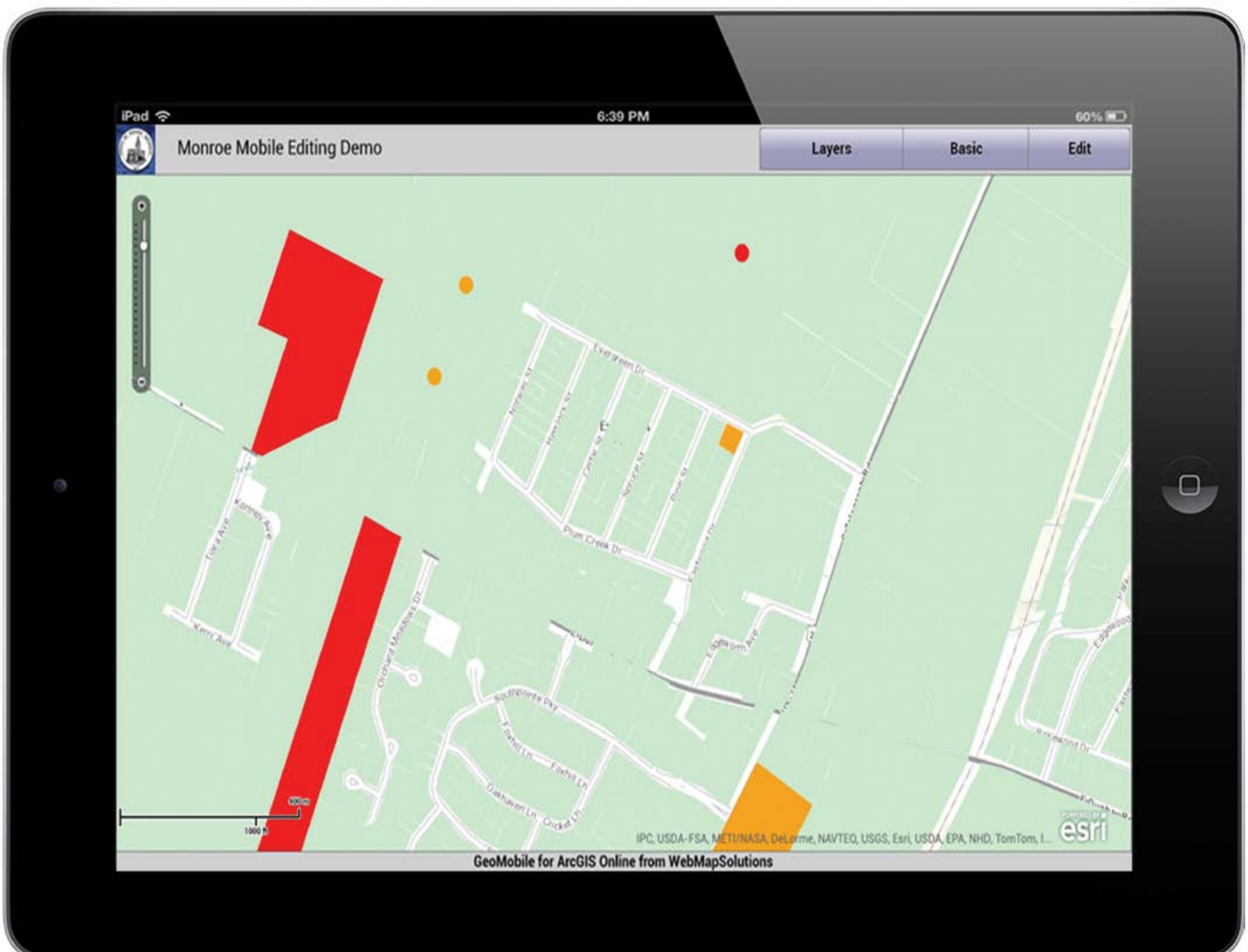
Moving Forward

WebMapSolutions' work with Monroe County is ongoing, and field testing is under way. Boudrie suggested color coding the inspected parcels based on damage levels to provide a picture of not only where team members have been but the overall pattern and extent of damage to these communities. Mobile app development continues, with new features being added to the app including auto map rotation so users can reorient the tablet.

The mobile app can potentially improve not only Monroe County's responsiveness in reporting damage assessments to state officials but also its team's workflows by improving data accuracy and making data more accessible and easily analyzed.

For more information, visit Monroe County at www.co.monroe.mi.us or WebMapSolutions at www.webmapsolutions.com or contact Jeffrey Boudrie at Boudrie_boudrie@monroemi.org or Matt Sheehan, principal at WebMapSolutions, at matt@webmapsolutions.com.

↓ Figure 3: Colored Parcels based on Damage Level



Better and Better

A strategy for improved locational accuracy

By Juan Tobar, GISP, South Florida Water Management District

Editor's note: Florida's oldest and largest water management district developed a strategy for improving the locational accuracy of permit boundaries that have been maintained in its GIS. By using the parcel boundaries, which have a horizontal accuracy that meets or exceeds National Map Accuracy Standards, the district did not have to spend a great deal to make significant improvements in locational accuracy.

The South Florida Water Management District (SFWMD), which issues permits for consumptive water use and surface water management, needed to improve the horizontal accuracy of its permits to better support regulatory activities. About half of these permits are environmental resource permits that never expire, and the other half are consumptive water use permits that are valid for 20 years.

The permits are used by engineers, environmental scientists, hydrologists, and compliance staff to make informed decisions during the application review process and for postpermit compliance. For these reasons, it is important that even the oldest permits are depicted as accurately as possible in the GIS.

The district issued its first permit in 1972. Since that time, the GIS unit has used basemaps of varying quality to capture these features. From 1972 to 1987, permits were drawn directly on US Geological Survey 1:24,000-scale topographic quadrangle maps and Mylar overlays. From 1988 to 1995, permit boundaries were digitized using SPOT 10-meter panchromatic and 20-meter multispectral scanner imagery as the basemap. Starting in 1995, 1-meter digital orthophoto quarter-quadrangle maps were used for the same purpose.

In 1999, parcel basemaps began being

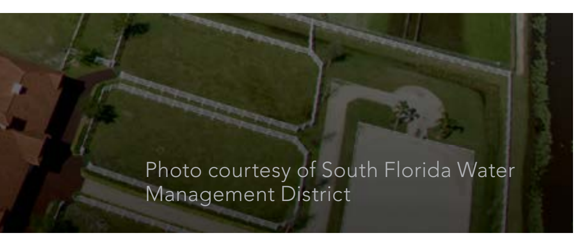


Photo courtesy of South Florida Water Management District

used for permit locations in some—but not all—counties. Permits are correlated to parcel boundaries so parcels can be used as a control to measure the horizontal accuracy of the permits. Where a strong correlation exists between the two boundaries, parcel boundaries can replace permit boundaries. Today, all permits are digitized to the parcel level. However, the GIS contains data from previous years that is of questionable accuracy.

The Regulation Bureau of SFWMD has been using Esri products since 1991, when permits were stored in ARC/INFO coverages and edited using a menu system written in ARC Macro Language (AML). Today these permits are stored in an ArcSDE database and edited using an ArcMap extension that was written in C#. The majority of extract, translate, and load (ETL) functions, including the scripts for the Buffer-Overlay and correction phase analyses, were coded in Python.

Applying Buffer-Overlay

Positional or spatial accuracy refers to the accuracy of a test feature when compared to a control feature. Methods for determining the positional accuracy of points are well established and are usually provided as the Euclidean distance between the test point and a control point. The measure of error can be reported as errors in x, y, and z. Descriptive statistics can be generated based on these numbers.

Determining the positional accuracy of a polygon is more complicated, but there are a number of methods that can be used. The simplest to implement is the Buffer-Overlay method of Goodchild and Hunter (1997). Buffer-Overlay works by creating a buffer around a higher-accuracy control line and then noting the length of a less accurate test line within the buffer. The results are expressed as the ratio:

$$\frac{\text{Length of Test Line within Buffer}}{\text{Length of Control Line}}$$

If the ratio is less than 1, the process is repeated with a larger buffer until the length of the test line within the buffer is greater than or equal to the control line. The accuracy of the test line can then be said to be plus or minus the buffer distance.

To thoroughly test the limits of Buffer-Overlay, a pilot area was chosen consisting of the boundaries of 259 environmental resource permits for one township/range in Lee County, Florida. Lee County was selected because it is an area known to have permits that were highly displaced from the associated parcel boundaries.

A straightforward method for determining the horizontal accuracy of the polygons that are related to parcels is to measure the offset between polygon vertices and parcel vertices and then calculate the root mean square error (RMSE). The RMSE provides a measure of accuracy for the entire feature class but does not indicate the accuracy of individual polygons, hence the need for Buffer-Overlay.

Buffer-Overlay is usually implemented by buffering a control line and quantifying how much of the test line is found within each buffer. This works well with simpler control datasets, such as shorelines, but is not practical when using parcels. In this case, there are many more control features than test features, and buffering each parcel polygon to look for a test feature is not practical.

To solve this problem, the procedure is reversed by buffering the permit lines (test) and quantifying how much of the parcel line (control) is found within each buffer. The pseudo code for calculating the initial horizontal accuracy is shown in Figure 1a .

```
For each permit
Buffer from 0.5 ft to 60 ft @ 0.5
ft intervals
Clip the parcel lines (control)
using the buffer
Drop dangling nodes (where length
= buffer)
Calculate the Ratio or Cumulative
Probability (CP)
```

$$CP = \frac{\text{Length of Clipped Parcel Line}}{\text{Perimeter of the Permit Line}}$$

```
If CP ≥ 1
    Horizontal accuracy is ± the
    buffer distance
Else If CP < 1 and buffer < 60
    Next buffer
```

↑ Figure 1a: Pseudo code for calculating initial horizontal accuracy

This procedure was run on all polygons in the pilot area. Figure 2 (on page 23) shows →

a random sample of the cumulative probability curves for 21 permits. On this graph, the x-axis represents the distance buffered from 0.5 to 60 feet at 0.5 ft intervals. The y-axis represents the cumulative probability. When the curve reaches 1 or more on the y-axis, the length of clipped parcel line is greater than or equal to the perimeter of the permit line. In these cases, the buffer distance is assigned as the horizontal accuracy of the permit. Those curves that never reach 1 are outside the maximum buffer distance of 60 feet.

Correction Phase

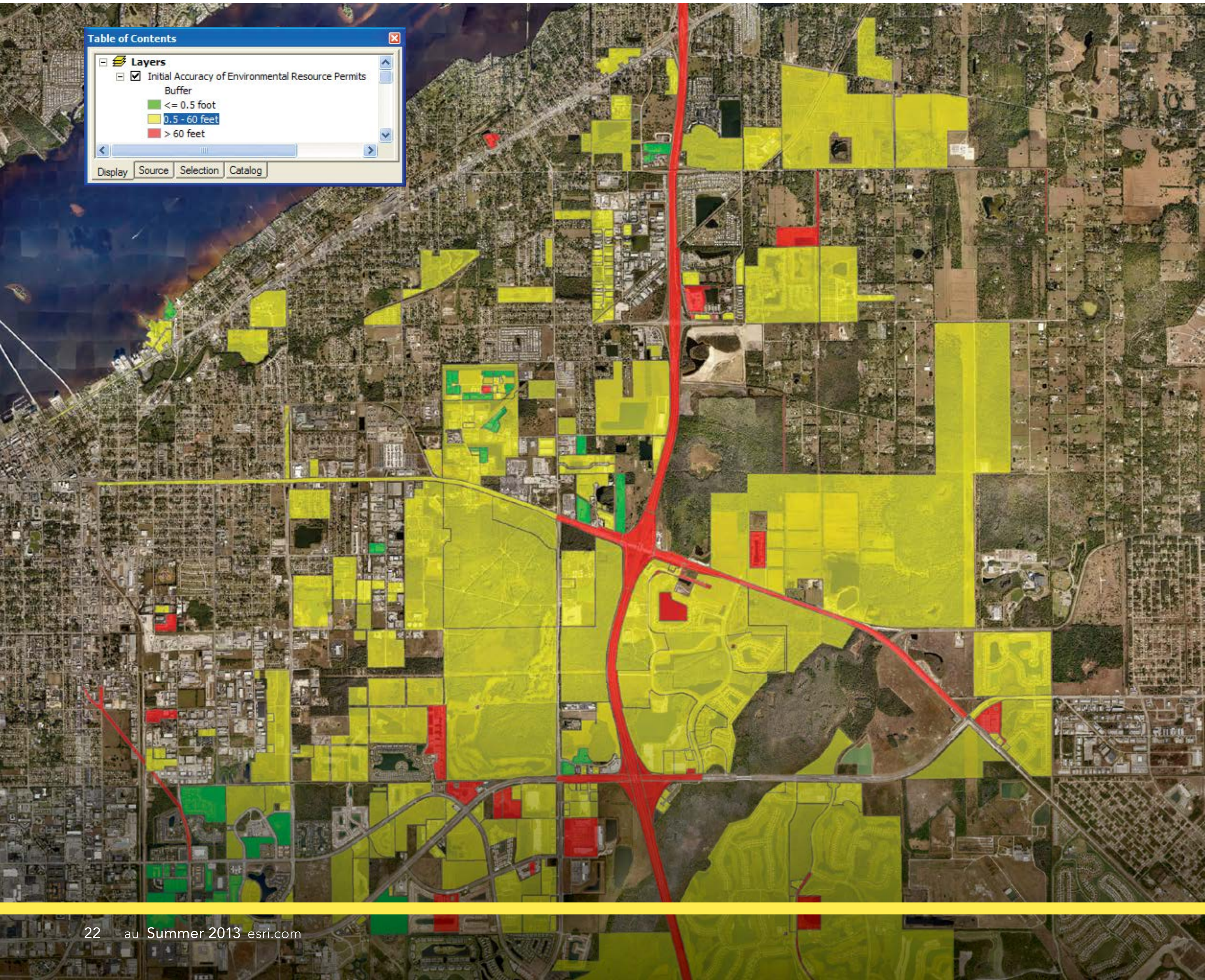
The next logical step involved building the extracted parcel line segments into polygons using the topology tools in ArcMap. In some cases, line segment artifacts are extracted that form closed rings and result in polygon builds that are significantly larger or smaller in area than the original permit. These are excluded through an area comparison. The pseudo code for the correction is as follows:

```
For each permit
Build parcel lines as polygons
If polygon area is 0.03 * permit
area
    Build Succeeds
Else
    Build Fails
```

↑ Figure 1b: Pseudo code for correction method

The confidence interval on the estimate of RMSE for x and y at 95 percent probability was calculated using 30 coordinate pairs from the pilot area at the initial condition and after correction (shown in Table 1). The RMSE measures are circular for both conditions. This means that the values are relatively similar between x and y and indicate that there is no systematic error in the data that would produce more errors in any particular direction. After Buffer-Overlay, the corrected RMSE x values dropped by 4.7 feet from 20.22 ± 5.74 to 15.52 ± 5.78. Corrected RMSEy values dropped by 9.42 feet from 22.18 ± 7.29 to 12.76 ± 4.6. This indicated a significant improvement in the data.

↓ Figure 6a: To thoroughly test the limits of Buffer-Overlay, a pilot area was chosen consisting of the boundaries of 259 environmental resource permits for one township/range in Lee County, Florida. Initial inaccuracies are shown.



Confidence interval on the estimate of RMSEx at 95 percent probability	Initial x/y dimension values	Corrected x/y dimension values
RMSEx + 1.96 * S_{RMSE} > e_{xi} > RMSEx - 1.96* S_{RMSE}	20.22 ± 5.74 = 14.49 to 25.95	15.52 ± 5.78 = 9.75 to 21.3
RMSEy + 1.96 * S_{RMSE} > e_{yi} > RMSEy - 1.96 * S_{RMSE}	22.18 ± 7.29 = 14.89 to 29.46	12.76 ± 4.6 = 8.16 to 17.35

↑ Table 1: Initial and corrected RMSE

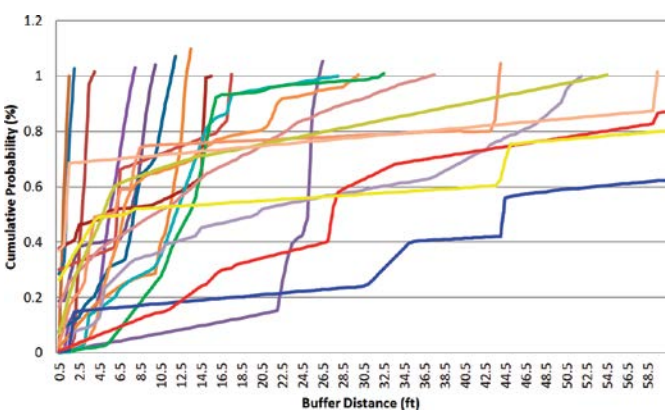
A graph of the initial horizontal accuracy distribution from 0 to 60 feet for all 259 permits shows two peaks at either extreme. On the left side of the graph, 13 percent of the data (or 34 features) had high accuracy, with horizontal displacements from parcels of 0.5 feet. On the right side of the graph, 12 percent of the data (or 31 features) had low accuracy, with horizontal displacements from parcels of 60 feet. Between these two peaks, the curve was skewed to the left but otherwise randomly distributed and contained 75 percent of the data (Figure 3).

The Correction Phase involved replacing the permit boundaries with the polygons built from the clipped parcel lines. Once this was complete, RMSE for the feature class was recalculated (see Table 1) and Buffer-Overlay accuracies for each of the 259 permits were recalculated.

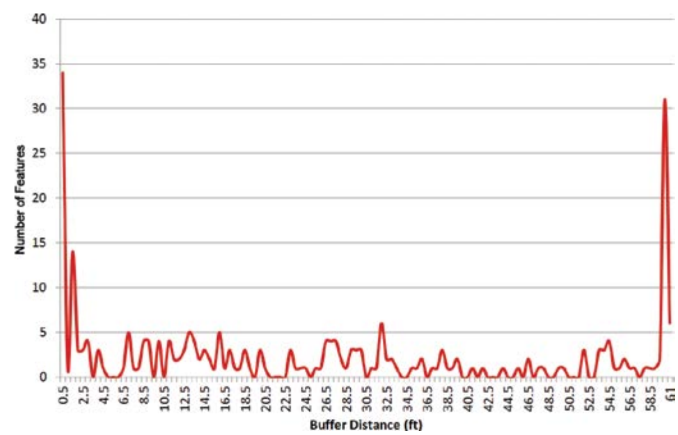
The graph in Figure 4 shows the initial (red) and corrected (green) distributions for permit boundaries with accuracies between 0 and 30. After correction, 52 percent (135 features) of the data had high accuracy of 0.5 feet. Note that the corrected curve runs above the initial curve for accuracies of 1 foot. The percentage of records between 0.5 and 60 feet was reduced from 75 percent to 40 percent. Notice that the amplitude of the corrected curve (green) was reduced and runs below the initial curve for buffer distances from 1 to 60 (as expected). Finally, 12 percent of the data still had low accuracy (i.e., > 60 feet) representing features with accuracies beyond the 60-foot maximum buffer distance.

The graph in Figure 5 shows the cumulative horizontal accuracy distributions. In the best-case scenario, this would be a straight line across the y-axis at 259 indicating that all features had accuracies of 0.5 feet. The red curve represents the initial conditions, with 13 percent of features having accuracies of 0.5 feet; the green curve represents the correction with 52 percent of features having accuracies of 0.5 feet.

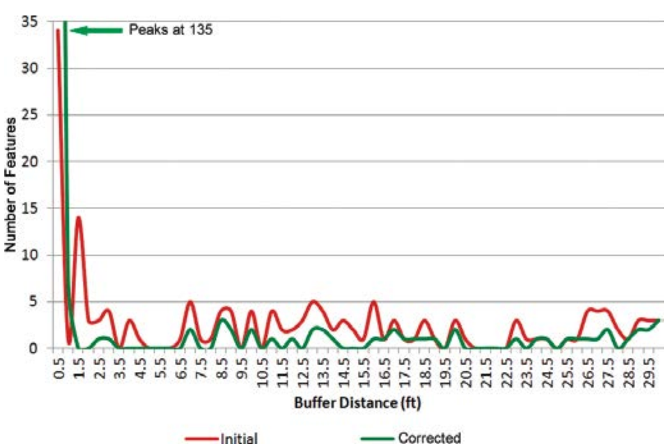
The two maps in Figures 6a (page 22) and 6b (page 24) depict the horizontal accuracy at the initial condition and after correction. Green boundaries have accuracies of 0.5 feet, yellow boundaries have accuracies



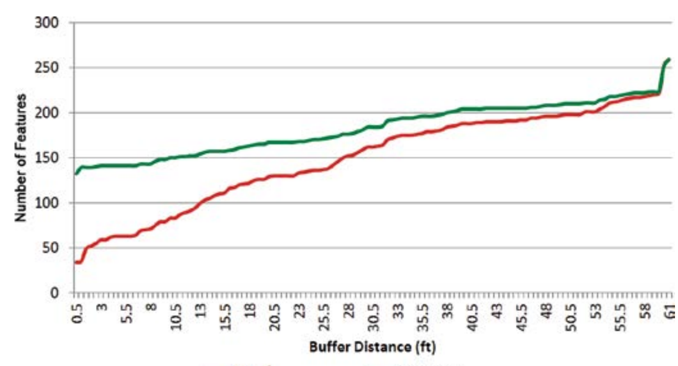
↑ Figure 2: A random sample of the cumulative probability curves for 21 permits



↑ Figure 3: The initial horizontal accuracy distribution from 0 to 60 feet for all 259 permits



↑ Figure 4: Initial and corrected cumulative accuracy distributions



↑ Figure 5: Initial and corrected cumulative curves from 0.5 to 60 feet, and red boundaries have accuracies > 60 feet. The second map shows a significant increase in the number of permits with accuracies of 0.5 feet.

Conclusion

Most data stewards would acknowledge they have data that should be improved but lack the time and money to make improvements. Many of these datasets are based on or directly related to higher-accuracy datasets that could be used as controls to determine and improve horizontal accuracy.

In this example, Buffer-Overlay was used to determine and improve the horizontal accuracy of environmental resource permits using parcels as controls with excellent results. Buffer-Overlay is conceptually simple. It uses buffer and clip, two of the most common geospatial operators, and is easy to automate. The cost of improving data using Buffer-Overlay is low, confined to algorithm development and CPU cycles, leaving the data steward free to focus on other more important tasks.

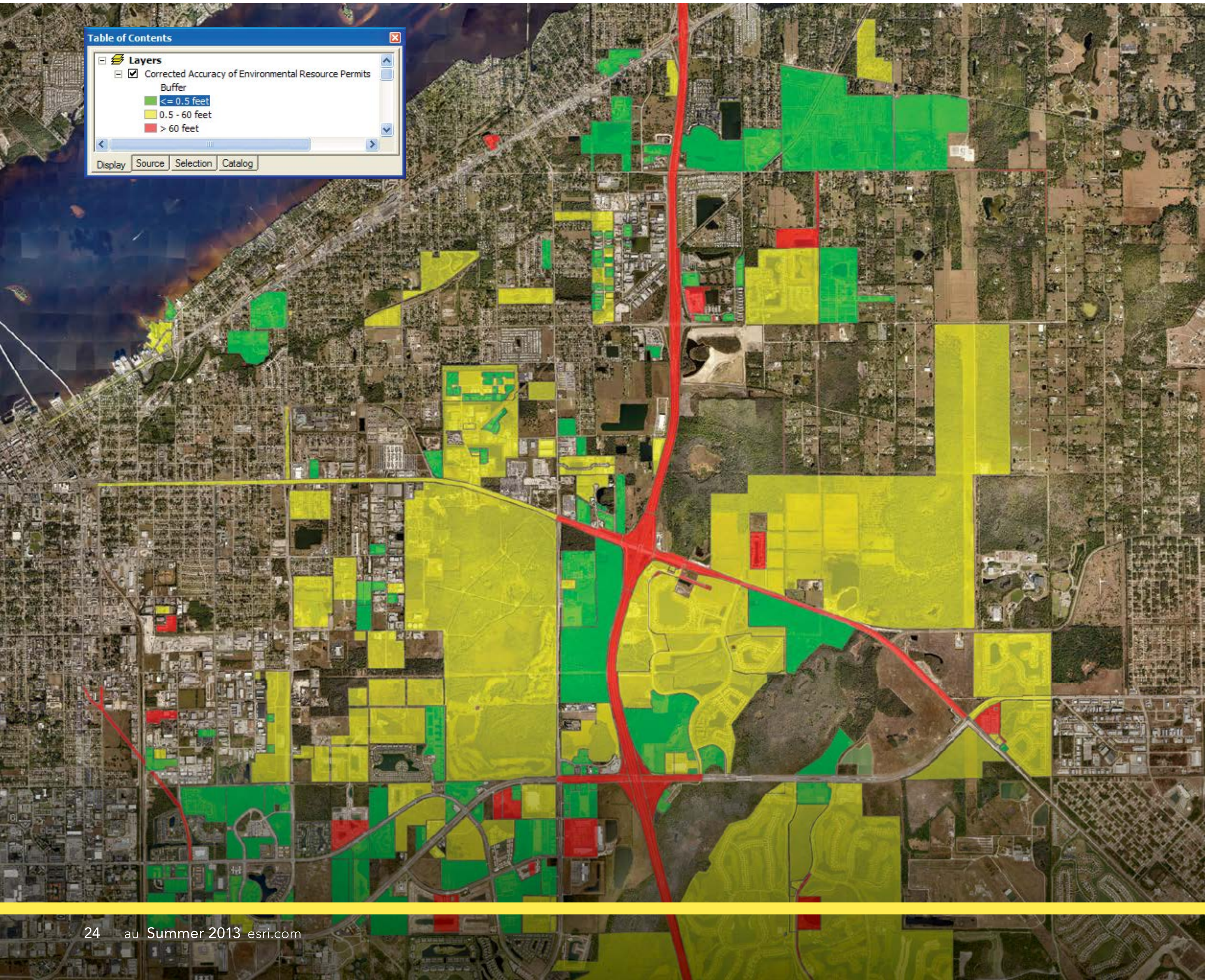
About the Author

Juan Tobar has a master's degree in geography from Hunter College, a bachelor's degree in geology and geography from the University of Miami, and more than 20 years of hands-on experience with geospatial technologies and Esri products. He worked as a senior programmer/analyst for Miami-Dade County from 2000 to 2001 and as GIS coordinator for the City of Bakersfield, California, from 1997 to 2000. He currently works as a science supervisor for the South Florida Water Management District in West Palm Beach, Florida. He can be reached at jtobar@sfwmd.gov.

References

Goodchild, F. M., and G. J. Hunter, 1997. "A Simple Positional Accuracy Measure for Linear Features," *International Journal of Geographical Information Sciences,* 11(3):299–306.

↓ Figue 6b: Corrected classification



Making Census Data More Useful

Geostatistics Portal benefits public and private sectors

By Janusz Dygaszewicz and Agnieszka Nowakowska, the Geospatial Unit in the Central Statistical Office of Poland, and Marta Orłowska-Krzyżyk, GISPartner Sp. z o.o.

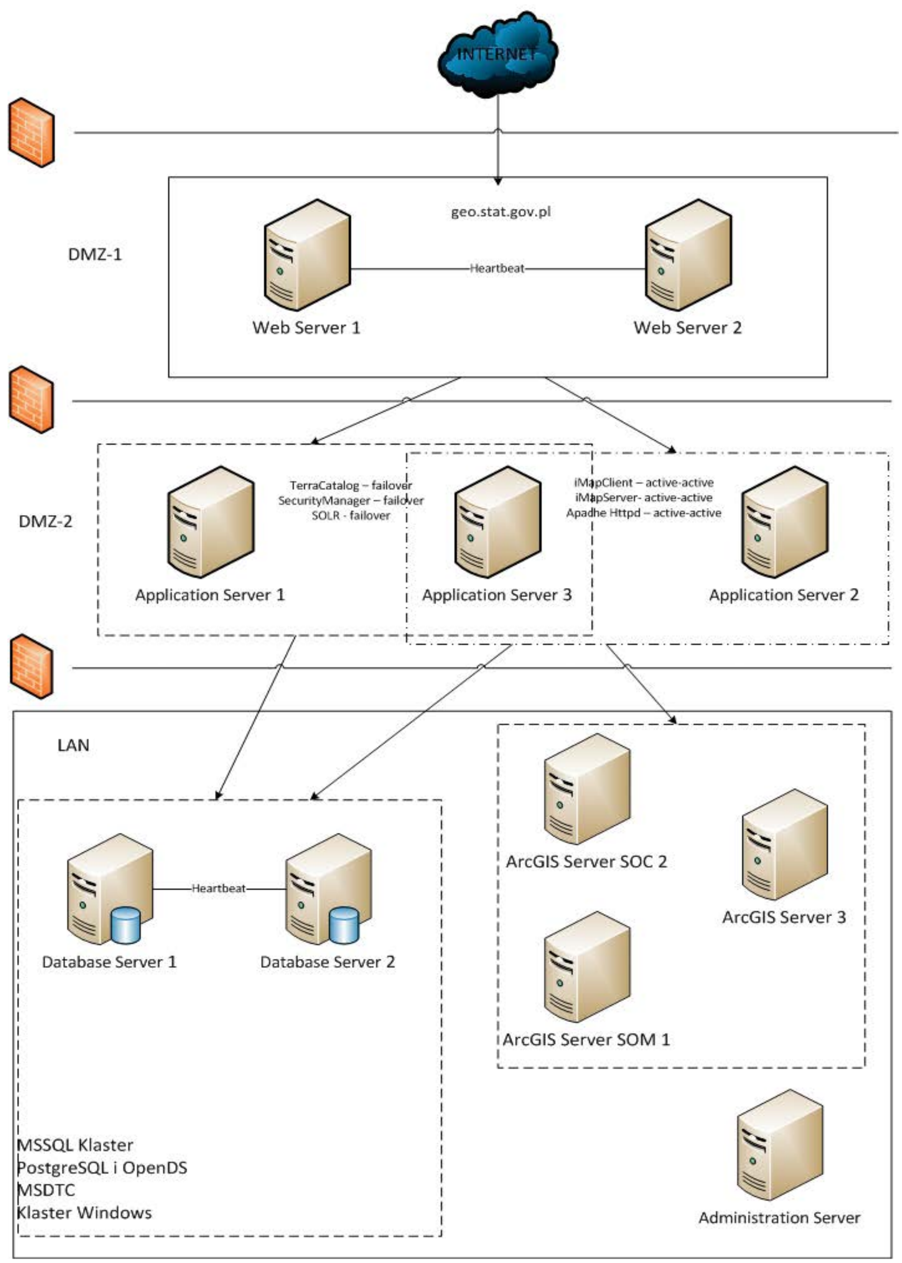
We live in a global village. We can transfer and share information and localize it spatially. However, information must be readily available, quickly accessed, and simple to interpret. Social, trade, and government portals are created with this in mind. Sharing data that has been collected contributes to the creation of an information society. The Republic of Poland is developing the Geostatistics Portal, which collects, presents, and shares statistical data.

Throughout the world, collecting and processing data are performed by national statistical offices. These offices are tasked with providing reliable, fair, independent, and high-quality statistical information on the current state and changes in society, the economy, and the environment for use by domestic and international audiences. Public statistical institutions collect, store, and analyze statistical data and share it as resultant statistical information.

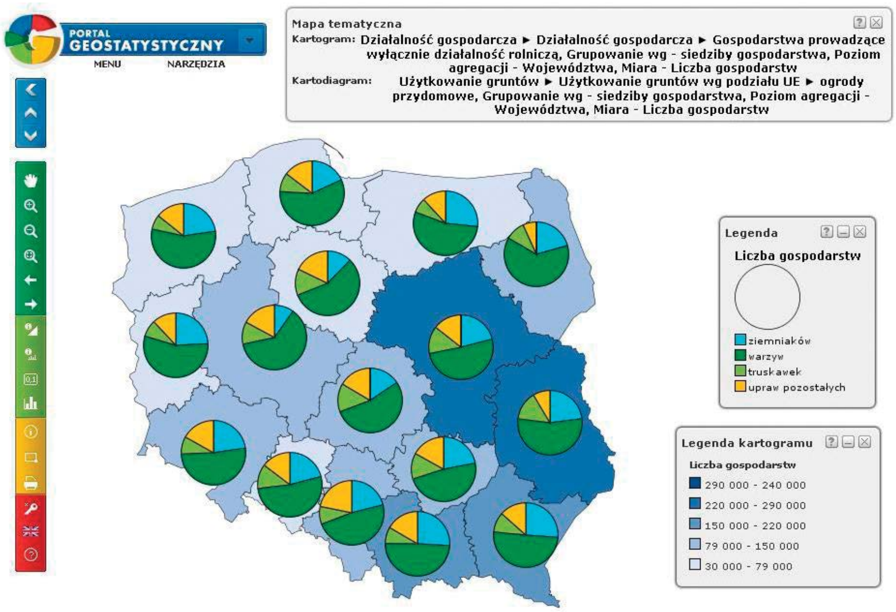
Using GIS in Goverment Statistics

Until now, the Central Statistical Office of Poland (CSO) disseminated statistical data on its website as statements and announcements made by the CSO president. These announcements were also published in the CSO Official Journal and the Official Journal of the Republic of Poland, *Monitor Polski*), and distributed as press releases at the CSO president's press conferences and in publications. Data was also disseminated in databases and data banks that range in scope from the narrowly focused Demographic Database to the more general Local Data Bank.

Using GIS technology in the Agricultural



↑ System Architecture



↑ Thematic data presented as a diagram map

Census 2010 and the Population and Housing Census 2011, both nationwide censuses, provided georeferenced statistical data that can be presented on the Geostatistics Portal.

During the last few years, GIS use for official statistics has increased. This was a byproduct of European Commision (EC) regulations. In 2007, the Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007, establishing an Infrastructure for Spatial Information in Europe (INSPIRE), came into effect.

This directive was incorporated into Polish law on March 4, 2010, as the Spatial Data Infrastructure Act. The act defines the basic principles for the creation and development of a spatial data infrastructure (SDI) in Poland. This SDI will function on all levels of public administration and serve all spatial data users in Poland and the EU. The INSPIRE Directive and subsequent SDI act defined the spatial data themes and public authorities responsible for publishing datasets and services used in these themes. The president of the Central Statistical Office of Poland (GUS) is responsible for two of these data themes, the statistical units and population distribution (or demography).

Apart from the requirements of INSPIRE, Eurostat has noted that georeferencing statistical data and using an innovative web application to publish the data greatly increases value of the final product as well as creating new data. One of the goals of the European Statistical Programme 2013–2017 is support for the development of fact-based policies through wider use of georeferenced statistical information on society, the economy, and the environment.

While preparing for the census, use of GIS statistics increased. In 2009, paper statistical maps showing statistical division borders were scanned and calibrated. The boundaries of statistical regions and census enumeration areas were digitized, and the acquisition of statistical address points (i.e., dwelling locations) began.

Digital maps were used in both censuses for updating the statistical address point database for municipalities. A dedicated web application allowed municipality authorities to view and edit address point positions on a map. A precensus visual survey delivered as a mobile application on a smartphone used the GPS receiver that let enumerators determine their location as well as view and edit address points on a map. The census itself used a dispatcher application for monitoring and coordination.

A Management Tool

A modern solution for the spatial presentation of statistical data, the Geostatistics Portal collects, presents, and shares information with a wide audience that includes public administrators, entrepreneurs, and individual users as well as scientific researchers. All data for this comprehensive solution data is processed to retain statistical confidentiality and conform to European standards.

The Geostatistics Portal is helpful for making strategic decisions on all levels of management. The project contributes to the establishment of a complete and coherent e-administration system that supports the development of entrepreneurship by facilitating access to current information on the social and economic status of the country. This is of strategic importance for society and the national economy. A given area can be monitored and analyses and simulations performed to generate forecasts, estimate risks, and develop preventive measures.

Building the Portal

Through a tender process, CSO staff selected Esri partner GISPartner Sp. z o.o. of Wrocław, Poland to develop the Geostatistics Portal. The company has considerable experience developing large spatial information systems.

The Geostatistics Portal was created using state-of-the-art solutions from GISPartner and Esri. It consists of a central database based on Microsoft SQL Server and ArcSDE software, metadata catalog, data server, and spatial services based on ArcGIS for Server technology, ArcGIS for Desktop, and the iMap map portal designed by GISPartner Sp. z o.o. The portal provides access to Web Map Services (WMS) published by other servers.

The system has a multilevel architecture. At the first level, servers perform load balancing that ensures failure-free and optimum operation as well as an even load on all servers. In addition, servers are set in a failover cluster, a system configuration designed to sustain critical system tools. *[In a failover cluster, independent computers are grouped so they work together, increasing availability and scalability.]* Without high accessibility, many services could not be maintained.

At the next level, application servers receive system traffic. If a server fails, it is automatically turned off by the load balancer. A database cluster, based on a Microsoft solutions failover cluster, is at the third level. At any point in the system, its efficiency can be increased or its configuration changed while maintaining the existing hardware infrastructure or expanding it.

Maintaining the security of the collected data and its statistical confidentiality was an important aspect of the system. Consequently, many solutions were applied to the hardware infrastructure, software, and functionality of the system. All geostatistical data is kept on database servers that can be directly accessed only from the internal GUS network. Access to the system's advanced functions requires a system account.

Functionality and Scope

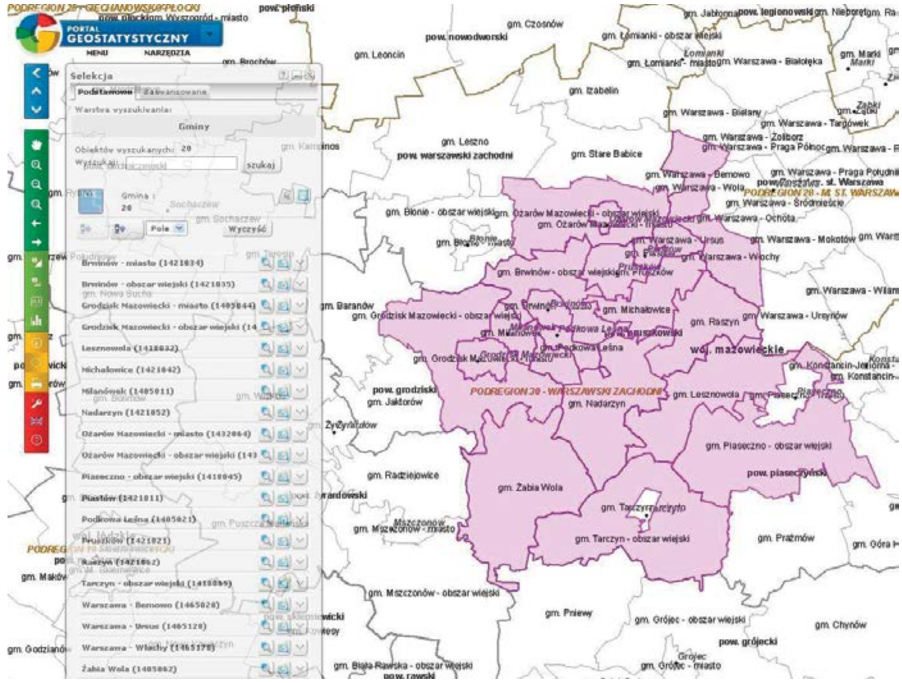
The Geostatistics Portal is a tool for interactive cartographic presentation of census results. The results were developed in the Analytical Microdata Database (AMD), which uses IT tools to generate various data reports such as tables and multidimensional cubes. Aggregated data was prepared for the Geostatistics Portal in AMD. The aggregates have been replicated to a database in the portal.

Statistical data in the Geostatistics Portal is presented on predefined basemaps that contain orthophoto map, administrative division, statistical division, locality centroids, and street network and address points layers. The two latter layers are available only to internal users (i.e., registered users).

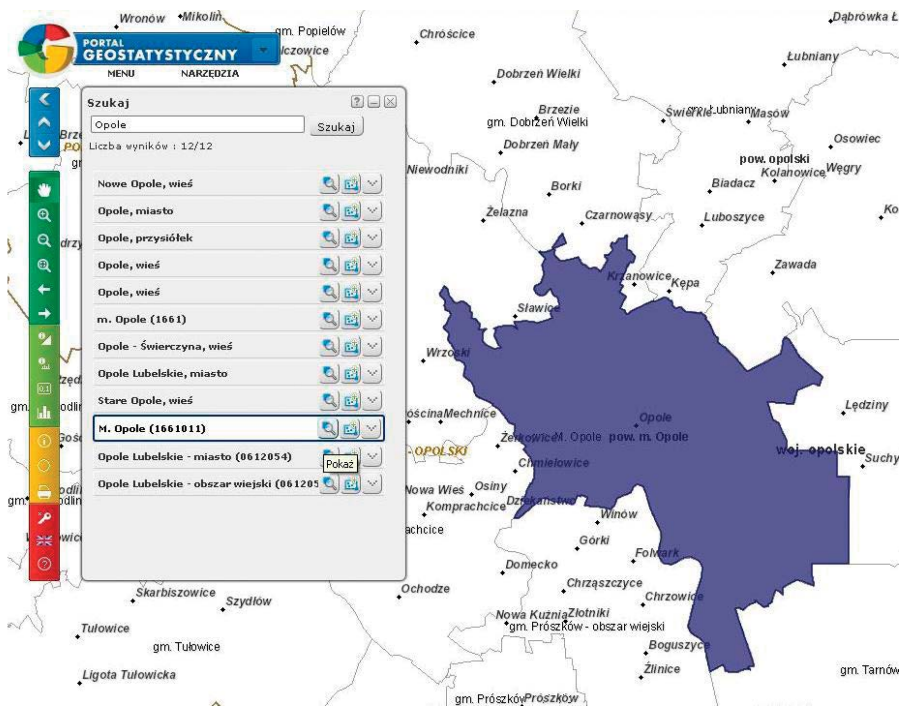
The Geostatistics Portal's intuitive user interface allows quick and easy access to statistical information. Portal users can select a thematic phenomenon from a predefined list or find it using a search engine. Data is presented using cartographic methods such as choropleth maps and diagram maps. Circle, bar, proportional and/or structural, and complex diagram maps are used.

For presentations of all types, users can define visualization parameters, such as aggregation level (e.g., territorial unit) of the output, as well as the following (if applicable): symbol, color range, number of classes, and classification methods. For all thematic phenomena, users can generate table statistics and histograms.

Users also have at their disposal tools such as object identification, object selection, locality search, address search (accessible to internal users), and attribute and spatial search tools. A specified map extent can be printed or exported to various file formats. The portal is also compliant with Open Geospatial Consortium, Inc. (OGC), web services. WMS services can be added to the map window.



↑ Object selection



↑ Locality search

Apart from predefined spatial analyses, internal users can prepare their own thematic maps based on any feature of the data model using multidimensional spatial analyses, (e.g., line analysis, distance analysis, or buffering).

To fulfill obligations of the INSPIRE Directive, an INSPIRE Services Subsystem was created as part of the Geostatistics Portal. It provides access to data and metadata related to statistical units and population distribution (demography). The subsystem is composed of a metadata catalog and discovery, view, and download web services.

The portal will provide access to a wide range of thematic phenomena.

Results of the Agricultural Census 2010 can be viewed on 550 choropleth and diagram maps grouped in 10 main topic areas: income, economic activity, income structure, use of equipment, sown area, land use, farm animals, economic activity of people in individual holdings, and the workloads of individuals on those holdings.

Results of the Population and Housing Census 2011 can be viewed on 2,000 choropleth and diagram maps grouped in 39 main topics.

Expansion Project

Currently, the Geostatistics Portal presents only census results. In the future, CSO will provide access to georeferenced results of other surveys from the official statistics survey program. The project will need to be expanded to accomplish this. The Geostatistics Portal Expansion project was submitted to the Integrated Computerization of the State Programme in the 2014–2020 budget projection.

Until now, statistical survey results have been published at the administrative division level (e.g., voivodeship *[province]*, county, municipality). In the Geostatistics Portal expansion would implement other territorial divisions such as kilometer grids as specified in the INSPIRE Directive executive legislation. To facilitate this, it is essential to collect statistical data with a spatial reference—preferably to x,y coordinates or at least an administrative or statistical territorial identifier.

The power and uniqueness of the Geostatistics Portal lies in its characterization of aggregated data, contained only in official statistics, and the presentation of this data in a georeferenced format that preserves data confidentiality for individuals.

For more information, contact Agnieszka Nowakowska (a.nowakowska@stat.gov.pl) at Central Statistical Office or Marta Orłowska-Krzyżyk (mkrzyzyk@gispartner.pl) at GISPartner (www.gispartner.pl).

About the Authors

Janusz Dygaszewicz is the director of the Programming and Coordination of Statistical Surveys Department in the Central Statistical Office of Poland and the author of modern technological solutions used in the 2010/2011 census. He is also the director of the Central Census Bureau, the Deputy General Census Commissioner, and an expert who serves on many European Commission (Eurostat) working groups on spatial information and censuses. Dygaszewicz graduated from the Gdańsk University of Technology, Faculty of Electronics, where he studied information technology and automatics.

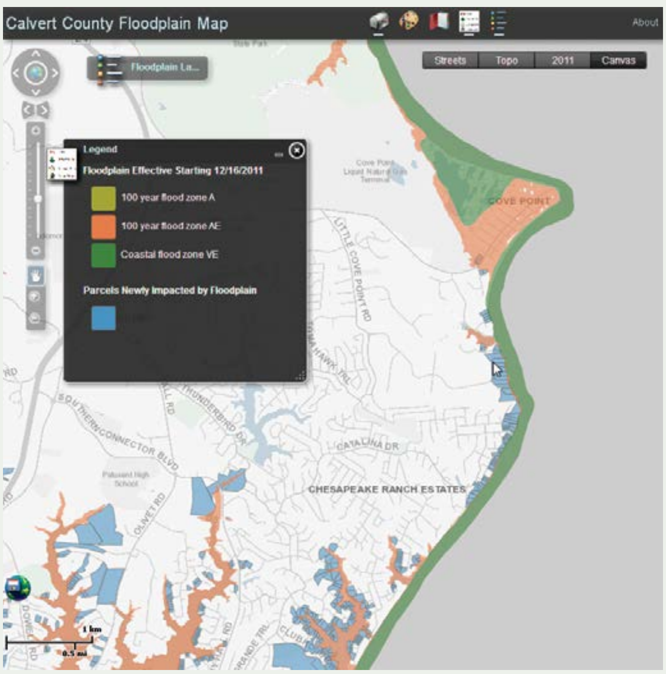
Agnieszka Nowakowska heads the Geospatial Unit in the Central Statistical Office of Poland that is responsible for the implementation of the Geostatistics Portal project that presents the census results. She was the manager of the Census Management Center during Agricultural Census 2010 and Population and Housing Census 2011. Nowakowska is a graduate of Warsaw University of Technology, Faculty of Geodesy and Cartography, and completed postgraduate studies on project management at Warsaw School of Economics.

Marta Orłowska-Krzyżyk is the marketing specialist at GISPartner. She has a master's degree in business management at the Technical University of Wrocław. She has worked for GISPartner since its inception in 2003 and uses GIS tools every day.

Geospatial Outreach

Calvert County creates public-facing GIS

By Matthew DeMeritt, Esri Writer



↑ The Calvert County Floodplain Map helps homeowners determine their current flood risk, as well as future flood risk, based on the preliminary Digital Flood Insurance Rate Maps (DFIRMs).

Over the past year, the GIS team for Calvert County, Maryland, launched an ambitious expansion of GIS services to local citizens. Using ArcGIS API for Flex and a vendor-designed solution based on ArcGIS API for Silverlight, Calvert's small GIS staff quickly designed and deployed a wide array of web maps that put information about the county's history, recreation sites, the environment within easy reach of the public.

It started with a needs assessment more than 10 years ago. Calvert County officials funded an exploration of the potential benefit of developing a GIS program. Based on that assessment, the county began developing a geospatial program with the help of Geographic Technologies Group (GTG) from North Carolina.

At the time, Kathy O'Brien, GIS coordinator at Calvert County, served as the only staff for the program. She worked with GTG to acquire new aerial imagery and build a substantial foundation of GIS data. In the next two years, planimetric, street, and address data was developed, and the construction of a full parcel dataset was under way.

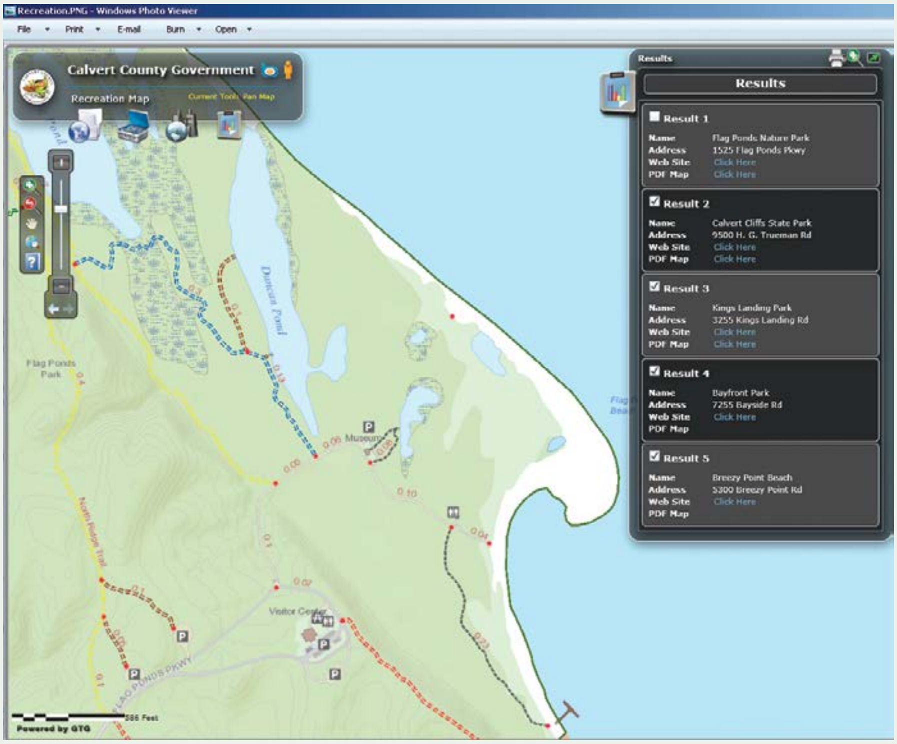
By the end of the second year, an internal desktop GIS client was rolled out to county departments. In time, the tools, data, and mapping services for county departments grew, as did the GIS group. Two additional GIS staff members were hired. "As soon as the departments started seeing what they could do with GIS, they really wanted to use it," said O'Brien.

Engaging Public Maps

At the same time, interactive maps became more common on municipal websites, and the tools for creating browser-based maps were easier to use.

"We wanted to make sure the citizens of Calvert County were also able to access the power of GIS," said O'Brien. To get quality, interactive maps out to the public, GIS analyst Erick Pate and team

↓ Calvert County's Historic Imagery Viewer allows visitors to look back in time at the growth of businesses and housing since 1938.



↑ Citizens of Calvert County can use the Recreation Map to locate parks and facilities and other natural resources in the county.

began working with GTG's Geoblade Web, which uses ArcGIS API for Silverlight, to roll out public-facing maps. At the same time, they were creating maps using ArcGIS API for Flex.

"We used both platforms to suit different needs of each mapping project," said Pate. "We wanted to use the platform that best suited the purpose of the map being developed. Geoblade is easily configurable and provides a nice collection of tools and controls. The maps are a good way for the public to perform basic spatial analysis."

Geoblade Web is primarily used to help local residents determine whether their property could be subject to strict development regulations designed around the Chesapeake Bay Critical Area. Maryland's Chesapeake Bay has been a major state issue since the harmful effects of pollution became apparent in the 1970s. Using the county's large store of spatial data, Pate created an interactive map that identifies the protected area, which extends 1,000 feet inland from the Chesapeake Bay, as well as its tributaries and tidal wetlands. Because complex regulations govern development in this critical area, Pate's map serves as an essential "first look" for local property owners considering any type of construction. Residents can also use Geoblade Web to view topographic and property information or to search for specific recreational opportunities.

The GIS team used ArcGIS API for Flex to create applications and give residents quick, easy access to information when an extensive collection of mapping tools isn't required. The county's Floodplain interactive map, which helps citizens determine whether a property meets flood insurance requirements, was an ideal project for ArcGIS API for Flex. The GIS team also uses this API for maps of county-funded capital construction projects; local election districts, precincts, and polling places; and census data.

Compared to similarly sized counties, Calvert has an unusually large amount of aerial flyover imagery that goes back for decades. Its first aerial capture is almost 80 years old and was (figuratively) collecting dust until Eric Benson, another member of the GIS team, included it in its Historic Imagery viewer. Ten other captures taken in the intervening decades were also included as base layer options within the Flex-based viewer.

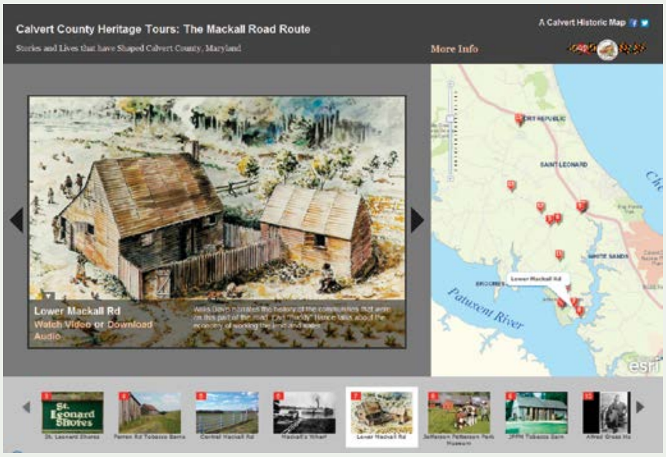
"The Historic Imagery viewer is a good example of data being useful in the proper format," said Benson. "Comparing images in a format where you can toggle between maps is much easier than flipping through hard copies of aerial maps."

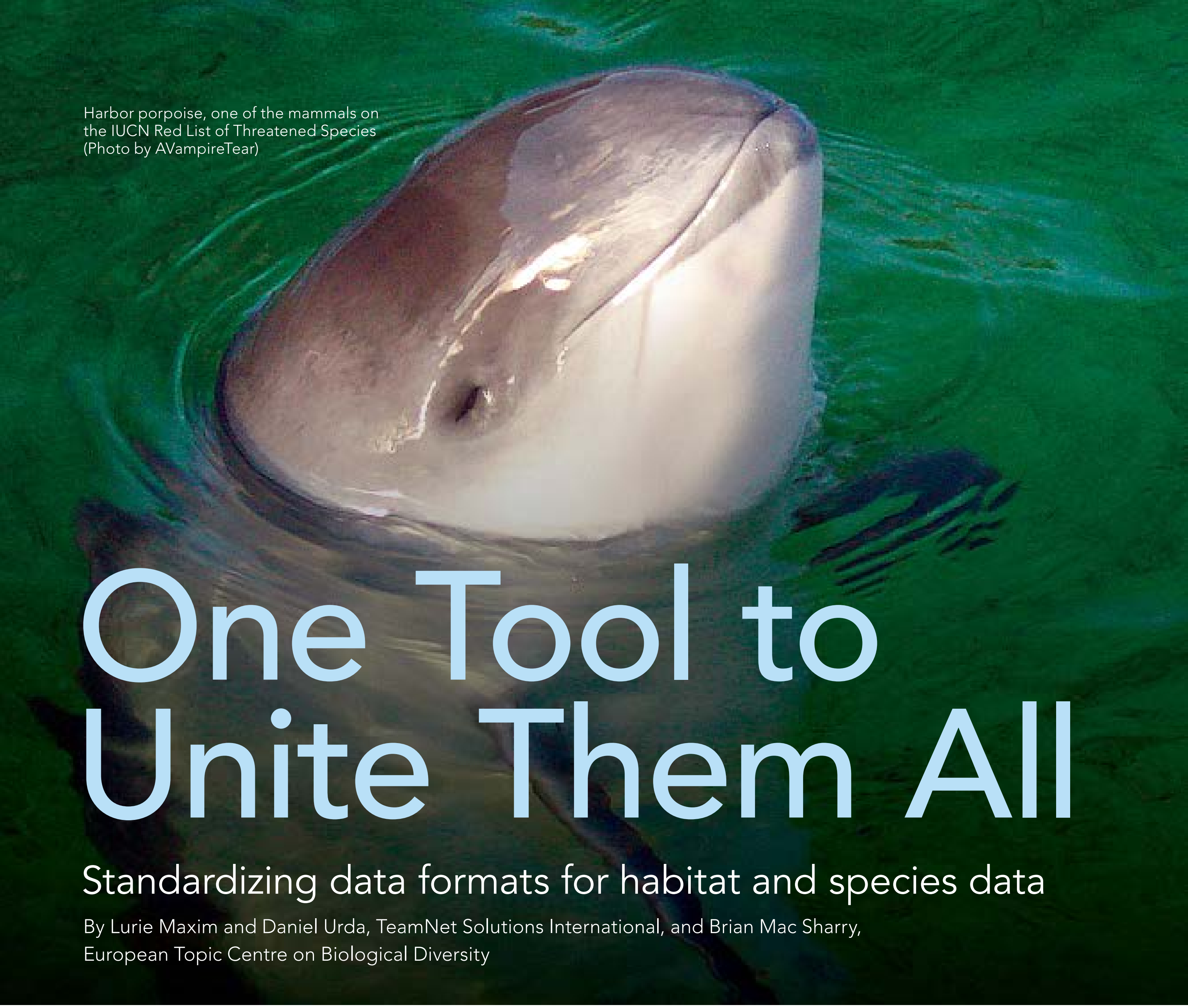
Benson can also take credit for a story map that has won the acclaim of city managers, residents, and Maryland tourists. The Mackall Road Route story map was created to accompany the county's Community Planning and Building Department heritage tour project. The interactive map highlights 15 locations along Mackall Road. Click on one and a narrated video opens that explains the story behind that location.

The county GIS website also provides access to an archive of scanned historic maps going back centuries. Visitors can browse and zoom in to its curated collections for reference purposes or simply out of curiosity.

"The beauty of these mapmaking tools is how easily they plug into our geospatial system," said O'Brien. "We can add new sites as needed at a comfortable pace." Calvert will continue to add specific web maps to its interactive maps collection as requested.

↓ Eric Bension created the much acclaimed Mackall Road Route story map to accompany the county's Community Planning and Building Department heritage tour project.





Harbor porpoise, one of the mammals on the IUCN Red List of Threatened Species (Photo by AVampireTear)

One Tool to Unite Them All

Standardizing data formats for habitat and species data

By Lurie Maxim and Daniel Urda, TeamNet Solutions International, and Brian Mac Sharry, European Topic Centre on Biological Diversity

Editor's Note: The European Topic Centre on Biological Diversity (ETC/BD) is an international consortium that assists with the European Environment Agency (EEA) in reporting on Europe's environment, provides information that aids development of sustainable policies, and builds infrastructure for carrying on these tasks. The ETC/BD had a tool developed and delivered in an ArcGIS Python toolbox that helps member states convert locally available data about distribution of species and habitat types into a standard format for analysis and sharing.

During the last decades, the European Union (EU) and European Environmental Agency (EEA) have led the struggle to conserve Europe's natural environment through extensive funding and by establishing a uniform practice in the field for all member states.

The Habitats Directive and the Birds Directive are among the most important legislation addressing the problem of nature conservation. These documents instituted the Natura2000 network of protected sites, which seeks the preservation of habitats and species of community importance for future generations.

The Habitats Directive's objective is to ensure that all the species and habitats of community interest, which are listed in its annexes, will be maintained at or restored to favorable conservation status. Article 17 of the Habitats Directive established a requirement that reports on the implementation of the Directive be prepared by the member states and be sent to the European Commission. A similar provision is found in Article 12 of the Birds Directive. These reports, submitted every six years, must provide extensive data regarding the conservation status of species and habitats that are favorable, inadequate, unfavorable,

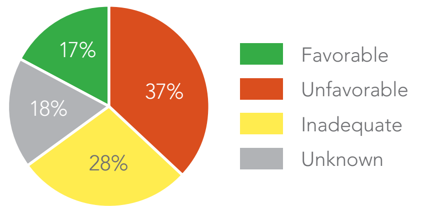


Figure 1: Habitats Conservation Status in 2007

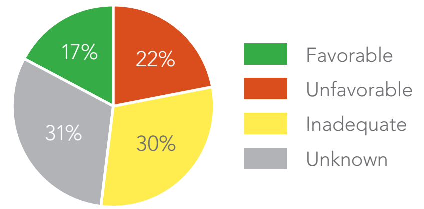


Figure 2: Species Conservation Status in 2007

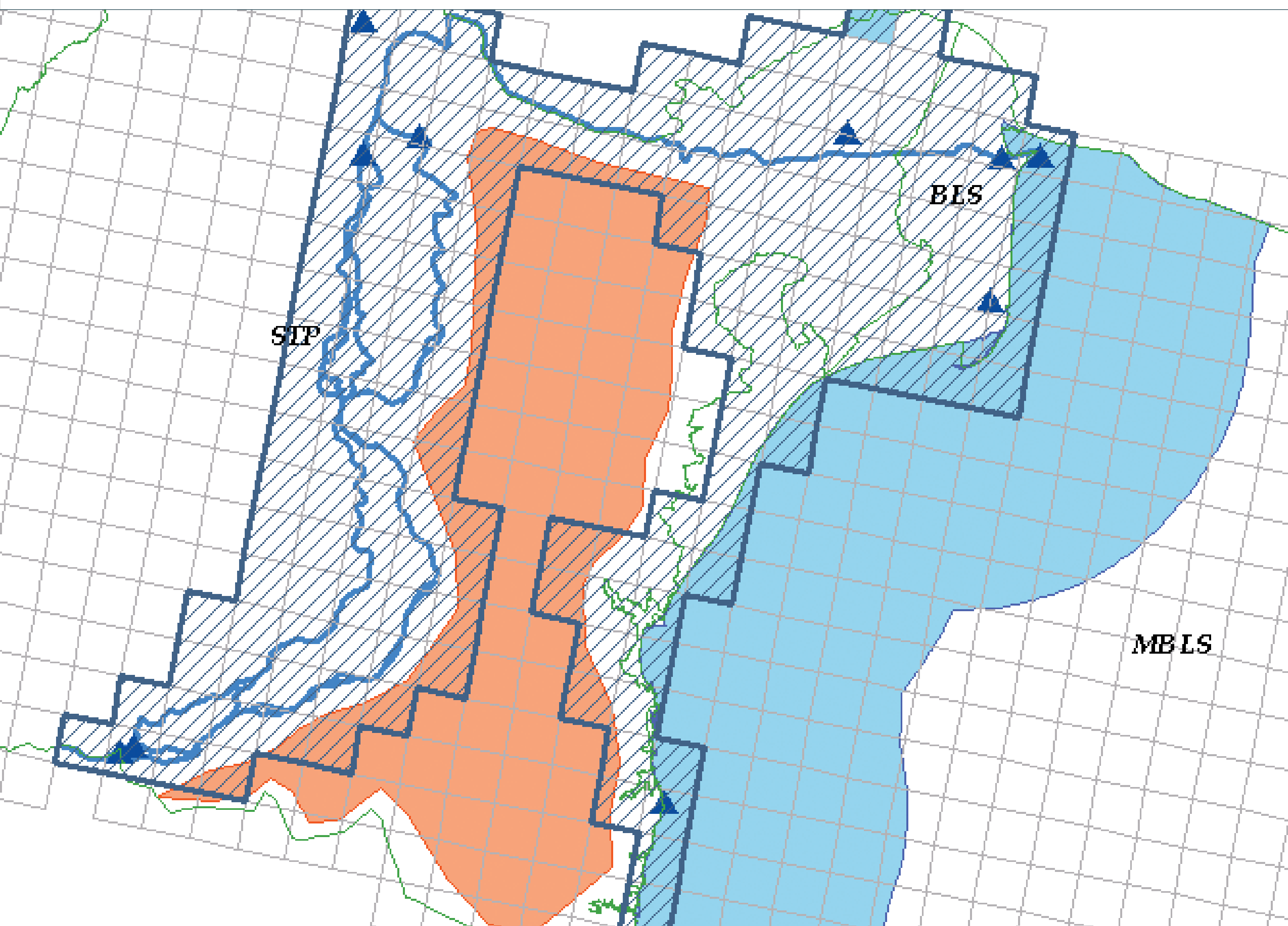
or unknown. In the 2007 report, only 17 percent of the assessments of species and habitats were assessed as favorable. For a significant percentage of species and habitats, data was insufficient to assess the conservation status.

Among the provided data, of primary importance is the geographic distribution and range of the species or habitat types, which is (naturally) in a GIS format. While most member states have collected data on habitats and species of community importance, the data is inconsistent. Different member states have opted for different means of representing this data. Some states maintain precise observations of particular species or habitats, while others have identified contiguous areas where a certain habitat type occurs. Other states have data based on a national grid system,and still others have data in a variety of forms. In 2007, the 25 EU member states provided approximately 16,000 maps that used 32 projections.

It is crucial that this data be harmonized and aggregated across member states so it can be adequately analyzed and the conservation status of species and habitats assessed at the European biogeographic level. Consequently, the EEA and ETC/BD wanted to provide national organizations in all 27 member states with tools to create standardized outputs that could be used for the June 2013 reports.

The actual task of developing a tool for this spatial data was awarded by ETC/BD to TeamNet International, Romania. Because ArcGIS for Desktop has been adopted on such a large scale by national environmental agencies and environmental organizations, it was decided that the tool should be delivered in the form of a Python-based toolbox. The tool, publicly available on the EEA website, provides compatibility with ArcGIS for Desktop from versions 9.3.1 to 10.1.

Known as RangeTool, this tool helps member states convert locally available data about the occurrence or observation of species and habitat types into a standard format. Besides providing a consistent



format, the tool also computes the range for the selected species or habitat types. Both outputs are based on a user-chosen grid system (either national or Europe-wide). Both are represented as merged cells of the original reference grid that was provided as input.

While RangeTool generates distribution data by simply combining the different data provided by the member states and matching it with the grid cells, a more complex approach is needed for calculating the range. A natural range is determined by ecological conditions. It can be discontinuous and have gaps. Incomplete observational data also contains gaps. During the previous Article 17 reporting period, each member state designed its own algorithm for calculating range. As a result, the quality of reported ranges was uneven.

RangeTool generates grid-based ranges for species and habitats in an automatic and consistent way. It uses as input a grid-based map of distribution derived from locations of confirmed sightings or occurrences. In addition to existing distribution data, the tool requires information about the correlation between certain species or habitat types and biogeographic regions. Such data is provided in tabular form and GIS format by the ETC/BD.

RangeTool leverages both formats to adjust the generated ranges to existing biogeographic regions. Consequently, the range will extend only over those biogeographic regions for which species or habitats were reported as present. It also provides a method for excluding from the range locations and areas where certain species or habitat types cannot extend such as a large body of water for terrestrial species or habitats or large urban or industrial areas. The tool can generate a single range for species split across multiple files, even when geometries differ.

RangeTool also offers quality control for input data. It uses the tabular data about the correlation between species, habitats, and biogeographic regions. The tool can inform the user about the lack of presence in an expected biogeographic region, or conversely, the presence in an unsuitable biogeographic region. Optionally, the RangeTool quality control can also make use of the data reported by member states regarding the occurrence of particular species or habitats in Natura2000 sites (along with the geographic extent of the sites). In this case, the tool also notifies users about the lack of occurrence or observations data about species and habitat types in the sites in which the species or habitat have been reported but where no distribution data was provided.

Conclusion

RangeTool helps EU member states harmonize available spatial data about species and habitat types of community importance so they can submit standard reports in June 2013, making the assessment of the conservation status for European biogeographic regions easier and more accurate. RangeTool can be downloaded from the European Topic Centre on Biological Diversity website at http://bd.eionet.europa.eu/activities/Reporting_Tool/Reporting_Tool_Software

More details about the 2007 assesment of the conservation status can be found at http://bd.eionet.europa.eu/article17.

Sperm whale, another mammal on the IUCN Red List of Threatened Species (Photo By Gabriel Barathieu)

About the Authors

Lurie Maxim, PhD, is GIS manager for TeamNet Solutions International from Romania. He worked as director of UNESCO Pro Natura NGO, as head of protected areas service within the Romanian Ministry of Environment, and as Article 17 project manager in the European Topic Centre on Biological Diversity of the European Environmental Agency. He has extensive experience in GIS as related to nature conservation and protected areas.

Brian Mac Sharry, PhD, is a GIS manager at the European Topic Centre on Biological Diversity of the European Environmental Agency. He has extensive experience in GIS as related to nature conservation and protected areas at both the national level (in Ireland) and at the European level.

Daniel Urda is a GIS developer at TeamNet Solutions International. He has extensive experience using the ArcGIS framework for developing tools for nature conservation. He graduated with a degree in computer science and is currently studying for a master's degree in distributed systems at Vrije University, Amsterdam.

Wolverine, a species onthe IUCN Red List of Threatened Species (Photo by Zefram)

From Months to Minutes

Web mapping empowers transportation authority's customers

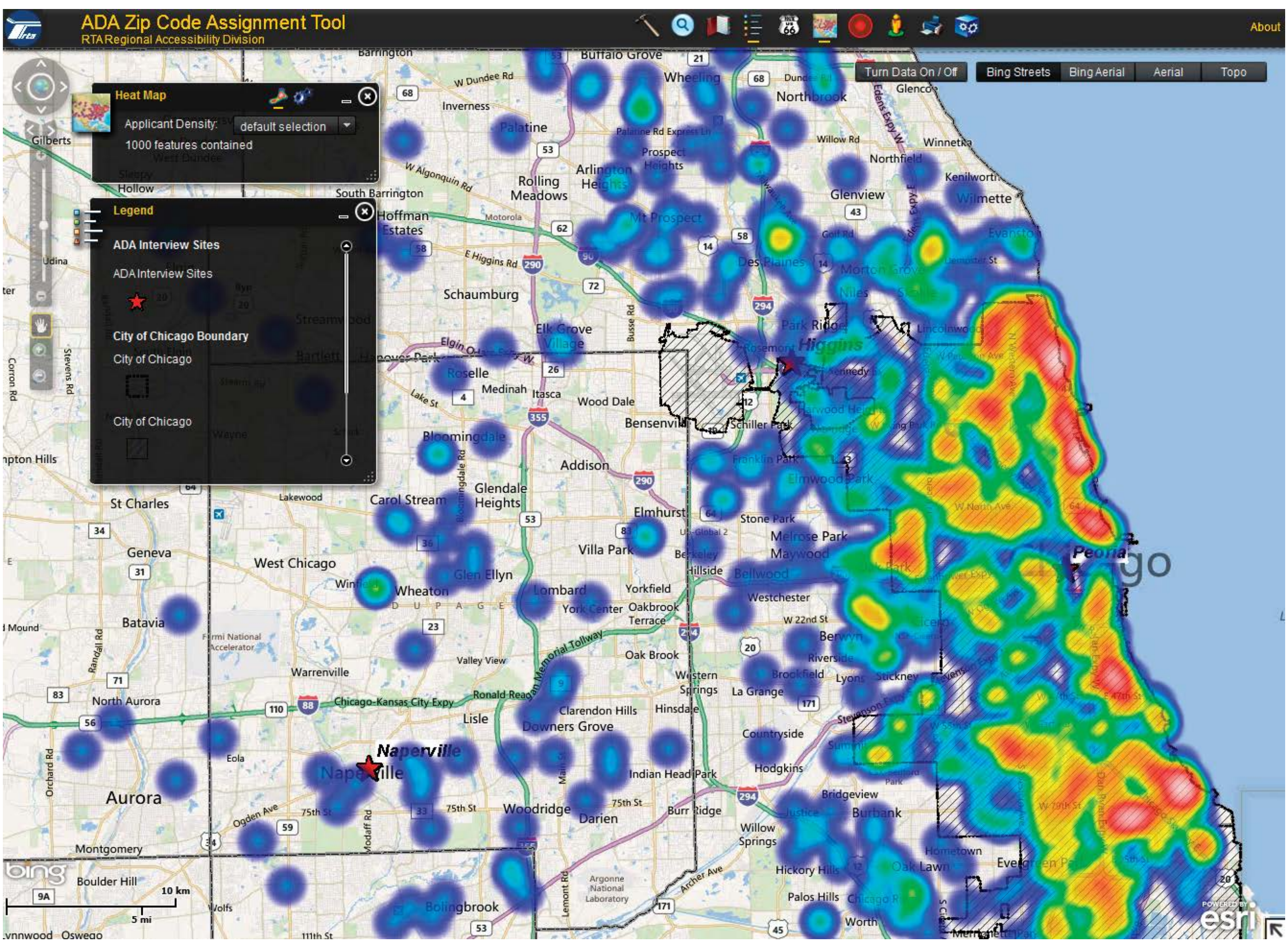
By Matthew DeMeritt, Esri Writer

Web mapping applications created by an Illinois regional transportation authority have made it much more responsive to requests from both internal and external customers and saved both time and money.

The Regional Transportation Authority (RTA) oversees three transit agencies in northeastern Illinois. Together, those agencies provide nearly 2 million rides per day, making it the third-largest public transportation system in North America. As the planning and financial oversight agency for Chicago Transit Authority (CTA), Metra, and Pace Suburban Bus, RTA warehouses planning and financial information for the northeastern Illinois transit system on a public-facing website called the Regional Transportation Authority Mapping and Statistics (RTAMS.org). The website now enables the public and affiliated agencies to perform geospatial analysis on corridor, demographic, and most transit-related data through various specialized browser-based map viewers.

Prior to the creation of its new digital system, each map request RTA received involved several time-consuming procedures. "Requests for mapping each senate district, or for maps of every house district, literally required at least a month of solid work," said Brad Thompson, an RTA planner. Instead

↓ RTA staff use the ZIP Code Assignment Tool to identify potential new facility locations based on user origin densities.



of ordering separate hard-copy maps of Chicago's dozens of wards and districts, visitors can now go to an online map where they can interactively select a dataset, transit service, or jurisdiction and view it.

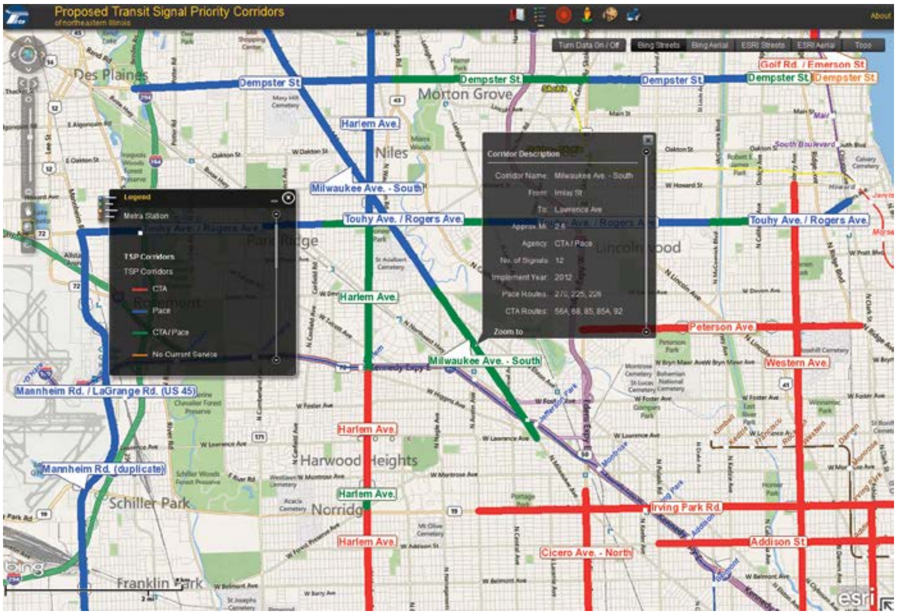
"Now, we'll get a request in the morning, and I can publish one .mxd file by the afternoon," said Thompson. "Visitors can run their own type of spatial analysis—and they don't ever have to know what a shapefile is or how to open an attribute table."

How did this happen? Although RTA had no dedicated full-time GIS staff, planners Thompson and Hersh Singh are experienced GIS users. However, they had little programming expertise.

Thompson attended the Esri International User Conference in 2010 to investigate software-based mapping solutions that required minimum coding skills. "After seeing a demo of ArcGIS API for Flex where an Esri staff member created an interactive map in minutes, I knew that was the solution for creating a browser-based map system to phase out RTA's paper map production process," said Thompson.

"The customizable appearance of Flex and the ability to easily add functionality with minimal coding inspired us to dive deep into it." Within months, Thompson and Singh had created multiple browser-based applications that served the needs of internal transit staff and the public.

RTA's web apps range from maps for identifying RTA-managed transit-oriented development studies to maps that display demographic data indicating an area's potential to generate local transit trips based on transit trip rates. Serving this information on the web makes it possible for users to interact with data, allowing user-defined scaling, queries, and other functionality that would not be possible with static paper maps at fixed scales.



↑ Users can identify and view associated information on proposed Transit Signal Priority corridors in northeastern Illinois.

RTA can easily add and customize content and tools using ArcGIS Viewer for Flex. The default configuration includes tools and preconfigured templates for serving geospatial content in a browser-based viewer. Capabilities of an application can be extended by customizing the default widgets that are included or by using widgets that have been created and shared by the Esri community. These resources enable heat mapping, routing with directions and travel times, querying, editing, and exporting maps as JPEG files.

Since installing ArcGIS for Server and learning the ins and outs of Flex, Thompson and Singh have deployed numerous mapping applications that assist in the management of RTA programs. One of RTA's mapping applications includes an Interview Site Assignment Tool used for assigning Americans with Disabilities Act (ADA) paratransit applicants within a ZIP Code to the nearest ADA site, where their ability to take fixed route transit services can be assessed.

Using an editing widget, staff can reassign ZIP Codes to different interview sites based on applicant wait times to be seen for an appointment. Thus, the wait times at each of five interview sites is monitored, and, when necessary, ZIP Codes can then be reassigned to other sites to equalize wait times among all sites.

RTA also designed and deployed a Travel Training Trip Manager for ADA customers. This application greatly increases staff efficiency by combining several tasks in one easy-to-use mapping interface. The RTA Travel Training Program teaches individuals with disabilities and older adults how to use fixed-route buses and trains.

To evaluate if a fixed-route trip is an option, RTA staff go through a lengthy process of collecting information regarding the potential trip. The ADA Travel Trainer Trip Manager then provides a one-stop location for collecting all pertinent information in the evaluation of a potential fixed-route based trip. Once deployed, this application immediately resulted in increased travel training staff efficiency and productivity.

RTA will also soon deploy a mobile data collection and editing tool for managing interagency signage throughout the region. Based on ArcGIS Runtime SDK for iOS, the app will allow staff to add new sign locations using the device's GPS as well as collect and edit attribute information in the field.

ArcGIS for Server has enabled RTA to serve many different geospatial datasets internally and externally. Now geospatial analysis is available to the public and staff without requiring they know anything about GIS.

Civic Crowdsourcing Enabled

Local governments strapped for funds can take a hyperlocal approach to funding community projects using a new GIS-based application. ZenFunder is a web application for civic crowdsourcing that lets residents help make their community a better place to live by proposing or contributing to projects in their neighborhood.

Monies raised go directly to solving a specific problem instead of disappearing into a general municipal fund. The application is unique in that it allows residents and governments to collaborate. Because cities, elected officials, and neighborhood councils can participate without being charged processing fees, 100 percent of committed money goes to funding projects.

A funding platform like Kickstarter, ZenFunder provides a quicker way to translate a good idea into reality. Built specifically to meet the needs of local government and education, it combines "crowdfunding" with participatory budgeting. ZenFunder makes sure requirements, budgets, and assessments are completed. Organizations that join ZenFunder can use either the free or premium versions. For an annual fee, the premium version provides more robust tools for managing funds.

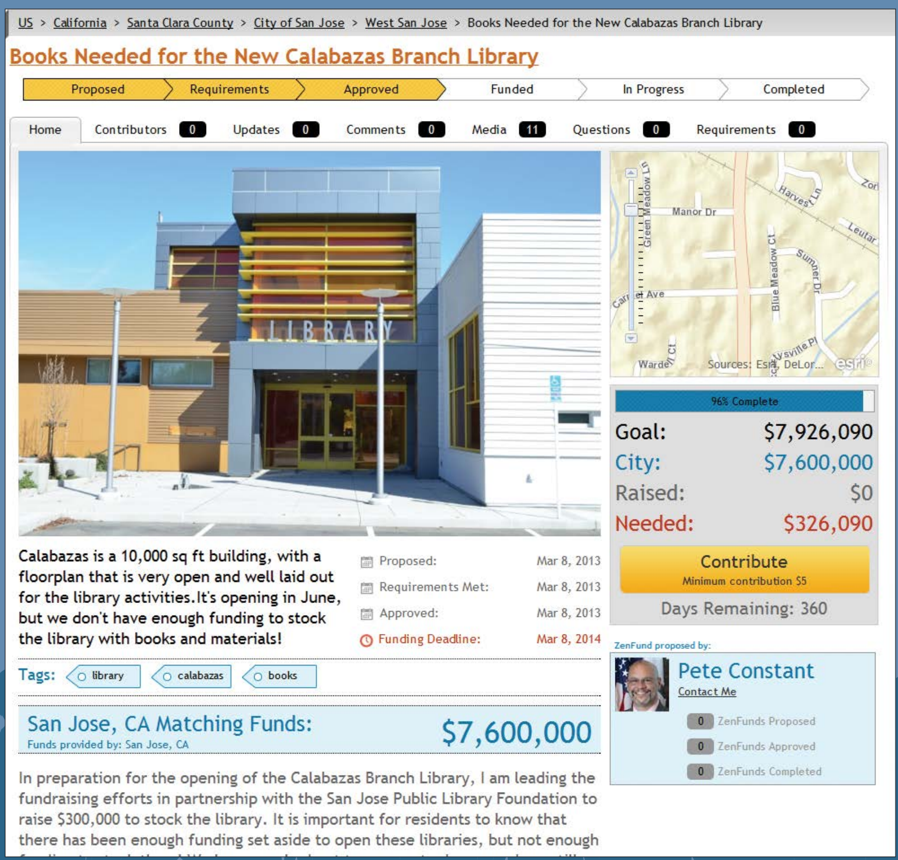
With either version, after a city signs up for ZenFunder, anyone can create a new project. Once a project reaches a minimum funding threshold, it is reviewed by the city. If it is not approved, the money is returned to contributors. If the project is approved, it is posted on the website along with project details, requirements, and community comments. Project locations are mapped so residents can easily find projects to fund that are nearby. Contributions can come from local government, corporate sponsors, and community members.

In recent years, funding for projects that significantly contribute to the quality of life in communities has grown scarce for several reasons. Property taxes, the major source of revenue for most local governments, were adversely affected by the downturn in real estate values that began in 2007 and has still not completely reversed itself, according to a report for fiscal year 2012 issued by the National League of Cities. To fill holes that appeared in budgets, many governments depleted their reserves, which has, in turn, caused rating agencies to downgrade them, making it more difficult and expensive to borrow funds. Funding for local projects through the Community Development Block Grant (CDBG) program is also a less viable alternative. Between 2002 and 2013, total grant expenditures declined 23 percent according to a report issued by the US Department of Housing and Urban Development.

ZenFunder offers an alternative and innovative method for meeting a community's needs. When he first learned about ZenFunder, San José City council member Pete Constant immediately recognized its potential for aiding the city. The first project was raising additional funds to complete the Calabazas Library, which has been closed for remodeling for about two years. Although $7.6 million had been spent on the structure, no funds were set aside for stocking the library shelves. This project would raise a little over $325,000 to improve the library's collection. Two other projects, both for pedestrian crosswalk flashing beacons to improve safety at busy crosswalks, have also been proposed.

"ZenFunder is based on the premise that if everyone gives a few dollars, we can fund important hyperlocal projects that directly benefit our community," said Constant. "This is really democracy in action."

↓ Using ZenFunder, residents can work with government to improve their neighborhoods.



Making It Real

"Live by the Code"

By Monica Pratt, *ArcUser* Editor

Tech, code, and people: Esri program manager Jim McKinney used those three words to summarize the Esri International Developer Summit (DevSummit), held March 25–28, 2013, in Palm Springs, California.

"It's about the tech—the technology, the products—as much as it's about the code. It's really about the people," he said at the start of the Plenary Session. "It's about you, real people, doing real things, that matter."

The nearly 1,600 attendees who came for the eighth annual event by developers, for developers, *were* the focus all four days. "You are the people who can think through what is needed and wanted," said Esri president Jack Dangermond. To that end, Esri shares its development strategies—both immediate and long term—and best practices for working with Esri development tools.

But DevSummit is more than a show-and-tell event. It brings those who develop with Esri technology face-to-face with those who develop it. Developers interacted directly with the more than 300 Esri software development staff who were available throughout the summit.

This year, the number of attendees who focused primarily on GIS development nearly equalled those who were mainstream developers. The balance of attendees indicated they were academics, managers, and business owners. More than a third of the attendees were from outside the United States, and nearly a third were first-time attendees. For those actively writing code, the majority use JavaScript, followed by Python and .NET.

The 2013 DevSummit packed a lot of activity into four days. The presummit hands-on workshops on iOS 6, Dojo, HTML5, JavaScript, and Python were sold out. Technical and user presentations dominated the agenda, which was supplied exclusively as a phone or tablet app. While sessions were shorter and more focused, there were 28 more of them this year. User presentations were voted on by the attendees.

Shorter and less formal tech transfer sessions continued into the evenings. In Speed Geeking, Esri staff gave five-minute presentations on various aspects of the technology to constantly changing groups of 8 to 10 attendees. Lightning Talks shared knowledge on a range of topics through rapid-fire presentations by attendees.

↓ Jeff Jackson, who leads the applications development teams, emphasized that Esri builds applications using its own SDKs, or "eats its own dog food."

Attendees could show their skills at the Hackathon.

In formal presentations and informal discussions, the new generation of Esri technology was the underlying theme. As Dangermond observed, "This generation of our tools is—I'll just say the word—*transformational*, because it moves it into a new space, a platform space, and the opportunities are immense to be able to configure and take geography and geographic understanding everywhere."

Making It Real Time

Esri technology for dealing with Big Data was a wildly popular topic at DevSummit. Esri technology evangelist Mansour Raad introduced the newly released GIS Tools for Hadoop, which deal with the volume, velocity, and variety of Big Data by taking advantage of cooperative processing between Hadoop and ArcMap to spatially analyze, visualize, and interactively query billions of records.

At ArcGIS 10.2, Esri will release ArcGIS GeoEvent Processor for Server, a new approach for helping discover the value of the flood of data being captured through sensor networks in real time. "There probably are more sensors in this room than there are people," said Adam Mollenkopf, the product lead for GeoEvent Processor, during the Plenary Session. "As a developer, leveraging these sensors in your applications can provide tremendous value to your end users."

The extension lets ArcGIS for Server ingest real-time data from data sources ranging from Twitter to Sierra Wireless devices using connectors. Because many of these connectors will be available on GitHub, they can be tweaked to meet specific needs, or the software development kit (SDK) can be used to create custom connectors.

Continuous processing and analysis are performed on events as they are received. The stream processing logic can filter streams based on event attributes or the current location of sensors inside or outside an area of interest. Output can be integrated with operations dashboards or custom apps created with any ArcGIS API or ArcGIS Runtime SDK to use real-time data for more immediate response.

Disconnected Productivity a Reality

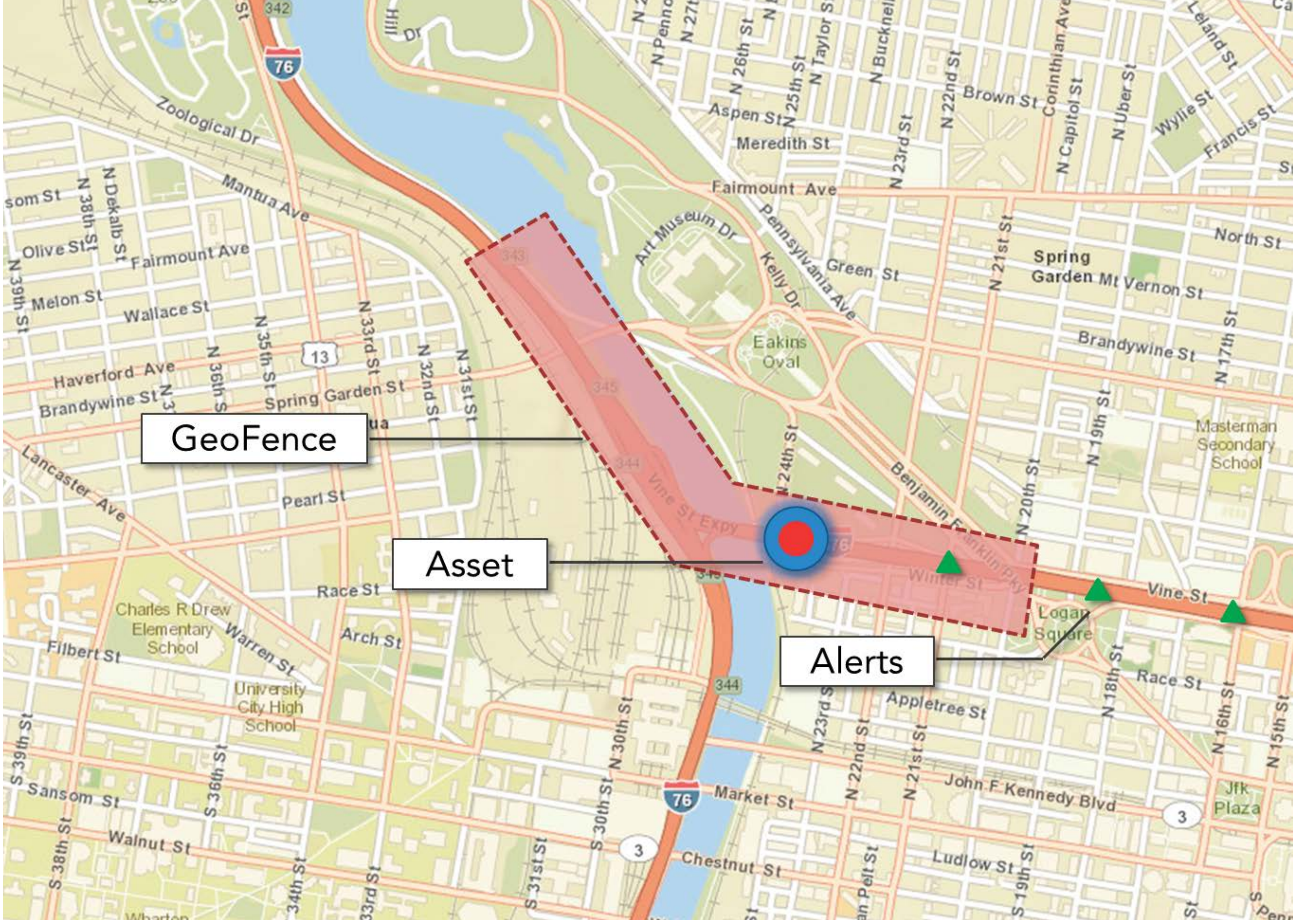
Esri developer Euan Cameron outlined the evolution of the ArcGIS Runtime SDKs and APIs, another piece of the Esri platform. These are a common set of technologies deployed to the desktop, embedded in systems, and used on phones and tablets. With the next full release of the ArcGIS Runtime SDKs and APIs this summer, functionality of the core will increase so more can be done when devices are disconnected from the online infrastructure or local server.

Just what can be done with mobile devices at ArcGIS 10.2 was demonstrated by Esri Runtime SDK product engineer Will Crick. After accessing a map authored in the cloud using a modest smartphone, Crick put the device in airplane mode and then queried and edited data, performed reverse geocoding, and did some routing—all with the airplane icon prominently displayed on-screen.

How was this possible? Data and functionality were downloaded to the device as a geodatabase implemented using SQLite. In addition, if connectivity becomes available, the device can be synchronized with the cloud. "We're going to release this across all the Runtime SDKs at 10.2, and when we do that, we believe we're going to be the first mapping API that has this offline capability," said Crick.

Decisions, Decisions, Decisions

In his summit keynote, speaker Jared M. Spool observed that "the best products are made up of decisions, lots of decisions." How the design decisions that affect interface design are made was the topic of his speech.



↑ The release of ArcGIS GeoEvent Processor for Server with ArcGIS 10.2 was announced. It employs a new approach for helping discover the value of the flood of data being captured through sensor networks in real time.

The founder of the world's largest usability research organization, User Interface Engineering, analyzed numerous examples from the web to show how each demonstrated one of the five styles of design: unintended, self-design, genius, activity focused, and experience focused.

Over decades of studying how successful companies make design decisions, he has found that two design approaches—activity focused and experience focused—which are not based on rules or dogma—yield far superior results because in design work, "exception cases far outnumber normal cases. So you're always designing for exceptions. You're always designing for constraints. You're always designing for trade-offs. So this is key."

Knowing these patterns, design comes down to simply answering the question, What kind of designer do you want to be? "And I've got to tell you, none of this is rocket science. I can tell you it's not rocket science because NASA's one of our clients, and they have very strict rules as to what is rocket science. They have told us, 'This is definitely not it.'"

You Are the Button

Amber Case's Plenary Session talk on location and the future of the interface focused even more precisely on developing effective interfaces for GIS applications.

Case, former CEO of recently acquired Geoloqi and now head of the Esri R&D Center in Portland, Oregon, is deeply interested in the interaction of humans and computers. She noted that tools have evolved from being extensions of the physical self to extensions of the mental self. Unlike physical tools that retain the same size and function, mental tools are much less constrained and change form and function rapidly.

Buttons on the interface move, morph, and—increasingly—melt away. With the addition of locational awareness, buttons may no longer appear on the interface because the user becomes the button. The user's location triggers events. This makes interaction with the application far less intrusive because locational context lets the application anticipate the user's needs and wants.

In closing, Case said, "I'd encourage all of you to think a little bit wider—how you can solve real-world problems by adding locations and how you can actually bring more of what was formally stuck on the web as static content to life [by] assigning location to it and delivering it to where it actually is, where people actually are."

Starting Out Showing Off

True to the summit motto, "Live by the Code," the Esri DevSummit Hackathon kicked off festivities on March 24 at 1:00 p.m. With dinner and snacks provided, contestants toiled through the night in a large ballroom. They used the new ArcGIS for Developers website; Esri web and/or mobile APIs; and data from Riverside County, California, to come up with innovative location-based apps. The next day, weary competitors Christopher Moravec, Mara Stoica, and Ryan Colburn, creators of the Animal Spotter App, emerged as the winners and were rewarded with DevSummit passes. Michael

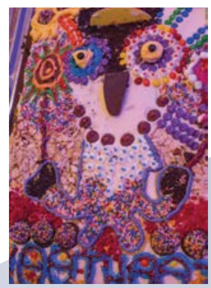
← Conference diversions included a cake-decorating contest.

van der Veeken and Paul Kaiser were second, and Christoph Sporri, Andry Joos, and Michael Faulcon were third.

Developers could also compete in another hackathon, the 100 Lines or Less ArcGIS JavaScript Code Challenge (ArcGIS.js <= 100) without setting foot in Palm Springs. The contest was run through GitHub, the web-based hosting service for software development projects. Phil Leggetter received a one-year subscription to ArcGIS Online with his winning entry. Stan McShinsky's was second, and Ognian Samokovliyski's was third.

Playing Hard Too

Good times, food, drink, and the famous Esri dodgeball tournament were on the agenda Wednesday evening. Much Ado about Balls topped 30 teams to win passes to next year's DevSummit. From a giant game of Jenga to a cake-decorating contest, attendees had a lot to keep them entertained throughout the evening.



After a few final technical sessions and the closing sessions, Esri staff and developers alike headed home after an intense four days with a better idea of how to work together more productively.

Build It
and Make Sure They Come

Seven steps to success with ArcGIS Online

As a GIS manager, you deal with limited resources—time, money, and staff—and the need to meet the rising expectations of your customers, both internal and external.

Those customers aren't as patient as they used to be. They expect maps in their apps, are used to apps that don't have a learning curve, and aren't going to wait for you to send them a PDF of a map.

You know all these things. That is why you wanted an ArcGIS Online subscription in the first place. Now that you have that subscription, here are seven steps that will help you get the most out of it. Follow these steps and your customers will use your site to help themselves, which will really help you.

1 Configure portal

2 Create groups

3 Organize useful content

4 Create useful information products

5 Provision users

6 Connect with enterprise systems

7 Evangelize

1 Configure portal

Don't just set up your account; sell it by making it useful and attractive to your organization by customizing it. You can change the Home page to brand it with your organization's look and feel by adding a custom banner, logos, and text. Think about how your organization works with geospatial information and what content it possesses. Decide what content to feature and create galleries to show it off. Entice and enlighten visitors with a featured content gallery that has custom thumbnails that make it easy to identify the content. For more information, see "Show Off: Make GIS resources more visible and valuable" in the Spring 2013 issue of *ArcUser* magazine.

2 Create groups

While you are thinking about how your organization uses geospatial information, also think about who uses it. Often, datasets, maps, and apps will be used by members of more than one department. Let the site encourage, not discourage, collaboration by creating groups for shared content. For more information on this and other topics related to setting up your site, see "Get Up and Running with ArcGIS Online for Organizations" in the Fall 2012 issue of *ArcUser*.

3 Organize useful content

ArcGIS Online will make all kinds of content available in a controlled manner. With ArcGIS Online, you can share map services, web maps, web apps, and packages of all sorts—layer, map, and geoprocessing. Inventory these existing resources and figure out who is using them and who could benefit from them. Register map services, web maps, and apps with ArcGIS Online and add links to useful content shared by outside organizations through ArcGIS Online.

4 Create useful information products

Use existing data, maps, and models to create web maps, web apps, map services, and other products that answer the questions and meet the needs of people in your organization. With the ArcGIS Online map viewer, your users can make their own maps. Not only do they get the information they need more quickly and easily, but you can make more productive use of your time by letting them help themselves using the content available at your ArcGIS Online site.

5 Provision users

Making ArcGIS Online a resource for the entire organization requires more than just creating groups for them. You will need to invite people to those groups. Show them the benefits of using the site, make them feel wanted, and get them involved as contributors. Your site needs their continued support to be successful.

6 Connect with enterprise systems

Your ArGIS Online subscription also lets you expand GIS to others in your organizations without having them learn a thing about GIS. With Esri Maps for Office, managers and knowledge workers can use your GIS resources without ever leaving the familiar confines of Microsoft Excel. For more details on using Esri Maps for Office in your organization, see "Extending GIS without Extending Your Day" in the Fall 2012 issue of *ArcUser*.

7 Evangelize

Don't let your ArcGIS Online site remain the organization's best-kept secret. Use every opportunity to demonstrate how everyone, not just GIS-savvy staff, can benefit from the information products you've created on your ArcGIS Online site.

ArcGIS Online needs to remain as dynamic as your organization. Staff changes, workflows are modified, and organizational priorities evolve. Your site should reflect these changes. Regularly add new users to groups and poll existing ones to learn what resources and products will help them work more efficiently. Evaluate not only group memberships but the need to create new groups or retire old ones.

Follow this game plan and not only will you make your ArcGIS Online site a highly visible asset to your organization but you will demonstrate the value of GIS in improving processes, communication, and efficiency.

What Can You Do with a Story Map?

Story maps, built using free Esri story map templates, are a great way to quickly build useful and attractive information products tailored to your organization's needs. You can do a lot more with story maps than identify the best restaurants in town or nearby historical landmarks. Organizations can use them to communicate policy, involve the community, promote a cause, demonstrate benefits, provide public information about an event, educate, or simply inspire.

A story map is a web map that has been thoughtfully created, given context, and provided with supporting information so it becomes a stand-alone resource. It integrates maps, legends, text, photos, and video and provides functionality, such as swipe, pop-ups, and time sliders, that helps users explore this content. It is a fully functioning information product. While map stories are linear in nature, their contents can also be perused in a nonlinear fashion by interacting with the map.

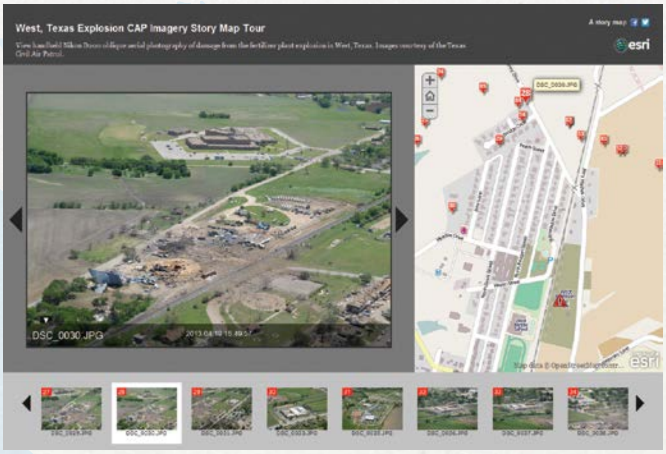
Using the templates, you can publish a story map without writing any code. You simply create a web map, supply the text and images for the story, and configure the template files provided according to the instructions in the download.

A constantly growing collection of free story map templates are available at the Storytelling with Maps website (storymaps.esri.com/home/). Currently, templates that create tours, map matrixes, multipaned comparison displays, and sidebars exist. The Esri Story Maps team is continually developing new templates that refine map-based functionalities and user experiences.

Story maps will help you get the most out of your ArcGIS Online account. You can create map stories to meet specific needs as well as share map stories made by others both inside and outside your organization.

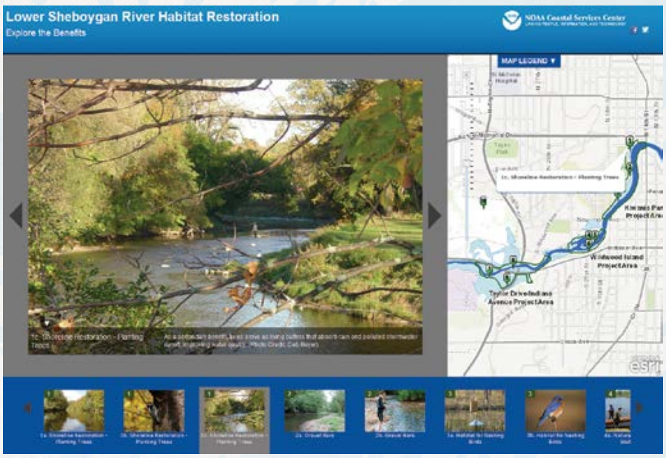
Get the Community Involved

The West Florida Regional Planning Council holds numerous events that promote community involvement. This story map highlights the events the council held in 2012 in a way that makes a connection between the people and places where these events occurred.



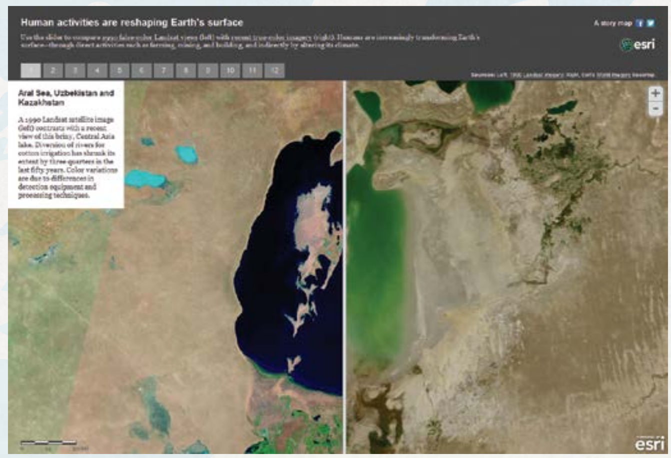
Provide Transparency

In this story map, residents of San Bernardino can see where and how public works money is being spent.



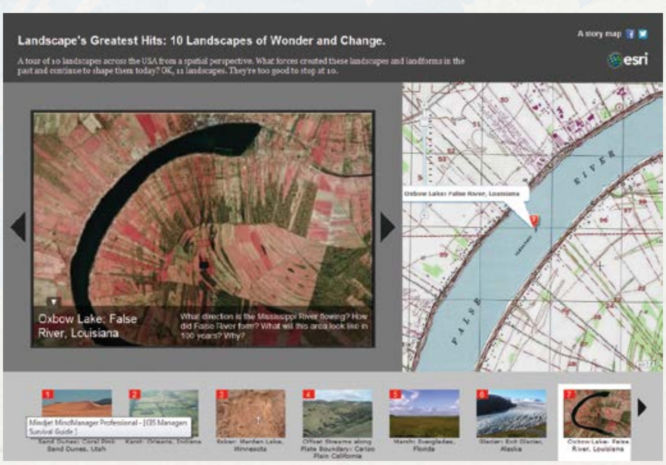
Demonstrate Benefits

This story map created by the National Oceanic and Atmospheric Administration (NOAA) shows the benefits from habitat restoration projects along the lower Sheboygan River that will help return the recreational, economic, and hydrologic benefits of healthy river habitat.



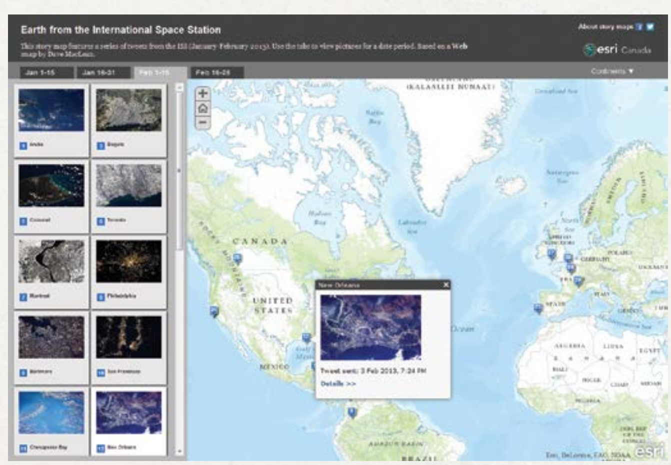
Give New Perspective

This story map provides insights into climate changes that have occurred in recent decades using images from Landsat's 40-year archive.



Educate

This collection of astonsihing landscapes provides a great starting point for learning more about the forces that shape landforms.



Inspire

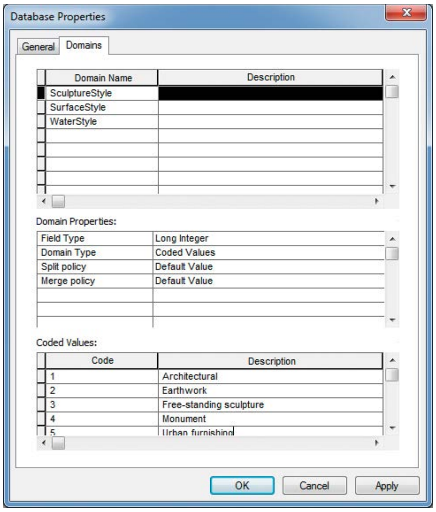
This story map shows a selection of Tweets from Commander Chris Hadfield from the International Space Station showing various sites in Canada.

Create Your Own Collector Map

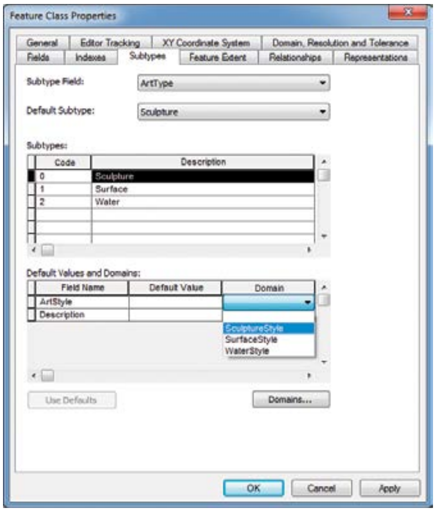
By Keith Mann, Esri Product Marketing

What you'll need:

- ArcGIS Online Subscription (free 30-day trial available)
- ArcGIS 10.1 for Desktop—Basic, Standard, or Advanced license level (free 60-day trial available)
- Collector for ArcGIS (available at Apple App Store or Google Play at no cost)
- A smartphone (iOS or Android)



↑ To make field collection quick and reduce errors, first set up domains on the Community file geodatabase.



↑ Next set up subtypes on the CommunityArt feature class.

Collector for ArcGIS gives you a new way to use your iPhone or Android smartphone to map information. With it, you can capture and update both tabular and spatial information using the built-in GPS capabilities of the device or by tapping on the map. Field crews can use Collector to plan routes, get directions to work locations, use data-driven forms to improve data input quality, capture photos and videos of assets, and seamlessly integrate information back into the organization's GIS.

In this tutorial, you'll learn how to create a basic Collector map from scratch. You'll be able to use the map in the Collector for ArcGIS app to go out into the field and collect locations and a few attributes about landmarks in your community.

Getting Started

First, create a workspace and map layer for this project.

1. In Windows Explorer, create a new folder named CollectorProjects.
2. Open ArcCatalog and, in the Catalog tree, right-click Folder Connections, click Connect to folder, and then navigate to the CollectorProjects folder. Select it and click OK.
3. Right-click the CollectorProjects folder, choose New > File Geodatabase, and name it Community.
4. Right-click the Community geodatabase and create a new point feature class named CommunityArt. For coordinate system, choose WGS 1984 Web Mercator (auxiliary sphere). Click Next. Accept all the default settings until you get to the Fields panel.
5. In the Fields panel, add three new fields named ArtType, ArtStyle, and Description. Make the Data Type for ArtType and ArtStyle fields Long Integer. Make the Data Type for the Description field Text.
6. Leave ArcCatalog open. Click Finish to close the Feature Class Properties dialog box.

Create Domains and Subtypes

When you create a Collector map, you'll want to make it as easy as possible for the person using Collector to capture attributes of the things they're collecting correctly. You do this by providing organized lists of the attributes so that the person using the map can simply choose the correct attribute from the list. This makes data collection more efficient and reduces errors caused by typing on a small smartphone screen.

In this step, you'll create three lists (called domains). Each list represents a different style of community art. You'll also create three subject categories (called subtypes) that represent the different types of community art. Then you'll attach the appropriate list with each category.

1. In the ArcCatalog Catalog tree, right-click the Community geodatabase and choose Properties. Click the Domains tab and create three new domains: SculptureStyle, SurfaceStyle, and WaterStyle. Set the Field Type to Long Integer and the Domain Type to Coded Values for all three domains.
2. Click the box to the left of SculptureStyle to select it. In the Coded Values table, create five coded values, as shown in Table 1.

Code	Description
1	Architectural
2	Earthwork
3	Free-standing sculpture
4	Monument
5	Urban furnishing

↑ Table 1: SculptureStyle Coded Values

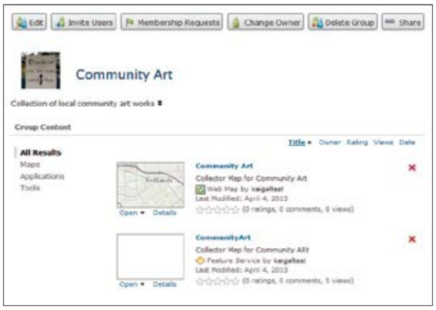
3. Click the box to the left of select SurfaceStyle and enter the values in Table 2 in the Coded Values table.

Code	Description
1	Mosaic
2	Mural
3	Painting
4	Stained glass

↑ Table 2: SurfaceStyle Coded Values

4. Click the box to the left of select WaterStyle and enter the values in Table 3 in the Coded Values table.

↓ Once the service is published, create a group and invite your field team so it can use the CommunityArt map with Collector.



Code	Description
1	Fountain
2	Water feature

↑ Table 3: WaterStyle Coded Values

5. Click Apply and then OK to close the dialog box.
6. In the Catalog tree, right-click the CommunityArt feature class and choose Properties. Click the Subtypes tab and then click the drop-down for Subtype Field and choose ArtType. For Code 0, change New Subtype to Sculpture. Add Code 1 and add Surface for Description. Add Code 2 and add Water for Description. Click Apply.
7. Click the box to the left of Code 0 to select the Sculpture subtype. In the Default Values and Domains table below, click in the Domain box and, in the drop-down, choose SculptureStyle.
8. Choose the SurfaceStyle domain for the Surface subtype.
9. Choose the WaterStyle domain for the Water subtype. Click Apply. Click OK to close the dialog box. Close ArcCatalog.

Publish and Configure Your Map

In this step, you'll use ArcMap to create a map that uses the CommunityArt feature class as a layer, enable it to store attachments, and publish it to your ArcGIS Online account.

1. Open a blank map in ArcMap.
2. Open the Catalog tree. If you don't see the folder connection to your CollectorProjects folder, right-click Folder Connections and click Refresh.
3. Expand the CollectorProjects folder and the Community geodatabase.
4. Right-click the CommunityArt feature class and choose Manage > Create Attachments.
5. Drag and drop the CommunityArt feature class onto your map.
6. Choose File > Sign In and log in to your organizational account if necessary.
7. Click File > Share As > Service and click Next. In the next panel, click Publish as a Service.
8. In the Publish a Service dialog box, click the drop-down for Choose a connection and choose My Hosted Services (My Organization). Your organizational account should be listed under Choose a connection.
9. For Service name, enter CommunityArt. Click Continue.
10. In the Service Editor panel, click Capabilities and check Feature Access and uncheck Tiled Mapping.
11. Click Item Description. For Summary, put Collector map for Community Art, for Tags, put Art, Community. Click Sharing and check My Organization, not Everyone.
12. Click Analyze at the top of the Service Editor dialog box. Click Analyze and review any messages. You should only have two medium and one low severity messages because in this tutorial, you are not using a feature template set and you are not publishing any data.
13. Click Publish.

Configure Your Collector Map in ArcGIS Online.

Once the service is published, open ArcGIS Online (and sign in if necessary). Click the My Content drop-down and My Content and verify your service has published and the CommunityArt feature service is being shared with your organization.

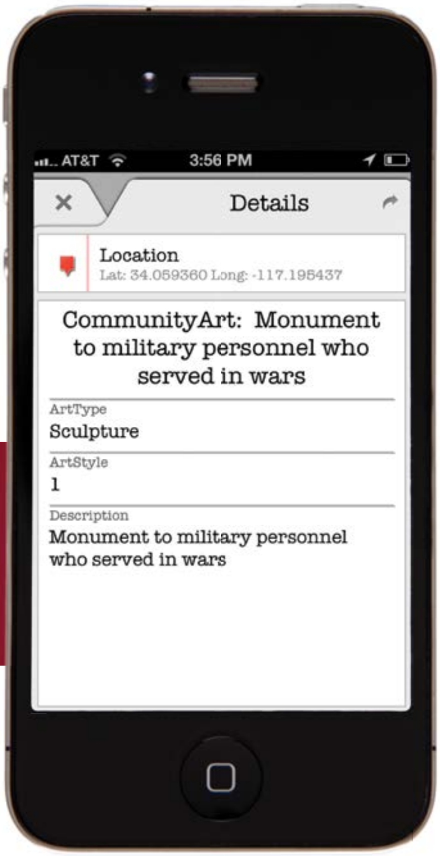
It's likely that you'll want to send other people out into the field with Collector to use your Collector maps. The best way to accomplish this is to create a group and invite your field team to the group. This way, you can have different field teams working on different projects.

1. Now create a Group by clicking Groups and then Create a Group and use the values in Table 4.

Name	Community Art
Summary	Collection of local community art works
Description	Collection of local community art works
Tags	Art, Community
Status	For Organization, uncheck "Users can apply to join group".

↑ Table 4: Create a Group

2. Next, click Map to open a new map. Click the Add drop-down and then Search for Layers. Search for CommunityArt in your organization. Click Go. Click Add to add CommunityArt to the map.
3. Click the Details button and choose the Show Contents of Map icon.



↑ When your field team is collecting data, the domains and subtypes will make it easy to populate the form for each feature collected.

4. Click the CommunityArt layer to see the three types of community art. Move your cursor over the CommunityArt layer name in the table of contents and click the arrow that appears to the right. Choose Change Symbols.
5. Click Sculpture. In the Change Label and Symbol pop-up, click Change Symbol. In the Change Symbol pop-up, choose Shapes from the drop-down. Choose a red symbol and increase the size of the symbol to 36 pixels. Click Done. Click OK.
6. Change the symbol for Surface to the same symbol style at 36 pixels but make it green.
7. Make the symbol for Water the same style and size as Sculpture and Surface but make the color blue. Click Done Changing Symbols.
8. Click Save, then Save As. For title, type Community Art; for Tags, type Art Community; and for Summary, type Collector Map for Community Art. Zoom the map in to your community and click Save Map.
9. Click Share and check My Organization, Members of these groups, and the Community Art group. Click Close.

Test Your Collector Map

Note: If you haven't used the Collector app before, take a few minutes and go through the basics of using the app by viewing the video on the Collector for ArcGIS page (resources.arcgis.com/en/collector/).

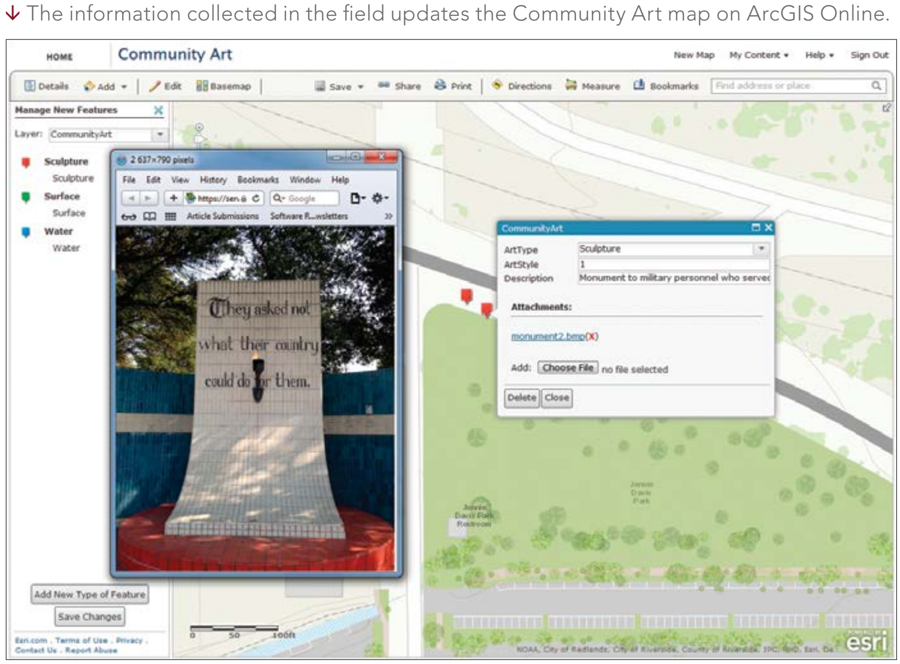
1. Go outside and open Collector for ArcGIS on your iPhone or Android device. Log in to your ArcGIS Online organization account.
2. Tap the Community Art map to open it. Stand near the item you want to collect information for and tap the My Location tool to show your location on the map. If you need to collect something that you can't stand next to, you can zoom in and tap on the map to add a new item.
3. Tap the Collect tool to collect information about the artwork.
4. Tap in the Type of Art field and select Sculpture, Surface, or Water. Tap in ArtStyle field and select the appropriate style of art. Now tap the Camera tool, tap Add, then tap Take Photo or Video. Take a picture of the artwork, then tap Use. Tap Done and Done again.
5. Move to another location and repeat the process.
6. Once you're finished collecting, close Collector and return to your desktop or laptop. Log in to your ArcGIS Online organization account. Open the Community Art map.
7. The locations you created with Collector should now appear on your Community Art map on ArcGIS Online. You can explore the collected data, edit it, and share the map with other people in your organization.

Conclusion

This tutorial introduces how to create and share your own Collector map and use it with Collector for ArcGIS. Using domains and subtypes will help you create a proper data dictionary for the types of information you want to collect in the field, simplify the data collection process for your field team, and help reduce errors.

Using groups in ArcGIS Online will improve your ability to manage multiple field data collection projects and control access to Collector maps. With Collector for ArcGIS, you can also get directions from your location to features in your map or between features, change visibility for features on your map, create and use bookmarks for easy navigation to points of interest, and track where field staff go while they're working in the field. For more information about Collector for ArcGIS, visit resources.arcgis.com/en/collector/.

↓ The information collected in the field updates the Community Art map on ArcGIS Online.

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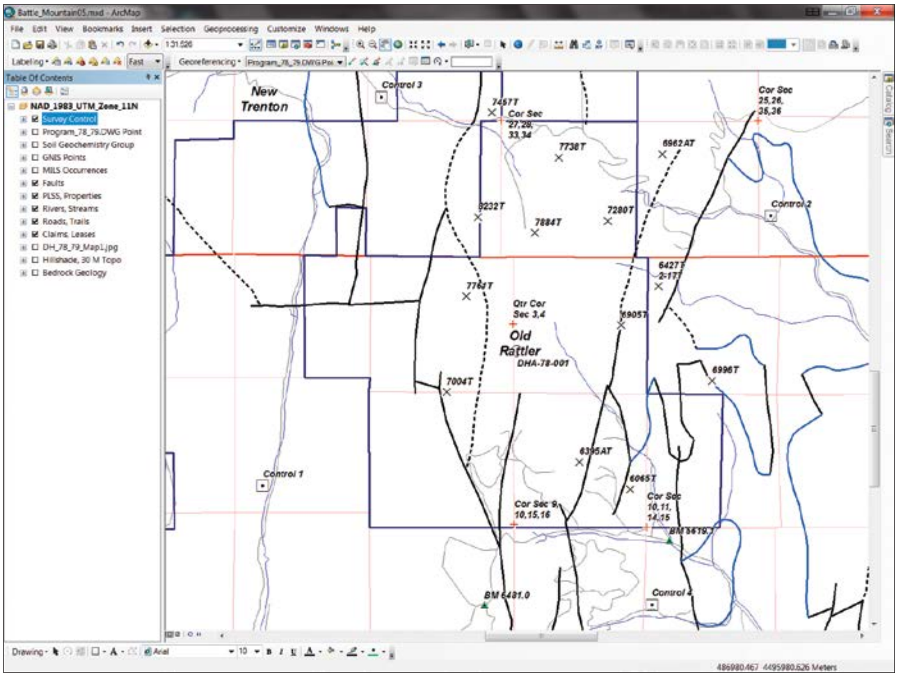
Teaching Local Coordinates to Play Fair

Defining and managing a local grid in ArcGIS 10.1

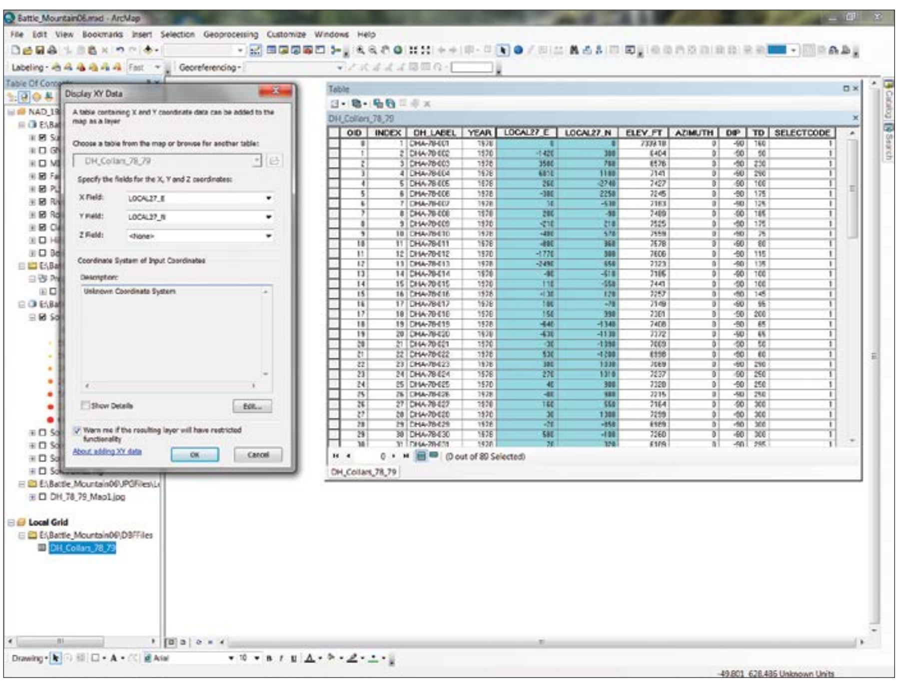
By Mike Price, Entrada/San Juan, Inc.

What You Will Need

- ArcGIS for Desktop (Advanced, Standard, or Basic)
- Sample data from the *ArcUser* website
- A good basic knowledge of ArcGIS for Desktop



↑ This exercise uses data related to mining activity around the Old Rattler claim in Battle Mountain and includes completely synthetic drill hole collar locations and topographic survey control data.



↑ In the TOC, right-click DH_Collars_78_97.dbf and select Display XY Data. Fill out the dialog box as shown.

This article builds on the techniques learned in "Good, Better, and Best: Converting and Managing Local Coordinates in a Projected System," which ran in the Spring 2013 issue of *ArcUser* magazine.

That exercise showed how to place a locally referenced scanned map and a computer-aided drafting/design (CAD) drawing in a projected coordinate system. Using the ArcGIS 10.1 Georeferencing tool, local control points were connected to coordinates that were surveyed in the field. By connecting a high-quality scanned map and CAD layer to carefully surveyed points, both products were georeferenced with surprising precision.

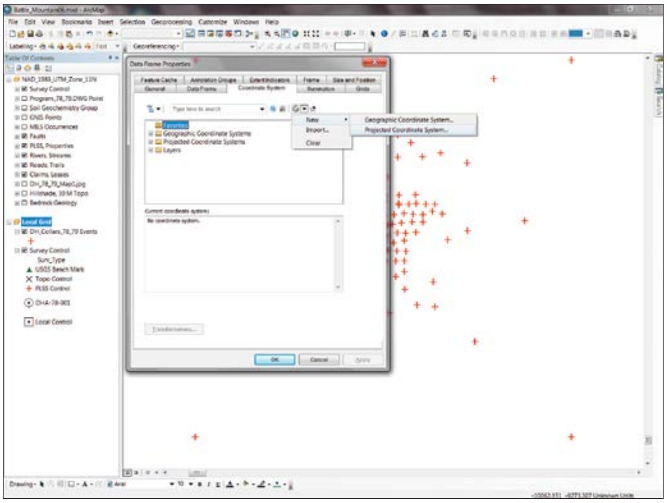
Continuing to Battle the Mountain, Locally

Like the previous exercises, this exercise uses data related to mining activity around the Old Rattler claim in Battle Mountain, Nevada. The data includes completely synthetic drill hole collar locations and topographic survey control data for more than 80 holes drilled in 1978 and 1979. In the previous exercise, we inspected the relative locations of many drill hole collars that were originally defined in a local grid, changed the scale and units, and compensated for a rotated local grid.

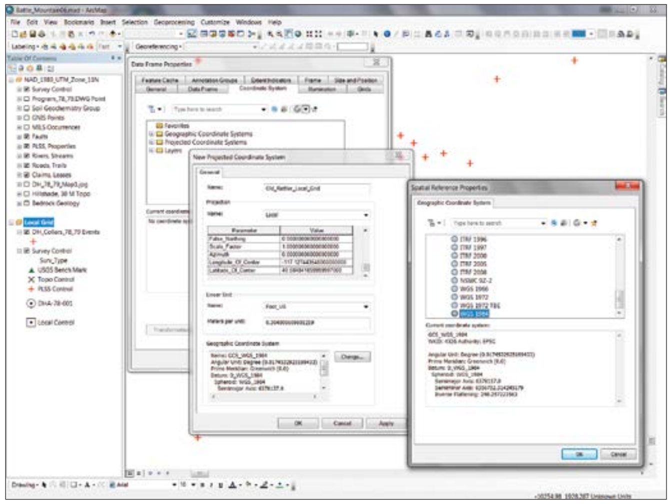
Unfortunately, due to the quality of the scanned map and limitations of the CAD file, we could not validate the data. However, during a subsequent search of legacy data, we discovered an old database file containing information about 84 exploration holes drilled in 1978 and 1979. The simple collar file includes drill hole names, local coordinates, total depth, and orientation. The file also includes local coordinates for survey points labeled Control 1 through Control 4. It would be great if these collar points were registered in Universal Transverse Mercator (UTM) North American Datum (NAD83), but this is enough information to get started moving them to projected coordinate space.

DHA-78-001 marks the origin of the local system, so we sent the surveyors back to the field to precisely capture its coordinates in UTM meters and NAD83 decimal degrees. The major axes of the local grid are rotated about 17 degrees to the right (clockwise), which approximates the local magnetic north in the late 1970s. Since we are not sure field staff who collected the original data even understood datums, we will register the local grid in NAD83. All early field measurements seem to be recorded in feet, so we will specify US Survey Feet as the local unit.

First, we will need to create a new data frame in the existing project, then post the collar points, add the known UTM NAD83 Survey Control as a reference, and experiment with local grid parameters to see if we can match local control with a known survey. This might sound quite complicated, ➔



↑ Create a new custom projected coordinate system called Old_Rattler_Local_Grid.



↑ Set the longitude and latitude of the center for the custom local coordinate and set linear units to Foot_US.

but the matching process is very hands-on and visual, though it often requires multiple iterations to define the best fit.

Legacy Data on Drill Hole Collars

Download the sample dataset from the *ArcUser* website (www.esri.com/arcuser) and unzip it locally.

1. Open Battle Mountain05.mxd in ArcMap. Zoom to the extent of Survey Control layer and make only the Survey Control, Faults, PLSS, Properties, Rivers, Streams, Roads, Trails, Claims, and Leases layers visible. Save the project, renaming it Battle_Mountain06.
2. To begin, insert a new *unprojected* data frame. On the Standard menu, choose Insert > Data frame. Do not add any data because ArcMap will adopt the projection used by that data. Right-click New Data Frame and choose Properties.
3. In the General Tab, rename the data frame Local Grid, set the Map Units and Display Units to Feet, and activate the Maplex Label Engine. Click the Coordinate System tab and verify that no coordinate system is specified. Apply these updates and save the project. Local Grid is now the active data frame.
4. Click the Add data button, navigate to \Battle_Mountain05\DBFFiles, and load DH_Collars_78_79.dbf. Inspect this table of legacy data and observe the local Easting (LOCAL27_E) and Northing (LOCAL27_N) fields. Someone made a very general assumption that the datum might be NAD27 (if a datum was even considered). Scroll to the bottom of the table to see the four control points used in the previous exercise.
5. In the table of contents (TOC), right-click DH_Collars_78_97.dbf and select Display XY Data.
   Set X Field: to [LOCAL27_E] and Y Field: to [LOCAL27_N].
   Leave Z Field: set to <None>, as we have not validated [ELEV_FT].
   DO NOT define a Coordinate System.
   Click OK.
6. Change the point symbol to something distinctive such as the red 14-point crosshair symbol. Check the coordinates of the four bounding control points. These points no longer have the units of measure assigned to them previously and have reset to Unknown Units. Reopen the data frame properties and change units back to Feet.
7. Bring the Survey Control reference data into the new data frame. Change the TOC display to List by Drawing Order and make the NAD_1983_UTM_Zone_11N data frame the active data frame. Right-click Survey Control and choose Copy. Right-click the Local Grid data frame name and select Paste Layers(s). Position the Survey Control layer below DH_Collars_78_79 Events and expand its legend. The UTM NAD83 survey data provides a reference that can be used to determine the projection parameters for the local system data. Save the project again.

Chasing the Rattler: The Fun Starts

This is the challenging part of our adventure. The well-defined UTM NAD83 survey data has been added to the Local Grid data frame which also contains the mapped origin and widely spaced control points of the local grid. The grid origin (we think) was aligned using magnetic north, and map units are certainly imperial (feet).

The grid origin is essential. Our surveyors just returned from the field with very carefully derived longitude and latitude in World Geodetic System 1984 (WGS84) for the collar of DHA-78-001. This information should be sufficient to define a coordinate system for the Local Grid data frame. Once it is created and tested, this local coordinate system can be saved to the Favorites in the list of ArcMap's projections so it can be used to register other early project data including the Program_78_79 CAD drawing.

1. Open Properties for the Local Grid data frame and select the Coordinate System tab. Mouse over the small icons to the right of the search window to locate the Add Coordinate System icon and click its drop-down arrow.
2. Choose New > Projected Coordinate System. Name the new coordinate system Old_Rattler_Local_Grid. Change the Projection Name to Local. Now fill in some of the blanks. Scroll down past False_Easting and False_Northing and type in the values in Table 1 for some other parameters. Our surveyors

collected very precise WGS84 geographic coordinates for the origin drill hole, DHA-78-001. Longitude and latitude values are necessarily very precise, representing centimeter-level measurements. Check them carefully as you enter these values.

Scale_Factor	1.00000000
Azimuth	0.00000000
Longitude_Of_Center	-117.12744354
Latitude_Of_Center	40.58484186

↑ Table 1: New Projected Coordinate System

3. Set Linear Unit to Foot_US and change the Geographic Coordinate System to GCS_WGS_1984. Click OK twice to update the Local Grid coordinate system.
4. The Tranformations warning box appears. Click Yes (Remember, never check the box next to Don't warn me again ever). Click OK twice.
5. Return to the Coordinate tab and click the Transformations button. In the Geographic Coordinate Systems Tranformation dialog box, set Convert from: to GCS_North_American_1983; set Into: as CGS_WGS_1984, and set Using: to NAD_1983_To_WGS_1984_5. *This is a very important step*. Click OK to close Data Frame Properties and apply the update.
6. Zoom to the layer extent and see how well the control points on the drill collars data matches Survey Control points. Zoom to the DHA-78-001 (the origin that is labeled) and check its coordinates. They should be very close to (but perhaps not exactly) 0,0. If you have a difference of more than a foot, return to the data frame's Coordinate System properties and check the values entered for the longitude and latitude center coordinates. Save the project.
7. Notice that four red crosshairs in the display's corners are still orthogonal (i.e., not rotated). This will be fixed interactively in a later step. Zoom back to the extent of the Survey Control layer and save the project. With the origin pinned, we are on our way to defining a local coordinate system.

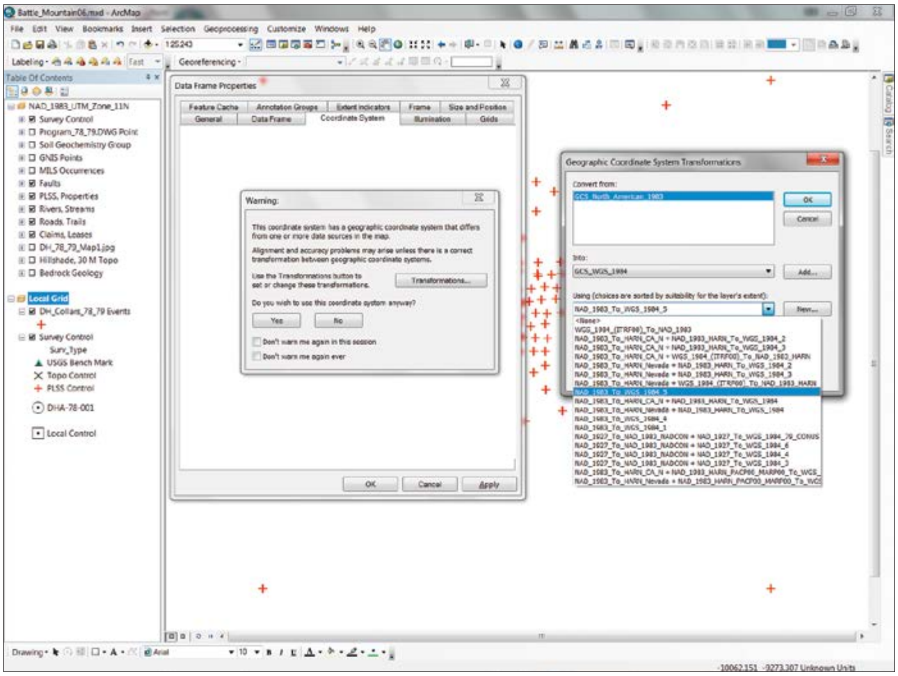
Modifying Our Local System

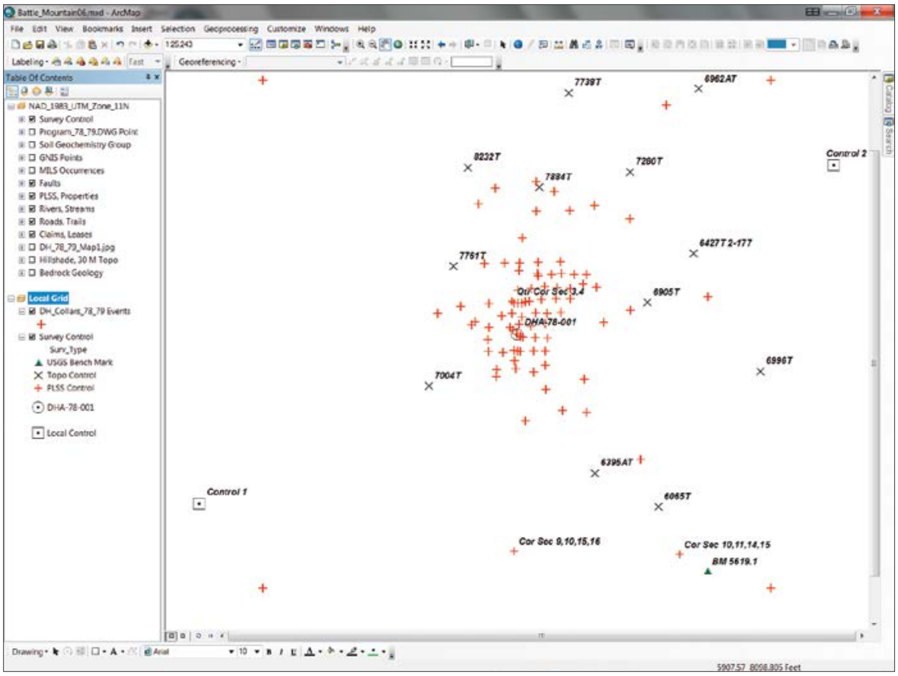
After defining the origin, we can focus on the grid's rotated azimuth.

1. Reopen the Local Grid Properties and click the Coordinate System tab. Double-click Old_Rattler_Local_Grid and set the Azimuth: to 17 and click Apply.

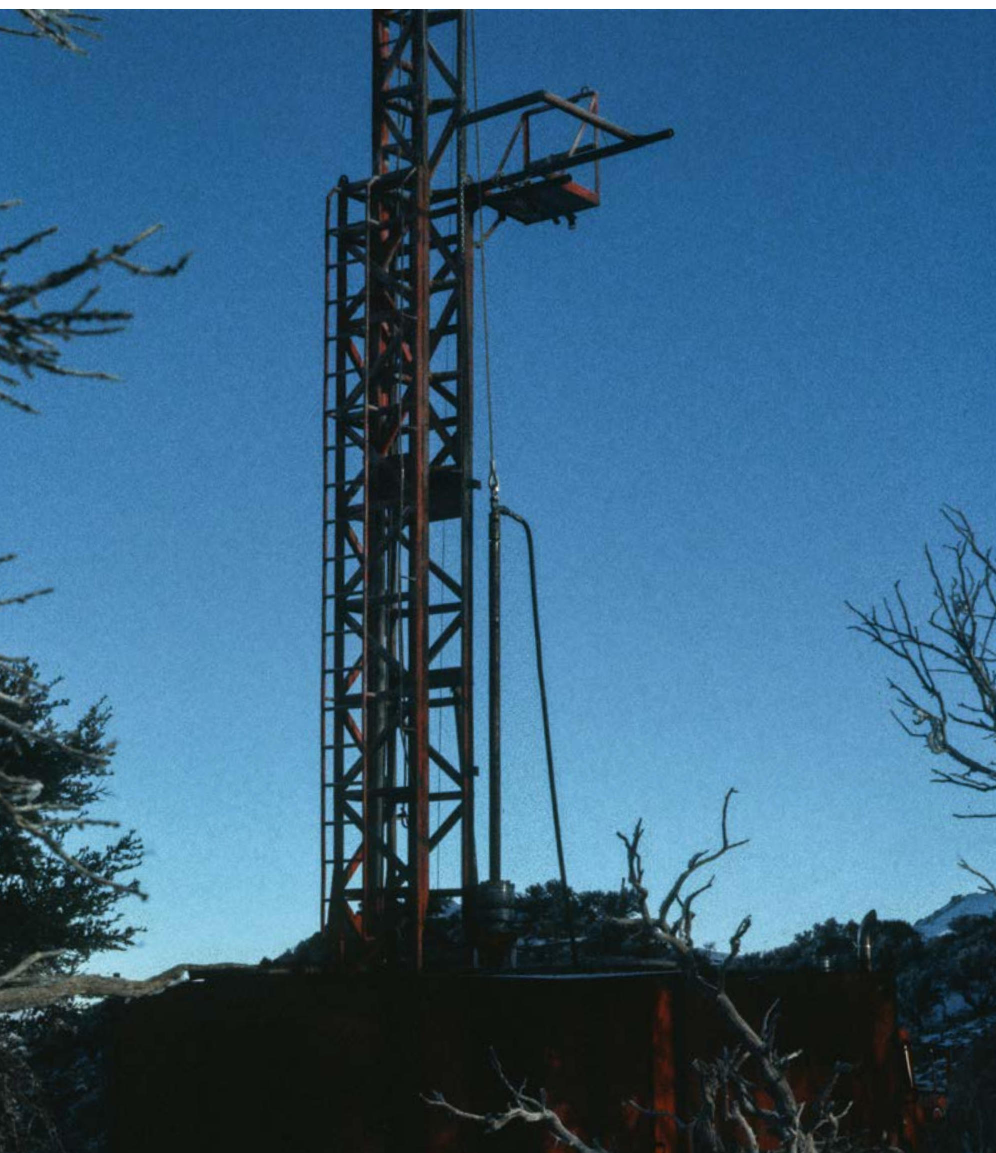
This rotation approximates the →

↓ Setting the geographic coordinate systems tranformation is *very* important.





↑ Note how well the control points on the drill collars data matches Survey Control layer control points.

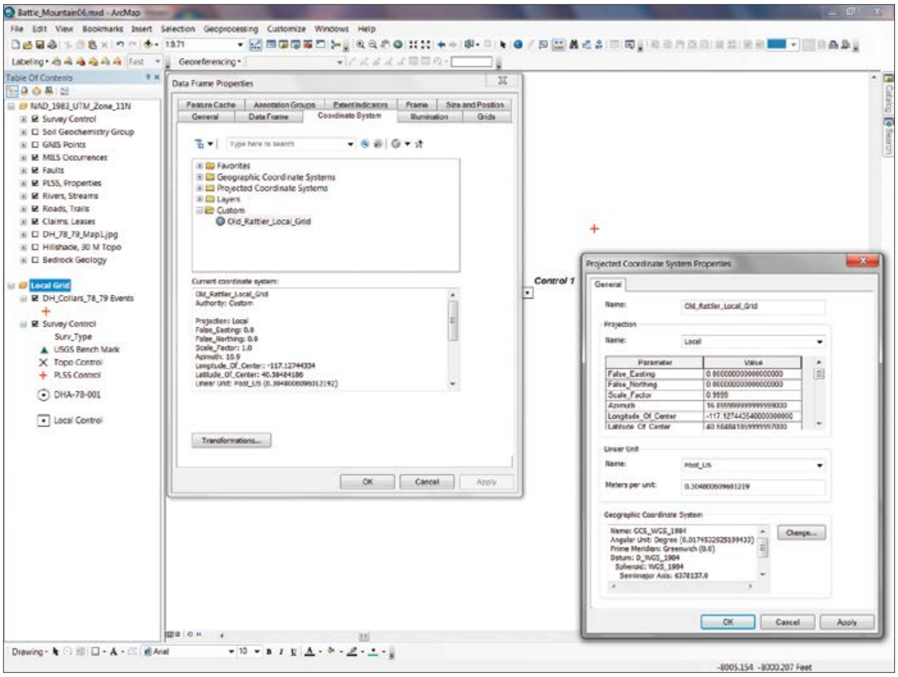


magnetic declination in northern Nevada in 1978. If your local grid has an unknown rotation, you can calculate it geometrically from known points in local and projected systems or just experiment. If your local grid applies False Easting and False Northing offsets (some do to avoid negative coordinate values), find out what they are and include them, expressed in local units.

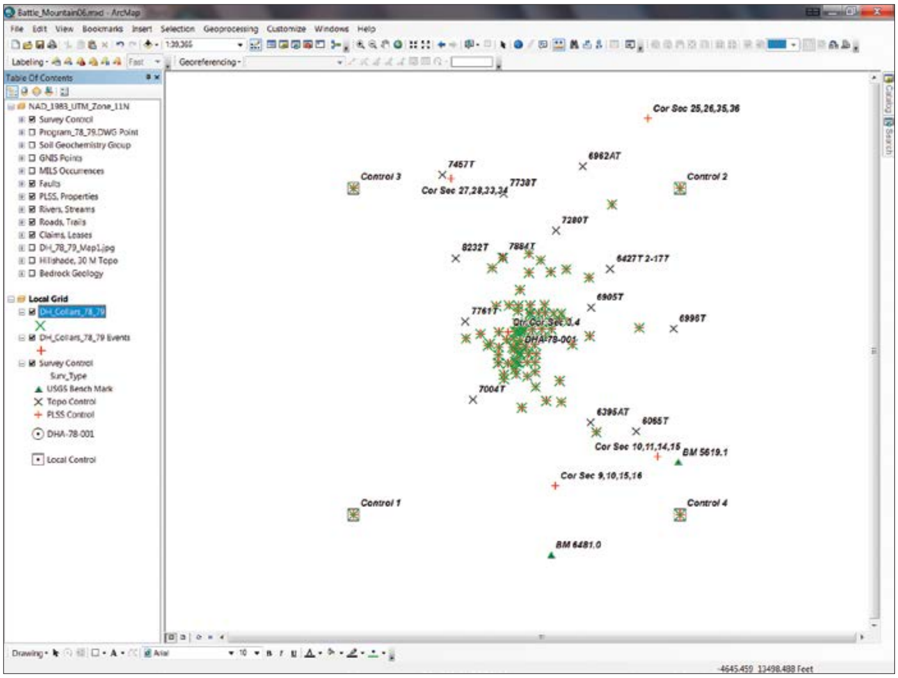
2. Now see if survey and drill collar data control points are coincident. Zoomed out, they should appear very close. Zoom in to Control 2 and measure the distance between Control 2 and its companion point in the collar table. The collar control point should appear to be about 20 feet southeast of Control 2. Remember that the grid rotation was set to 17 degrees, which appears to be too far. *Do not change the view scale.*
3. Return to Coordinate System properties and set Azimuth to 16.8. Apply the change and study the difference. Now the collar control point falls about 20 feet northwest of Control 2. Split the difference and try an azimuth of 16.9 degrees. Reset the azimuth and check the results. This time, zoom way in to Control 1 and measure. The collar control should be only a foot or so from Control 1. Notice that the collar point is directly northeast of Control 1, located southwest of the grid's origin. Let's fine-tune our coordinate system next. Save the project.

Tuning and Saving Our Local Grid

Remember the Scale_Factor parameter? It might be the least understood of all projection parameters, but it is very important. A very slight stretch to the local system is needed to obtain a best fit. Return again to Coordinate System properties, set a Scale_Factor of 0.9999, apply the change, and zoom way in to Control 1 to inspect the results. Check out the DHA-78-001 origin and the other three control points. The differences between control points and collar points should be very small. Tweaking the origin would get them a bit closer; but controls points are already well within the tolerances that our surveyors might achieve. Save the project again to preserve the Local Grid settings.



↑ Split the difference and reset azimuth to 16.9 degrees. Also set the scale factor to .9999.



↑ Export DH_Collars_78_79 Events as a shapefile, add it to the project using the coordinate system of the data frame, and change the symbol to a green X.

Now save this local coordinate system so it can be applied to other spatial datasets, including CAD data. This acceptable local grid can be saved to our Favorites in ArcMap. Open Coordinate System properties and observe the rightmost, star-shaped icon. Highlight Old_Rattler_Local_Grid and click this button to save this coordinate system to your Favorites. The Old Rattler coordinate system will now be available whenever needed.

Managing the Local Grid

All or some of the DH_Collars_78_79 Event points can be exported as a shapefile or a feature class.

1. Right-click the DH_Collars_78_79 Events layer in the Local Grid data frame and choose Data > Export Data. Save the shapefile in \SHPFiles\Local as DH_Collars_78_79 and click Yes when asked if you want to add this layer to the project and use the coordinate system of the data frame. Change the symbol to a green X and zoom to the map extent. Now for the real test.
2. Copy the DH_Collars_78_79 shapefile layer in Local Grid and paste it into the NAD_1983_UTM_Zone_11N data frame. Make the NAD_1983_UTM_11N data frame active and zoom to the extent of the DH_Collars_78_79 layer. Carefully study the map. Notice the properly rotated control points match the origin drill holes. Save the project.
3. Before applying the Old Rattler coordinate system to the Program_78_79.DWG Point data, a little "housecleaning" is needed. The two-point CAD world file previously used to register the Program_78_79.DWG Point file should be removed from the project and any reference to this earlier relationship erased. The best way to do this is to first remove Program_78_79.DWG Point from the UTM data frame, save the project, and close ArcMap.
4. Open Windows Explorer or another file manager and navigate to \Battle_Mountain06\CADFiles\Local and delete all files under Program_78_79.DWG except Program_78_79.DWG.Points (including the .lyr, .xml, and especially the .wld files).
5. Restart ArcMap and reopen the project. In ArcMap, open the ArcCatalog window, navigate to \CADFiles\Local, and locate Program_78_79.DWG.Points. Right-click the CAD file and select properties. Open the General tab and notice that the Spatial Reference is undefined. Click the Edit button and select Old_Rattler_Local Grid from Favorites. Click OK several times to assign this coordinate system. Open Properties for Program_78_79.DWG Points to verify that the coordinate system has been applied.

6. To test this CAD projection, drag just Program_78_79.DWG Points to the ArcMap canvas. These points should post right on top of the DH_Collars_78_79 points. In the background, you created a standard Esri projection file that is located in the same folder. It has the same root name as the CAD drawing and a .prj extension

Tip: Want to know how ArcMap stores the information about coordinate systems you save as Favorites? In ArcCatalog, browse to C:\Users\<your user name>\AppData\Roaming\Esri\Desktop10.1\ArcMap\Coordinate Systems.

Summary

This tutorial actually uses the same steps covered in the previous article "Good, Better, and Best: Converting and Managing Local Coordinates in a Projected System," in the Spring 2013 issue of *ArcUser* magazine, but this time these steps were performed in a different order to define a local coordinate system in a new data frame.

1. Move: Use geographic coordinates to define the local origin.
2. Rotate: Experiment with the local azimuth to align survey control.
3. Scale: Use adjusted US Feet units to minimize distortion away from the local origin.

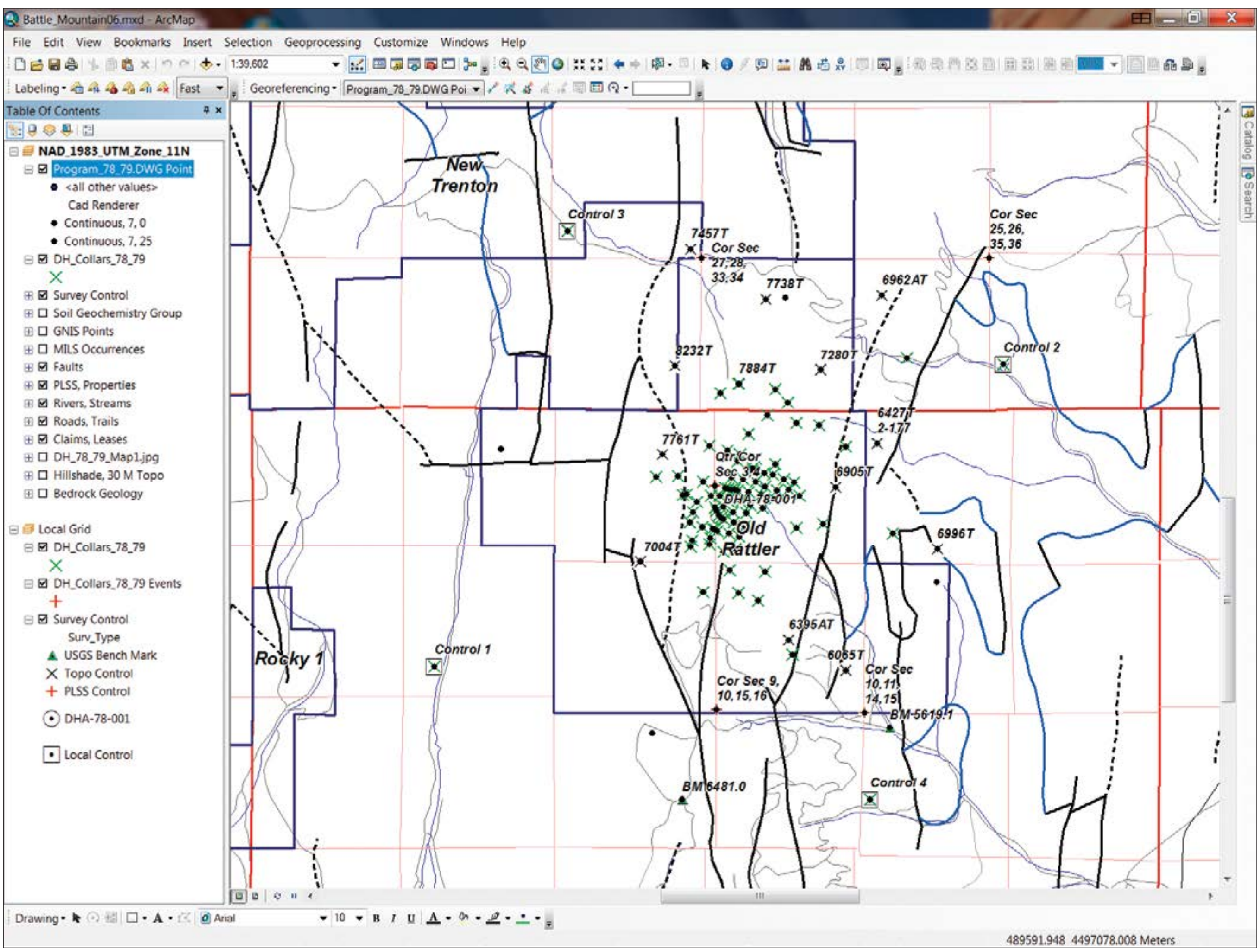
In this tutorial, we won the fight with Battle Mountain by successfully defining a local coordinate system that will properly register local vector data in any data frame containing a properly defined coordinate system.

Try this three-step approach with other local data. Remember that you must obtain the highest-quality survey data available to define a local origin and any Easting/Northing offset. Also, you must calculate (or carefully estimate) any grid rotation. Always reinspect the data as you tune the coordinate system. Feel free to contact me at mike_price@frontiernet.net and let me know how this method works for you.

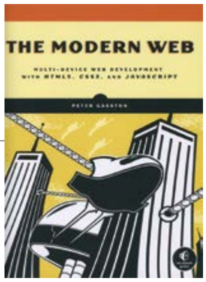
Acknowledgments

Thanks again to the US Geological Survey (USGS), the Geological Survey of Canada (GSC) and Geoscience Australia (formerly Australia Geological Survey Organisation that have developed the basemap data that support this training series. And special thanks to my geologist and firefighter friends who support and test these tutorials. I could not create field-ready materials without their valuable input and assistance.

↓ After eliminating the projection file for the CAD points layer, apply the Old_Rattler_Local Grid projection to it and add it to the NAD_1983_UTM_Zone11N data frame.



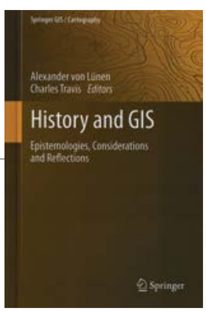
GIS Bookshelf



The Modern Web: Multi-Device Web Development with HTML5, CSS3, and JavaScript

By Peter Gasston

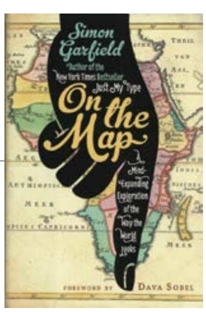
The target audience for this book is the person who wants to get involved in building websites, web applications, and packaged HTML hybrid applications that work intelligently on browsers across devices. The book presumes the reader has working knowledge of HTML, CSS, and JavaScript. While the basics of these technologies are not covered, their new and near-future capabilities are described in detail. This no-nonsense book provides clear explanations and practical examples that show how these technologies are implemented on devices ranging from tiny phone screens to giant HDTVs. Techniques and best practices help developers anticipate and deal with the challenges of displaying content across multiple devices despite quirky browsers and constantly changing technologies. As GIS has expanded, many GIS professionals who have been focused on applications for the desktop now find themselves involved in the development of applications for the web and mobile devices. This lucidly written book can help get them quickly up to speed. No Starch Press, 2013, 264 pp., ISBN: 978-1593274870



History and GIS

Edited by Alexander von Lünen and Charles Travis

While the use of GIS for economic and social history, historical geography, and particularly ancient history has become widespread, mainstream historians have made little use of the technology as a research tool. This collection of papers explores why this is the case. The editors posit that most historians are not convinced the intellectual benefit justifies the commitment needed to overcome the technological challenges. Contributors provide their answers to the question "why historians should use GIS", rather than discussing how to use GIS for historical research. Dr. Alexander von Lünen is a geography research fellow at the University of Portmouth, Hampshire, UK. Dr. Charles Travis received a doctorate in historical-cultural geography from Trinity College Dublin and is a postdoctoral research fellow with the Trinity Long Room Hub. Springer, 2013, 256 pp., ISBN: 978-9400750081



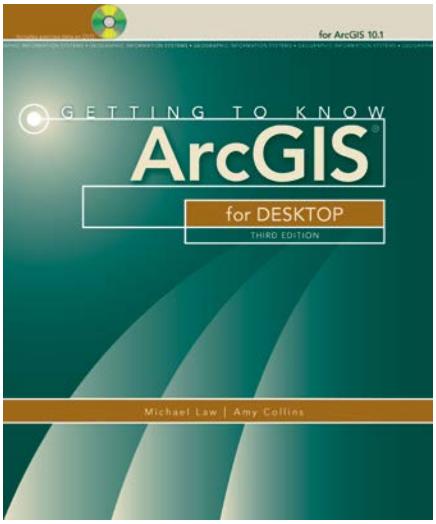
On the Map: A Mind Expanding Exploration of the Way the World Looks

By Simon Garfield

Thanks to the digital revolution, we are living in the most transformative age of cartography. "More people use more maps than at any time in history," observed the author, Simon Garfield, in this exuberant and erudite book that outlines the history of our relationship with maps. This collection of stories about maps provide fascinating insights into the people who made them and the times in which they lived. They demonstrate how maps, once impressively large, expensive, and rare, have become small, inexpensive, and pervasive but remain vitally important for what they tell us about ourselves. "For when we gaze at a map—any map, in any format, from any era—we still find nothing so much as history and ourselves." Gotham, 2012, 464 pp., ISBN: 978-1592407798

Getting to Know ArcGIS for Desktop,
Third Edition

By Michael Law and Amy Collins



The GIS bestseller was originally published in 2001. This workbook, designed for beginners, introduces GIS principles using hands-on exercises using ArcGIS 10.1 for Desktop. These exercises teach how to use the software to query and analyze data and create maps. In addition to the main exercise, each chapter has suggestions for related activities and tips and shortcuts for using the software. New topics in the third edition include exploring online resources and working with raster data. *Getting to Know ArcGIS for Desktop* can be used as a classroom text, independent study guide, or reference. It is indexed and has a glossary of GIS terms. It includes a DVD containing the maps, data, and results for the exercises and access to a 180-day trial of ArcGIS 10.1 for Desktop.

Both authors have GIS backgrounds and technical writing experience. Michael Law worked for Rand McNally Canada and as a cartographer for Esri Press, where he developed cartography for books and edited and tested GIS workbooks. Now based in Toronto, Canada, Law continues to work with GIS software, writing technical documentation, teaching training courses, and designing and optimizing user interfaces. Amy Collins was introduced to GIS when she began working as a technical editor at Esri in 2002. She is currently a writer and editor based in northern California and continues to develop GIS materials. Esri Press, 2013, 768 pp., ISBN: 9781589483088

Expanding Worlds

First Esri education ambassador visits Ghana

By Bob Kolvoord, Interim Dean
College of Integrated Science and Engineering, James Madison University

I was named Esri's first education ambassador in 2012. Michael Gould, global education manager at Esri, had approached me earlier in the year about a pilot program the company was creating to introduce GIS to secondary students living in developing countries.

In October 2012, I traveled to the Republic of Ghana to teach for a week at SOS-Hermann Gmeiner International College (SOS-HGIC) in Tema. The college is a project of SOS Kinderdorf International, which helps prepare students with promise from SOS Children's Villages in Africa to enter educational institutions of higher learning. Kinderdorf is the world's largest charity organization dedicated to sheltering orphaned and abandoned children. Prominent supporters include Nelson Mandela and the Dalai Lama.

Stephen Bempah Owusu, a teacher in the Information and Communication Technology (ICT) department at SOS-HGIC, and James Annan-Aggrey of SAMBUS Company Ltd. had teamed together earlier in 2012 to introduce GIS concepts to the students at the college so that they would have some familiarity with the technology before I arrived. SAMBUS is a longtime Esri distributor and a supporter of GIS initiatives in Ghana.

While GIS has been used for some time across the African continent, there have been few inroads in teaching it to primary and secondary students. With support from Esri, SOS-HGIC, and SAMBUS, we wanted to reverse this trend. As an advocate of using GIS in K–12 education in the United States, I was excited to have the opportunity to work with students abroad. My overall goal was to help them build their skills in GIS and—more importantly—spatial thinking and analysis.

"The great thing about GIS is that it provides a good and practical example for showing convergent technologies and concepts in ICT," Owusu said. GIS fits into the existing curriculum for students working toward the International General Certificate of Secondary Education and International Baccalaureate, which includes networks, GPS, databases, modeling, and simulation.

I taught a GIS class consisting of 21 students and 10 staff members from SOS-HGIC and six teachers from three local high schools. The teachers plan to use GIS to give students the opportunity to explore the technology's many uses.

I began the week by introducing the class to ArcGIS. Some of the students and teachers had received the earlier GIS training, but for many in the room, this was their first taste of geospatial technology. One challenge I have found in working across cultures is locating the data and examples that best connect with my audience. World demographics were a big hit with the young people and adults, especially when we focused on African countries.

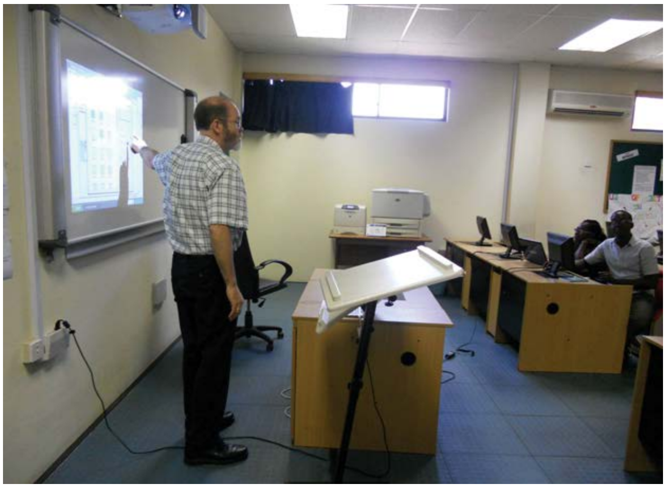
One of the interesting things about SOS-HGIC is that students come from a variety of countries within Africa. Our group included students from Burkina Faso, Lesotho, Malawi, and South Africa. This diversity enlivened discussions, especially whenever the group compared Ghana's economy and health demographics with those of its African neighbors. As the students identified patterns and looked for possible explanations, basic spatial thinking skills were being reinforced.

While the students worked through the basics of vector and raster GIS functions, including map layouts, queries, and symbology, they also learned about GPS. Along with global data, we were fortunate to have local data from SAMBUS. The students could work at a variety of scales and create maps of the areas where they live.

"The whole GPS/GIS training program was educational for me, especially because we were dealing with things I could relate to as a geography student," said one participant. "The data analysis and selection tools that we learned about got me thinking about the advantage it could provide to me to work in multinational and government agencies."

I encouraged the teachers to consider using geospatial technologies in the classroom and preview curricular materials, and I showed the students how to do more advanced geospatial analysis. The

↓ Bob Kolvoord, the first Esri education ambassador, spent a week at the SOS-Hermann Gmeiner International College (SOS-HGIC) in Tema, Ghana.



↑ Kolvoord taught a diverse class: 21 students from Burkina Faso, Lesotho, Malawi, and South Africa; 10 SOS-HGIC staff members; and six teachers from three local high schools.

students enjoyed using the solar radiation tool in ArcGIS Spatial Analyst to explore the variation in solar exposure in an equatorial country, such as Ghana, compared to the much more northerly latitude of my home state of Vermont. We then discussed the solar potential of Ghana and whether the country could export sun-generated electricity to other countries.

As to the future of using GIS in teaching, Owusu said it will now happen regularly at SOS-Hermann Gmeiner International College.

"The use of GIS in classes at the college will become a regular part of delivering curriculum," Owusu said. "In addition, the possibility of running a weeklong program for more students to appreciate the use and benefits of thinking spatially during the summer break is being explored."

For all of us, the class provided a step into a new world. For the students and teachers, it was the world of GIS. For me, it was a new continent and different culture. I think each of us has had our world made just a little bit bigger.

Interested in Being an Esri Education Ambassador?

Many schools and universities in developing nations lack qualified GIS teachers. A brief educational visit from an experienced GIS instructor can provide just the kick-start these schools need. In response to the many requests Esri receives to support underprivileged schools, the company recently set aside a modest budget to help fund such education ambassador visits. Requests from schools will be prioritized and based on the available budget.

Visits will typically last five to ten working days and focus on giving the students hands-on training in Esri technology so they can start to solve community and global problems.

Are you interested in becoming an education ambassador? Send a summarized biographical sketch and a statement of your specific teaching expertise to edambassadors@esri.com.

↑ Students stroll across the SOS-Hermann Gmeiner International College in Tema.

The Undead

Liven Up the Classroom

By Edward González-Tennant, Monmouth University

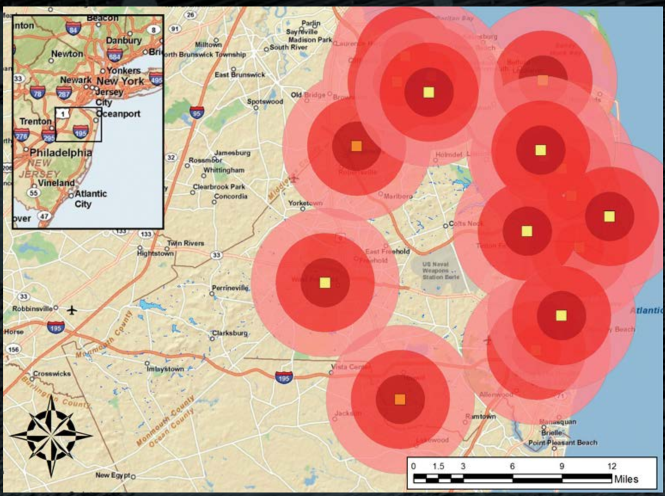
Editor's note: How do you keep less motivated students from turning into zombies when teaching geospatial analysis? Edward González-Tennant, assistant professor of anthropology and director of the GIS program at Monmouth University in New Jersey, found an effective and entertaining approach.

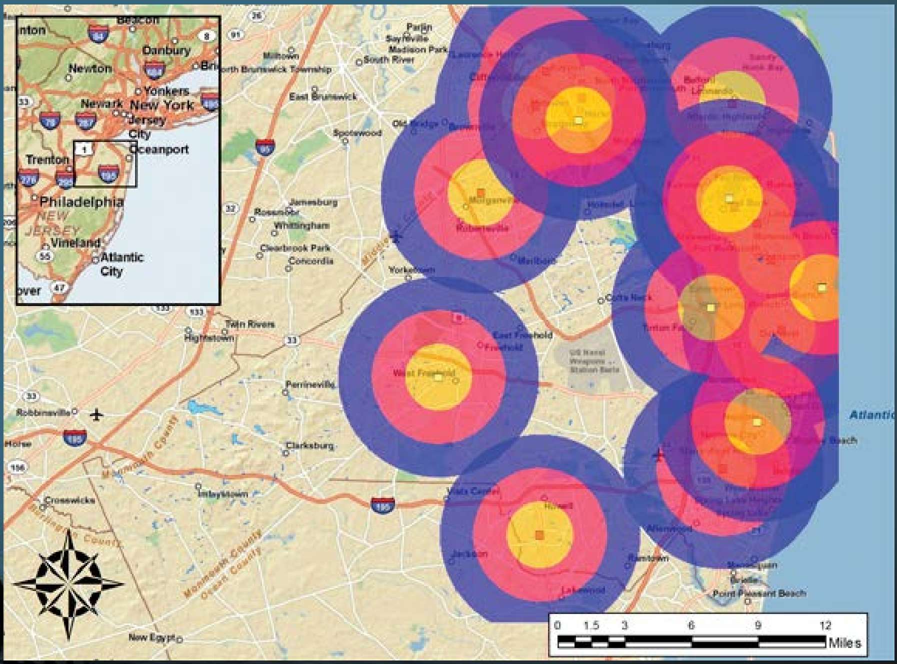
GIS educators face unique challenges regarding the teaching of geospatial analysis. While job opportunities and an interest in mapping attract many students, others are less likely to see the value of GIS as it relates to their scholastic or career interests. Reaching reluctant pupils requires innovative ways of connecting geospatial analysis with interesting topics.

Crafting interesting lessons that teach distance analysis and habitat modeling can be especially challenging for educators. The concepts are technical and the process seemingly complicated because it involves arranging and changing data to accomplish various analyses. To engage students in these topics, I combined them with my personal interest in all things zombie.

As the director of the Monmouth University GIS Program, I am primarily involved in student recruitment activities as a guest lecturer and campus-wide presenter. As part of Monmouth University's 2011 GIS Day events, I gave a presentation entitled "Popular Culture and GIS: Using Geospatial Technologies to Model and Prepare for the Zombie Apocalypse." My geospatial analysis of a potential zombie apocalypse was so popular that I am often asked to deliver some version of the talk to various classes and groups.

↓ Simple buffer analysis of the zombie horde





↑ More accurate measurement of movement of the zombie horde obtained through Euclidean distance analysis

My decision to use the zombie apocalypse as a teaching tool was based on its use by other agencies, including the Centers for Disease Control and Prevention Zombie Preparedness pages (www.cdc.gov/phpr/zombies.htm) on emergency preparedness and the Missouri Department of Conservation's Flesh Afield site (mdc.mo.gov/zombies) about invasive species.

In my case study, I modeled a zombie apocalypse in Monmouth County, New Jersey, as a way to introduce students to specific geospatial skills while keeping their attention. The analysis focused on two time periods: the initial outbreak and the predicted distribution of zombies in the following weeks and months. This analysis required students to consider four basic questions.

1. What are the basic characteristics of a zombie horde?
2. Which locations are the most susceptible to zombie outbreaks/contamination?
3. Which forms of spatial analysis are most appropriate for modeling a zombie apocalypse?
4. What might the postapocalypse spatial patterning of zombies look like?

Answering the first question involved grappling with a classic debate among zombie fans. Do zombies shuffle slowly, as in the classic *Night of the Living Dead* movie, or quickly, as in more recent films like *28 Days Later*? Ultimately, I decided to model the horde's movement at a steady 1.5 miles per hour, based on zombie hordes in novels and movies that tend to shuffle slowly across the landscape.

Which Way Will They Go?

The second question addressed potential zombie outbreak locations. Traditionally, zombies often rose from their graves due to radiation, voodoo, and other causes. Today, zombie outbreaks are viewed as the result of some kind of pandemic. My analysis used this second scenario, given its increased popularity in recent years.

Modeling a zombie outbreak provides an excellent opportunity to teach students about various distance modeling techniques and think critically about the strengths and weaknesses of each approach. These approaches included buffer analysis, Euclidean distance, and network analysis. The roads and health care facilities data used for theses analyses are available from the New Jersey Geographic Information Network (njgin.state.nj.us/)

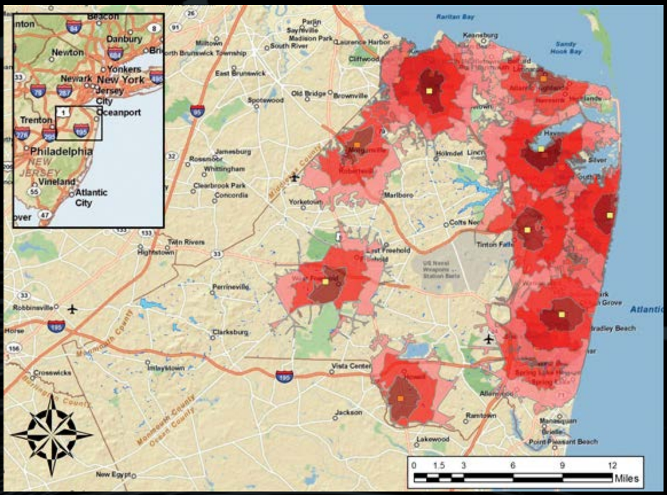
Simple buffer analysis places radiating circles corresponding to expanding distances/times around the medical facilities. The innermost circle corresponds to one hour (1.5 miles, or 7,920 feet) of movement by the zombie horde. The middle circle corresponds to two hours (3 miles, or 15,840 feet) of movement, and the outermost circle corresponds to three hours (4.5 miles, or 23,760 feet) of movement.

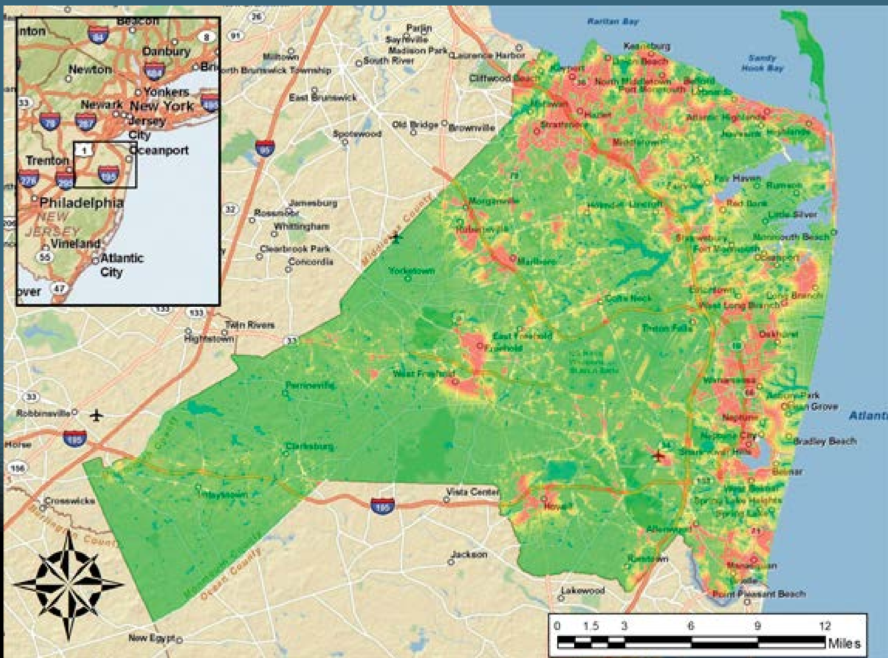
Of course, there are drawbacks to using buffer analysis. Planning movement and actions based on buffer analysis is hindered as exact measurements are unavailable. Another form of analysis is required to produce specific distance measurements.

Euclidean analysis calculates, for each point in space, the actual distance from a source point. This form of analysis provides more accurate data. Users can see the exact distance measurements between various locations and any given outbreak point.

Euclidean analysis has its drawbacks as well. While returning a more accurate measurement, this form of distance analysis ➔

↓ Network (or service area) analysis provides the best approach for modeling the initial movement of the zombie horde.





↑ Using fuzzy logic to model post apocalyptic distribution of zombies

treats the landscape as an empty Cartesian plane and is little more than a measure of distance "as the crow flies."

Network analysis creates an area (polygon) that encompasses all accessible streets within a given distance or time. Sometimes referred to as service area analysis, this form of spatial analysis takes into account the placement of streets and is often used for logistics planning.

This form of analysis is appropriate for analyzing the spread of a zombie horde. Zombies are more likely to wander along streets than cross open fields, bodies of water, or other areas. Network analysis not only takes features of the landscape into account, but it also returns exact measurements like Euclidean distance analysis. It is a preferable method for predicting the spread of a zombie horde, and this is particularly true given a 1.5 mph rate of movement radiating out from medical facilities

Predicting Zombie Habitat

While predicting the movement of zombies at the beginning of the zombie apocalypse is certainly useful for planning your way home, survivors will be faced with additional obstacles in the days and months following the initial outbreak. This is where site suitability analysis comes in handy. Suitability modeling typically answers the question, Where is the best location? This could be the best location for a new road, pipeline, housing development, or retail store. In this case, it answers the question of where zombies are most likely to congregate following an outbreak.

Suitability analysis is a more complex process than distance analysis. Several variables are taken into account and modeled in relation to one another. I chose fuzzy logic to model the post-apocalypse distribution of zombies. This analysis is covered in detail by the Esri online course "Using Raster Data for Site Selection (for ArcGIS 10)." Fuzzy logic is useful when the definition of phenomena and things affecting them are imprecise. It is typically used to model suitable habitats for plants and animals that do not follow mapped features the way (living) humans do.

The preliminary zombie habitat model used three types of data. The first variable, land use, is available as a download from the New Jersey Geographic Information Network (njgin.state.nj.us/). The data was reclassified and higher weights assigned to areas of human disturbance. Places like shopping centers and industrial areas are likely to attract zombies. Alternatively, open fields and swampy areas were given less weight because it is less likely that zombies would congregate in those areas.

The second variable involved classifying bodies of water. These areas were classified as deterrents to zombies because they caused zombies to slowly shuffle away given the lack of human population.

The third variable was major highways. These areas were classified as highly likely to have zombies since popular culture always shows these areas as the location of secondary outbreaks. These two datasets were downloaded from the US Census Bureau 2010 TIGER/Line Shapefiles website (www.census.gov/cgi-bin/geo/shapefiles2010/main).

Areas with the highest probability of zombies following the initial outbreak were symbolized with red. This was always an interesting moment in the zombie presentation because students immediately related to the results of this analysis.

Light Approach, Serious Learning

This approach has been an entertaining and useful introduction to spatial analysis for my students at Monmouth University. It invites students to think critically about space. The class discusses why network analysis is the most appropriate geospatial technique for modeling the initial spread of zombies given that they move primarily along roadways at an average speed of 1.5 mph and spread out from health care facilities. We review why fuzzy logic is suitable for modeling the postapocalyptic distribution of zombies, which is similar to the ways animals ignore political boundaries and man-made features.

For more information on this project, visit my blog post on it at goo.gl/exm6P. In addition to images showing the various analysis techniques, visitors can download a Microsoft PowerPoint file for use in classroom presentations. The file includes additional background on zombies and can be modified with new images to accommodate new geospatial analysis of zombies. Please credit Edward González-Tennant (www.gonzaleztennant.org) if you use the file or accompanying images.

For more information on Monmouth University's GIS program, visit www.monmouth.edu/academics/GIS/default.asp.

Not Just Plane Art

ArcGIS brings children's art photomosaic to life

By Carla Wheeler, Esri Writer

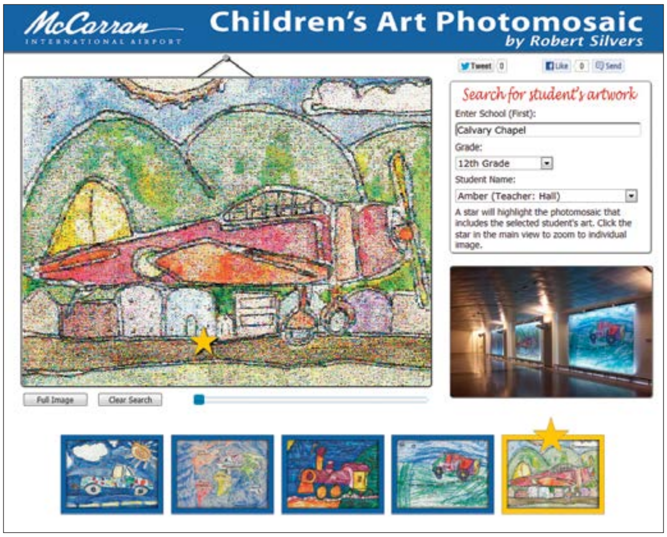
When you enter the D Concourse tram station of the new $2.4 billion Terminal 3 at McCarran International Airport in Las Vegas, Nevada, you will see stunning photomosaics of children's art by artist Robert Silvers that show planes, trains, hot air balloons, and other modes of transportation.

But there's another way to see the jigsaw-like pieces of student art up close. Senior GIS programmer Don Kang from the Clark County Department of Aviation and his team created the Children's Art Photomosaic website, which lets you view the art from anywhere in the world. With a little help from ArcGIS, Kang and his team also built an application for the site that uses an image service created in ArcGIS for Server to zoom in closely to better see the smaller pieces of student art within Silvers' 10 photomosaics.

Click a bright red biplane, zoom in, and you will see individual crayon and pencil drawings of hovering helicopters, chugging trains, and roaring rockets. Tap on any of the images, and a pop-up window appears with the student artist's name and grade, the teacher's name, and their school.

The art project began in 2008 when the Clark County Department of Aviation, which manages McCarran International Airport, partnered with the local school district and invited students to submit artwork depicting planes, trains, automobiles, and vehicles for an art installation at the D Concourse tram station. The station serves as gateway to the state-of-the-art Terminal 3, which opened last summer.

Nearly 33,000 unique pieces of art were submitted by students from all grade levels, kindergarten through high school, and of those pieces, 10 student entries were selected to be re-created by Silvers, a renowned artist credited with inventing the photomosaic process while a student at the Massachusetts Institute of Technology. Silvers used all 33,000 student art pieces—some multiple times—to



re-create the 10 winning works as photomosaic displays.

The Department of Aviation's website team created a site to display Silvers' work that let the viewer zoom in and out of the images in a photomosaic and see the smaller pieces of art that compose each one. The team also was asked to devise a way for web visitors to locate these smaller works of art using information about specific student artists.

When considering how to solve this problem, Kang recalled a demonstration of a Microsoft Silverlight application at a Microsoft MIX conference. The presenter zoomed deep into an image while still maintaining clarity. Not having Silverlight in its arsenal, the team brainstormed ways to achieve similar outcomes with the tools available to them.

Kang soon realized that image caching would be the perfect solution for the problem he faced. Since the photomosaic images were not georeferenced, the team applied a local spatial reference (i.e., one not associated with any map coordinate system) so Esri's ArcGIS for Server could process the cache.

"We were excited to have created a tile map service using the cached images, but we were still faced with the challenge of making these images searchable," explains Kang. "For search functionality, we created a fishnet polygon layer with each boundary lined up exactly over each tile and then joined them to a spreadsheet based on the tile's x and y position."

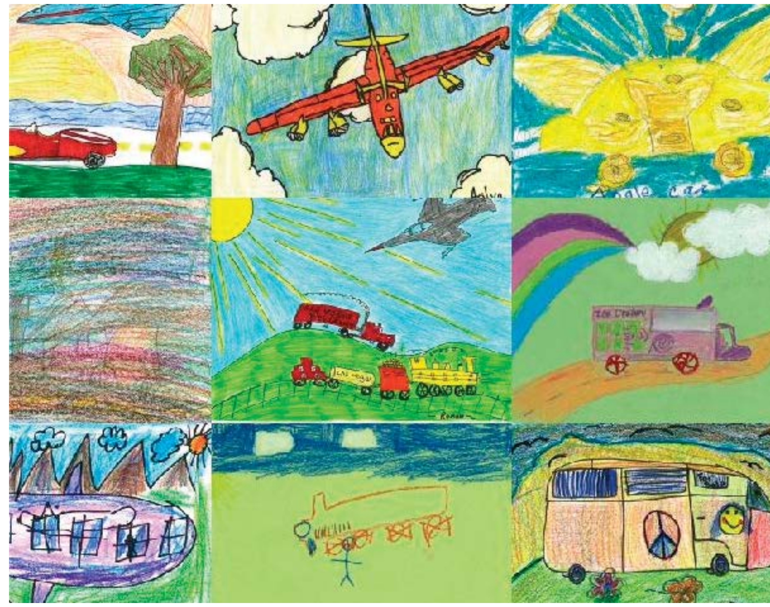
With these two pieces in place, Kang used ArcGIS API for JavaScript to create a unique application that would meet the website team's goal of allowing users to zoom in to and out of the photomosaic images as well as search and locate students' art by school, grade, or teacher name.

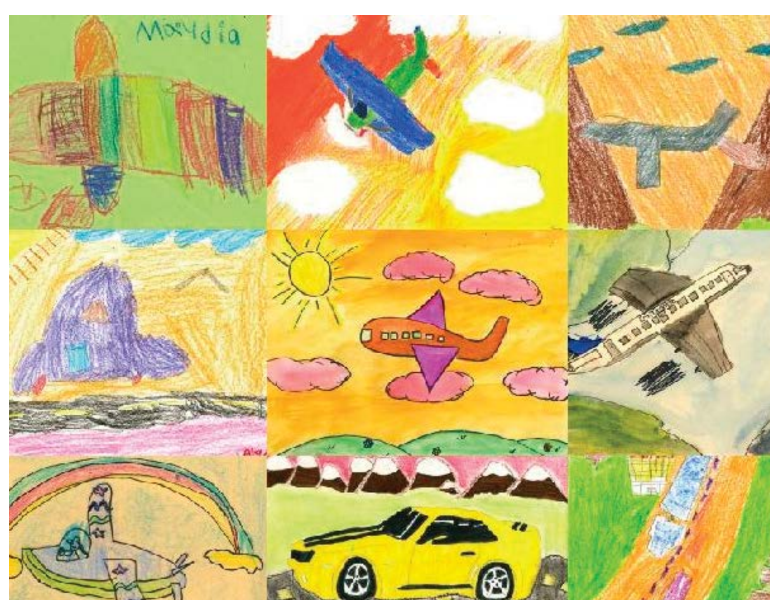
Normalizing the attribute data for the photomosaics posed some challenges for Kang's colleague Kristy Graczyk, a senior engineering technician. Each of the 10 mosaics are composed of approximately 10,000 images for a total of 100,000 images. Each image has attribute data—the student artist's name, school of origin, teacher, and grade level—that was entered in a spreadsheet. Graczyk manually reviewed the data, correcting spelling errors and identifying incomplete information. Once the spreadsheet was vetted, Graczyk designed the website, giving it a bright and uncluttered feel.

To celebrate the project that was more than four years in the making, McCarran International Airport hosted a reception in October 2012 at the D Concourse tram station. Honored guests included Silvers and most of the 10 student artists whose works he recreated. This was the first time the student artists, their families, and their teachers viewed the photomosaic art installation. The evening also featured the launch of the Children's Art Photomosaic website. Using a computer set up at the event, guests had a great time searching the online photomosaics and locating the works of friends, children, and grandchildren.

"I think we really enjoyed this process and are so proud of what we have created because at the onset, this wasn't considered a GIS project. But we ended up with an amazing final product by utilizing a GIS application in a new and unique way," said Kang. "I can't say for certain, but I think this could be the first-ever art website that uses GIS technologies."

For more information, contact Don Kang, senior GIS programmer for Clark County Department of Aviation, at dongk@mccarran.com.





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