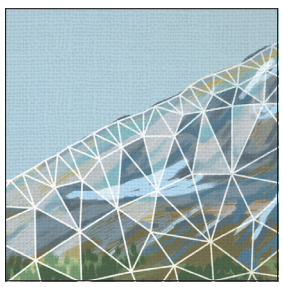
ArcNews

Esri | Winter 2011/2012 | Vol. 33, No. 4

Through the Macroscope: Geography's View of the World

By Jerome E. Dobson, Professor of Geography, University of Kansas



We have in our hands a new scientific instrument as powerful as any that have come before it, including the microscope and telescope. Collectively, GIS, GPS, satellite remote sensing, and popular geographics constitute a *macroscope* that allows scientists, practitioners, and the public alike to view the earth as never before.

Today, this geographically enabled macroscope (which was first proposed by Joël de Rosnay in 1975) allows humans to visualize earth processes extending over vast regions or even the whole globe while still maintaining the finest measurable detail. We who use it can capture and analyze far more complete representations of places and features than ever before. We can "see" earth features, such as gravity and magnetism, that are invisible to the naked eye and yet as real and commanding as the mountains and valleys we've seen all along. Most important, we can marshal this diverse information into working models of earth processes large and small.

continued on page 4

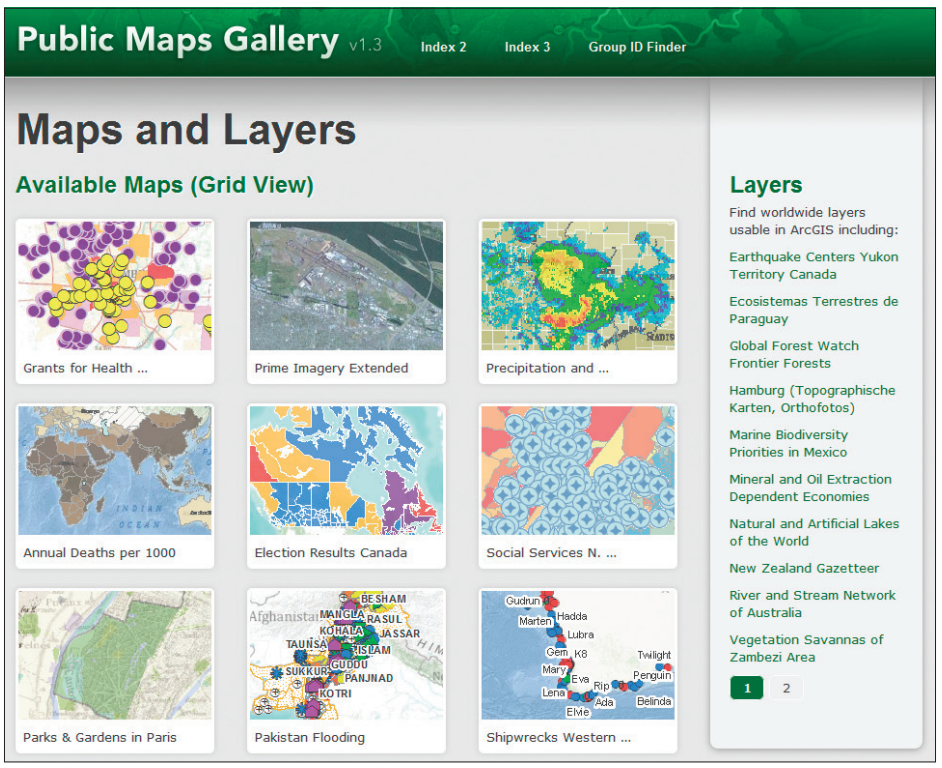
Danish Energy Company Focuses on Smart Grid

The staff of DONG Energy—which is headquartered in Denmark—has a vision to supply reliable energy without CO_2 emissions. To make energy production cleaner, the company is increasing the use of wind power. The company is also testing and implementing various smart grid technologies as part of an international utility initiative to combine telecommunication capabilities with electric distribution for more reliable and precise energy service. *(See the article on page 14.)*

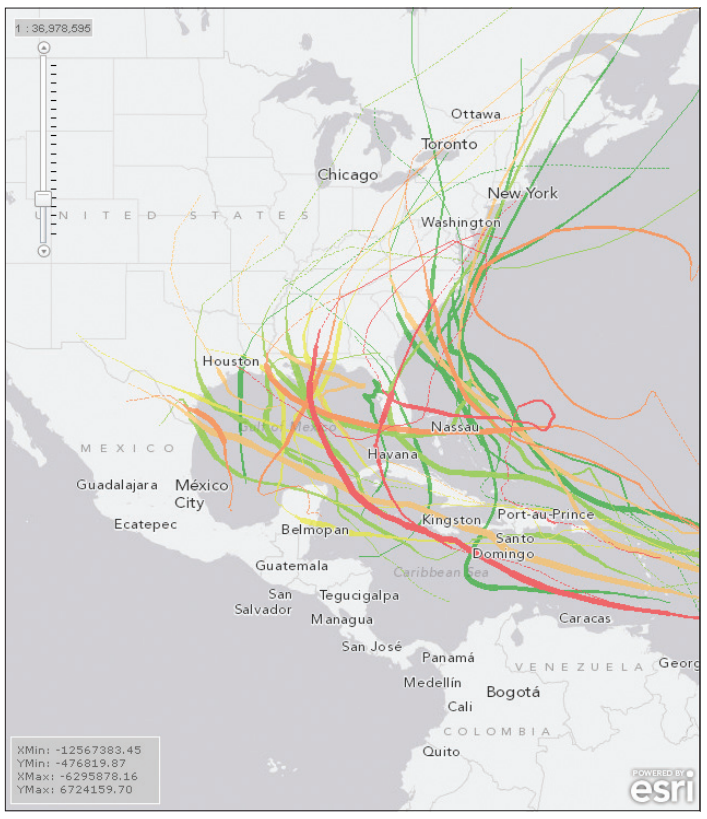
New Map Template Provides Fast Access to Web Maps

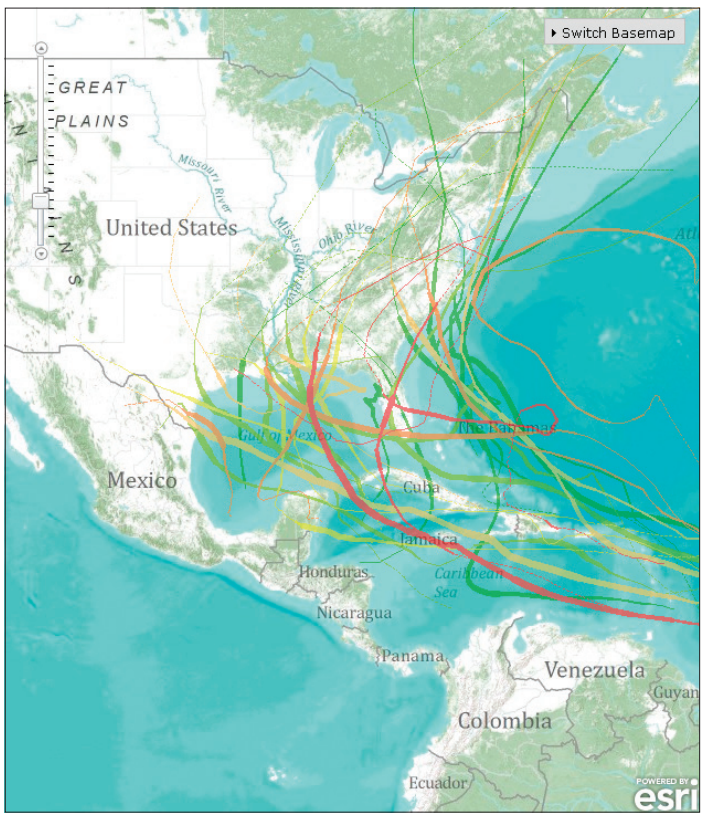
A new way to access ArcGIS Online web maps is to use the Public Maps Gallery template. The template allows users to quickly set up a map gallery web page on their own site while managing the content for it through ArcGIS Online services. The system is lightweight, easy to use, and free.

continued on page 3



The Public Maps Gallery template is designed for ArcGIS Online users who want to showcase their maps, layers, and mobile apps in a dynamic gallery.





ArcGIS Online: What's New?

The *Light Gray Canvas Map* is a perfect alternative to traditional basemaps, which can have an abundance of detail that obscures data overlays. Any existing map backdrop can be changed to the *Light Gray Canvas Map* for a cleaner, less cluttered presentation of operational or custom data. See the article on page 10.

Project Funded by Department of Energy

Esri Partnership to Improve US Fuel Efficiency Standards

Researchers at the University of California, Riverside (UC Riverside), along with partners from several public and private organizations, have received a $1.2 million grant from the Department of Energy (DOE) to research ways to increase fuel efficiency standards. Specifically, the study will evaluate technologies that provide feedback to drivers so they can cut harmful emissions and reduce fuel consumption. As a project partner, Esri will provide its ArcGIS GIS software for mapping, navigation, routing, and vehicle tracking.

The three-year project, named the Next-Generation Environmentally Friendly Driving Feedback Systems Research and Development, began October 1, 2011. It will establish comprehensive driver feedback technology that improves fuel efficiency of passenger cars and fleet vehicles. This technology already exists on a small scale. The study will make large advances in developing a fully integrated information system that includes better trip planning and routing, improved efficiency while driving, and comprehensive reporting on a periodic basis.

continued on page 2

Esri Partnership to Improve US Fuel Efficiency Standards

continued from cover

"Esri and its ArcGIS software are making it possible for us to track vehicle progress and allow users to see the current vehicle locations on a map," says Matthew Barth, the principal investigator on the project and director of UC Riverside's Center for Environmental Research and Technology at the Bourns College of Engineering. "ArcGIS is also being used by dispatchers for comparison of the planned routes with actual routes, mapping of ecofriendly vehicle paths, and mobile integration to update drivers with new itineraries."

The project is one of 40 being funded through a more than $175 million DOE program aimed at improving the fuel efficiency of the next generation of vehicles. The projects will help ensure that the technologies are available to help automakers achieve new fuel efficiency standards. By integrating driver feedback technology, it is expected that overall fuel savings will range from 10 to 30 percent.

Public partners of the project include UC Riverside and UC Berkeley, which will provide behavioral analysis of drivers, and Riverside Transit Agency and California Department of Transportation, both of which will provide fleet vehicles for testing.

Esri will actively support the Center for Environmental Research and Technology throughout the project. The field operational tests will be performed on a variety of in-use vehicles from commuters and commercial fleets operating throughout Riverside and San Bernardino Counties.

For more information on GIS technology for transportation, visit **esri.com/transportation**.

Featured in This Issue

Regular Features and Departments

Editor-in-Chief
Thomas K. Miller

Associate Editor
Matt Freeman

Graphic Designer
Steve G. Pablo

Founding Editor
Karen Hurlbut

***ArcNews* Subscription Additions or Deletions and Changes of Address**
To subscribe to Esri publications, visit **esri.com/subscribe**. To unsubscribe from Esri publications, visit **esri.com/unsubscribe**. Requests for back issues, missed issues, and other circulation services may also be sent via requests@esri.com; 909-793-2853, extension 1-2778; or faxed to 909-798-0560. To update your mailing address, visit **esri.com/coa** or use any of these e-mail, phone, or fax options. Outside the United States, please contact your international distributor to subscribe, unsubscribe, or change your address. For a directory of distributors, visit **esri.com/distributors**.

How to Reach *ArcNews*
Tel.: 909-793-2853, ext. 1-1660

Article submission guidelines/advertising information:
esri.com/arcnews

ArcNews
Esri
380 New York Street
Redlands, CA 92373-8100, USA
tmiller@esri.com

See *ArcNews* Online at
esri.com/arcnews

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

New Map Template

continued from cover

Individuals and organizations can use the gallery template to provide their customers with fast access to commonly needed mapping information. Template users take advantage of the free account tier of ArcGIS Online, which is limited to two gigabytes, to store maps, map layers, and mobile apps. Basemaps, such as Esri's *World Topographic Map*, *Ocean Basemap*, and the new *Light Gray Canvas Map*, are already hosted on ArcGIS Online, so the storage footprint of a web map is small—usually just a few kilobytes.

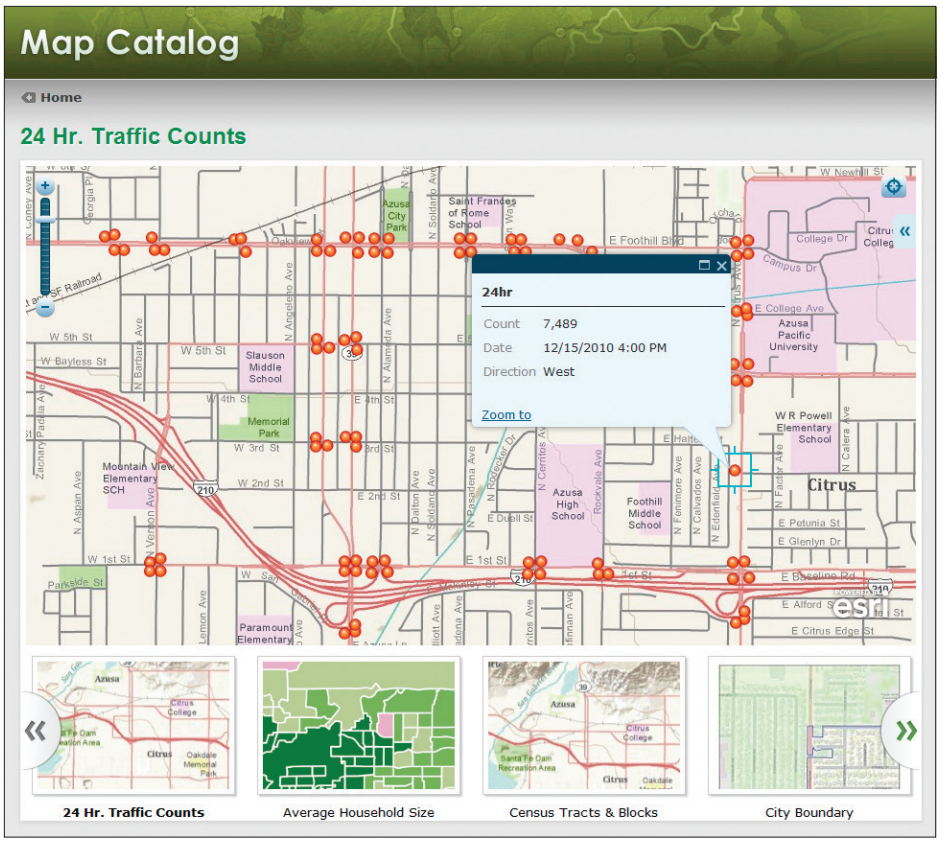
The gallery is dynamically linked to ArcGIS Online through a publicly shared group and the items it contains. The owner of the group can add and share items with or unshare and delete items from the group, and the changes are automatically synced with the gallery.

Nearly all the elements of the gallery are customizable with simple edits to just a few files. Users with a basic understanding of how web pages are put together will have no trouble customizing the template to fit the look and feel of their website. More experienced web developers will be able to do much more, including embedding the gallery in a web page.

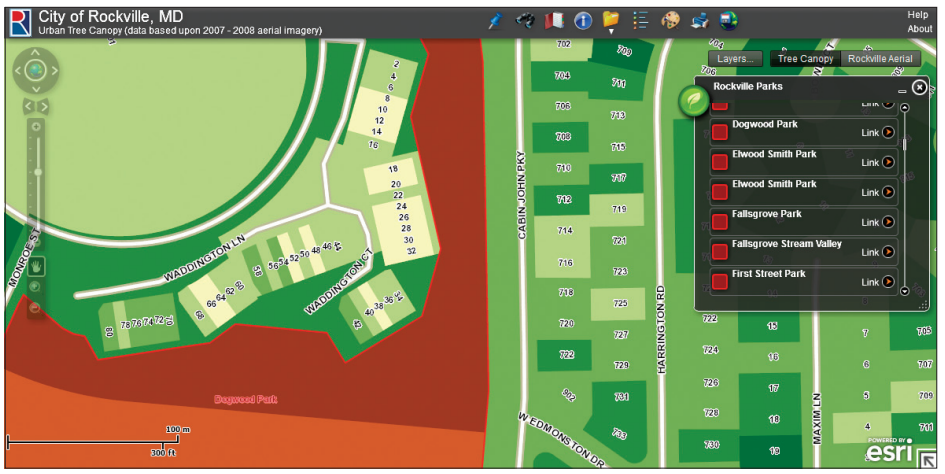
The Public Maps Template was first showcased in the Extend the Reach of Your GIS seminar (the latest component of the Success with GIS Series of seminars from Esri). The seminar, which was held in 67 US cities last fall, taught attendees how to leverage current capabilities in ArcGIS to efficiently share geographic knowledge within their organizations and with the public. Seminar materials, including a video about configuring the template, can be found at esri.com/seminarresources.

The template is available at no cost through ArcGIS Online. Go to arcgis.com and search apps for "Public Maps Gallery." Select the 1.3.1 Public Maps Gallery template item to learn more about it, as well as download it. There's a tutorial for getting started with the gallery template in the Fall 2011 issue of *ArcUser* titled "Use ArcGIS Online to Manage Your Own Custom Map Gallery."

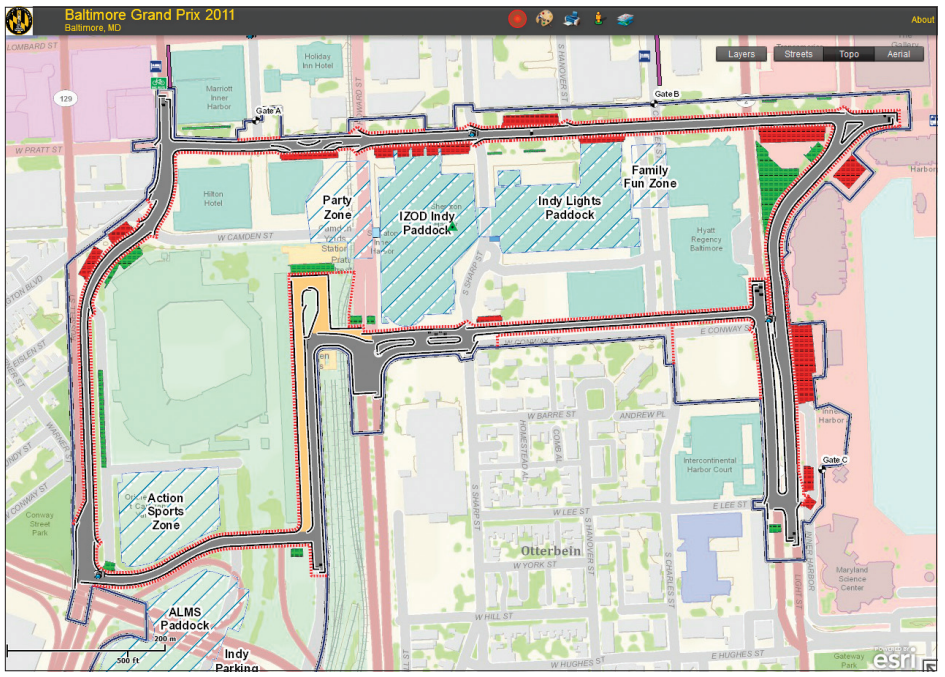
For more information, visit arcgis.com.



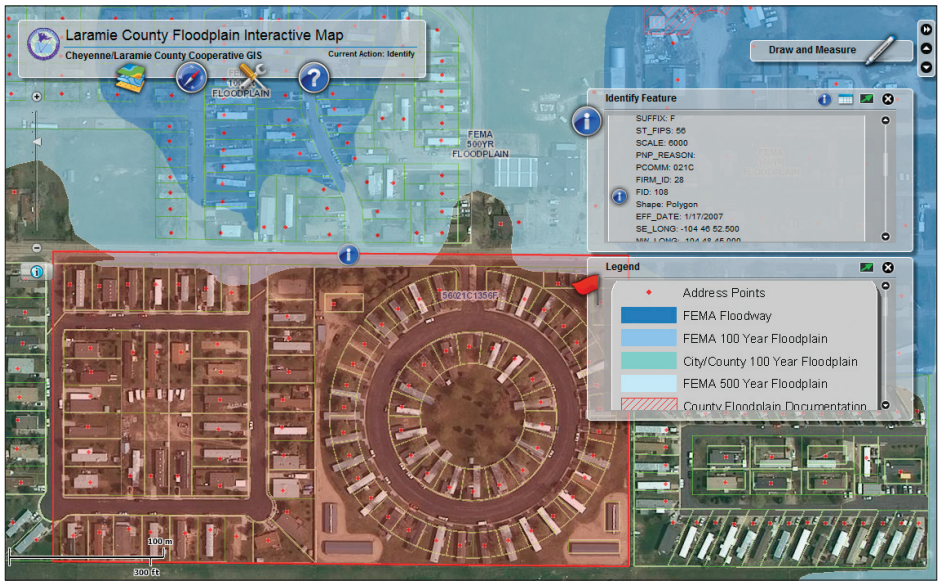
The City of Azusa, California, Map Catalog (gis.ci.azusa.ca.us/map/catalog.html) is used to access city demographics, earthquake faults, local wildland fire history, and 24-hour traffic counts.



This urban tree canopy map with a local park system overlay is available through the City of Rockville, Maryland, Maps Gallery.

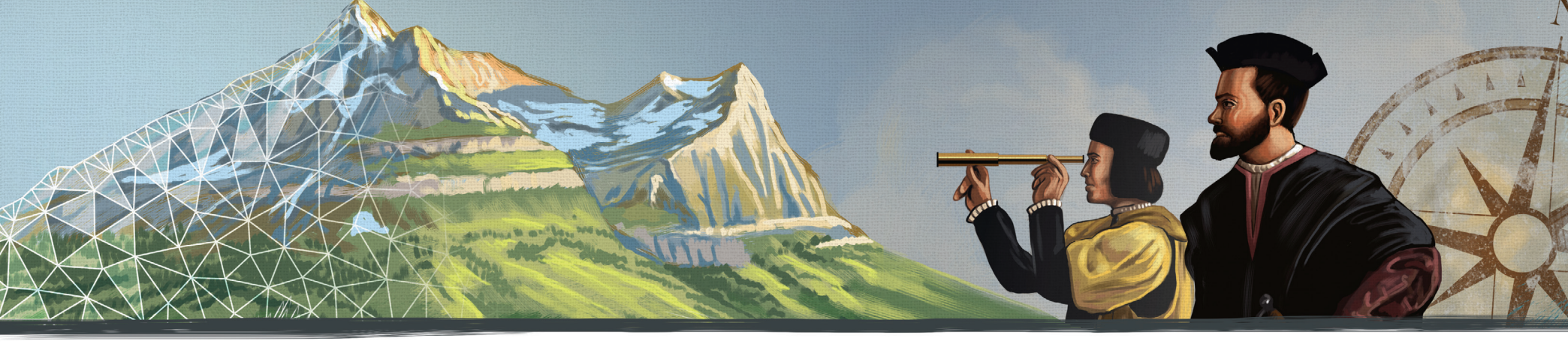


The City of Baltimore Maps Gallery (cityview.baltimorecity.gov/maps) includes the interactive *Baltimore Grand Prix 2011* map to help citizens visualize the layout of the race course.



The Laramie County, Wyoming, *Floodplain Interactive Map* is available through the Cheyenne and Laramie County GIS public maps gallery.

The *Special Area Plans* map is part of the Spatial Information Collection (gisdev.dublin.oh.us/portal) for the City of Dublin, Ohio. It includes graphic concepts and design recommendations developed for nine geographic areas as part of the city's land-use plan.



Through the Macroscope: Geography's View of the World

continued from cover

The microscope allowed humans to see smaller particles and organisms and led to scientific revolutions in biology, medicine, and nuclear physics. The telescope allowed humans to see farther away with greater detail and led to revolutions in astronomy and geodesy.

Will the macroscope similarly lead to scientific revolutions of its own? Will it change the way science itself is conducted, as those earlier instruments did? Has this scientific revolution already begun? Yes, but it has done so slowly and mostly unrecognized by pundits and the public alike.

In 2008, the *Proceedings of the National Academy of Sciences* announced that cattle and deer can sense magnetism. Biologists in Germany and the Czech Republic discovered this amazing and previously unsuspected phenomenon not by sensing brainwaves or measuring body chemistry but by "analysis of satellite images, field observations, and measuring 'deer beds' in snow."

In the 1990s, a geophysicist solved a mystery that had perplexed hydrologists for decades—a significant portion of the global transport of water had never been explained. Perusing satellite imagery, he suddenly realized that the answer lay in vast currents of water vapor drifting through the atmosphere. He calculated their mass and followed their flows and found the H_2O that had been missing from the global water cycle equation.

Thus, in two diverse realms of science, the geographically enabled macroscope actively bolstered the analytic powers of specialized disciplines. Where will this lead?

Geography in the Crucible of Science

Is geography a science? Yes, most definitely, because science would be diminished too much without it.

In classical times, geography was viewed as a fundamental science and humanity on par, at least, with the specialized disciplines of today. During the Middle Ages in Europe, however, notions of real-world geography devolved into fantasies, and no term for geography was in common usage even in the highest realms of government and academe. The discipline thrived again from the mid-15th to mid-20th centuries based on an evolving chain of influences from exploration to westward expansion to geopolitics. Since 1948, however, geography has undergone a second academic purge, primarily in the United States, and the word itself has lost ground to a host of popular aliases, *geospatial* not least among them.

Finally, we practitioners have an instrument that potentially enables us to reinstate geography in science as it was practiced in classical times and in the Renaissance. What will science, enhanced by the macroscope, look like a generation or more from now?

First, we, its stewards, must decide what to do with this new instrument and what role we will play in the science that follows. Will geographers and GIScientists drive the revolution or merely go along for the ride? In the case of animal magnetism, for instance, why didn't we, who worked intensely with such imagery for decades, notice this odd phenomenon long before the biologists did? In the case of global water circulation, why didn't we, who used the imagery routinely and knew its spectral characteristics so well, make that discovery ourselves? Instead, we spent enormous efforts trying to get rid of the haze that was blocking our view of the ground but was, for the geophysicist, the key to a scientific breakthrough of historic proportions.

Bluntly, how did we get scooped on major discoveries so easily resolved with our own data? Why was science held back until biologists and geophysicists discovered those insights themselves? Surely, we must rethink our own functions, motivations, and pursuits if we want to be the ones making discoveries, grabbing headlines, and gaining financial and administrative support for our work.

How Will Geography Itself Fare?

By any measure, geography has been remarkably productive in the past half-century, and yet department after department has been closed. In 2007, I wrote in *ArcNews* that only two geography departments remained in the top 20 private universities in the United States. Four years later, no viable ones are left. The University of Southern California abolished its geography department in favor of a geospatial technology program, and Johns Hopkins University's Department of Geography and Environmental Engineering slipped to only two geographers in a faculty of 18.

To anyone who values education, it should be self-evident that such widespread blindness toward any discipline inevitably must have a damaging impact on science itself. Accordingly, I offer two propositions:

- *Proposition 1—Science itself is rife with errors and omissions* due to lack of geographic input in formulation and testing of theory.
- *Proposition 2*—Any well-trained geographer or GIScientist who focuses on any popular tenet of conventional theory, emphasizes the missing spatial components, and works conscientiously *can make groundbreaking discoveries in one year of elapsed time*. In common English, I am suggesting that earth science as a whole is so flawed by lack of spatial thinking that there will be "easy picking" and lots of "low-hanging fruit." Discoveries will come easily, but acceptance may take decades, since that depends on the culture of science far more than factual evidence.

To illustrate, let's focus on continental drift, as suggested by de Rosnay in *The Macroscope*: "Around the concept of continental drift it is possible to teach the complementary aspects of geography, geology, biology, and ecology. . . ." Then I will focus on another of my favorite topics, the origins of human culture.

Continental Drift and Plate Tectonics

There is no better case than plate tectonics to demonstrate the abiding value of spatial evidence and, simultaneously, society's habitual rejection of it. Starting with the European discovery of the Americas, it took about half a century to produce a decent map of their coasts and only another half-century for Abraham Ortelius to notice the fit between South America and Africa and propose they must once have been joined. In the third edition of his popular text *Thesaurus Geographicus* (1596), he proposed the theory of continental drift in no uncertain terms. Yet there is no known instance of anyone citing his remarkable insight over the next four centuries. Others did reach the same conclusion—Lilienthal (1756), DeBrahm (1771), Snider-Pellegrini (1858)—always based on the fit of coasts, but all were ignored or dismissed until Alfred Wegener in 1912. Soon, he too was rejected and ridiculed for his unconventional theory until ocean floor spreading was discovered and accepted as proof in the early 1960s.

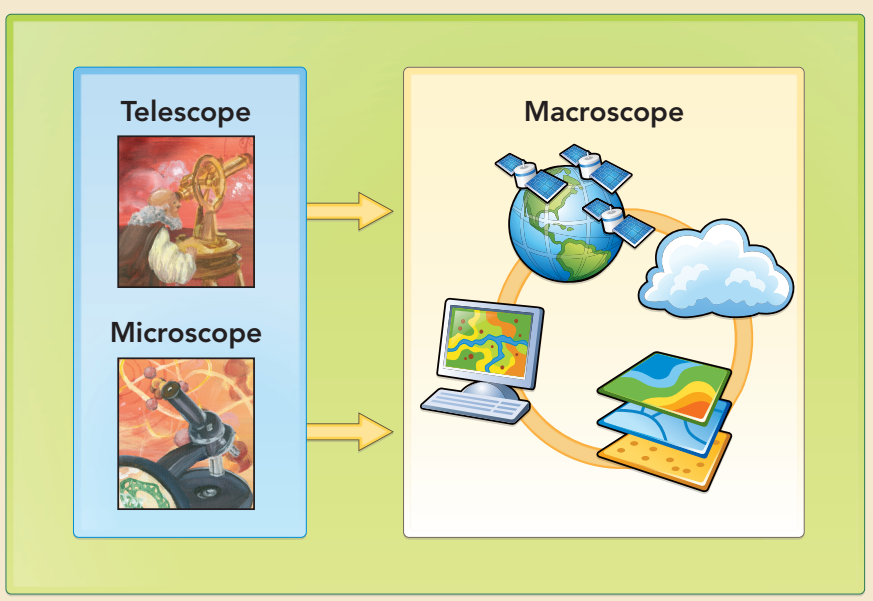
For thousands of years, the interplay of our community—geographers, cartographers, geodesists, and surveyors—with the rest of science was central to the advancement of fundamental theories, including plate tectonics. Sometimes we led science theory, as when Bouguer found that mountains are lighter than other crust (1737–1740) and the Great Trigonometrical Survey of India confirmed his findings (early 1850s), and together they laid the foundations for current understandings of plate tectonics. Sometimes we proved the grand theories of others, as when de Maupertuis (1736) and La Condamine (1736–1743) proved that the earth bulges at its middle, thus confirming Isaac Newton's theory that centrifugal force opposes gravity in planetary motions.

Still, we somehow never managed to claim a place among the authoritative disciplines in that realm of science, even though much of it is called paleogeography. One major factor is the scientific community's overwhelming preference for *process logic* over *spatial logic*. Spatial logic accepts morphology, spatial distribution, and spatial association as primary evidence of earth processes that must be tested through process-oriented research. Conversely, process logic accepts contemporary knowledge about individual earth processes; synthesizes general theory; and proposes all sorts of tests, though rarely are the tests overtly spatial.

Today, the macroscope has much to offer, opportunities abound, and dramatic new insights are likely. Geographers, cartographers, and GIScientists are ideally suited, for instance, to verify previously discovered continental fits and search for new ones. Likewise, our community is the one most capable of developing a spatial statistic to measure the probability of fit among coastlines. In GIS per se, it's up to us to develop the functionality to move land masses independent of earth coordinates. When available, this new capability should be used to follow all paths connecting known or suspected continental fits. The ultimate challenge, of course, will be to disassemble all land masses into their geologic formations; run spatial

The Macroscope

The macroscope was first proposed by Joël de Rosnay in 1975. His foresighted book, *The Macroscope*, brilliantly proclaims the need and lays the intellectual foundation for such a technological advancement. Writing so early in the history of GIS, however, he does not seem to be aware that work had already begun on his marvelous instrument. He mentions geography, but only as one of many disciplines that one learns in school and that can be illuminated by posing great questions about how the world works. He says, for instance, "Around the concept of continental drift it is possible to teach the complementary aspects of geography, geology, biology, and ecology. . . ."



statistics, such as principal components analysis, to determine their affinities to one another based on age, lithology, paleontology, polarity, and elevation/bathymetry; and then reassemble the whole earth based on evidence rather than theory.

The rewards may be invaluable for understanding deep earth processes, estimating seismic risks, reconstructing the paleogeography of plant and animal life, predicting the distributions of oil and other essential minerals, and scores of revelations yet to come.

Origins of Human Culture

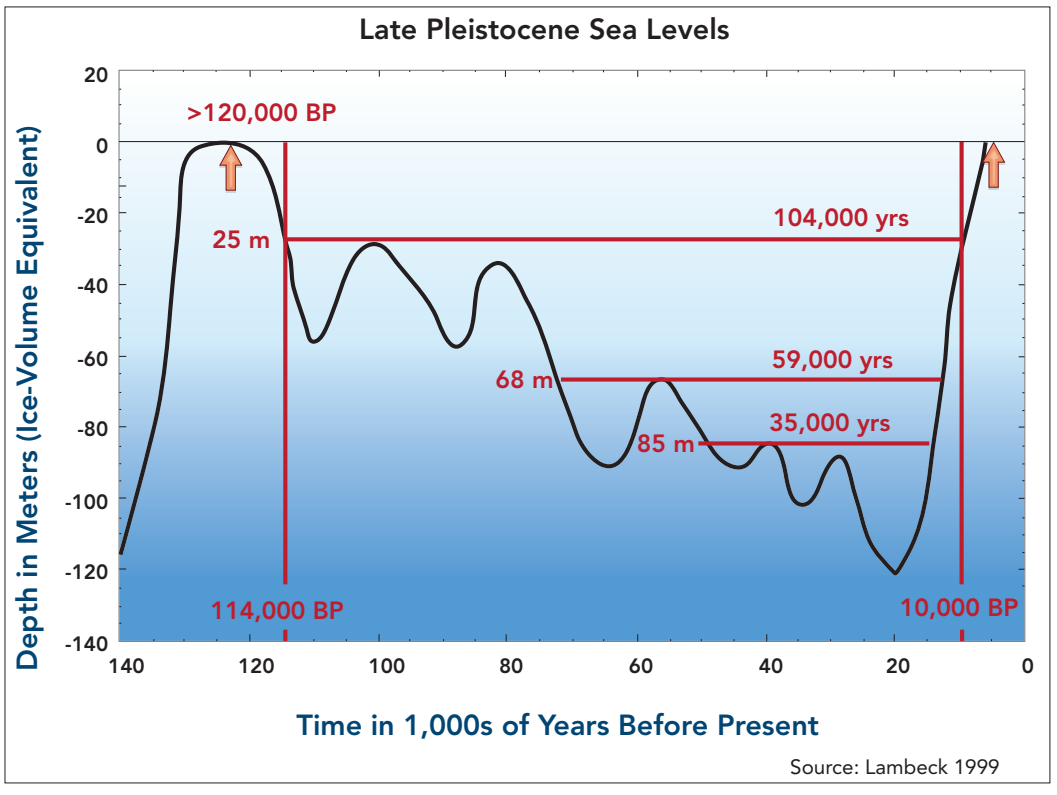
Take a look at the graph of global sea level rise below, annotated to show how long each zone was exposed. Has anyone ever told you that for 104,000 years, the world ocean remained at least 25 meters lower than it is today? That for 59,000 years, it was at least 68 meters lower, and for 35,000 years, it was at least 85 meters lower? That geographic information has to be the single most important clue to how and where humans developed into the sentient beings of today. Yet scientists routinely call the old coast a "land bridge," as if it were only good for getting from one place exposed today to another place exposed today (e.g., Siberia to Alaska, Asia to Japan, Australia to Tasmania).

Make no mistake. That was a vast coastal plain, and people surely lived there.

The rise and fall of sea level during the ice ages—due to water tied up in ice sheets and then released during interglacial periods—is like a vast millennial tide, and its total area is equivalent to the continent of North America in size. It is flat, coastal, and mostly tropical and would have been the best place to live during the ice ages. Yet we collectively have never mapped it or agreed on a name for it.

Here again, the opportunities for geographic revelations are boundless. Our community is the one best suited to map the land that was inundated. We can trace the old coasts at various stages and times over the past 120,000 years and predict likely settlement sites and trade routes. We can document authoritative and unproven claims of ancient structures on land and underwater, entering them into a proper GIS with precise coordinates, attributes, and confidence levels. Ultimately, we can build a 3D geovisualization so the land now below sea level can be studied like the land above.

The rewards will be invaluable for understanding the human and biophysical processes operating during the ice ages. Consider, for instance, that sediments deposited from the ice sheets of 20,000 years ago do not lie in the deltas of today but rather in the old deltas, 400 feet down. The greatest scientific revolution, however, may lie in better understanding of human evolution itself, since several glaciation cycles coincide with the time period, 120,000 years, in which modern humans are known to have existed.



Global sea level rise and the number of years each zone was exposed.

"Aha!" Revolution Under Way. Mind Your Step.

I've had a few "aha" moments enabled by the macroscope.

First, once, while conducting fieldwork in the Adirondack Mountains of New York State at the center of the acid rain debate, I found myself in a forest so dense and disturbed that I could shoulder forward at no more than one-half mile per hour. I could see merely a few feet ahead, but I had with me a map of land-cover types previously classified in the laboratory—a bit of the macroscope, one might say. Checking the map, I realized the unusual forest before me went on for miles in every direction. More important, it displayed a discernible pattern that revealed dramatic new insights into the lake acidification process that so concerned the nation at the time.

Second, while working in Liberia in 1981, my attention was drawn to the geographic distribution of mineral deposits in West Africa, which I later compared to those of South America. That line of reasoning, enhanced by the macroscope, soon led to numerous continental fits that had never been noted before. Now, as always since 1596, the question is: Do continental fits imply adjacency? In terms of pure geometry, South America fits beautifully when turned 90 degrees clockwise from its traditional fit with Africa, and Australia exquisitely matches eastern North America. Both fits have considerable geologic evidence in their favor as well. But does that mean each pair actually did lie side by side at some time in its geologic past? The centuries-old lopsided debate lumbers on.

Third, years later, reading a science magazine, I ran across a forthright statement that sea level had risen 400 feet over the past 20,000 years. I immediately saw it as the key to a mystery that had puzzled me since boyhood. That aha moment prompted a series of geographic questions: What

continued on page 6

Popular Geographics

Neogeography, GIS 2.0, FOSS4G: More than a mouthful of names have been suggested for the nebulous collection of geographic technologies (popular computer mapping and imaging sites, volunteered geographic information [VGI], public domain software, spatially enabled social networking, crowdsourcing, etc.) that so excite the public today. To me, it's all just the democratization of geography and geographic information science that I have publicly advocated since 1983. Hence, I suggest *popular geographics* as the covering term for all geographic information technologies that can be understood and employed at little or no cost without much formal training, in the same sense as *popular science* and *popular mechanics*.

Through the Macroscope: Geography's View of the World

continued from page 5

is missing from the archaeological record? Were coastal populations identical to inland populations? Might there have been some factor, cultural or physical, that caused systematic differences between coastal and interior people? My brother Jeff Dobson, also a geographer, pointed out that iodine is primarily a coastal resource. Noting that Neanderthals lived primarily in places that are iodine deficient today, I spent several years investigating iodine in human evolution.

My purpose here is not to discuss the insights themselves, and certainly not to prove that I was right, but rather to share some lessons learned from the overall experience.

These three experiences in diverse realms of science support, first and foremost, both of the propositions stated above. Clearly, there is much left to discover, and our community is in an ideal position to advance the macroscope and support or lead the coming revolution in science theory.

Furthermore, there is much personal satisfaction awaiting those who take up the gauntlet and wield the macroscope to advance science theory. After each of the aha moments listed above, I came down from the mountain—literally in one case and figuratively in the others—so elated that adrenaline fueled my research for several years to come.

But the road will not be easy. Revolutions always stir passions. Prepare yourself for praise from those who appreciate spatial logic but rejection, even humiliation at times, from those who don't.

Fervor is essential. Wegener's own father-in-law, the renowned climatologist Wladimir Köppen, advised him not to publish his revolutionary theory for fear of the damage it would do to his reputation and career. How different the history of earth science might have been if Wegener had shown less fervor . . . or Ortelius had shown more.

Ultimately, it will be essential to upgrade the scientific method. Our community must insist on testing all earth science hypotheses for space as well as time, entity, and process. We must insist that all other disciplines live up to our standards, which are far more demanding in terms of space.

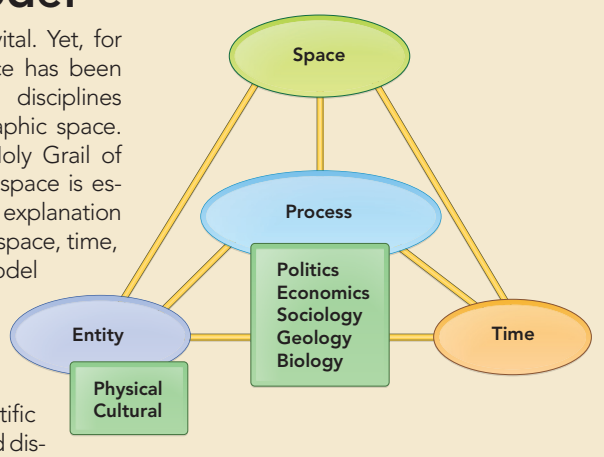
It will be essential to allow investigators to ask "stupid" questions arising from spatial evidence without penalty, as long as they truly ask and do not proclaim unproven truths. Otherwise, science will throttle its best and brightest minds—those most suited to the new way of thinking—and hold back the advancement of science theory.

A concrete step in this direction will be to recognize a new grade of hypotheses so encompassing that testing requires simultaneously or subsequently rethinking many related hypotheses and even widely accepted theories. Perhaps they should be called *hypertheses* (meaning "above or beyond") rather than *hypotheses*. At present, there is no middle ground between an individual hypothesis proposed for testing and an encompassing theory widely accepted by many scholars in any given field. Hence, conventional wisdom based on popular theory often trumps the facts at hand without prompting much reconsideration of existing theory. Alternatively, hypertheses could be tested first for their central claim and then, if found solid, would force rigorous testing of related hypotheses and theories.

The macroscope enables, and even entices, its users to view old questions in new ways. *In terms of pure geometry*, for instance, South America may fit Africa better when rotated 90 degrees clockwise than it does in the fit that has been observed for four centuries.

The STEP Model

In the real world, space is vital. Yet, for a century and a half, science has been dominated by specialized disciplines that routinely ignore geographic space. Process is, of course, the Holy Grail of science, and understanding space is essential to the discovery and explanation of real-world processes. The space, time, entity, and process (STEP) model envisions a future science more closely aligned with the real world. The new spatially enabled science also implies increased scientific integration across entities and disciplines both physical and cultural; improved connections to real-world entities through GIS, remote sensing, popular geographics, and fieldwork; and greater emphasis on place-based research.



The macroscope is here today, and science is already changing in response to it. We are entering a new scientific era that may be every bit as exciting and enlightening as the revolutions prompted earlier by the microscope and telescope. Surely our professional lives will be richer, and science itself will gain, if we, who know the marvelous instrument best, insist on using it ourselves to tackle the greatest mysteries of our time. Surely we must insist on reviving the classical model in which geography is viewed as a fundamental discipline.

Again, I urge, bring back geography! To science . . . education . . . business . . . and government! The benefits to science and society will be incalculable.

About the Author

Jerome Dobson is president of the American Geographical Society and a professor of geography at the University of Kansas. He is a Jefferson Science Fellow, a fellow of the American Association for the Advancement of Science, and chair of fellows of the University Consortium for Geographic Information Science. He formerly served as senior scientist in the Office of the Geographer and Global Issues, United States Department of State, and as a member of the distinguished research and development staff, Oak Ridge National Laboratory. For further reading, see the author's previous *ArcNews* article "Bring Back Geography!" (Spring 2007). Also see:

Dobson, Jerome E., Richard M. Rush, and Robert W. Peplies. 1990. "Forest Blowdown and Lake Acidification," *Annals of the Association of American Geographers* 80(3): 343–361.

Dobson, J. E. 1992. "Spatial Logic in Paleogeography and the Explanation of Continental Drift," *Annals of the Association of American Geographers* 82(2): 187–206.

Dobson, J. E. 1996. "A Paleogeographic Link Between Australia and Eastern North America: A New England Connection?" *Journal of Biogeography* 23: 609–617.

Dobson, J. E. 1998. "The Iodine Factor in Health and Evolution," *Geographical Review* 88(1): 1–28.

For more information, contact Jerome E. Dobson, University of Kansas (e-mail: dobson@ku.ed).

Janice Thomson: Tireless Wilderness Advocate

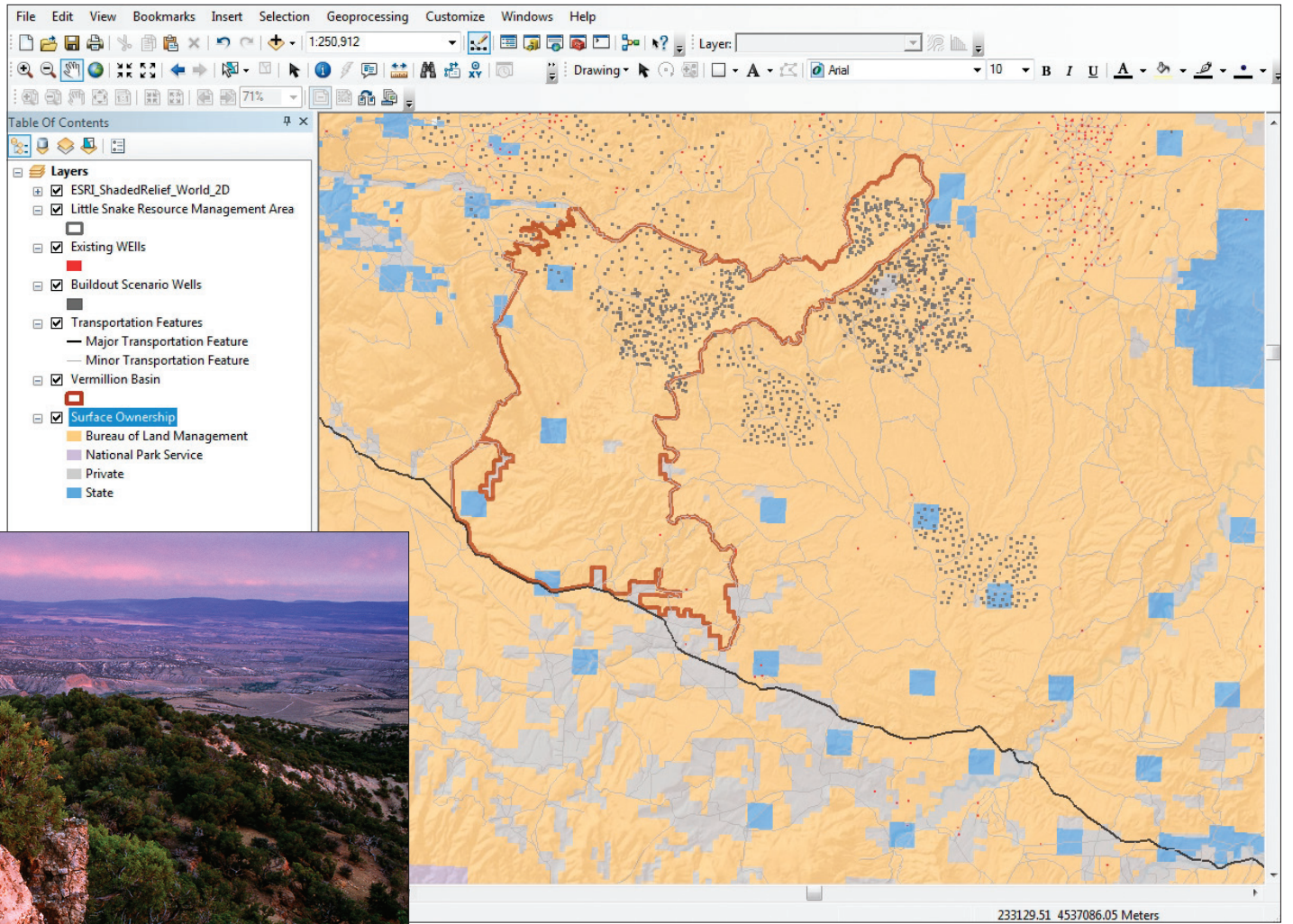
NGO Non-Governmental Organization

GIS Hero

Janice Thomson

An avid hiker who adores the mountains of the Northwest, Janice Thomson was drawn to The Wilderness Society out of a desire to defend the wildlands she loves. In her current position as the society's director for the Center for Landscape Analysis, Thomson integrates a wide variety of data items into spatial analyses and tenable maps. These maps are then used to promote the goals and values of The Wilderness Society to agencies working directly with the land. As a lifelong wilderness advocate, Thomson has put her passion to work protecting America's public lands.

The scenic Vermillion Basin (photo: Sam Cox).



Build-out scenarios, like this one of the Vermillion Basin, illustrate development plans and help predict habitat impacts.

Cofounded in 1935 by renowned wildlife ecologist Aldo Leopold and several other prominent conservationists of the time, The Wilderness Society has a mission to "protect wilderness and inspire Americans to care for our wild places." The Wilderness Society works to protect the United States' 635 million acres of national public lands. Among other conservation actions, the organization has led the effort to permanently protect as designated wilderness nearly 110 million acres in 44 states to date. Thomson's ability to infuse these efforts with geospatial intelligence makes her integral to achieving these objectives.

Thomson received her master's and PhD degrees in geology from Dartmouth College. After graduating, she went to work for Lockheed Engineering and Sciences, mapping land cover in the Chesapeake Bay Watershed. After a year and a half with Lockheed, Thomson started her journey with The Wilderness Society in 1992.

Much of Thomson's work centers on habitat degradation sometimes associated with the extraction of fossil fuels, especially oil and gas. By applying spatial analysis to the relationship between oil and gas infrastructure and various natural resources, Thomson is able to create maps that are, in turn, used to craft development recommendations. These recommendations, made through the Bureau of Land Management (BLM), promote optimized solutions that integrate oil and gas industry development plans with strategies for protecting the land's ecological and wilderness values.

"We provide the best science possible and advocate strongly for lands that should be protected from development, and we provide recommendations for how other lands can be developed in ways that minimize ecological impacts," says Thomson.

The vast interdisciplinary cooperation required for development in the oil and gas industry makes the merging of information into a viable recommendation no small feat. Couple a complex industry with conservation goals and the delicate interdependence of wild ecosystems, and the task of providing sound counsel to all the stakeholders becomes even more daunting. This is where Thomson comes in. She takes natural resource datasets and industry development plans that are impracticable alone and combines them to create functional maps that expand organizational awareness. This increased understanding is crucial to facilitating sustainable development in the oil and gas industry.

"The Wilderness Society is an organization that integrates science, policy, and advocacy," says Thomson. "Our integrated approach allows us to bring unique GIS analyses to the table to answer questions that maybe other government agencies or entities aren't asking. We're then able to share that information with all the players involved in a given project—people like county commissioners, conservation partners, and oil and gas professionals."

The staggering diversity of wildlife poses a critical challenge for future development. "The effect of habitat fragmentation varies tremendously by species; that's why this work is all done on a species-by-species basis," says Thomson. "We use studies completed by field biologists who have measured the responses of different wildlife species in proximity to oil and gas development, and fortunately, some of these biologists are publishing information about spatial metrics that we can measure using GIS."

By integrating biological literature with spatial data, Thomson was able to illustrate and compare development with mule deer migration routes in the Upper Green River valley. Her efforts resulted in accessible analytic data that demonstrated the impact of infrastructure development on mule deer. This data was put to use to create specific setup recommendations BLM could use for future development plans.

Another way that Thomson encourages environmental consideration is by creating build-out scenarios of roads and well pads and providing informed projections of the impact on local species. "We give people a qualitative picture and quantitative story," says Thomson. "These projections are really powerful to bring to the table at a meeting with county commissioners, the BLM, and any other local stakeholders. Projections allow us to illustrate what the scenario they're supporting would look like on the ground and what its likely impacts would be on the important species in the region."

The employment of a similar build-out scenario contributed to a recent win for The Wilderness Society. After years of discussion surrounding potential land management plans for the Little Snake resource area in northwest Colorado, The Wilderness Society presented a build-out scenario demonstrating how proposed oil and gas development would affect the Little Snake area. A particular area of concern was Vermillion Basin, an area of northwest Colorado with profound wilderness character and value to locals. When the final management plan came to fruition, the Vermillion Basin was granted administrative withdrawal of oil and gas development.

Thomson knows that a well-crafted map has the capacity to advocate certain development methodologies simply by being available for consideration. With this function in mind, she puts relevant maps in front of decision makers.

"Creating a map about a particular resource and getting it into the hands of stakeholders often gets the map into closed-door meetings," notes Thomson. "The map can then be a voice when someone from our staff is not able to be a voice."

Thomson works courageously to promote engagement with wildlands and understanding of the tremendous value that these lands hold. "GIS helps connect people with the land," Thomson says. "These lands provide vital services to communities, whether it's clean water and air, income from recreational visitors, cultural values, or spiritual significance. It's really exciting to represent these values on maps to allow people to share their own accounts and why they believe land needs to be protected." Her tireless work advocating for wilderness has made Janice Thomson a true GIS hero.

For more information, contact Janice Thomson, director of the Center for Landscape Analysis, The Wilderness Society (e-mail: janice_thomson@tws.org).

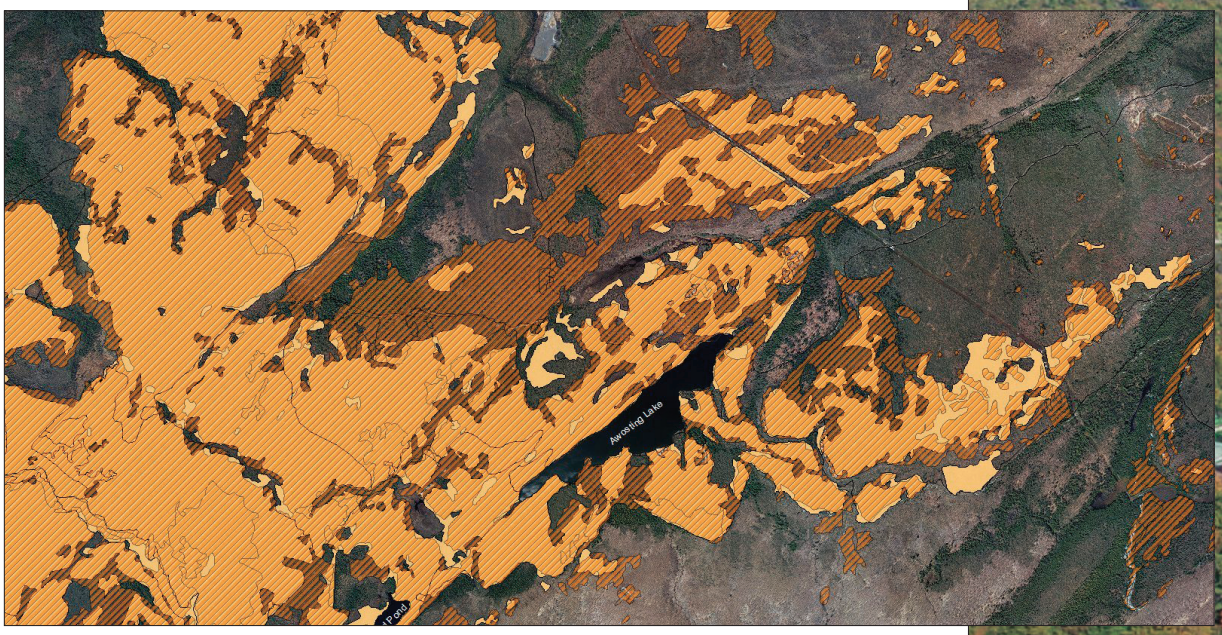
What Makes New York's Shawangunk Mountains One of the "Last Great Places"?

By John Thompson, Director of Conservation Science, Mohonk Preserve, Inc.

NGO Non-Governmental Organization

Highlights

- GIS maps demonstrate the relationship between rare species and their habitats.
- With GIS, scientists and managers illustrate and describe the importance, requirements, and changes in ecological communities.
- GIS analysts used ArcGIS to identify and describe ecological threats and then prioritize restoration strategies and actions.



Vegetation change was analyzed using GIS. Aerial photo interpretation was digitized from both 1948–50 photos and 1994 photos. Cross-hatching shows areas of ridgetop pitch pine barrens in 1948–1950; tan areas show current pine barrens. One-third of pine barrens became forest between 1950 and 1994.

Due to its rich biological diversity, New York State's Shawangunk Mountains region is one of the most important sites for conservation in the northeastern United States. Because of the many rare natural communities and species found here, the New York Natural Heritage Program ranked the Shawangunks highest in biological diversity, and The Nature Conservancy recognized them as one of the "last great places" on earth. The northern Shawangunk Mountains support 42 state rare species, eight state rare ecological communities, and three globally rare ecological communities in a largely forested landscape surrounded by residential housing and agricultural uses.

This is a surprisingly rugged landscape, with cliffs up to 350 feet tall topped by pine-dominated crags sloping into steep hemlock ravines. Though 27 million people live within 100 miles of the northern Shawangunks, the mountains support a rather wild landscape. The sustainability of this unique area in an ever-changing world is dependent on the cooperation of scientists, land managers, and the public. GIS provided a comprehensive tool to visualize and understand this intricate landscape.

Why is this area so ecologically rich? The ridge-forming bedrock, Shawangunk Conglomerate, is resistant to erosion but has been faulted and jointed through plate tectonics. Glaciations wore away bedrock around the conglomerate, shaping cliffs, scooping out mountaintop "sky lakes," and forming waterfalls and ice caves. The sharp relief, varied soils, and ecological dynamics of this landscape create the foundation for the diverse mosaic of natural communities that occur here.

Conservation on the ridge began with the accumulation of property by mountain resorts, at both Mohonk and Minnewaska Lake, established in the 19th century by twin brothers Albert and Alfred Smiley *(see sidebar below)*. The resorts promoted people's relationships with nature and each other. As mountain farms were abandoned, the mountain resorts purchased the surrounding lands to add to their holdings. Eventually, the resorts grew to own nearly 20,000 acres. With time, the regional resort industry declined; the only resort still surviving is the Mohonk Mountain House.

In the mid-20th century, interest in protecting this rare ecosystem grew. In 1963, the Mohonk Trust was formed by Smiley family members (descendants of the Smiley twins) and friends to provide conservation, education, scientific research, inspiration, and recreation. The trust began its existence by acquiring outlying lands of the Mohonk Mountain House, eventually becoming the Mohonk Preserve and growing to nearly 7,000 acres. Most other large landholdings have become

Mohonk to Redlands: The Smiley Connection

Though the headquarters of Esri, in Redlands, California, is 2,200 miles from New Paltz, New York, there is a strong connection spanning that distance that has been built over 120 years by the Smiley family.

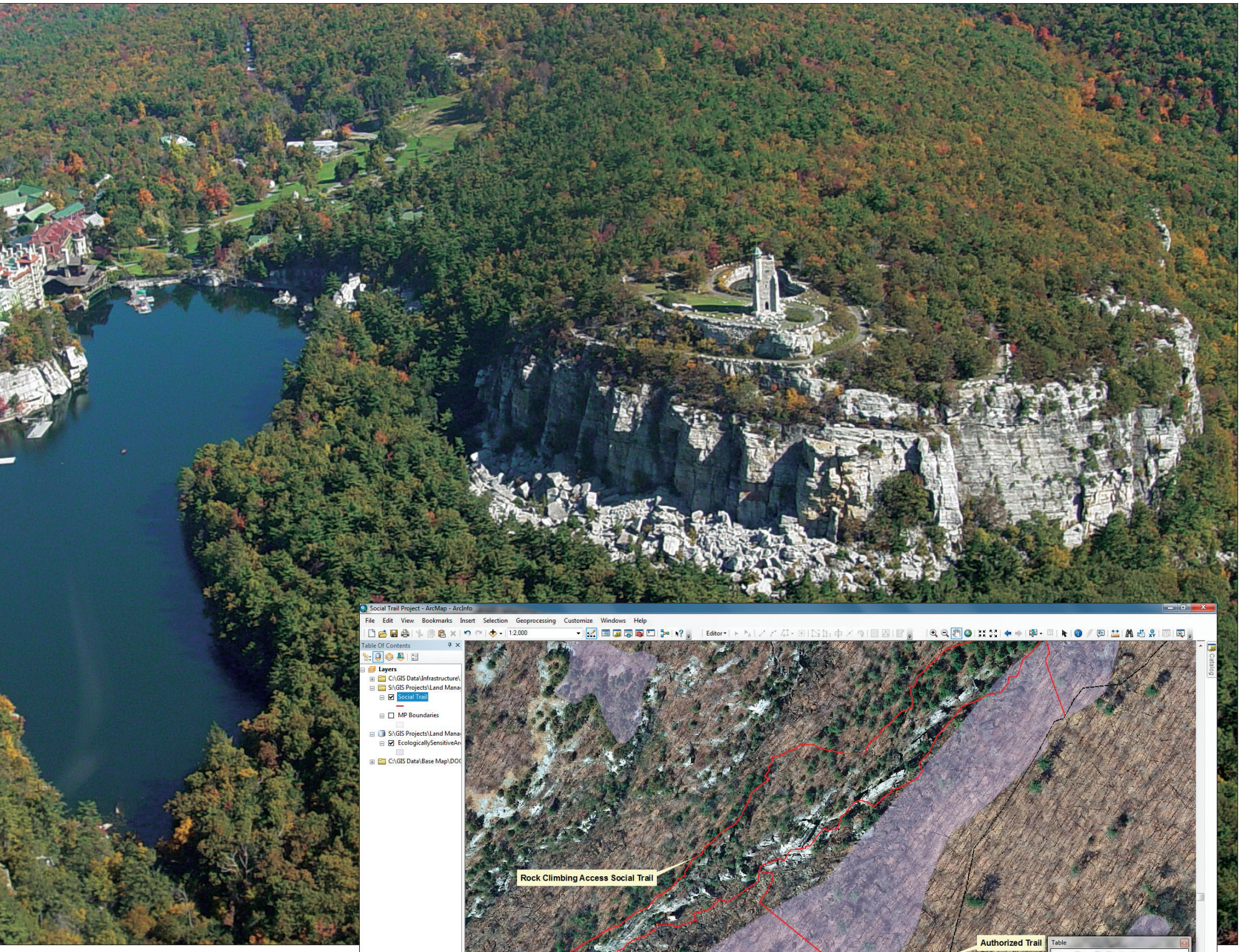
In 1869, twin brothers Albert and Alfred Smiley established the Mohonk Mountain House resort on a mountain lake halfway between the Hudson River and the Catskill Mountains in New York State. Founded on Quaker principles to refresh the spirit of its guests with emphasis on promoting friendships and inspiration from nature, this grand Victorian hotel became one of the most prominent summer resorts in the United States. The Smileys built carriage roads and summer houses to emphasize scenic vistas and make nature more accessible. Alfred went on to start Cliff House in 1879 and Wildmere in 1887, resorts at nearby Minnewaska Lake, with a network of carriage roads connecting to Mohonk.

Through its beginning decades, Mohonk would close for the winter months, allowing maintenance and preparation for the next season. Alfred's son Frederick, looking for other opportunities outside New York, ventured to Southern California and discovered a growing city in Redlands with a spectacular vista of the beautiful San Bernardino Mountains. In 1889, Alfred, suffering from rheumatism, was lured to join his son in the warm climate of Redlands. Alfred in turn convinced Albert to join him, and together, they assembled Canyon Crest Park. The Smileys would make their winter home in Redlands. The beautiful gardens of the estate they created were open to the public, attracting thousands of tourists each year to the city of Redlands.

Albert and Alfred were famous for their philanthropy and civic service, becoming known as Redlands' "patron saints." The twins led the effort to fund and build the A. K. Smiley Memorial Library, donating parks and public spaces and beautifying the growing city of Redlands—giving their fellow citizens opportunities for culture and beauty that continue today.

Albert and Alfred Smiley led the effort to fund and build the A. K. Smiley Memorial Library (in the background), donating parks and public spaces and beautifying the growing city of Redlands.

Alfred died at 74 years old, in 1903, in Redlands. Albert died 9 years later, also in Redlands. Both led accomplished lives of social action. The vision of the twins continues to thrive, as Mohonk was recognized by the United Nations Environment Programme in 1994 for 125 years of environmental stewardship. The benevolent heritage that was passed down through the Smiley family eventually led the twins' descendants to form the Mohonk Trust in 1963 to further a concerned understanding among humans and between humans and nature. In 1978, the trust split into Mohonk Consultations, promoting peace and sustainable use of the earth, and the Mohonk Preserve, a 7,000-acre member-supported nature preserve dedicated to environmental education and stewardship of the land.



Mohonk Mountain House is perched on the edge of Mohonk Lake.

Unauthorized, or "social," trails often run through ecologically sensitive areas. Land managers are comparing recreational impacts to fragile natural resources to identify problem areas and develop mitigation plans.

part of what is now Minnewaska State Park Preserve, a refuge over 20,000 acres in extent.

In the 1980s, some land managers began working together, realizing that they faced similar challenges. But landholdings were large and complex. The Shawangunks have been studied for more than 100 years, and land management was done mostly by "gut feeling."

Composed of nonprofit and public organizations, the Shawangunk Ridge Biodiversity Partnership uses science and land management strategies to preserve sensitive wildlife habitats and other natural resources of the Shawangunks. The partnership formed in 1994 as a collaboration of Cragsmoor Association; Friends of the Shawangunks; Mohonk Preserve; New York-New Jersey Trail Conference; New York State Department of Environmental Conservation; New York State Museum; New York State Natural Heritage Program; New York State Office of Parks, Recreation and Historic Preservation; Open Space Institute; Palisades Interstate Parks Commission; The Nature Conservancy; and US Fish and Wildlife Service. The initial step for the partnership was to inventory and map rare species and habitats in ArcGIS. By mapping the vegetation communities and descriptions into ArcGIS, partners could then visualize how the pieces fit together through shared maps.

The partnership has used ArcGIS to identify and map the key ecological communities of the ridge and the greatest threats to their long-term sustainability. As it turned out, many of the original intuitions were largely correct, but scientists and managers, through GIS maps, could illustrate and describe the importance, requirements, and changes in ecological communities that each organization needed to understand to effectively manage and communicate to their constituents. Partners developed a cooperative, ridge-wide plan to preserve the beauty and ecological integrity of more than 40,000 acres of the Shawangunks while maintaining high levels of public access and enjoyment and sharing natural resource information on surrounding properties with local towns.

Using science to inform and conduct land management, the partnership has inventoried and mapped the forests, barrens, and wetlands in and around the ridge. The first set of partnership guidelines was developed for managing the land and all its resources as one integrated landscape. Prior to the formation of the partnership, focus had been on individual rare plant and animal populations and patches of rare communities. Thorough mapping and analyses, along with "seeing the big picture," showed the importance of the matrix forest in protecting conservation targets—biological connections between rare communities became more apparent. The timing and extent of historic disturbance events, such as wildfire, wind, and ice storm damage, are being mapped and are better understood through space-time analyses.

An important finding of these studies is that areas of disturbance-dependent natural communities are stable for long periods of time on shallow soils, even in the absence of disturbance events. Ecological threats, such as encroaching development, forest fragmentation, and invasive species, were identified and described by GIS. While depicting the threat of these stressors (current extent and potential impacts), GIS is used to prioritize restoration strategies and actions. Visualizing the ridge as a whole will help ensure the survival of the sum and all its parts.

About the Author

John E. Thompson was appointed as director of Conservation Science at the Mohonk Preserve this year and oversees the Daniel Smiley Research Center, a world-renowned natural history collection. Thompson has been using GIS for biological conservation for nearly 20 years.

For more information, contact John Thompson, director of Conservation Science, Mohonk Preserve, Inc. (e-mail: jthompson @mohonkpreserve.org).

ArcGIS Online: What's New?

This regular column contains information about the latest updates to ArcGIS Online including new content contributed by Esri and the user community.

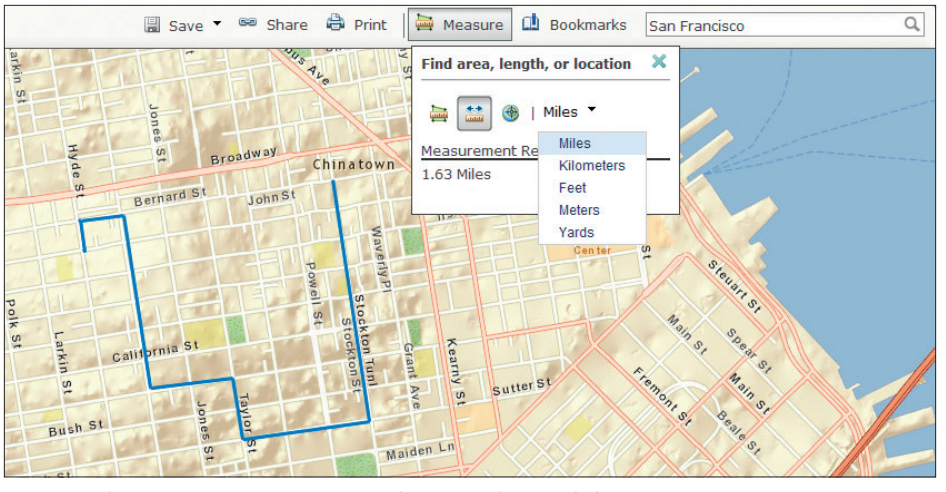
New and Updated Basemaps

The latest addition to the ArcGIS Online basemap collection is the *Light Gray Canvas Map*, available at **arcgis.com** and ArcGIS Explorer Online. The *Light Gray Canvas Map* features an overall soft gray color for land and darker gray for oceans and other bodies of water. These shades provide a pleasing neutral background so that data overlays contrast sharply with the rest of the map. With fewer features and labels on the map, there is more freedom to color and label data. The map is a perfect alternative to traditional basemaps, which can have an abundance of detail that obscures data overlays. Any existing map backdrop can be changed to the *Light Gray Canvas Map* for a cleaner, less cluttered presentation of your operational or custom data. This new basemap and the recently released *Ocean Basemap* have been added to the basemap gallery picker in the **arcgis.com** map viewer and ArcGIS Explorer Online.

The latest contributions to the *World Topographic Map* include new content for Great Britain, Ghana, Spain, and the Netherlands, as well as several areas in Canada—Cape Breton, Nova Scotia, and Gatineau, Quebec—and the United States. Content was updated and expanded for Greece and some areas in the United States, including Delaware County, Ohio, and Washington, D.C. Data from Esri Partners DeLorme and NAVTEQ has been added, as well, for several areas around the globe, including North America, Australia, New Zealand, and southern Africa. The same data from DeLorme and NAVTEQ has also been added to the *World Street Map*. Data for Great Britain, Spain, and the Netherlands has been contributed through the Community Maps Program.

The *World Topographic Map* and *World Street Map* and associated reference layers have been updated with the latest available NAVTEQ data for North America and Europe. The map update also includes additional levels of detail, globally down to 1:72,000, and for areas where large-scale data is available, for example, North America, South America, Europe, and the United States nationwide, down to 1:4,000. For metro areas, these maps go down to 1:1,000.

More recent and detailed imagery for the United States has been added to the *World Imagery Map* for several metropolitan areas and states. The *World Imagery Map* is one of three Community Maps, along with the *World Topographic Map* and *World Street Map*. Esri maintains and expands the level of detail of these maps through contributions of GIS organizations around the world. The *World Topographic Map* is updated on a monthly basis.



Measure distance or areas or get coordinates with one click.

The *World Street Map* and *World Imagery Map* are updated at least twice annually. For a complete list of all Community Maps updates and more details, visit the Community Maps Resource Center at **resources.arcgis.com/content/community-maps/about**.

Updated Task Services

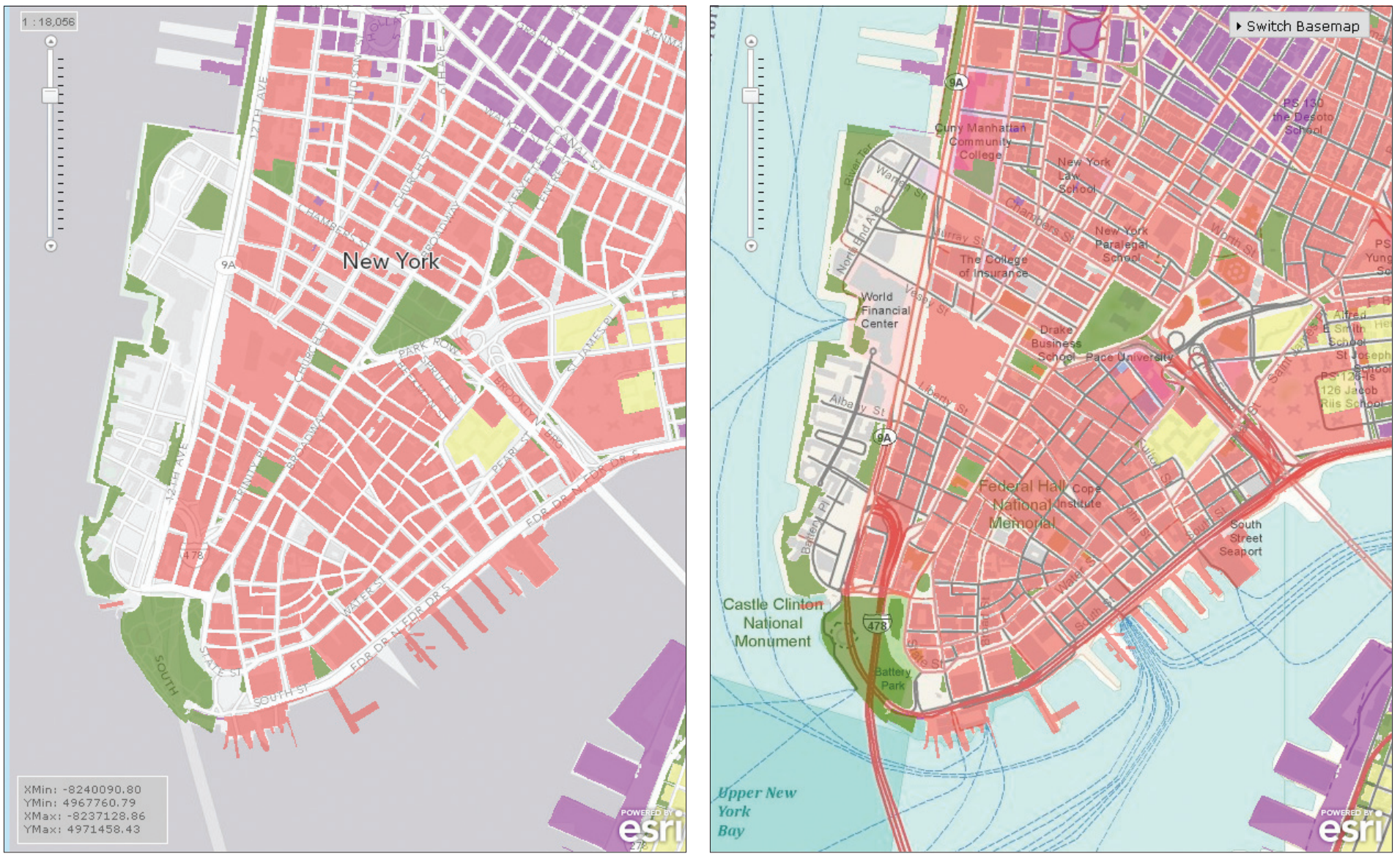
The ArcGIS Online World Geocoding Service address locators now use data from NAVTEQ. The European Address Locator has been updated with NAVTEQ Q1 2011 reference data, and the North American Address Locator has been updated with NAVTEQ Q4 2010 reference data. Both locators can be used to perform single address, reverse, and batch geocoding to find and display an address on a map. The World Routing Service now also uses NAVTEQ data. European Routing has been updated with NAVTEQ Q1 2011 reference data, and North American Routing has been updated with NAVTEQ Q4 2010 reference data. Both routing services aid the creation of street-level multistep and optimized routes between two or more points to display, along with driving directions.

Map Viewer Improvements

A number of enhancements have been added to the map viewer on **arcgis.com**. A measuring tool has been added to make it easy to determine the length of a line, the areas of a polygon, or the coordinates of a point on a map. Support for bookmarks has been added for quick navigation.

Users can now set the transparency of a basemap through layer properties. This will tone down basemaps and bring out the other layers. This can be done directly from within the map viewer by pausing the mouse pointer over a basemap name in the map contents window.

For a complete list of all updates, go to the help topic on **arcgis.com** and click What's new? To start using ArcGIS Online content and capabilities, visit **arcgis.com**.



With the *Light Gray Canvas Map*, you can create visually compelling maps that highlight patterns. Set the transparency to bring layers to the forefront.

Create, Share, and Browse Content in Country-Specific Languages

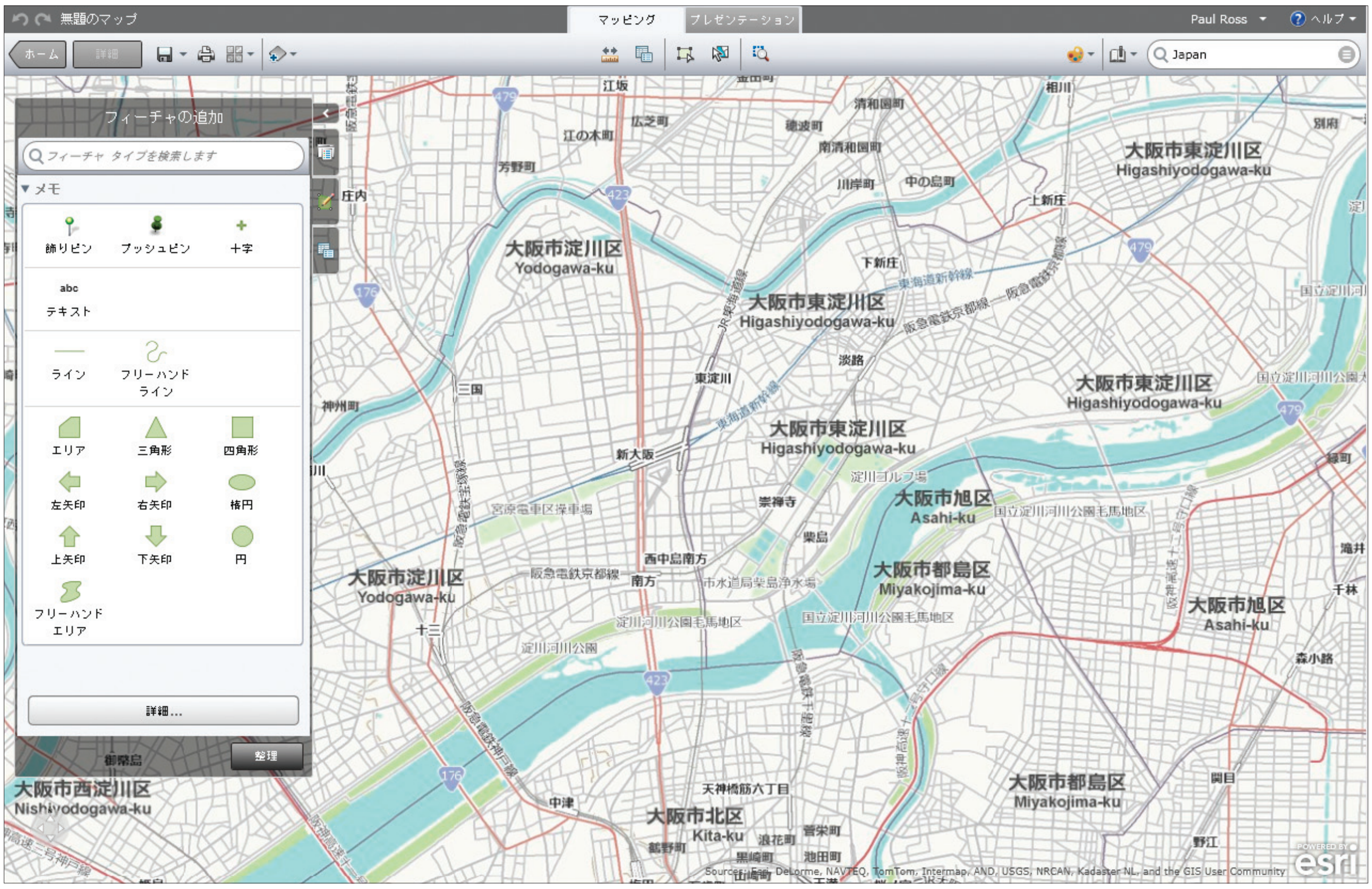
Access ArcGIS Online in 10 Different Languages

Esri is localizing ArcGIS Online in 10 languages to make it easier for users around the world to create maps, share their organizations' content, and collaborate with other users in their local language.

In this first localization release, in addition to English, users can interact with ArcGIS Online in Arabic, French, German, Italian, Japanese, Portuguese, Russian, Simplified Chinese, and Spanish. These languages will automatically be presented when users access ArcGIS Online through the web-based interface at **arcgis.com**. Once users have logged in to ArcGIS Online, they can choose to change their language and country setting through their user profile. For example, a user in Switzerland may choose to switch from English to German, French, or Italian, with a country setting for Switzerland.

Much of the ArcGIS Online content, including the home page, the featured maps and apps in the galleries, and the default map, will be displayed based on the user's language or country preference. Esri's international distributors have selected and contributed featured maps and apps and will continue to curate content to keep it up-to-date and relevant. The **arcgis.com** map viewer and ArcGIS Explorer Online will default to a country-specific basemap extent as a starting point for authoring new web maps. Since the core basemaps are global, users still have the choice to toggle between the different basemaps, such as *World Imagery Map*, *World Street Map*, or *World Topographic Map*, for a local perspective.

ArcGIS Online localization provides a unified user experience by also localizing the help system and the Resource Center into 10 languages. The item details pages for many featured items, such as a map service, web map, or web app, will show the description of the item and other metadata in one of the supported languages for the selected country. The same is true for groups, templates, symbols, and colors.



The ArcGIS Explorer Online localized user interface features translated maps and symbols.

ArcGIS Online provides a focused experience that speaks the local language of users around the world. Localizing ArcGIS Online into 10 languages is just the beginning. Over the coming months, ArcGIS Online will be translated into more languages to truly offer a global experience so that organizations around the world can leverage a new pattern of using GIS.

To experience ArcGIS Online in the language of your choice, visit **arcgis.com**.

Free App Now Available

Connecting ArcGIS to the Android Platform

Google Android users can now access data and mapping capabilities on their smartphones with the ArcGIS for Android application, which lets users find and share maps as well as deploy GIS data and functionality on Android devices. The free app is now available and can be downloaded directly from Android Market.

ArcGIS for Android is built on the ArcGIS Runtime Software Developer Kit (SDK). This SDK lets developers create custom, spatially enabled applications for Android devices and is designed to use web services available from ArcGIS. The ArcGIS Runtime SDK for Android is now available for free and can be downloaded from the Esri Resource Center.

ArcGIS for Android Application

A native app, ArcGIS for Android serves as a mobile gateway into the ArcGIS system and promotes collaboration and information sharing between users. They can use the app to explore maps, find places and addresses, query information hosted on either ArcGIS Online or ArcGIS for Server, and collect and edit data.

As this application is part of the ArcGIS system, existing Esri customers can access and share corporate maps to extend the reach of GIS to Android devices within the enterprise using ArcGIS for Server.

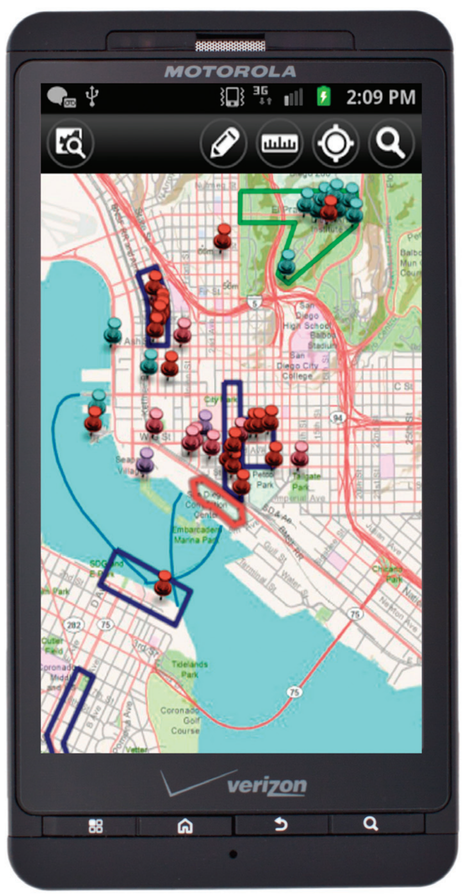
App Highlights

Users have the ability to navigate map galleries in just a few taps and search for and identify locations and GIS features. Detailed metadata is included to provide users with additional map information. The ArcGIS for Android application also provides an intuitive data collection and editing experience. The app includes a set of hosted industry-specific collection sample maps so users can test-drive data collection and editing capabilities. The embedded GPS or the map can be used to collect and update data, as well as attach photos, videos, PDFs, and Microsoft Word documents. Popular maps can be accessed faster by adding them to a favorites list. When interacting with the map, users can tap and hold to accurately locate a position on the map using a magnifier. Linear and area measurements can also be performed based on current location or by interacting directly with the map.

ArcGIS Runtime SDK

ArcGIS Runtime SDK for Android lets developers go beyond basic map viewing capabilities. It includes a plug-in to the Eclipse integrated development environment that provides a rich set of tools, documentation, and samples to help developers create custom applications. For example, users can

- Develop applications that use their own authoritative data.
- Display data on an ArcGIS Online basemap.
- Interactively add graphics and markups to a map.
- Query features or attributes within GIS data and display the results.
- Execute a GIS model using ArcGIS for Server and display the results.



Android users can use the ArcGIS app to quickly find and edit map features.

Developers and Esri Partners can easily build applications that work with their own published web services and use the runtime SDK to create applications that can be deployed within their enterprise or to the public via Android Market.

With this release, ArcGIS technology now runs on multiple mobile platforms and devices including iPhone, iPad, Windows Phone, and Android. "The Android smartphone and tablet market has really exploded," says David Cardella, product manager for Esri mobile technologies. "We see these devices increasingly being implemented within organizations that want to extend their enterprise GIS from the office to the field. They want to replace their paper-based workflows and improve the currency and the accuracy of their data—all in an effort to make more timely and accurate decisions."

To learn more, visit **esri.com/android**.

Major Trend Revealed in Census 2010 Data

US Race and Ethnic Diversity Increased Dramatically in the Last Decade

Highlights

- Esri's proprietary Diversity Index measures the degree of diversity in an area.
- Users can easily study the major demographic trends over a 10-year period using Esri's Census 2010 data.
- The pace of diversification is expected to escalate in the coming years.

Increased racial and ethnic diversity define one way that the United States population changed during the last decade. These differences have become increasingly evident for years; however, when Esri's data development team compared data from Census 2000 and Census 2010, some of the changes were quite startling, showing that the country is rapidly becoming more diverse, starting with the youngest population.

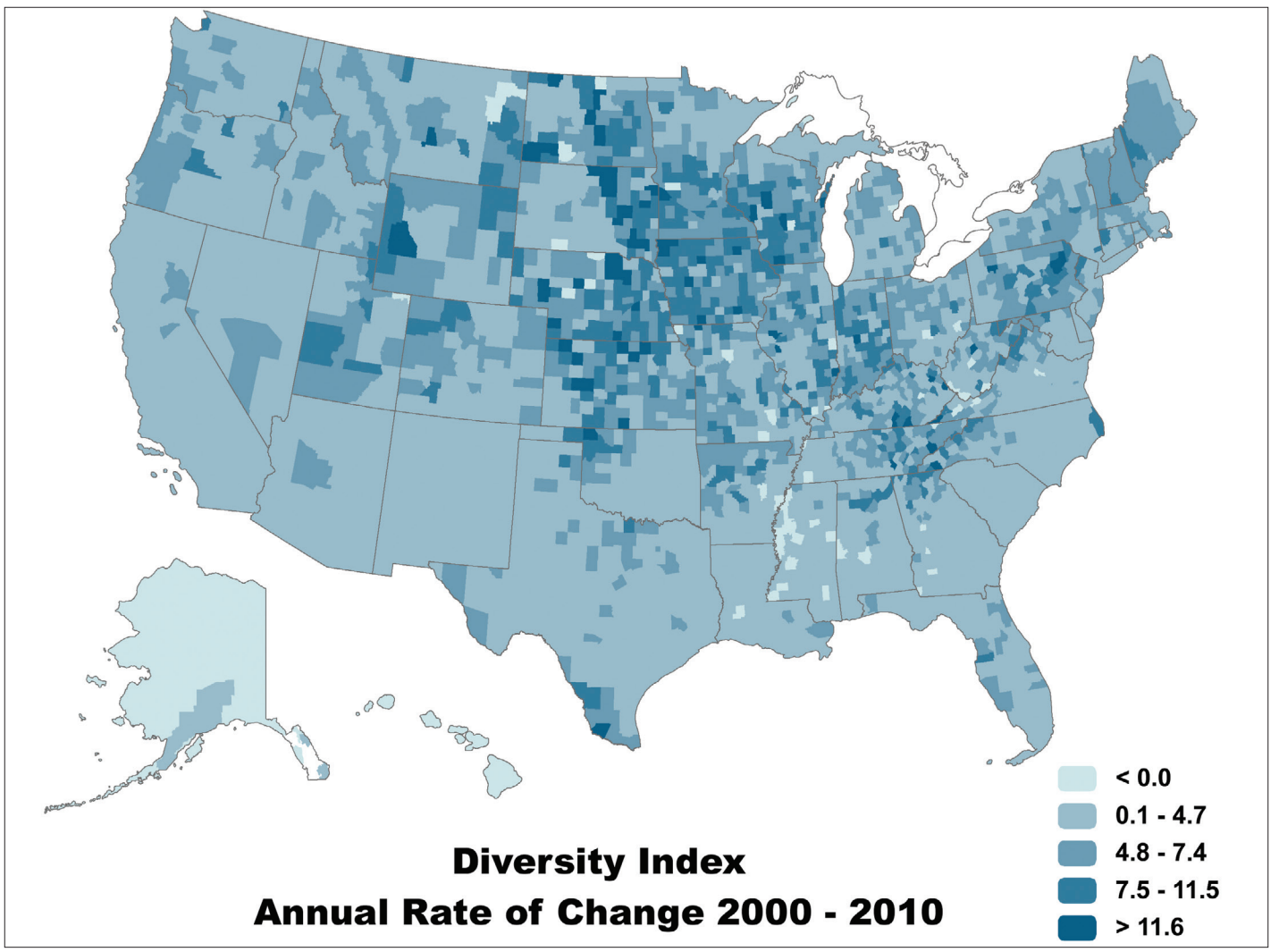
What Changed from 2000 to 2010?

From Census 2000 to Census 2010, the US population grew by more than 27.3 million people, for a total of 308,745,538. The Hispanic population increased by over 15.2 million people, accounting for 56 percent of all population growth during the decade, and now makes up 16 percent of the total US population. In 30 percent of US counties, the Hispanic population increased by 100 percent or more, and it doubled in Alabama, Arkansas, Kentucky, Maryland, Mississippi, North Carolina, South Carolina, South Dakota, and Tennessee. These increases in the Hispanic population can be attributed to immigration coupled with higher fertility rates.

The much-smaller Asian population grew by 43.3 percent, adding 4.3 million people for a total of 14.6 million. The smallest growth percentages occurred in the White and the Black or African-American population categories, which added 5.7 percent and 12.3 percent, respectively. The White population declined in 10 states and 44 percent of all counties, while the Black population declined in Hawaii; Illinois; Michigan; and Washington, D.C.

Large increases of Hispanic and Multi-Racial young people are driving this trend and indicate that the US population will continue to diversify. Today, approximately one in every two children younger than two years is non-White. Populations of people younger than 18 years grew in all race groups except for the Black and White categories, which declined by 0.4 percent and 2.4 percent, respectively. At 45.9 percent, the Multi-Racial category is the fastest-growing and youngest population category under age 18.

When users analyze the population by race and Hispanic origin, they see evidence of additional trends. The non-Hispanic White adult population grew by 4.4 percent, while the numbers of non-Hispanic White children declined by 9.8 percent over the decade. Non-Hispanic White children are now a minority in 10 states and Washington, D.C. These trends hint that the pace of diversification will escalate in coming decades.



US by county population diversity increases during 2000–2010.

How Does Esri's Diversity Index Measure Different Populations?

The Census Bureau collects data about six race categories (White, Black or African-American, American Indian or Alaska Native, Asian, Native Hawaiian or Pacific Islander, and Some Other Race), any combination of the six, and Hispanic or Latino ethnicity. Hispanic or Latino can be of any race. While these groups change independently over time, it is important to acknowledge and understand the totality of these changes.

To provide an accurate way to track this data, Esri created a proprietary Diversity Index that measures diversity on a scale of 0 to 100. The Diversity Index is defined as the likelihood that two persons, selected at random from the same area, would belong to a different race or ethnic group. For example, if an area's entire population belongs to the same race or ethnic group, the index is zero, showing that the area has no diversity. Conversely, if the population can be evenly divided among two or more races or ethnic groups, the area's Diversity Index increases, the upper limit being 100. The Diversity Index measures only the degree of diversity in an area, not its racial composition. In 2000, the US Diversity Index was 54.6; in 2010, it had risen to 60.6.

The Diversity Index by Geography and Age

Growth of an area's diversity is a powerful measure of change. The level of diversity varies from state to state. For example, the Diversity Index varies from highs of 81.5 in Hawaii and 81.3 in California to lows of 11.8 in Vermont and 11.6 in Maine. The Diversity Index doubled in 141 counties. Populations younger than 18 are diversifying faster than populations aged 18 and older.

The Diversity Index Can Help Organizations

The Diversity Index enables anyone to easily view the level of diversity for any geographic area in the United States. This information can be used to shape messages and services and target product launches and marketing campaigns more precisely to a particular group or groups of people.

What Other Population Changes Can We Expect?

What do these facts and figures mean to how the US population is changing? For one thing, the term *minority* will soon mean something very different to us as a society. For example, if current rates of US population growth and decline remain stable, by 2035, groups now considered to be minorities will outnumber non-Hispanic Whites. This crossover will happen much sooner in the category of children who are younger than age 18. In less than five years, non-Hispanic White children will be in the minority in that age group.

How Will These Changes Affect Us?

As our culture becomes richer, communicating and interacting with different racial and ethnic groups will continue to present opportunities and challenges. Organizations need to accommodate population changes by providing products and services in an appropriate, easily understood language that will appeal to multicultural populations. For example, government agencies could employ multilingual staff that can explain area programs; libraries can offer free tutoring in language and reading or offer senior programs that will serve more culturally diverse groups. Private-sector companies and government agencies can ensure that products and services are marketed and sold with the right messaging to attract different customer types and can assist different populations by providing easily accessible services in local, multicultural neighborhoods.

Assimilation and language isolation must be considered, particularly in Hispanic and Asian communities, where many households are multigenerational. Grandparents remain at home to care for young children while the parents go out and work. School-aged children are often better assimilated, speaking English with ease and frequently acting as interpreters for their older, less fluent elders. People in many households speak English at work and school but return to their country's customs and languages at home. Younger people are assimilating more easily by adopting social media as a primary method of communication; nearly all of them use a cell phone to make calls, take photos, and send text messages to friends and family.

Conclusion

Demographic changes do not occur rapidly. Having access to demographic data over a 10-year period allows users to analyze a wealth of data and discover major demographic trends. One such trend revealed by analyzing Census 2010 data was the dramatic increase in population diversity. This trend will continue to influence how agencies, companies, and organizations communicate, promote products, and serve the American public.

How to Access Esri's Census Data and Diversity Index

Esri's Census 2010 database (PL94-171 Redistricting file and variables from Summary File 1) is available for purchase in a variety of formats and geographies. The data is also available through the Esri Business Analyst product suite and Community Analyst. To learn more about Esri's Census 2010 data, visit **esri.com/data/census2010data.html**.

The Diversity Index is included in Esri's Updated Demographics database and is available through the Business Analyst product suite and Community Analyst. To learn more about Esri's Updated Demographics data, visit **esri.com/demographicdata**.

For Additional Information About Esri Products

Inside the United States, please call Esri at 1-800-447-9778.

Contact your local office:
esri.com/locations

Contact your local Esri reseller:
esri.com/partners

Esri's 2011/2016 Updated Demographics Data in 2010 Geography

Provides Superior Accuracy—Easy Access by Database, Report, Map, Software, Server, and Web

Highlights

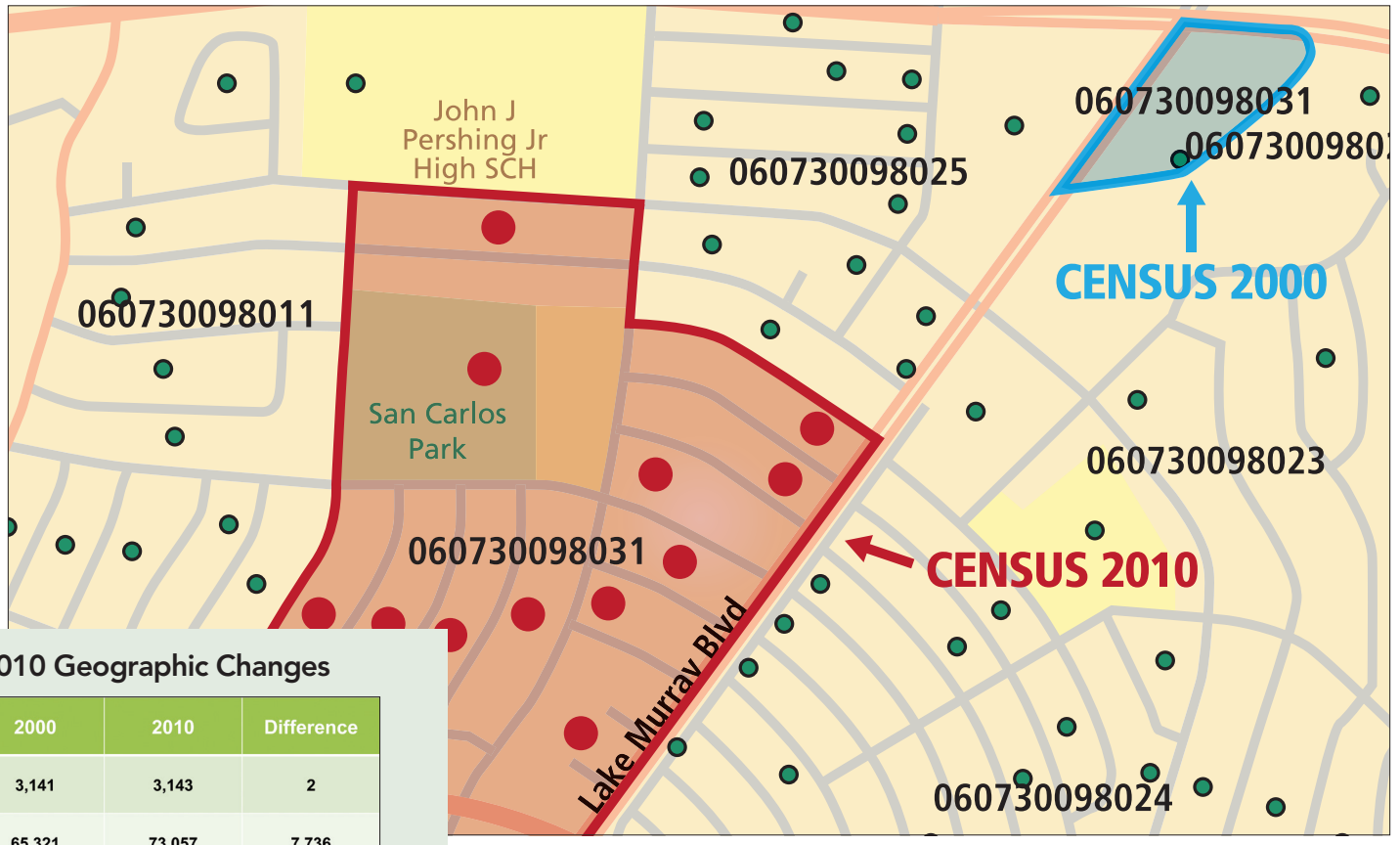
- Esri built its 2011/2016 Updated Demographics database based on Census 2010 counts.
- 2010 geography gives users the most accurate and useful data in current geographic boundaries.
- The 2011/2016 Updated Demographics database is provided in a variety of geographies and formats.

With the release of its 2011/2016 Updated Demographics data, Esri is the first major data vendor to deliver demographic data based on Census 2010 counts and 2010 geography. Esri's 2011/2016 Updated Demographics data includes current-year estimates and five-year projections of population, households, families, average household size, housing, age, household income, per capita income, and race/ethnicity. Esri built its 2011/2016 Updated Demographics data from Census 2010 because it is the most current available. To ensure a superior level of accuracy, Esri's data development team used its benchmarked methodologies to carefully analyze and update the data and geographic boundaries.

Census 2010 Geographic Changes

	2000	2010	Difference
Counties	3,141	3,143	2
Census Tracts	65,321	73,057	7,736
Block Groups	208,668	217,740	9,072
Blocks	8,205,099	11,078,297	2,873,198
County Subdivisions	35,317	35,703	386
Places (Cities & Towns)	25,150	29,261	4,111

The Census Bureau reports significant increases in the geographic inventory since the year 2000. Note the dramatic increase in smaller geographies, such as census tracts and block groups.



The Census Bureau can add new block groups to the inventory but also change the locations and boundaries of existing block groups. Here, Block Group 060730098031 (outlined in blue) shows its boundaries and location in Census 2000; dark red outlines its location in Census 2010 geography. The geocode is identical, but the boundary is completely different. Therefore, performing population or housing unit analyses with current data or projections using Census 2000 geography would yield completely inaccurate results.

Why Accuracy and Currency Matter in Data

Census 2010 data revealed dramatic new demographic trends for the United States. Changes such as increased population diversity; post-Katrina migrations; and effects of the recession, including reduced household incomes and the housing market crash, occurred in the United States between 2000 and 2010. Data from Census 2010 captured these changes for the entire country. Why are these changes so important? If an analyst uses data from Census 2000, events such as the growth of the Hispanic population, increased home vacancy rates, and lower household income would be overlooked. This type of example is exactly why Esri built its 2011/2016 Updated Demographics data based on Census 2010.

Why Currency Matters in Geography

Because data is only as accurate as the geography it rests on, currency in geography matters as much as accuracy in data. Geographic boundaries and inventory have changed drastically in the 10 years between each decennial census, particularly at smaller geography levels, such as census tracts, block groups, and blocks. These changes affect not only data viewed at standard levels of geography but also data for user-defined areas such as rings, drive times, and hand-drawn areas, which are calculated based on census blocks. Therefore, an update to standard geographies is produced with each decennial census. The table illustrates the dramatic changes in the inventories of smaller geographies that occurred between Census 2000 and Census 2010. *(See table at left.)*

Simple updates to geographies could be mistaken as changes to the populations or demographics of an area. Performing analyses with geographic boundaries from Census 2000, now more than 10 years old, can result in skewed results, such as the failure to identify annexations. For example, if a block group doubled in size between 2000 and 2010, analyses developed with 2000 geography would not reveal the accurate population count in this geographic area. Agencies could miss areas where services are needed, and companies might ignore markets that could support expansion and perhaps provide employment for local workers.

Basing its 2011/2016 Updated Demographics database on Census 2010 data and geography, Esri continues its history of using its proven methodology to provide users with the most accurate and useful data in current geographic boundaries.

How Users Can Access Esri's 2011/2016 Updated Demographics Data

For data users, the data is available as a database in a variety of geographies and formats. The data is also available in the Esri Business Analyst Online product suite and Community Analyst.

To learn more, visit **esri.com/demographicdata** or call 1-800-447-9778.

Easy Access by Database, Report, Map, Software, Server, Web

Use Esri Census 2010 Data for More Accurate Analyses

Esri's package of Census 2010 data combines data from the PL94-171 Redistricting file and variables from Summary File 1 (SF-1). So that users can perform more accurate analyses, Esri offers the Census 2010 data in a variety of nonstandard geographies, such as ZIP Codes and user-defined polygons, including drive times, rings, and hand-drawn trade areas. These geographies are not available from the Census Bureau. Esri also provides the Census 2010 data for standard census geographies such as states, counties, census tracts, and block groups. Esri's Census 2010 data includes demographic categories, such as population, age, race/Hispanic origin, household type, tenure and mortgage status, group quarters, families, average household size, and much more.

How Esri's Census 2010 Data Can Help Users

Important demographic changes, such as increased population diversity, rising home vacancy rates, and differences in family/household size, occurred between 2000 and 2010. These and other changes can significantly impact a community's viability. Agencies, companies, and organizations can use Esri's Census 2010 data to learn about these types of changes in their areas.

Using Esri's Census 2010 data in nonstandard geographies enables analysts to obtain a more accurate demographic profile of their trade areas. For example, if more families with children have moved into an area, agencies can determine if the community has enough housing, schools, and services to support an increased number of large households. Maps of the area can quickly confirm that needed services are in the best locations to reach the most people.

Companies will find the Census 2010 information invaluable when deciding to expand or relocate. After analyzing the population demographically, mapping the trade area by drive times can determine if a current or proposed location will be convenient for most consumers. Organizations that provide services to seniors can determine if an area has a sizable senior population and if services are available and conveniently located. Further analysis can reveal racially and ethnically diverse populations that may require different types of services. Mapping the service area by hand-drawn shapes can show the relationship of public transportation routes to populations and service locations.

To learn more about Esri Census 2010 data, visit **esri.com/census2010data** or call 1-800-447-9778.

Danish Energy Company Focuses on Smart Grid

By Rune Homann, Informi GIS A/S

Highlights

- ArcGIS maximizes the use of large data collections.
- GIS provides information to minimize the time customers are without energy.
- Large volumes of data from the SAP ERP and other systems are joined in the GIS.

Energy is the lifeblood of modern society. As one of the leading energy groups in Northern Europe, DONG Energy—which is headquartered in Denmark—keeps that lifeblood flowing for more than one million customers. The energy company is headquartered in Denmark and participates in energy procurement, production, trading, and distribution. The group also supplies energy to other utility companies.

To make energy production cleaner, the company aims to reduce CO_2 emissions significantly by increasing the use of wind power. The company is also testing and implementing various smart grid technologies as part of an international utility initiative to combine telecommunication capabilities with electric distribution for more reliable and precise energy service. All the while, DONG Energy continues to strive to meet the constantly increasing demands for more efficient workflows and better utilization of data.

In line with its objectives, the company is working to make GIS functionality available to more departments and people in the organization. The company is also making GIS available externally through self-service solutions for customers.

Realizing the Vision

The staff has a vision to supply reliable energy without CO_2 emissions. This vision reflects the fact that society wants both reliable supply and energy production that does not contribute to climate change. As a responsible energy company, DONG Energy focuses actively on helping balance these two objectives. This places increased demands on the network that distributes the energy from production to consumer.

The challenge is that the current energy system is unable to deliver highly reliable supply without CO_2 emissions. The majority of the energy used today primarily comes from power stations. Renewable energy sources are not fully reliable, as supply depends on the forces of nature.

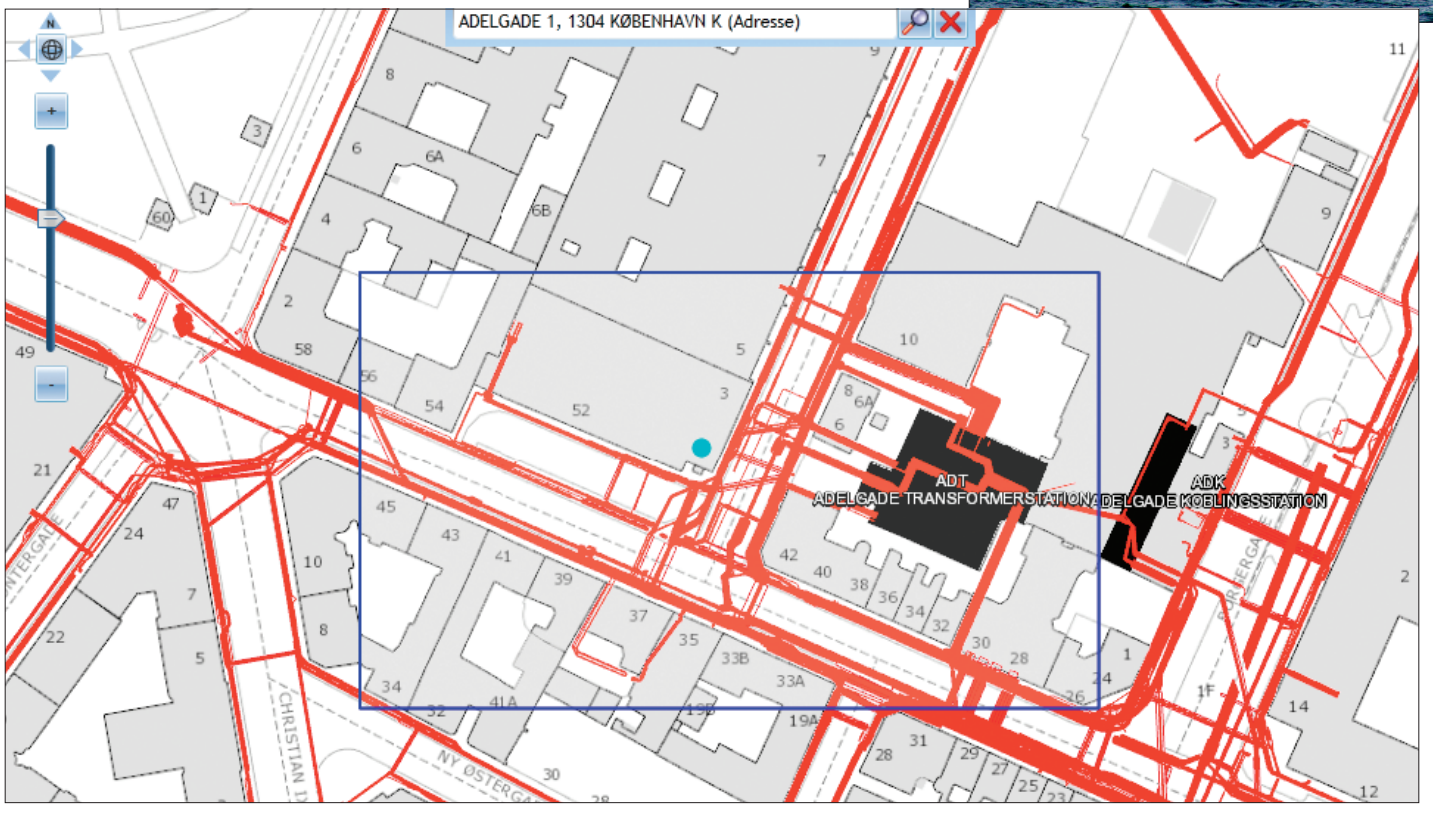
To make the vision come true, the company evaluated available geospatial technologies and decided to employ ArcGIS because of its comprehensive and flexible characteristics and its long-established interoperability with other systems and databases, ERP from Esri's Strategic Alliance Partner SAP being one example. The company first needed a complete overview of customers, the distribution network, and its component parts. Network awareness enables operators to view and analyze energy consumption at any given moment. It also allows the company to better regulate flow in the network and direct energy where it is needed. Awareness also makes it possible to decouple appliances that do not necessarily need power right at a given moment. By having an accurate and complete overview of the network, it is also possible to automate some of the working processes and make the supply to the customers as secure as possible.

The first step for the company was to raise the quality of data and visualize the entire network. This involves localizing all electrical assets and determining asset condition, asset relationships to each other and to customers, and the expected annual consumption. Data that previously had been available in the SAP system has been joined in ArcGIS to enhance the overview.

"A lot of things only become really apparent to us when they are visualized with GIS," says Signe Andersen, DONG Energy IT manager. "Right now we spend resources joining large volumes of data from the ERP and other systems in the GIS."

Andersen says the company used ArcGIS to create the best overview of customers and technical installations, provide the necessary analysis, and maximize the use of large data collections.

DONG Energy is among the world leaders when it comes to wind farms. It has more than 15 years of experience designing, building, and operating wind farms and has been involved in 5 of the world's 10 largest wind farms. By 2020, it will triple its production of renewable energy, and offshore wind will play an important role.

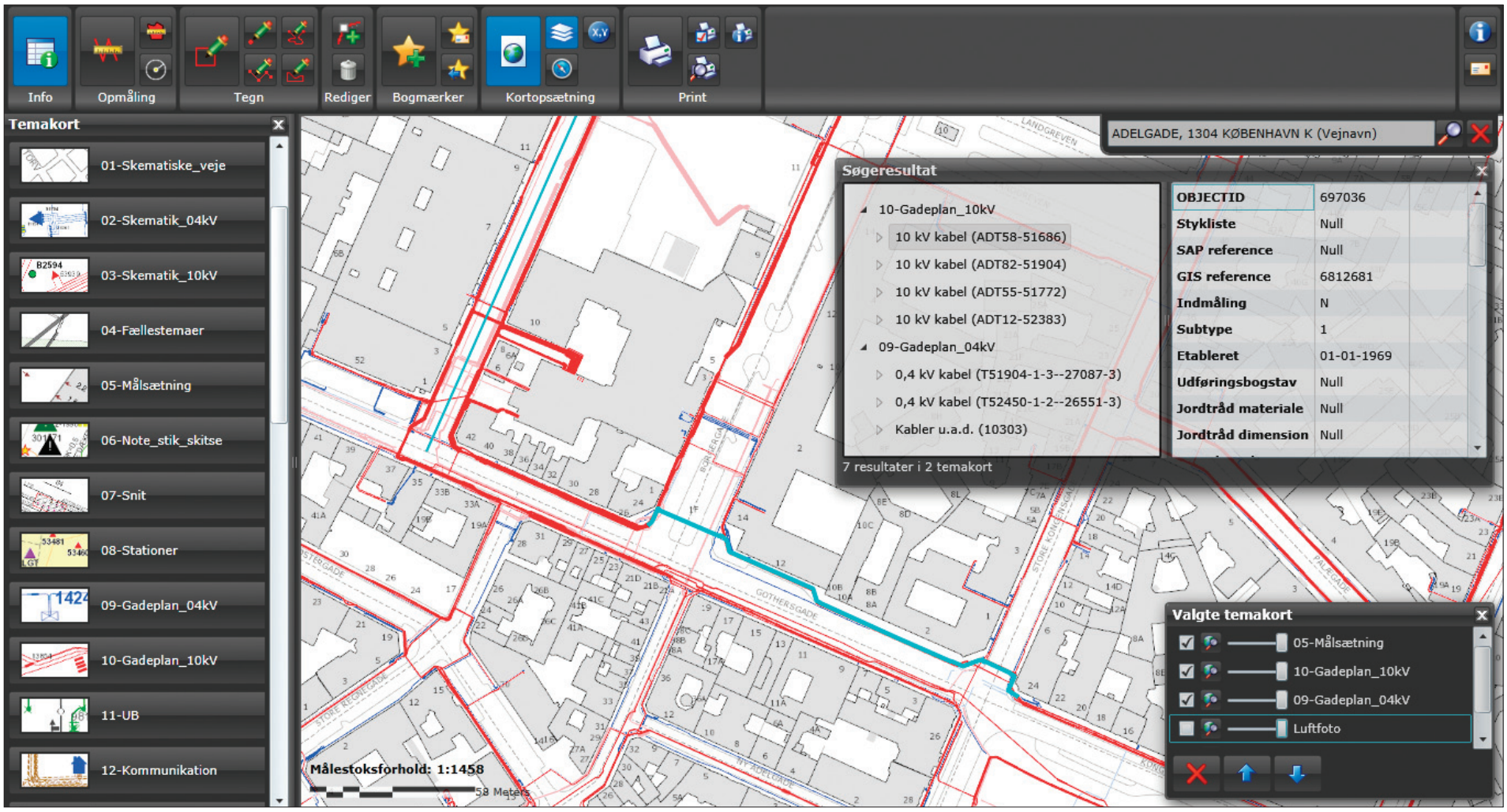


External contractors can use the web to order a map with information on lines and networks in the ground before they dig. The whole process runs automatically, and the PDF is generated and sent immediately. The solution handles approximately 30,000 orders a year.

"We have had much of this data in different systems since 2001," Andersen says. "Now we have recognized that it is difficult to use the data to the full extent when it is in many different IT systems, especially when the systems are not suitable to visualize and analyze the information as we can with GIS."

Improved Operations and Shorter Outage Periods

In large utilities like DONG Energy, there is always maintenance work to be done somewhere in the extensive network. This affects customers who will need energy. That energy must come from somewhere else during the period of maintenance work in progress. Therefore, it is important that the workflow be as quick and precise as possible when switching in the network. The company uses GIS to help make decisions that affect the fewest possible customers. GIS provides proper information



Using this GIS viewer, employees can perform geographic analysis. All the points of interest are visible in the viewer, and all network features are available. By using this kind of web solution, data and knowledge can be distributed throughout the organization.

beforehand to minimize the time customers are without energy. Especially in the case of a sudden outage, it is of crucial importance to be able to respond very quickly and precisely.

"It is important for our employees at all times to have an overview of the current state of the network," Andersen says. "In outage situations, we don't want the IT system to steal precious time. It is supposed to support you, give you the best overview, and be easy to operate."

In Denmark, utilities are benchmarked on how many customers are experiencing an outage and how long they are out of electricity. For the individual customer, for the economy, and for the image of the utility, it is extremely important to minimize the outage time. A broad overview of the customers and the grid is essential.

"Information must be available when it is needed, and it must always be in the right context," Andersen says. "We use IT and GIS as tools to improve work processes and customer information. They are tools like a hammer that must be good and easy to work with."

Getting Down to Business

"The business case is having multiple IT systems in combination with each other and having them integrated with the GIS," Andersen says. "In that sense, creating a smart grid has an almost unlimited potential."

Two examples of the real business benefit of a good ArcGIS software-enabled overview of the network are

• *Electric cars*—In DONG Energy's smart grid vision, electric vehicles are part of the problem and part of the solution. To charge the growing amount of electric vehicles will put extra pressure on the grid. At the same time, the use of electric vehicles pairs well with an increase in the amount of wind power in the grid, because drivers can charge the cars when there is enough wind power. To the company, the smart grid is about being able to, at a certain level, control the consumption at any given time to ensure a secure and reliable energy supply to all customers.

• *Cable replacement*—A large part of the company's underground cable network is about 30 to 40 years old, which is the life expectancy of copper cables. But whether the copper needs to be changed depends largely on how much power has been flowing through it. Without a good overview and high data quality, the company would have been forced to make a massive investment in new high-voltage cables, switches, and transformers everywhere the copper had reached an age of 40 years. That would have been very expensive—an estimated $100 million. But with an exact overview of the grid and the precise measure of how much power is flowing through it, the company can identify exactly where the copper needs to be replaced.

Tremendous Value

Andersen says they have reached the point where it is a pleasure to walk around in the organization and identify new opportunities for GIS innovation and new uses of GIS technology.

"Our staff understands that GIS helps them," she says. "As soon as they know that, they update the data every time, and the quality of data becomes 100 times better, which is vital."

The company is working toward automated processes, where the grid can automatically turn on or off a number of electrical installations to keep the best flow through the grid without disrupting any customers. It has for many years been inspired by a service-oriented architecture. But with more than one million customers, an increasing amount of data, and a growing need to analyze that data, the organization needed to aggregate it.

"We are now in place with the major standard systems, and there is tremendous value in analyzing data and finding new ways to use the knowledge we already have," Andersen says. "Data analysis will eventually take us from manual to automated decisions. We already have different transformers in the power grid that connect automatically, but it is still on a low level."

About the Author

Rune Homann has been with Informi GIS A/S since 2008. He is currently visiting an MBA program at the University of Southern Denmark.

For more information, contact Signe Bramming Andersen, IT manager, DONG Energy (e-mail: sigba@dongenergy.dk).

Rural Utility Gains New View of Network, Secures USDA Funding

Highlights

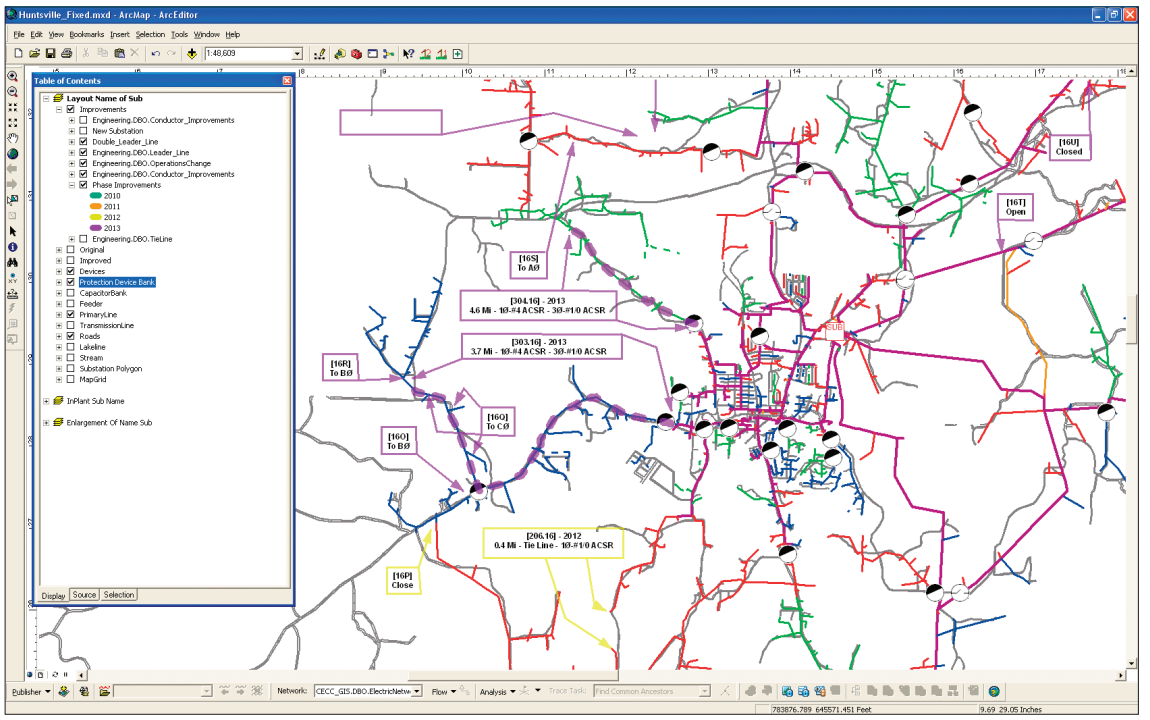
- The utility uses ArcGIS to look at individual customer accounts rather than rely on estimates and averages.
- GIS helps the utility manage and display report data in an organized structure.
- For planning and reporting, the utility relies on GIS-based maps that show load projection.

Carroll Electric Cooperative Corporation is a not-for-profit electric utility serving northwest Arkansas and southwest Missouri. To keep pace with the evolving needs of the industry, the company recently secured funding from the US Department of Agriculture's (USDA) Rural Development program for utilities that is available under the Rural Electrification Act of 1936. Direct loans and loan guarantees are available for facility construction, demand management, renewable energy development, and energy conservation programs.

As part of the process, Carroll Electric staff needed to acquire and clean up utility data stored in its GIS. The utility used the data to perform in-house analysis and planning to design a work plan that ensures growth and reliability. Plans are then reviewed, approved, and amended as needed within ArcGIS.

The move to ArcGIS has shown a significant difference in the loan application and reporting process. It has also changed the way the electric network is viewed by utility staff and the government agency.

"Using CAD, we were getting a very broad view of our system," says Taylor Wynn, GIS coordinator for Carroll Electric. "Since GIS is data driven, we get a more detailed view. Now, instead of basing estimates on an average load, we can look at individual customer accounts. We know how much electricity each customer is using and what phase of service that customer is receiving. We can determine what changes need to be made based on projected customer use. GIS also helps with operational decisions, such as balancing load on the feeders."



Map produced from Milsoft Utility Solutions data. Carroll Electric's *Electrical System Improvement* map helped the utility garner US Department of Agriculture funding.

An important part of the work at Carroll Electric involved data acquisition and cleanup. By making sure all utility data was as up-to-date and accurate as possible, Wynn is able to identify errors in the network before the information is handed over to the engineers.

"The data was all here; it was just in a hundred different places on paper," Wynn says. "One of the many reasons we chose GIS is because we wanted to maintain and update all facility data within one software system, as well as give everyone in the organization one source for viewing GIS information."

Now the GIS team at Carroll Electric can supply engineers with data to feed into an engineering analysis model based on technology from Milsoft Utility Solutions, an Esri Partner in Abilene, Texas. The engineers are then able to look at load balancing and system improvements based on forecast growth rates.

Growth rates are based on previous peaks, new service requests, and operational experience. The engineering analysis model is exported back to the GIS team for map production.

For planning and reporting, Carroll Electric relies on GIS-based maps that show how the company will accommodate load projection. With these maps, the utility is able to view and analyze customer usage, conductor length and size, phasing, and protection devices. The information helps determine system weaknesses, such as overloaded feeders, taps, and substation transformers. It can also be used to calculate voltage drop, determine whether certain customers experience low voltage during peak hours, and predict which protective device may potentially trip.

Reports created within the Milsoft application can justify new facilities by showing why and where a new substation is needed. GIS helps the utility manage and display report data in an organized structure, including information related to the current of the line at particular locations, voltage drops at certain line intersections, and the conductor size and age of older lines. This can be useful in analyzing which fix would be best when a number of options are available. GIS also can offer insight geographically, showing the utility which region might experience higher growth. Decisions for routing a conductor in an area near a lake or interstate corridor can be made based on right-of-way clearing, future patrolling, and potential growth.

Carroll Electric uses GIS to document plans and update as needed. Justification for funding involves economic analysis based on losses, projected load growth, and reliability on a new route versus an existing route.

For more information, contact Taylor Wynn, Carroll Electric Cooperative Corporation (e-mail: twynn@carrollecc.com).

Stemming the Tide of Bark Beetles

Flathead Electric Cooperative Finds GIS Can Help

Highlights

- ArcGIS became a primary tool in assisting the effort to stay ahead of potential tree problems.
- GIS is helping FEC ask better questions, spot problem areas, and be proactive rather than reactive.
- The geocoding function of ArcGIS allowed FEC to capture history of problem trees.

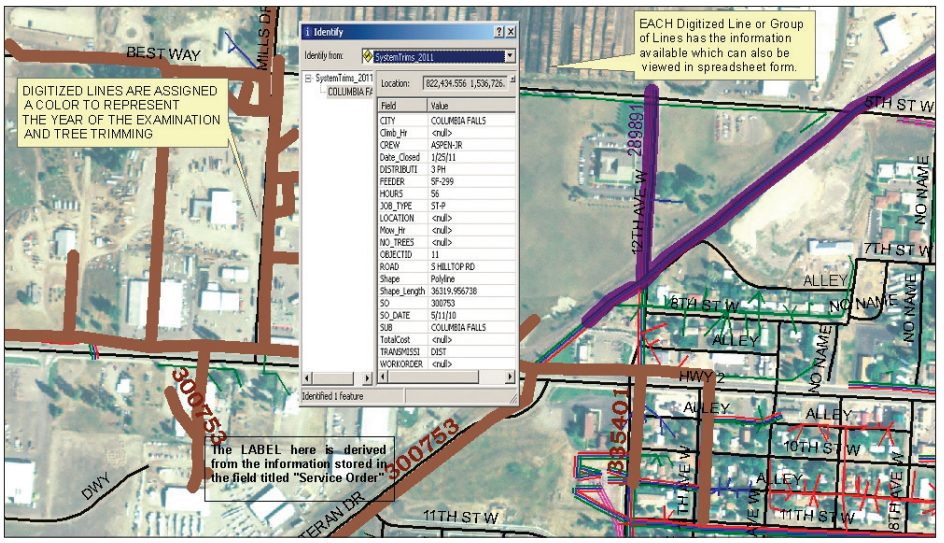
As bark beetles silently kill hundreds of thousands of acres of towering trees in the United States and Canada, Flathead Electric Cooperative (FEC) operators are growing concerned about what this means to its members in rural Montana. Dead trees along an electric distribution line represent a distinct fire hazard and power outage threat.

In 2007, the US Forest Service blamed the beetles for killing 3.9 million acres of trees in Colorado, Idaho, Montana, Oregon, Utah, Washington, and Wyoming.

"Our aim in general is to stay ahead of problem areas by keeping track of the trees that grow near utility equipment and lines," says Steve Quigley, vegetation supervisor at FEC. "Because of the beetle infestation, stretches of the electric distribution line that were previously clear of tree interference could become a concern. Here in our service area, the 'beetle kill' has been minimal compared to some of our neighbors to the north, such as British Columbia, Canada, and in the south, such as Helena and Deer Lodge National Forests."

FEC serves more than 48,000 metered customers throughout northwest Montana, ranging from Glacier National Park just west of the Continental Divide to Libby, Montana, near the Idaho border. Since 1937, the utility has grown from a small group serving a handful of rural homes and farms to the largest co-op in Montana, with a diverse mix of rural and urban residential, commercial, and industrial members.

Understandably, tracking tree health is a major concern for FEC. It is also a difficult endeavor. Much of FEC's 2,000 miles of overhead line runs through dense coniferous forests that provide limited access to field crews.



Digitized lines are assigned a color to represent the year of the examination and tree trimming, with a label displaying the field with the service order number connected to it.

Albeit a major threat, the bark beetle problem is just one of the many issues the right-of-way management department deals with using ArcGIS.

Getting Better All the Time

Quigley joined FEC in 1999. Since then, he has recorded all vegetation management activities—from planning to completion—in a Microsoft Excel spreadsheet and on large paper maps.

"The whole process was becoming very cumbersome and inefficient," Quigley says. "The spreadsheets have been a great method for storing the data, but it became apparent to me that there were better tools available, and technology had arrived that could also digitally preserve the information recorded on the paper maps."

Quigley recognized the value of ArcGIS technology and the many ways it could most benefit the co-op. The opportunity to collaborate with Gayle Chvilicek, a member of the FEC GIS/Mapping Department, opened up possibilities to use the valuable information Quigley had collected.

"It was the collection of data from the previous 10 years in the spreadsheet format that set the pattern for the fields within the feature classes," Chvilicek says. "This data and the format it was in worked fantastically with the geocoding function of the GIS software. It enabled us to capture the history of where problem trees had been and create a foundation from which to build the new feature classes."

Come Together with GIS

Since the company moved its vegetation management information to its GIS, there have been many benefits, including more accurate information of the service area and customer data. Quigley can now access that data, along with other useful tools, on a laptop. This saves time and travel, especially when work takes him to more remote areas for investigations and inspections.

In the office, Quigley is able to create paper maps for tree crews with notes and comments to assist them. The Master Jobs feature classes show data for previous years and allow the utility to see what needs to be done, as well as what type of problem trees are in a particular area. The Outages feature class tracks outages caused by trees. An unusual number of outages in an area would serve as a flag to warrant further investigation.

"These outages could be the result of many trees that have died and are beginning to topple into the line as a result of beetle infestation," Quigley says. "Many outages in an area caused by trees could also indicate that it is time to set up a system trim, possibly sooner than it was scheduled."

GIS allows the utility to identify patterns and detect problem areas. This helps direct tree crews to the most important needs first and, in many cases, take care of the situation before it becomes a costly problem.

For more information, contact Gayle Chvilicek, GIS/Mapping Department, Flathead Electric Cooperative (e-mail: G.Chvilicek@flathead.coop).

California Sunshine Is an Energy Gold Mine

Los Angeles County's Solar Mapping Portal Calculates Solar Potential and Cost Savings

Highlights

- The county deployed ArcGIS 10 for Server to drive the new site, enabling it to manage the enormous database and integrate multiple map services.
- The *LA County Solar Map* offers more than 100 million points for solar potential on rooftops and calculates solar radiation every five feet.
- GIS aids the *Solar Map* to cover more than 2,200 square miles and include all 88 cities.

Installing solar panels on a Los Angeles rooftop.

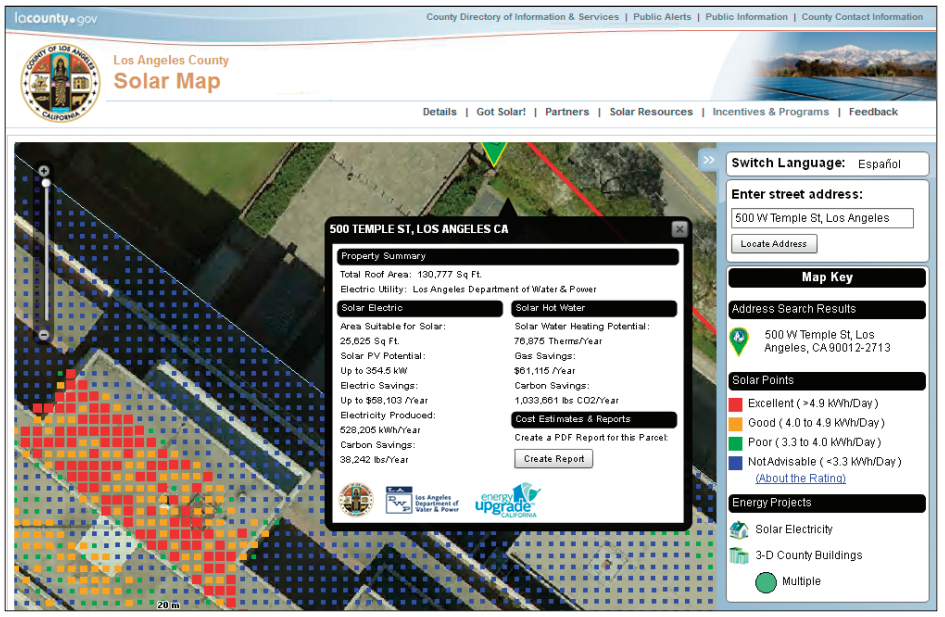
California looks to an energy future that includes renewable resources. Los Angeles (LA) County has abundant sunshine and is encouraging people to capture its energy by installing solar energy systems. A system's effectiveness to generate electric energy is dependent on the size and number of solar panels installed and how much sun reaches them. Since 2009, the *LA County Solar Map* has been an online map service that provides solar value analysis for commercial and residential buildings in the county and helps property owners make informed solar installation decisions.

Relaunched on Earth Day in April 2011, the *LA County Solar Map* (**solarmap.lacounty.gov**) is a simple, elegant map that generates sophisticated solar calculations for any building in the county. The service provides a detailed model of solar photovoltaic potential and accesses existing aerial imagery and data from the Los Angeles Regional Imagery Acquisition Consortium. Via the online map interface, anyone can select a location, see aerial imagery of rooftops and color-coded dots indicating the amount of direct sunlight hitting each portion of a selected roof, and perform analysis essential for making solar installation decisions. Available to everyone, the portal typically gets between 50 and 100 hits per day but has the capacity to serve many more people as demand for solar energy alternatives grows.

LA County geographic information officer Mark Greninger became interested in solar mapping because he wanted to put a solar panel on his own roof. He found he had to do a lot of research to understand his risks, rewards, and return on investment. Thinking that there must be an easier way, Greninger researched how other cities had approached the problem. He came across the *San Francisco Solar Map* model and looked into developing a similar application for LA County.

While looking at the feasibility of a solar map project, Greninger found that the LA County Internal Services Department (ISD) Office of Sustainability was already developing programs to support energy efficiency and solar installations. He partnered with ISD to apply for a County Information Technology Fund grant to implement the project. The Chief Information Office provided the technology expertise, and the ISD Office of Sustainability coordinated county support and policy development.

Once the county had acquired a grant for the project, Greninger contacted Esri Platinum Partner Critigen, the developer of the *San Francisco Solar Map*, and began working with its geospatial technology consultants to develop a then state-of-the-art solar map service built on the Bing Maps platform. On Earth Day 2009, LA County launched the service on **LAcounty.gov** and on Critigen's **SolarMap.org**. In a simple JavaScript-based interface, the solar map service showed parcel boundaries and information and solar potential by parcel. Although it was limited in its ability to show the specific locations suitable for solar cells, it was a major success, with more than 5,000 hits on its first day.



Solar Map shows rooftop suitability for solar panels and electric and gas savings per year. Red indicates excellent, and blue indicates not advisable.

Starting in late 2010, Greninger and Critigen began working on the next generation of the site, with advances in technology that would make the site cleaner, faster, and more robust. Greninger wanted the updated map to be simpler and more intuitive to use while being faster and able to handle high demand to show rooftop potential, pinpoint optimal panel placement, and quickly answer value questions.

LA County Solar Map covers more than 2,200 square miles and includes all 88 cities in the county and unincorporated areas. Detailed solar modeling of such a large area requires a massive database that on the previous platform was unwieldy and impossible to display.

The county deployed Esri's ArcGIS 10 for Server to drive the new site, enabling it to manage the enormous database and integrate multiple map services into the content provided by the site. All data was migrated into an ArcGIS geodatabase, thereby making it possible to use existing installations and solar-augmented parcels data countywide. By exploiting the caching capabilities of ArcGIS 10 for Server, as well as limiting the size of the solar data to that of rooftop locations' solar potential, the model quickly accesses data and is highly responsive. The software's Flex API delivers a professional-grade viewing experience.

A major step forward in solar mapping, the *LA County Solar Map* offers more than 100 million points for solar potential on LA County rooftops and calculates solar radiation every five feet. The database contains 250 million individual measurements, including shading from trees, roof features, roof pitch, nearby buildings, and mountains. Each cell grid has been converted to a dot that represents the amount of solar potential for 25 square feet.

The user types in an address and instantly sees the aerial image of the property, its roof, and the exact locations on the roof that receive the most sunlight. (It also shows the locations that receive the least sunlight, which is equally important information.) The model can be switched seamlessly between English and Spanish. The user can print out a report showing the details of the selected property. County-owned facilities are represented by six-inch resolution and can be viewed in highly detailed 3D solar models. The website also provides information about utility rebates and tax credits, comparative cost analysis for solar versus utility power, and other solar advantages.

The next iteration of the model will include sophisticated solar calculators. These will enable users to draw the location of a potential solar array on a roof and calculate the projected production and various financial benefits using local incentive, utility rate, and insulation data.

Solar installers get the most direct value from the portal's ability to perform analysis. This reduces installation costs, making solar a more desirable investment. For a nominal cost, they can buy the entire database of assessor information and use it for marketing research. Seeing relationships of solar potential, demographics, years of ownership, savings to clients, and current solar installations data helps these entrepreneurs see the best areas to canvass. Also, solar manufacturers and companies that build and distribute solar cells and modules can use the model to anticipate demand. City governments refer to the model to locate solar energy opportunities in their areas.

Additionally, plans are in development to add building energy efficiency calculator tools to the map so that property owners and managers may obtain complete building information on energy efficiency potential, as well as solar energy potential.

The accuracy of *LA County Solar Map* was tested by the University of California, Los Angeles, with findings that showed only a 4 percent level of inaccuracy. Analysis capabilities were independently verified as accurate by the US Department of Energy, which tested an array of monitoring production levels. These findings add credibility to the *Solar Map*'s authority, making it a valid reference for grant and loan applications, scientific analysis, and solar installation.

For more information, contact Mark Greninger (e-mail: MGreninger@cio.lacounty.gov). Learn more about Critigen at **www.critigen.com** or contact Ty van den Akker (e-mail: Ty.vandenAkker@critigen.com). Learn more about ArcGIS for Server at **esri.com/arcgisserver**.

A Science-Based Approach to Collaborative Decision Making at Ecosystem Scales

Where the Wild Things Are in Yellowstone Park

Highlights

- Ecologists use ArcGIS and a GeoDesign workflow to measure the impact of potential land-use change before it happens.
- Yellowstone scientists created an ArcGIS software-based ecological forecasting system.
- GIS lifts ecological issues from subjective opinion and polarization to a place where decisions are made using facts.

NGO Non-Governmental Organization

The human history of the Yellowstone region can be traced back to an undesignated time in tribal oral history more than 11,000 years ago, when many groups of Native Americans used the park as their home, hunting ground, and source for gathering medicinal plants. These traditional uses of Yellowstone lands continued until the first explorers and trappers of European descent found their way into the region, recounting tales of a bountiful land full of natural wonders where "fire and brimstone" gushed up from the ground. In March 1872, President Ulysses S. Grant signed into law a congressional act making Yellowstone the first national park in the world, an area so extraordinary that it was set aside and protected in perpetuity for the enjoyment of future generations. Thanks to its early designation and protection, Yellowstone is one of the few remaining intact large ecosystems in the northern temperate zone of the earth.

In recent years, managing these ecosystems has become increasingly challenging. Drought, wildfire, habitat fragmentation, contaminants, invasive species, disease, and a rapidly changing climate have begun to threaten human populations, as well as native species and their habitats. To plan for this uncertainty, a dedicated group of

GeoDesign helps us make better, more informed decisions through the rapid evaluation of design alternatives and their probable impacts on the environment and society.

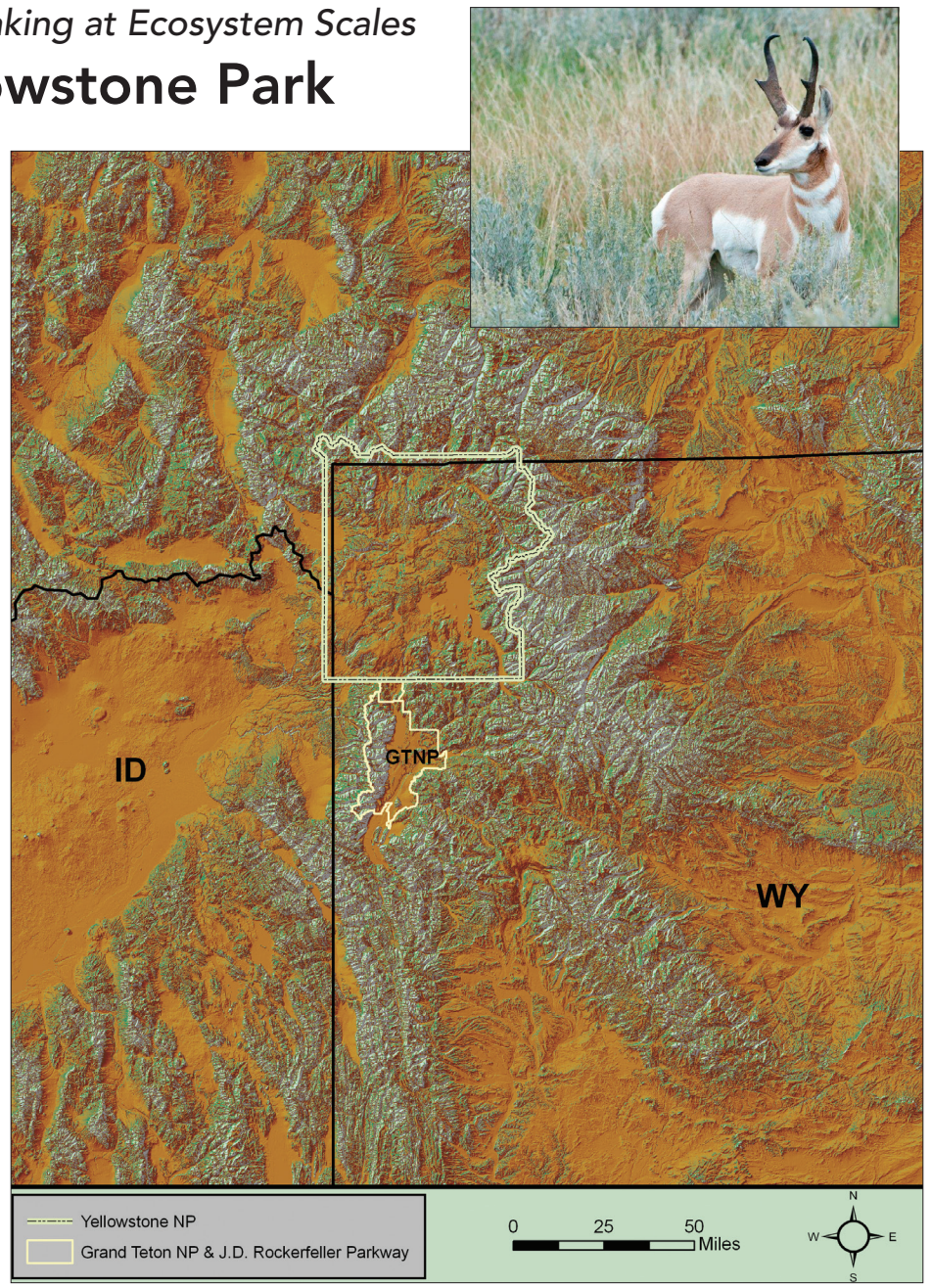
ecologists is using ArcGIS, statistical analyses, and a GeoDesign workflow to measure the impact of potential land-use change before it happens.

Ecological Forecasting

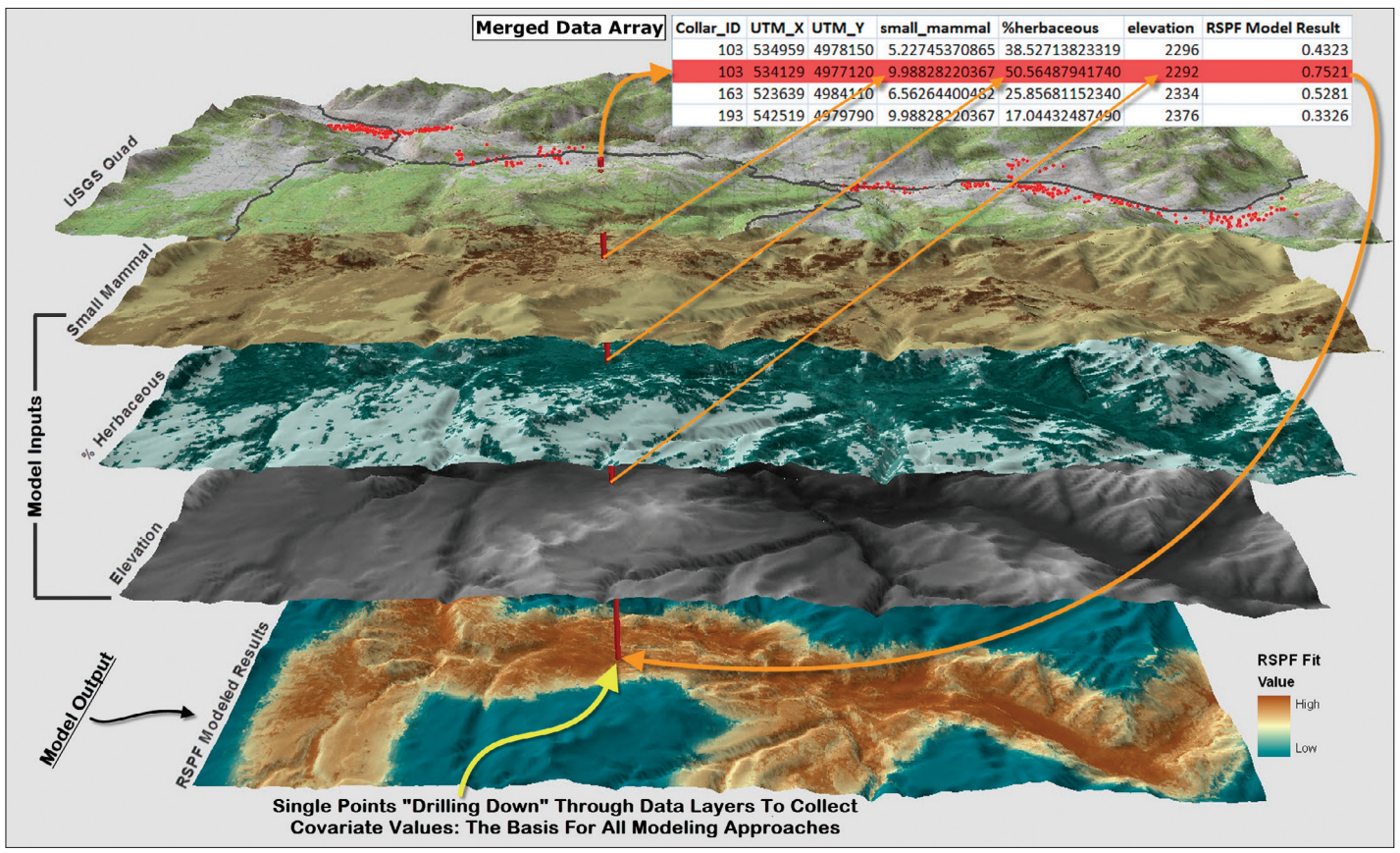
The Yellowstone Ecological Research Center (YERC), a private, nonprofit organization located in Montana, spends much of its time conducting long-term, large-scale, collaborative ecological research and education in concert with both public and private organizations. Historically, that work has relied heavily on ArcGIS to help organize, analyze, and visualize data on the health and status of native species and the land and water that sustain them.

Simulating ecological system dynamics is a complex undertaking. The sheer volume, variety, and complexity of geospatial data have grown exponentially in recent years, requiring the development of new tools and efficient workflows to help decision makers spend more time on the issues without having to sort through data. More importantly, decision makers need to be able to synthesize this data into standardized, transparent, and defensible information to support the management needs of today while preparing for the needs of tomorrow. And that means having a repeatable process, a core tenet of scientific inquiry.

To support the entire process of ecological forecasting, YERC ecologists, statisticians, and GIS analysts created the Ecosystem Assessment, Geospatial Analysis and Landscape Evaluation System, known as EAGLES, which is essentially GeoDesign at an ecosystem scale. EAGLES is an



The greater Yellowstone ecosystem. Inset: One of the park's pronghorn antelope (photo courtesy of Hamilton Greenwood).



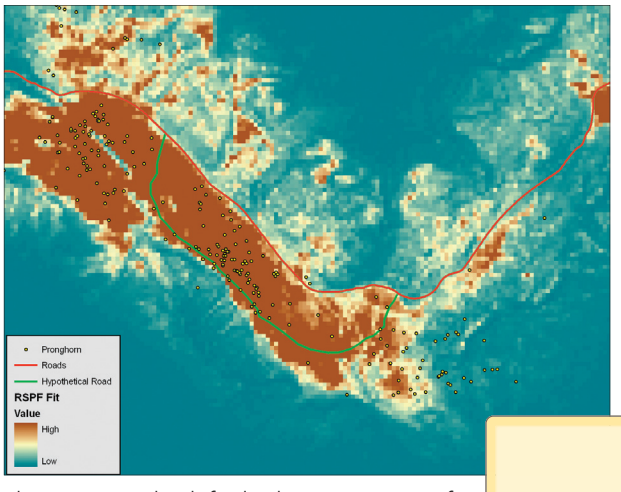
When all data is referenced in a common coordinate system, the referential link gives the scientist or manager the ability to investigate all the various interdependencies of a single point to all other data, increasing the efficiency and quality of the inquiry.

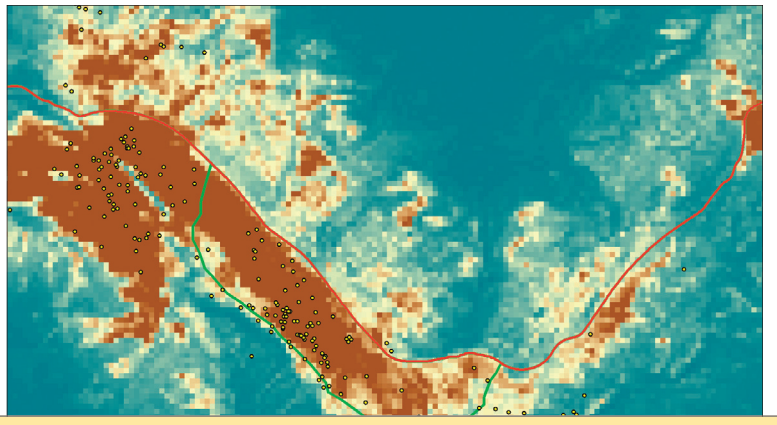
integrative workflow architecture that organizes vast amounts of historic spatial data, some covering the entire United States, with modeling routines to create predictive ecosystem and species models. ArcGIS is a key component of EAGLES, providing a mapping platform to make the data easily understandable to decision makers.

The workflow begins with the assembly of experts having a strong knowledge of the organism of interest, including physiological drivers, feeding habits, predator/prey relationships, competitive interactions, and habitat. Additionally, this effort can integrate pathogens, parasites, or other hazards. These experts help develop a conceptual model of key issues and management objectives. The conceptual modeling process begins with a verbal description of important relationships between the species of interest and its environment. The verbal description is then used to help select a set of hypothetical drivers to be considered for inclusion in the model. The environmental variables (i.e., covariates) and their relationship to the species of interest (i.e., response data) are referred to as a narrative model using a mind map *(see chart on next page)*.

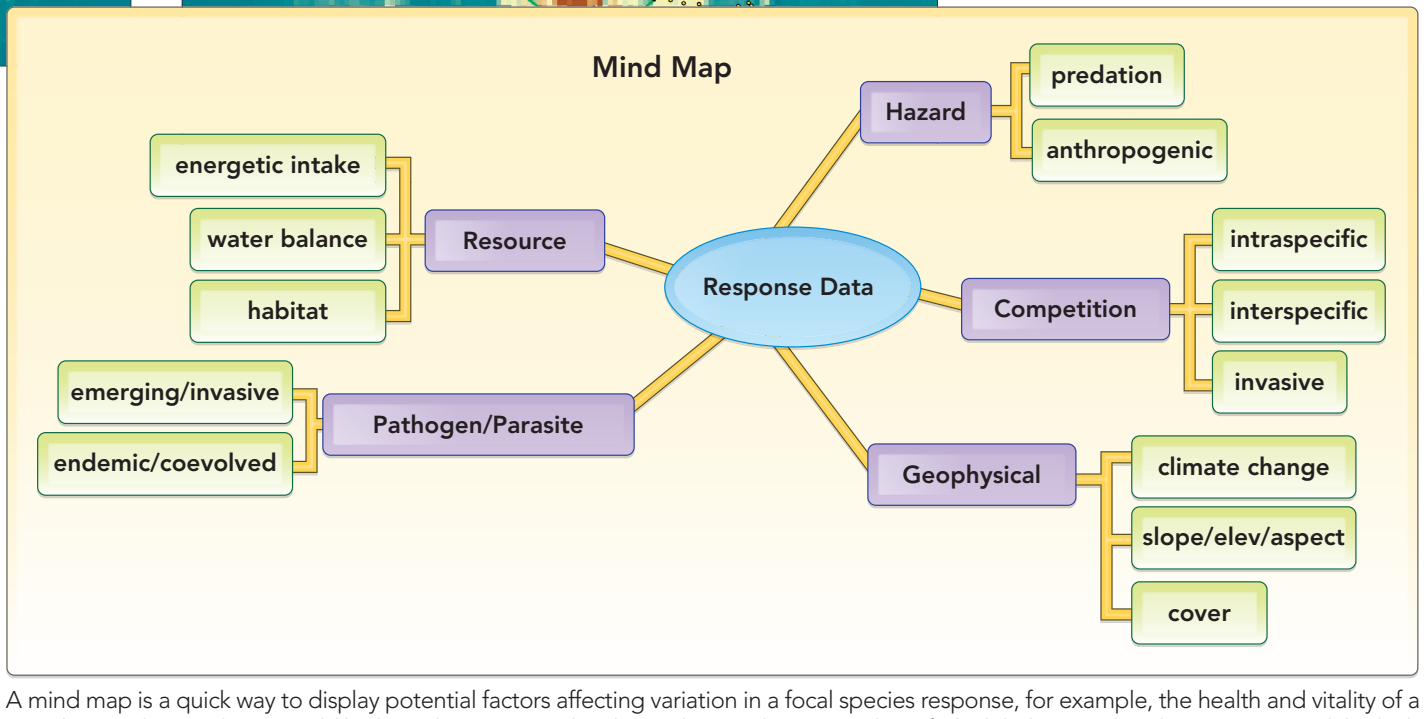
The Case of the Pronghorn Antelope

For example, the Yellowstone pronghorn antelope (*Antilocapra americana*) faces a suite of risks characteristic of small populations with geographic/demographic isolation, low abundance, and low recruitment. Decision makers need a management plan based on demographic monitoring of abundance, especially species vitality rates. This





The map on the left displays a portion of the original resource (RSPF) model showing predicted habitat use for pronghorn in Yellowstone National Park. The Swap tool was used to apply the resource model to a hypothetical road addition (shown in green). The new prognostic RSPF model output for pronghorn (right map) indicates that pronghorn would be excluded from portions of their original selected habitats.



A mind map is a quick way to display potential factors affecting variation in a focal species response, for example, the health and vitality of a population. The mind map could be based on present-day data or legacy datasets, either of which helps visualize the narrative model, which can get rather complex. The narrative model will eventually be used to create a quantitative model to support statistical analytics, which occur later in the workflow.

study focused on demographic monitoring, especially recruitment and survival; ecological interactions, especially predation rates and recruitment; and habitat assessment.

The issue assessment resulted in the creation of two narrative models, one representing birthing arenas and another for resource selection (involving the identification and use of viable habitats). In this case, species vitality could be explained by forage availability, predator intensity, geophysical context, and climatic variables. For example, the more rain, the more food, and the more newborns, the healthier the population might become.

Information Needs

Once the narrative models have been created, the next step is the identification and gathering of relevant datasets that could answer questions regarding road impacts, predator impacts, and range condition impacts on pronghorn antelope. A few of these datasets are elevation, topographic complexity, land cover, predation, and distance to roads.

In the case of the pronghorn antelope study, the species observations included 762 telemetry fixes from 26 collared animals from May to July of 2005. The spatial extent of the analysis was defined by this data in combination with expert knowledge of known habitat use. The spatial resolution for all environmental data was a 100-meter grid produced by resampling the data as appropriate.

Analysts used various modeling techniques to create forage, herbaceous, sage, soil, and cumulative net primary production (NPP) layers (i.e., process models). Additional models using empirical field data created coyote and wolf intensity of use and small mammal biomass layers. Finally, available space layers were created using one-kilometer buffers around each pronghorn location in which points were randomly generated over that space to simulate potential habitat use. Since the spatial scale at which pronghorn select their habitat was unknown, this process was repeated at three kilometers and five kilometers for comparative analysis.

Examining Alternative Futures—Ecological Forecasting

EAGLES has a tool called the Swap tool that enables users to build alternative scenarios (i.e., change models) using an already constructed model and change only one attribute while holding all else constant to examine the effects of that change on the model. This approach allows a transparent investigation of the changes in levels of treatments, such as geophysical layer alterations, changes in forage availability, or more sophisticated modeled input layer substitutions. The goal is to apply a model that previously "fit" to observed data for a potential scenario in an effort to make projections about the ecological ramifications of a given landscape change (i.e., impact models).

For example, a forecast about the impact of building a new road through a habitat would rely on the input of a new layer that contains the proposed road. The user can then apply the fitted resource model to the new road layer (instead of the original layer) and view the response surface under the changed landscape. Such projections allow a measured assessment of habitat change. Visualization of the resultant surface occurs in GIS, and the resultant equations and models can be examined statistically, as well. The intent is to provide a utility for planning for landscape change.

Humans with Nature

The benefit of the EAGLES toolset is that it streamlines the finding, compilation, and integration of data by allowing the user to identify the geospatial data inputs, region of interest, scale, and a common data resolution—even a temporal resolution—to make it easier to assemble available national datasets into a common georeferenced coordinate system using ArcGIS. Applying such a workflow to standardized datasets across the United States would help propel the adoption of GeoDesign.

Finding solutions to major ecological challenges will require new ways of thinking. It is no longer humans against nature or humans in nature—it is humans *with* nature. Whether it's Yellowstone's pronghorn antelope, grizzly bear populations, or the collapse of Pacific Northwest salmon runs, science and GIS have lifted each of these issues—and many others like them—from subjective opinion and polarization to a place where decisions can be made based on facts.

For more information about the Yellowstone Ecological Research Center, contact Jennifer Sheldon (e-mail: sheldon@yellowstoneresearch.org) or Bob Crabtree (e-mail: crabtree@yellowstoneresearch.org) or visit **www.yellowstoneresearch.org**.

For more information on how to put GeoDesign into practice, contact Mr. Shannon McElvaney, Esri (e-mail: smcelvaney@esri.com) or visit **esri.com/geodesign**.

Building a University of the Future

Highlights

- ArcGIS for Server provides the foundation for GeoDesign of university facilities.
- Integrating lidar data provided 3D modeling for new building sites.
- An integrated approach to design has saved thousands of dollars.

The University of Calgary in Alberta is considered one of the top research universities in Canada. It has more than 29,000 students and more than 4,000 academic and support staff. The university began using GIS for academic research 20 years ago and has now standardized the management of its geographic information with Esri technology. Realizing the value of geographic analysis for informed decision making, it has expanded the use of GIS to manage not only academic data but also institutional and administrative data.

Running a Smart Campus

The main campus has more than 20 academic buildings occupying more than 200 hectares, which is larger than Calgary's entire downtown core. In 2008, the university embarked on a $1.5 billion campus expansion, the largest capital expansion project in its history. Knowing that implementing a project of this size and continuing to maintain so many buildings would require a comprehensive understanding of every aspect of the campus—its landscape, people, buildings, and infrastructure—university planners relied heavily on ArcGIS and GeoDesign principles to help analyze and evaluate the impacts of design alternatives early in the development process.

The university maintains institutional data used for facilities management in a central data warehouse. Esri's ArcGIS for Server serves as the front-end technology that pulls data from ARCHIBUS, Esri Partner (Boston, Massachusetts) and creator of a solution used to manage spatial data and real estate, infrastructure, and facilities information. These recently integrated systems enable users to visualize and analyze both interior and exterior building data that's important to understanding how the campus currently works. Defining how the landscape works and evaluating whether it is working well are key tenets of the GeoDesign framework for landscape change. Evaluation of current processes allows proper "baselining" and the identification of key metrics against which design alternatives can be measured. The result is improved site planning and facilities design optimized for cost-efficient management and sustainability well after the initial project work is complete.

Understanding the physical constraints of a property is equally important. During site assessments, planners and landscape architects alike need to know how water flows across a property. This question came up early in the design phase, before construction, when the facilities management team approached the university's GIS team to create a campus drainage basin model. While there are no drastic slopes on the campus, there are low spots. Coupled with Calgary's high water tables, understanding these environmental issues was an important design constraint. If a basement is built in a particular location, the probability of flooding may be higher. Knowing where rainwater would drain allowed the team to see where flash floods might occur and then mitigate any potential dangers.

Understanding the terrain—the physical lay of the land—and how it affects drainage across this particular landscape has proved to be invaluable. The drainage basin model has been leveraged in planning new building sites and the expansion of the storm sewer system, including an innovative research project for filtering surface water before it enters the sewer system.

3D Data to the Rescue

The team combined light detection and ranging (lidar) data with high-resolution, orthorectified aerial photographs to create the drainage model data. ArcScene allowed decision makers to view and process the data in 3D while analyzing the effects of new construction sites on the existing grounds.

The University of Calgary uses ArcGIS to manage a $1.5 billion expansion and maintain the facilities on its 200-hectare campus.

Using lidar to map the campus allowed the team members to look not only on the ground but in the trees, as well. They recorded and processed the height of every tree on campus to provide even more information necessary for relandscaping after the expansion project, as well as to understand the position of shadows on potential buildings. Armed with this information, the team was able to optimize the planting of five trees for every tree removed during construction, along with native, low-water vegetation, helping the team achieve greenhouse gas and water use reduction goals.

Once the surface models were completed, the team generated 3D building models to use for shadow simulations during the next construction phase. Traditionally, the models have been leveraged to ensure that new buildings do not obstruct the views of existing buildings. In this case, the shadow models were used to track the sun's effect on a glass exterior compared to a solid wall structure. This method of optimizing the heating mechanics of buildings is an important consideration in an area as far north as Calgary, where sun angles change drastically depending on the season. In the summer, the sun is high, creating narrower shadows; in the winter, the reverse is true. Simulating 3D shadow effects based on sun angle allowed team members to calculate just how long a building would sit in shade at any time of year, enabling decisions to be made on the heating

The interactive room finder provides the ability to determine the user's current location and find the best path to a new destination.

needs and estimated costs to maintain the comfort level of that specific building.

As with many GIS projects, the development of one application often generates additional benefits. With the surface models in place and the building sites located, there was an urgent need to model the campus irrigation system. An application was developed to help map the changes caused by the construction. The irrigation model also provided the ability to monitor water usage and maintain asset inventories. This innovative application created a model for managing 8,500 sprinkler heads across campus and has helped grounds personnel better understand and manage the system. Knowing the flow rate and tilt angle of each sprinkler, the university is now able to calculate the volume of water it sprays, as well as the area it covers. The application can be used for the life of the campus and allows it to conserve water by reducing overlap and avoiding spraying water on roads and pedestrian walkways.

Coordinating Solutions

The GeoDesign process opened many new avenues to explore to increase efficiency around campus, even in areas where it wasn't expected. In a synergistic move with the new construction, the information technologies (IT) department also used ArcGIS to consolidate several computer centers where remote computer systems were once maintained. The consolidation freed up new space for faculty to use and has led to better communication and system coordination across campus. It also allowed a reduction in utilities costs for electrical and cooling systems.

"Using GIS as a decision-making tool is a smart way of gathering all the things you already know and placing them in a single spot so you can see the entire picture," says Tom McCaffrey, GIS coordinator, University of Calgary. "Understanding each layer of data as a separate entity is one thing; combining several layers together to get a coordinated solution to a complex problem is a completely different scenario. It's the difference between thinking in two dimensions versus thinking in three or four."

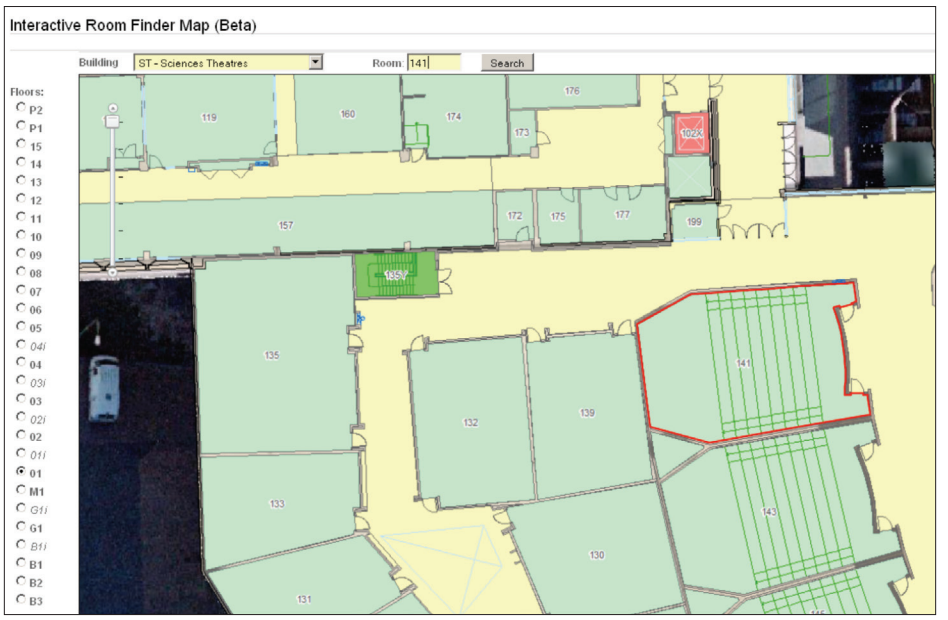
This understanding of how ArcGIS can be applied to different problems led the IT telecom group to reach out to the GIS team for help creating an application that would track telecom network lines, utility corridors, wiring closets, and utility shafts throughout the campus. While general maintenance for utilities and computer networking systems can be overwhelming if left unchecked, the ArcGIS for Server web-based application, when completed, will serve up 3D diagrams of the networks that administrators can edit and analyze at any time. Service technicians will also be able to trace, track, and repair faulty wires and equipment as these tasks are necessary. The system will enable them to monitor real-time data, plan networks, and prevent costly technical problems.

Improving Asset Management and Reducing Risk

The university currently needs to renew and maintain the exterior roofs of more than 90 buildings on several different campus sites. To make this process more efficient, the GIS team created a web mapping application that allows editing, updating, measuring, and reporting on government funding spent on reroofing the campus. Using ArcGIS, the team is now able to more effectively track life cycles and warranties of the roofing materials, which can potentially lead to thousands of dollars in savings on roofing jobs. Data on structures reported to the government is now documented using an accurate spatial and temporal method that provides strong accountability for how government money is spent. GIS has virtually eliminated the need for manual roof measurements that cost both time and money, as well as pose a potential safety risk.

From a risk management perspective, the university has also used ArcGIS to enhance public safety. Using a current model of the campus and incorporating up-to-date floor plans, emergency preparedness and evacuation plans were developed. Models and processes were discussed with local authorities and emergency responders to generate a map standard that was distributed to these stakeholders. The safety team created different scenarios and determined several possible routes for building evacuations. These plans were posted on a central website to help fire wardens understand the proper evacuation protocols. Future plans to integrate live security camera feeds into a secure campus web dashboard would allow the creation of a mobile command and control center.

ArcGIS was even used to design external lighting models for the university's safety walk programs. These models estimated ground illumination based on the type of light fixtures and any interference caused by vegetation or building shadows. Maps were then generated and given to grounds personnel to take corrective measures in illuminating unsafe areas.



Zoomed view in the room finder.

Enhancing the Campus Experience

To help students and visitors easily find their way around campus, the university developed an interactive room-finder application using institutional data. Users can input the building name and room number they wish to find, and the application generates a detailed map showing the floor plan with the desired room highlighted. Visitors can look up their destination using the online tool and determine the nearest parking area before arriving on campus. This enhances visitors' experience and helps them save time.

The interactive room finder will soon become available on mobile devices. Users will be able to take a picture of a wall marker to determine their current location and then enter their new destination. The map will show several route options—shortest path, indoor or outdoor routing, elevator access for the handicapped, or stair access for those who want more exercise.

Another future project will use administrative data to help students select classes based on spatial proximity. An application is being developed that will allow students to enter their ID numbers and generate maps that show their classroom locations, as well as the proximity to the next class, based on a specific time and day. This will help students familiarize themselves with the campus and select a schedule that offers reasonable travel times between classes.

"GIS technology offers endless opportunities for our processes to grow," says McCaffrey. "Processes that used to take weeks can now be done in minutes. Being able to see the entire picture at once is an option we've never had before. GIS allows us to plan at a much higher level than we could have ever imagined. Now, we look for new ways to view scenarios and come up with better ideas to manage them."

With all the efficiencies gained in their research, institutional, and administrative processes using Esri technology, the University of Calgary earns an *A* for GeoDesign and is well on its way to becoming a university of the future.

For more information, contact Tom McCaffrey, GIS coordinator, University of Calgary (e-mail: tmmccaff@ucalgary.ca).

For more information on how you can put GeoDesign into practice, contact Mr. Shannon McElvaney, Esri (e-mail: smcelvaney@esri.com), or visit **esri.com/geodesign**.

Esri® CityEngine®

Create High-Quality 3D Content

Design urban layouts in 3D for analysis and review.

Model 3D environments for entertainment and simulation.

Quickly create 3D models using real-world 2D GIS data.

Download your free 30-day trial at
esri.com/CityEngineTrial.

esri®

Assessing the Success of Surface Coal Mine Reclamation

Innovative GIS Tool Automates Watershed Erosion Modeling

By Shawn Huang, Anthony Alvarado, Lyle Zevenbergen, and John Cochran

Highlights

- Developed with ArcObjects, easiTool automates the workflow of watershed erosion modeling.
- ArcGIS streamlines creation of sound erosion models for 2,800 acres of reclaimed mined land.
- The easiTool interface performs data processing based on two geodatabases.

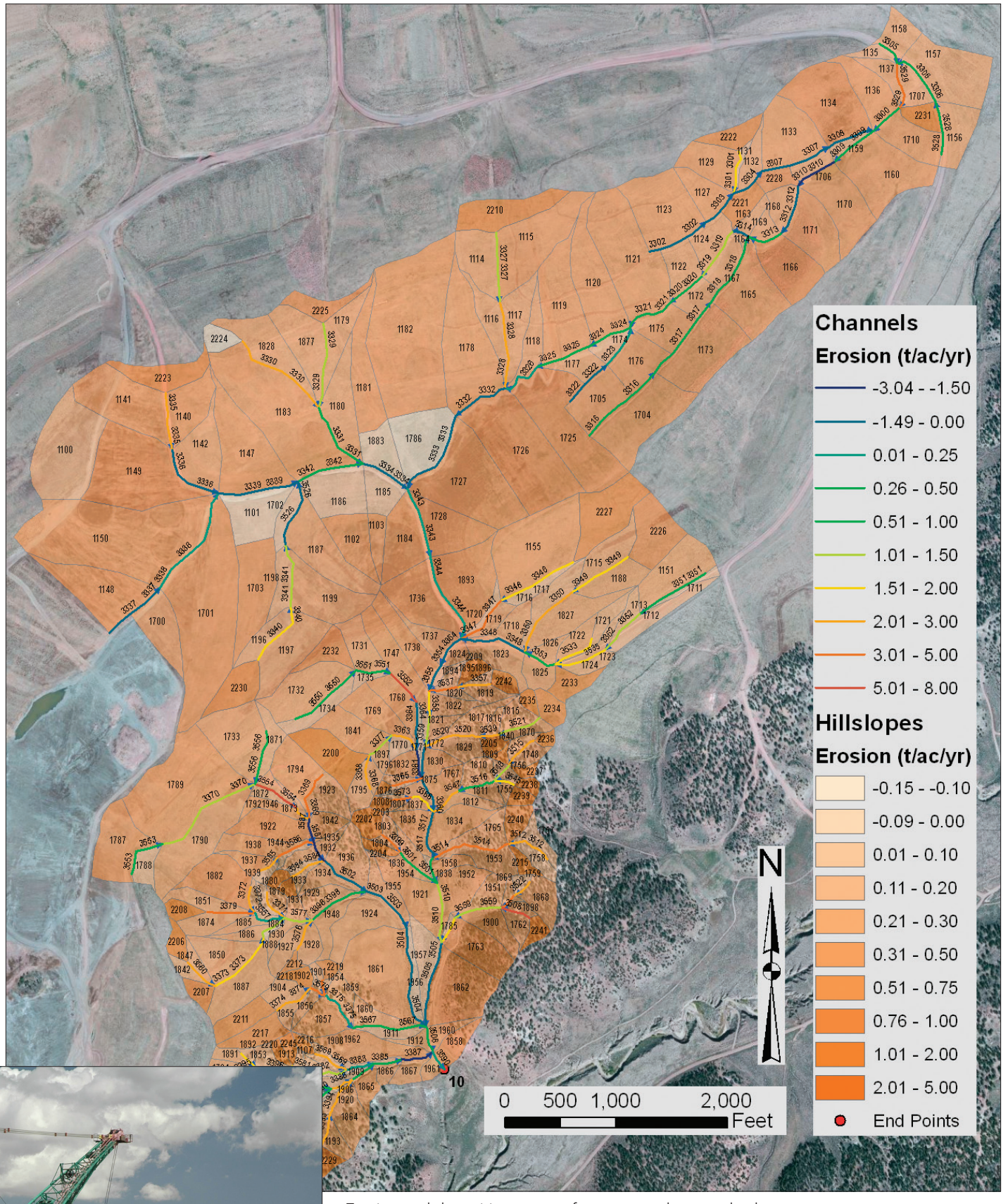
Peabody Energy, headquartered in St. Louis, Missouri, is the world's largest private-sector coal company, with more than 100 years of history. The company's coal products fuel 10 percent of all US electricity and 2 percent of worldwide electricity. Peabody Western Coal Company (PWCC), a subsidiary of Peabody Energy, operates the Kayenta Mine in northeastern Arizona. A significant portion of the company's coal derives from surface mining, which involves disturbing overlying rock layers to expose and extract coal reserves. The Surface Mining Control and Reclamation Act of 1977 demands that surface coal mine operators reclaim mined lands to meet a number of requirements, including achieving a postmining topography that approximates the premining topography.

Watershed Erosion Modeling

After reclamation activities have been completed at surface coal mines and vegetation has been established for a minimum of 10 years, surface coal mine operators are required to demonstrate that the reclaimed lands are stable with respect to erosion before the lands can be returned to prior owners.

Ayres Associates of Eau Claire, Wisconsin, has been performing watershed erosion modeling for PWCC's Kayenta Mine since the late 1980s, using the industry-standard erosion and sedimentation impacts (EASI) watershed erosion model to predict annual average runoff and sediment yield from natural and reclaimed watersheds. However, the traditional way to build a watershed erosion model was time-consuming and labor-intensive due to manual inputs of geometric characteristics, lengthy analysis of modeling results in a spreadsheet, and no direct visualization of modeling results in topographic maps.

To better assist PWCC in surface coal mine reclamation, Ayres Associates began developing a user interface for watershed erosion modeling in 2008 using GIS technology. ArcGIS and the geodatabase were chosen because they had been extensively used by Ayres Associates to organize, analyze, and display geospatial data, and ArcObjects provided a large and powerful family of components for the third-party development. In addition, PWCC had been using the ArcGIS set of tools for more than a decade to store and process various reclamation-related geospatial data and support internal reclamation planning, mining permit revisions and renewals, and annual compliance reporting to various agencies.



Erosion and deposition pattern for an example watershed.

Exposing and extracting coal reserves.

The user interface is called easiTool and was developed with ArcObjects to automate the workflow of watershed erosion modeling. By calling libraries from ArcObjects, easiTool populates geometric characteristics like length and area, calculates attributes like channel gradient, and determines spatial relations between watershed units through spatial queries. The tool performs data processing based on two geodatabases, which were designed to store geometric information and attributes about watershed functional units, model parameters, interface settings, and the EASI model results.

A coal pit before reclamation.

The recent tasks of watershed erosion modeling for PWCC were completed efficiently due to the use of easiTool. The comparison tables for runoff and sediment yield were generated automatically, and watershed units with excessive erosion or deposition were easily identified. Coupling the EASI model with the ArcGIS platform allowed rapid creation of sound erosion models for more than 2,800 acres of reclaimed mined land. These models were included in a phase II bond release application submitted to the Office of Surface Mining Reclamation and Enforcement in September 2010, as they demonstrate that postmining sediment yields are less than premining sediment yields and the reclaimed lands are relatively stable with respect to erosion.

About the Authors
Shawn Huang is water resources engineer/GIS application developer, Anthony Alvarado is project manager of geomatics engineering, and Lyle Zevenbergen is manager of river engineering for Ayres Associates. John Cochran is manager of environmental hydrology for Peabody Energy.

For more information, contact Lyle Zevenbergen (e-mail: lylez@ayresassociates.com) or John Cochran (e-mail: jcochran@peabodyenergy.com).

The Nuts and Bolts

Surface Coal Mining and Reclamation

Surface coal mining involves disturbing overlying rock layers (*overburden*) to expose and extract coal reserves using the area mining method wherein the overburden above the uppermost coal seam and the *innerburden* between the lower coal seams are removed in parallel strips (pits) across the coalfield until the area is mined. Area mining occurs progressively, beginning with removal of large vegetation (trees and shrubs) ahead of the pit prior to salvaging suitable topsoil in advance of the active pit. After being drilled and blasted, overburden material covering the shallowest coal seam is removed. As mining progresses, the overburden and innerburden are placed in piles in previously mined pits where the bottom seam has been completely removed, using draglines and auxiliary excavating equipment. This process is repeated in sequential fashion as the pit advances through the coalfield, resulting in several rows of removed overburden (spoil) piles and complete removal of the natural drainage network. As mining progresses and several rows of spoil piles are created, grading of the piles begins, using large equipment (bulldozers) to create a postmining topography.

The Surface Mining Control and Reclamation Act of 1977 demands that surface coal mine operators reclaim mined lands to meet a number of requirements:

- Grade spoil piles to achieve a postmining topography that approximates the premining topography.
- Minimize the impacts on the prevailing hydrologic balance.
- Limit the contribution of additional suspended solids to receiving streams.
- Support the proposed postmining land uses, such as livestock grazing and wildlife habitat.

The reclamation activities include the regrading of spoil piles to create an approved postmining topography, including restoring drainage networks, replacing salvaged topsoil, reestablishing vegetation cover, and implementing erosion-control measures.

The Office of Surface Mining Reclamation and Enforcement (OSM) is the US government agency responsible for regulating surface coal mining and reclamation activities. OSM assesses the success of reclamation activities based on performance standards, which include the requirement to minimize erosion and loss of topsoil and limit the contribution of additional suspended solids to receiving streams. The reclamation is considered to meet applicable performance standards if the postmining runoff is comparable to the premining runoff and the postmining sediment yield is less than or equal to the premining sediment yield.

Since the late 1980s, Ayres Associates has been using the erosion and sedimentation impacts (EASI) watershed erosion model. Because geographic characteristics had to be input manually, building a watershed model was onerous. In addition, analysis was lengthy, and modeling results could not be directly visualized on a map. Peabody Western Coal Company's (PWCC) early stability demonstrations required the use of CAD maps and laborious data manipulation to provide numerous inputs to the EASI model.

Watershed erosion modeling faces two major challenges: One is the organization of multiple datasets, and the other is the automation of the complicated workflow. Most physically based watershed erosion models, including EASI, require numerous datasets: aerial photography, topography, rainfall, vegetation, soil, erosion-control measures, and the drainage network. These datasets can be viewed as vertical layers within a watershed. The workflow of watershed erosion modeling involves

- Subdivision of a watershed into functional units (e.g., hillslopes, channels, and ponds) to reflect substantial variations in elevation, slope, soils, vegetation, land uses, etc.
- Identification of all watershed units
- Determination of spatial relations between watershed units
- Calculation of attributes like hillslope cover type and channel gradient
- Creation of input files for use in the model
- Analysis of output files produced by the model
- Visualization of modeling results

To overcome these labor-intensive and time-consuming processes and to help Peabody Western Coal Company comply with the Surface Mining Control and Reclamation Act of 1977, Ayers Associates developed easiTool with ArcGIS.

Connecting a Community

Singapore's OneMap Provides Integrated Services to Government, Business, and Local Users

Highlights

- ArcGIS provides data and maps for seamless data delivery throughout Singapore.
- Interactive applications are created for the public to use with ArcGIS and Java.
- Singapore's NSDI links 70 agencies together in data sharing.

There is high demand today for geospatial data when managing government information. In the island nation of Singapore, with a population of five million and a limited land area of 710 square kilometers, geospatial data and analysis are used to carefully plan economic growth and development, ensuring quality of life for its citizens.

Collaboration is key in Singapore. Beginning in 1959, Singapore attained self-government and set up many agencies to support the development of the fledgling nation. Today, Singapore's public service includes approximately 70 agencies under 15 ministries and an initiative for the entire government to share geospatial data with both public and private sectors and the community. As the country has matured, Singapore has faced challenges and opportunities that fall outside the traditional boundaries of each agency. While each agency is accountable for its individual roles, cross-agency issues have to be addressed so the public views the government as one seamless institution.

A Decade of Data Sharing

The Singapore Land Authority (SLA), the national land authority and one of the leading geospatial agencies, began the nation's networked government initiative back in the 1980s. SLA first formed when the Land Office, Singapore Land Registry, Survey Department, and Land Systems Support Unit merged. The agency is a statutory board under the Ministry of Law focusing on land resource optimization through development and regulation. SLA is responsible for all aspects of managing state land and buildings, from land sales, leases, acquisitions, and allocation to developing and marketing land-related products and maintaining the national land information database.

Today, SLA is driving the Singapore National Spatial Data Infrastructure (NSDI) with the Infocomm Development Authority of Singapore through the Singapore Geospatial Collaborative Environment (SG-SPACE) initiative. The primary goal of SG-SPACE is to unlock the potential of public-sector geospatial data to be shared and the cocreation of innovative services by public agencies, businesses, and communities. A longtime user of Esri GIS technology, SLA uses ArcGIS for Desktop and ArcGIS for Server to provide maps and applications over the web, for example, through OneMap (**www.onemap.sg**). OneMap is one of the successful outcomes of the SG-SPACE initiative. It is a collaborative, common platform for public agencies to share geospatial data and deliver services to the public.

One Vision, One Map

Agencies such as the land development and land transport authorities; the ministries of Community Development and Education; and those responsible for schools, youth, and sports use OneMap. The initiative provides a window to public-sector geospatial content through a common map platform that can be used to easily deliver map-based services and information.

Visitors to the site use icons to navigate Singapore, starting with an index map of the country. Users can view either street maps or land lots or both using a slider to change the transparency of the data layers. Searching and navigating are made easy through the use of an icon for themes. This provides a drop-down list of location information on community, health, and environmental services throughout the island. Places of interest, such as museums, inexpensive food complexes (called hawker centers), child care services, and parks and sports centers, can be easily found.

One pioneering application is the National Parks Board's Parks Live application. With this application, the public can now explore parks in Singapore using mobile phones as guides. The application shows a person's exact location and helps navigate within the park, providing interesting facts along the way.

Other applications provided through OneMap include searching for street addresses and finding directions to and from locations. Maps can be bookmarked to refer to at a later time, printed, and/or saved. Users can measure distance and area and draw temporary graphics on top of the map.

GIS 2.0

Built on Web 2.0 technologies, OneMap is user-friendly and convenient to leverage. ArcGIS provides the ability to manage and store data that can be leveraged in many different applications. It opens information sharing by providing SLA with the opportunity to rapidly create lightweight, focused applications using JavaScript. As a result, SLA and its data customers have deployed innovative mashups, combining internal and external data sources to create an array of applications on their own public-facing websites.

Vincent Hoong, Singapore Land Authority's chief executive, explains that the nation faced challenges that all nations face as they implement NSDIs. "The biggest challenge we have faced is obtaining good, authoritative data. Authoritative data [is] that closest to the source that collects [it] and [is] authentic and accurate for the functions [it was] intended and developed for."

SLA found that it was impractical and duplicative for one agency to collect all the data. Instead, each agency relied on the others for data sharing and application development. Since many data owners are reluctant to grant indiscriminate access to their data, SLA uses a policy framework to guide data owners on security and confidentiality.

Applications are linked directly to OneMap through the services and gallery icons, which provide drop-down lists of linked applications. Examples of services created include volunteering opportunities based on location, interest, and availability; hot spots for bird watching; retail promotions based on locations; and research on competition and market profiling for businesses at specific sites. Locations of emergency services, as well as water-level readings from 90 sensors located on canals and drains to monitor flooding, can be viewed.

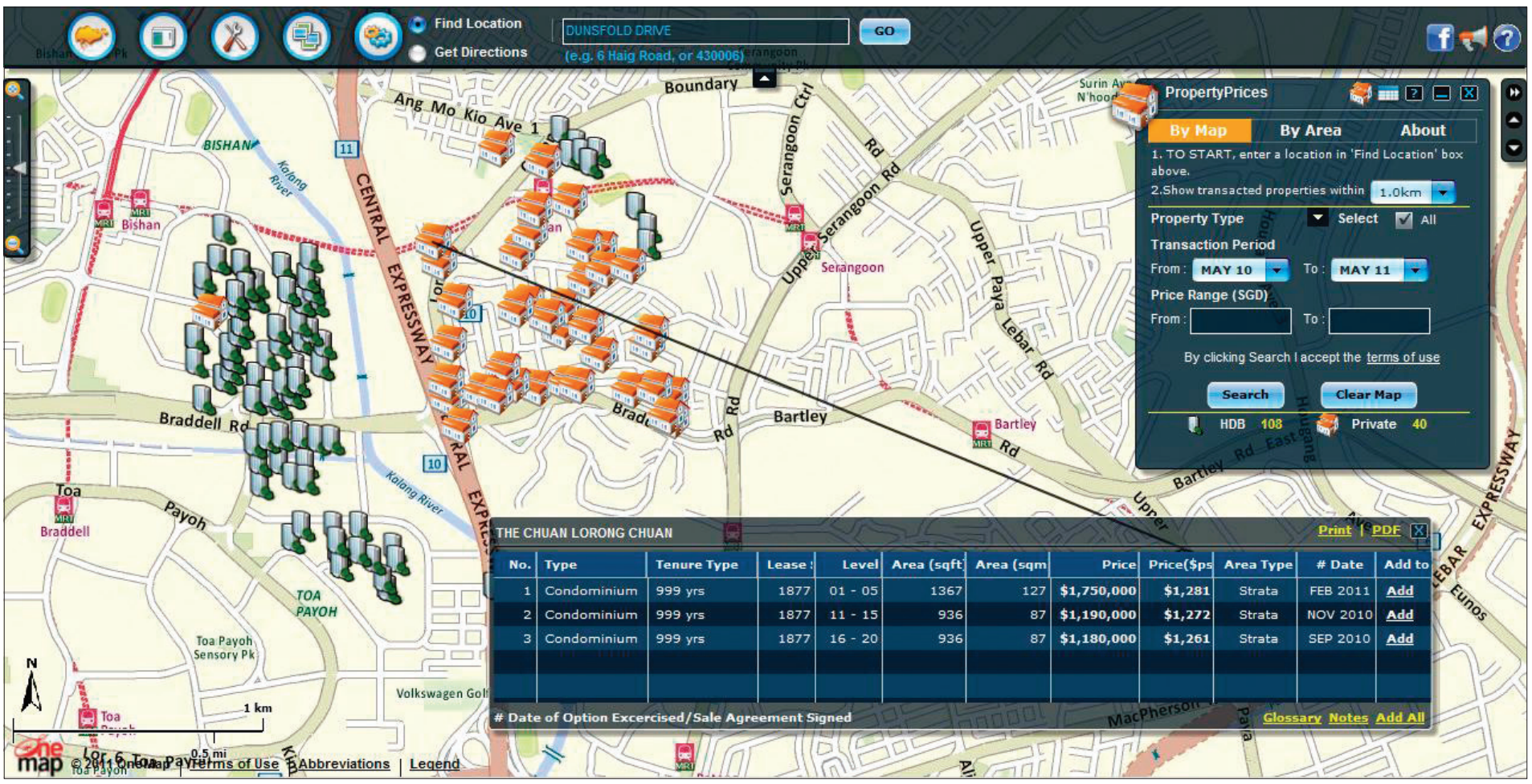
One service that has proved to be particularly popular is SchoolQuery, which allows users to find out whether their homes are within one or two kilometers of a particular school. Services continue to be added. The latest services include Space2Lease, which provides viewing opportunities of SLA and Housing and Development Board (HDB) properties available for lease in Singapore. The PropertyPrices service allows users to view the latest transacted prices for both private and HDB properties in Singapore. A navigation tool provided as an iPhone app for OneMap is also available in the Apple App Store.

Creating Spatial Awareness

Keeping abreast of new trends and innovative applications has helped Singapore create an integrated government that provides comprehensive services to the public. "Many decision makers have not realized and do not fully appreciate the potential and value of geospatial information," says Hoong. "It is only when people can appreciate the value of integrated geospatial information that efforts to increase data sharing, geospatial adoption, or application development can take root."

Hoong attended the 2011 Esri International User Conference to accept the Enterprise GIS Award from Esri president Jack Dangermond in recognition of the achievements of Singapore's SG-SPACE initiative.

For more information, contact Ming Khai Lim, Singapore Land Authority (e-mail: lim_ming_khai@sla.gov.sg). For more information on how GIS is used for spatial data infrastructure, visit **esri.com/sdi**.



Potential property buyers can log on to Singapore's OneMap and view private residential property transactions to make more informed decisions when purchasing a home.

Opening Up Health Reform

Riverside County's Public Health Department Takes a New Look at Grant Applications

Highlights

- County staff can now easily create drive times with GIS for several clinics.
- Up-to-date information, including Census 2010, is readily available for analysis.
- Community Analyst integrates well with the existing ArcGIS installation.

Staff at the Epidemiology and Program Evaluation Branch of the Riverside County Department of Public Health understand the power of a map. This branch performs most of the data profiling for anyone who needs map-level data at the Department of Public Health. The maps are used to promote and protect the health of county residents and visitors, as well as ensure that services promoting the well-being of the community are available. From grant work for funding health programs to ensuring that people across the county have fair and equitable access to emergency medical services, maps provide insight like no other tool.

Riverside County Department of Public Health oversees the health of almost two million people located in more than two dozen cities. Issues the department faces in this culturally diverse population include high rates of cardiovascular disease, obesity, and physical inactivity.

"It is our vision," explains Wendy Betancourt, public health program chief of Epidemiology and Program Evaluation at the Riverside County Department of Public Health, "that the county's residents will engage in active, healthy lifestyles; enjoy good physical and mental health; and have access to appropriate and cost-effective preventive, primary, specialty, and emergency care. This can be achieved through a high level of public and environmental health services and mental health programs where these services are most needed."

To target these areas and manage a finite arsenal of resources and government funds, the Riverside County Department of Public Health turned to GIS to help make decisions. The department has been a user of ArcGIS for Server and ArcGIS for Desktop for a number of years. It uses ArcGIS to easily share data back and forth between other Riverside County departments and the federal government, whose staff are also standardized on the software.

Easy Drive-Time Analysis for Health Reform Law

Staff at the Epidemiology and Program Evaluation Branch found out about a new Esri software solution—Community Analyst—through a list service and decided to explore its possibilities. Epidemiologist Kevin Meconis and research specialist Wayne Harris have put the web-based mapping and reporting solution to work analyzing data. They are specifically using the solution to help the county adhere to a new health care reform law that requires the county to ensure that its clinic system serves low-income community members and the uninsured. The federal health reform act includes $11 billion for nationwide expansion of community clinics like these, and California is gearing up to receive $1 billion of that money. Riverside is looking forward to securing some of this funding for its community clinics. The law takes effect in 2014, but Meconis and Harris are using Community Analyst to research a preparatory grant application that in essence gives them a head start to this process.

The grant application requires a map product displaying a 60-minute drive time of the catchment area surrounding each clinic; Meconis was able to easily mark on the map the exact locations of the clinics based on the clinic addresses and then calculate drive times for each clinic. "There was no other way to do this that was as convenient," says Meconis. "I don't think we would have been able to perform this function any other way."

And even though this particular feature of the software was new to Meconis, in less than a day, he understood how to use the software and created a customized drive-time analysis on a dynamic map. This analysis was then easily output in the format he needed to submit for the grant.

The Latest Data at Users' Fingertips

The ability to generate profiles was another feature of this GIS solution that the epidemiologists and researchers appreciated. Before using this solution, staff would have to find the area on a map that they were interested in and then ferret out tabular data from multiple sources, such as the American Community Survey (ACS) and the US Federal Department of Finance and Population estimates.

Once the raw data is found, it needs to be put into the proper format to be seen and searched through a mapping interface. That process could be drawn out and cumbersome, and while Meconis says he and his colleagues are pretty good at hunting for data, the time it takes to find it can certainly be used on more valuable efforts. All this information became available to them. From ACS data contained in one-, three-, and five-year databases, as well as data from the Census 2010, Census 2000, and 1990 Census, Esri offers current-year demographic estimates that are included in the licensing of the solution. Geographies not supplied by the Census Bureau are also available through Community Analyst and include ZIP Codes, designated market areas, rings, drive times, and hand-drawn areas. Data for states, counties, tracts, block groups, places, core-based statistical areas, congressional districts, and county subdivisions is also provided.

"One of the requests we always get is to find the latest data that is available," says Meconis. "Before, the most up-to-date data we had to work from was usually several years out of date; now we have the 2010 estimates right at our fingertips."

Branch staff help with several grant applications each year. Sometimes, depending on the nature of the grant, the department must also apply for many certifications for federally qualified health centers. This means they routinely have to provide documentation to their funding sources that they do indeed serve the communities they state they are serving.

Part of this process requires the ability to create custom profiles based on selecting more than one ZIP Code and aggregating the data. Now the staff select the appropriate areas around each of these clinics, as well as parse the included data with their own data. "This is incredibly convenient, because all the data is in one place, and we don't have to look elsewhere for information on race, ethnicity, age structure, economic indicators, and other information," says Meconis.

Managing Workflows for More Efficiency

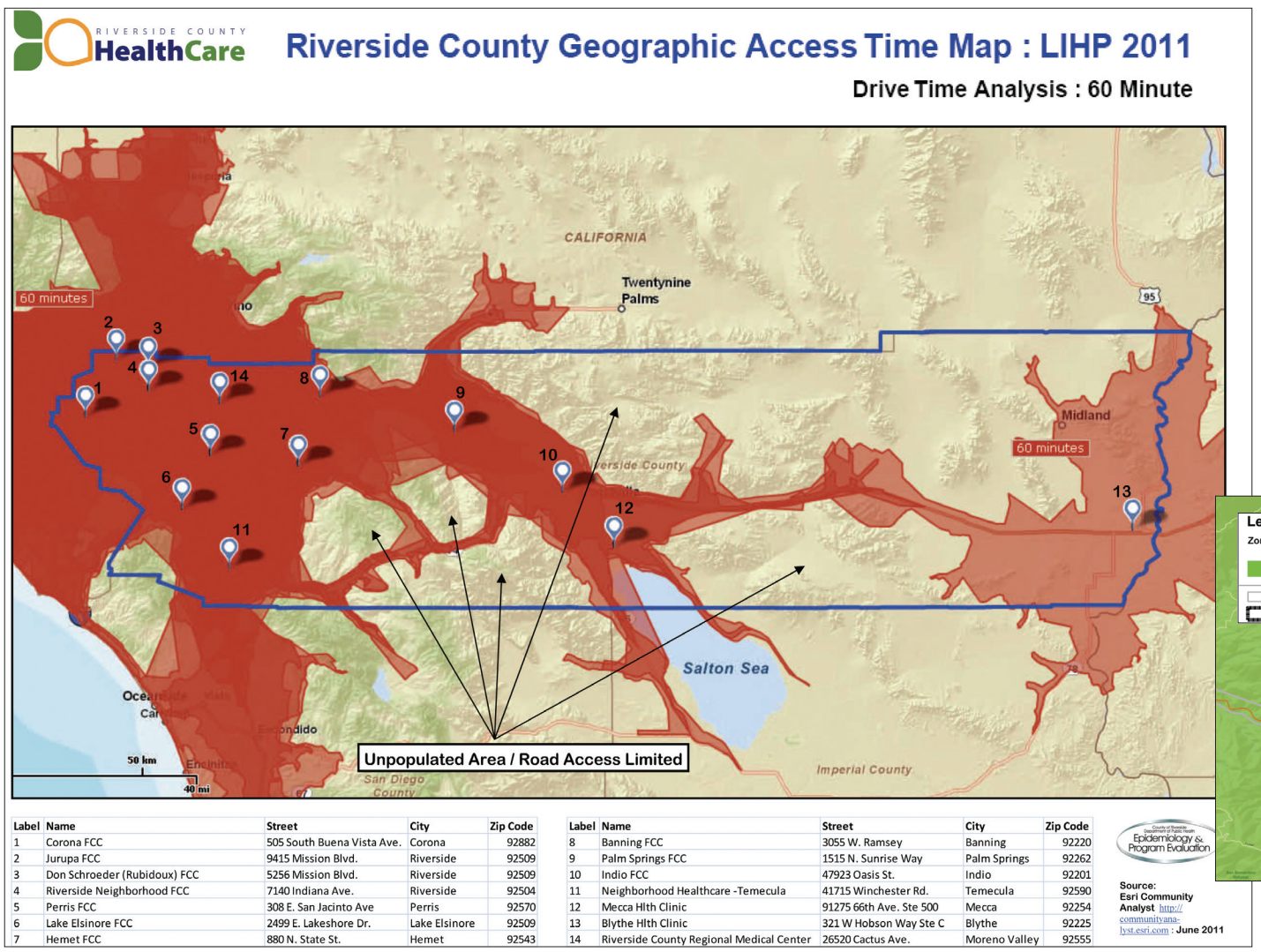
Community Analyst integrates well into the workflow of the branch staff. They support more than 10 departments in the Riverside County Department of Public Health using ArcGIS in many different capacities.

Currently, branch staff are working on a grant program for healthy homes funding that helps people remediate older houses that might contain dangerous substances, such as mold, insects, or lead paint. GIS is used to find and identify locations for at-risk housing across the county to help target their services. Since this information is all available from the county databases—which are maintained in geodatabases—ArcGIS can be used to easily find and analyze the information, such as identifying older neighborhoods and specific homeowners.

GIS is also helpful for supporting the emergency medical services program. By looking at ambulance service areas on a map, branch staff are able to ensure that the ambulance companies are in compliance with county regulations for response times to incidents. "Anytime there is an issue with a provider about where a call is located and whether it is inside a particular boundary or not, maps are used to resolve the dispute," says Meconis.

The county also works with schools and law enforcement to obtain grants for educational programs promoting safe walking to and from school. Detailed maps show the community where schools with high pedestrian traffic are located, as well as areas that have had past incidents, and help them plan routes that are safer.

For more information, contact Wendy Betancourt, Riverside County Department of Public Health (e-mail: wbetanco@rivcocha.org).



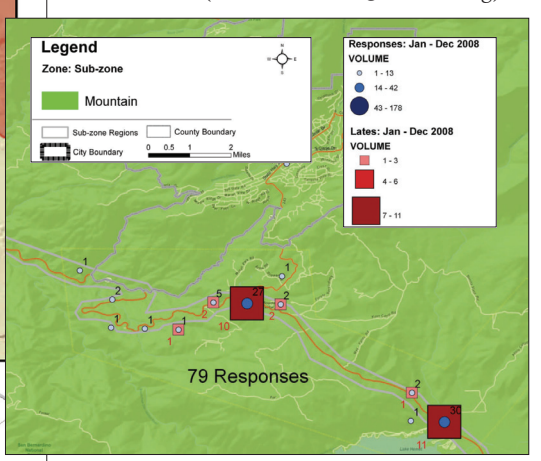
Label	Name	Street	City	Zip Code
1	Corona FCC	505 South Buena Vista Ave.	Corona	92882
2	Jurupa FCC	9415 Mission Blvd.	Riverside	92509
3	Don Schroeder (Rubidoux) FCC	5256 Mission Blvd.	Riverside	92509
4	Riverside Neighborhood FCC	7140 Indiana Ave.	Riverside	92504
5	Perris FCC	308 E. San Jacinto Ave	Perris	92570
6	Lake Elsinore FCC	2499 E. Lakeshore Dr.	Lake Elsinore	92509
7	Hemet FCC	880 N. State St.	Hemet	92543

Label	Name	Street	City	Zip Code
8	Banning FCC	3055 W. Ramsey	Banning	92220
9	Palm Springs FCC	1515 N. Sunrise Way	Palm Springs	92262
10	Indio FCC	47923 Oasis St.	Indio	92201
11	Neighborhood Healthcare -Temecula	41715 Winchester Rd.	Temecula	92590
12	Mecca Hlth Clinic	91275 66th Ave. Ste 500	Mecca	92254
13	Blythe Hlth Clinic	321 W Hobson Way Ste C	Blythe	92225
14	Riverside County Regional Medical Center	26520 Cactus Ave.	Moreno Valley	92555

Epidemiology & Program Evaluation

Source: Esri Community Analyst http://communityanalyst.esri.com : June 2011

Riverside County is using Community Analyst to apply for grants for low-income community clinics, analyzing how long it takes for members of these communities to travel to the clinics.



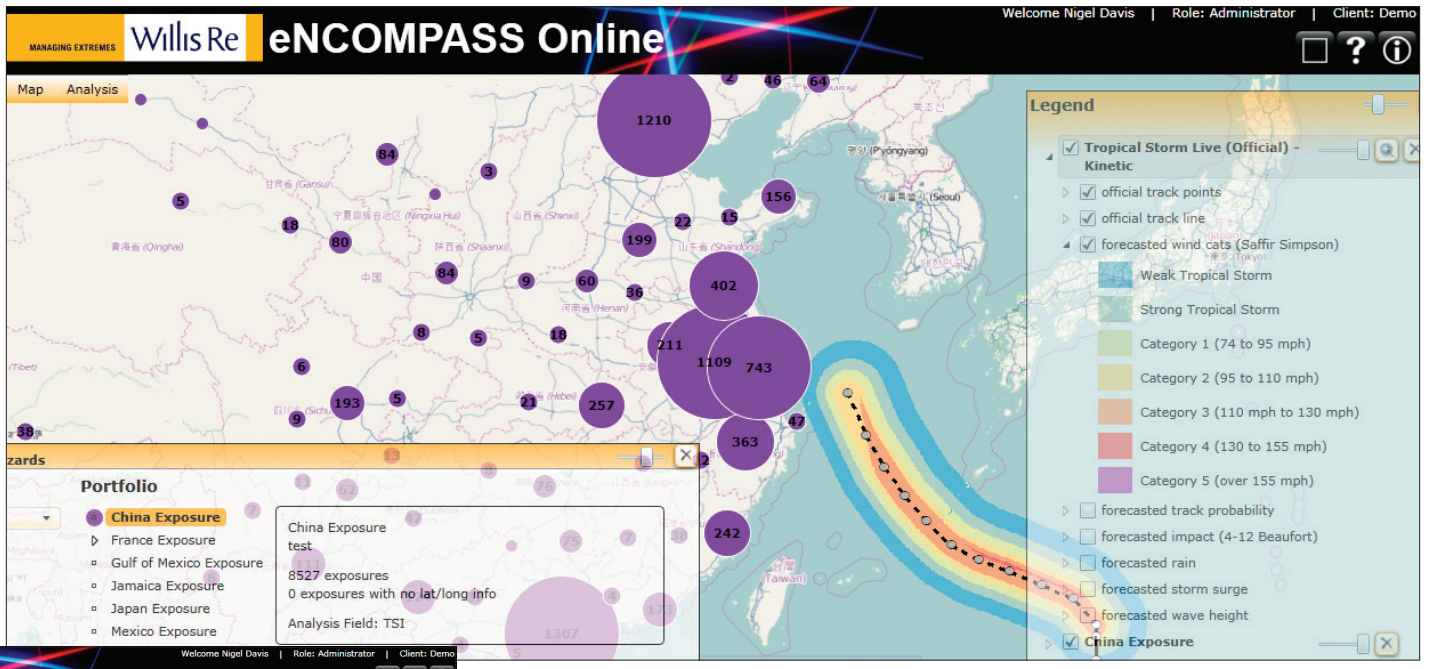
This ArcGIS analysis allowed branch staff to make sure ambulance services were in compliance with county regulations for response times to incidents.

Putting the Pieces Back Together

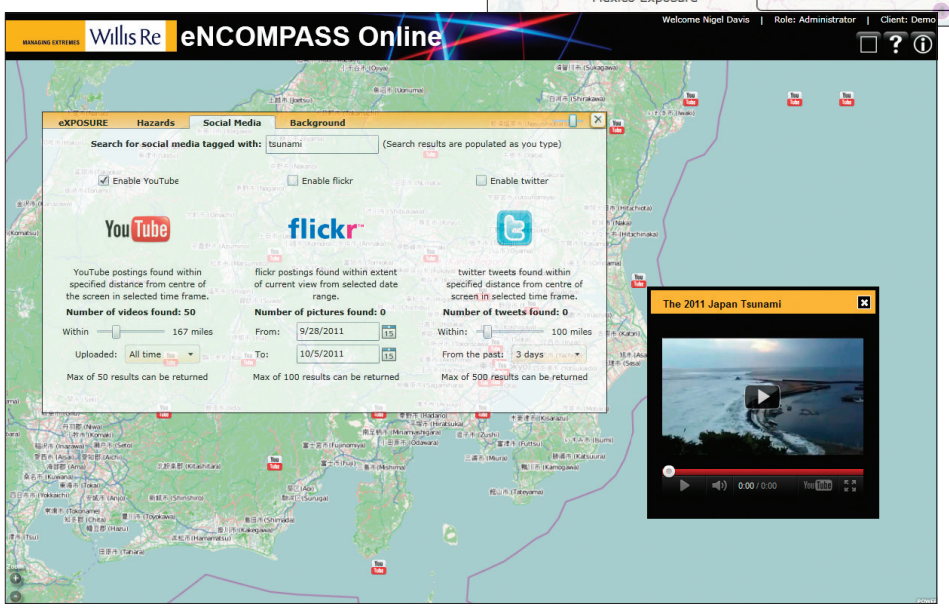
From Crowdsourcing to Tsunami Zones, Willis Re Relies on GIS for Accurate Event Response

Highlights

- Using ArcGIS, insurance risks in a tsunami zone can be easily identified.
- GIS can help brokers find all the Flickr posts within 100 meters of an insured property.
- eNCOMPASS Online streamlines policy data capture to include addresses, not just postal or ZIP Codes.



Willis Re's eNCOMPASS Online includes data that covers major perils worldwide, including live feeds like this tropical storm tracker.



Visualizing social media posts allows insurers to get reports on events as they happen.

reinsurance carriers, as well as national catastrophe schemes in many countries around the world.

Following the magnitude 9.0 earthquake that rocked Japan on March 11, 2011, and set off a tsunami, Willis Re quickly went to work gathering critical information for its insurance clients. Using an online system called eNCOMPASS, Willis Re provides data on policies and hazards and other related spatial information to its clients to view and analyze. In turn, insurers use the information to understand clients' needs, analyze potential insured losses, and pay out claims.

Preparing for the Worst

Willis Re's core focus is to provide insurance companies with a superior understanding of the risks they face. When the organization anticipated that a large number of hurricanes would make landfall last year, it was inspired to build eNCOMPASS to estimate the potential impact of large tropical storms and exposure for clients.

Willis Re's clients can conveniently log on to eNCOMPASS Online from anywhere in the world and quickly visualize all policies for locations in the path of a storm. Once the affected policies are selected, all the descriptive information associated with those policies becomes available for further analysis and action. Using this data, loss adjusters, as well as the policyholders themselves, are contacted, ensuring that response and customer service are accurate and timely.

The software on which eNCOMPASS is built is ArcGIS, which was chosen following a deliberate and intense review of potential technologies.

Willis Re is one of the first in the insurance business community to understand and implement a solution that integrates all levels and supports open access, collaboration, and transparency. It is able to do this because it has access to authoritative data and can create high-quality maps that support visualization, spatial analysis, and models through a rich application.

eNCOMPASS Online includes data that covers major perils worldwide, from flood zones in Latin America to earthquakes in New Zealand. Willis Re staff use live feeds for real-time or near real-time information on events. For example, the United States Geological Survey (USGS) live feed is used to display recent significant earthquake activity around the globe.

Events Increase Data Appetite

When the earthquake and subsequent tsunami hit Japan, Willis Re staff derived a bespoke—or custom-made—estimated representation of the tsunami zone using GIS geoprocessing, a digital elevation model (DEM), and ground observations. The DEM was derived from Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) sensors. ASTER provides remotely sensed terrain data that is easy to access and of a reasonable resolution (30 m) and wide coverage. Land elevation and slope were derived to analyze where inundation from water would take place. This tsunami dataset was loaded in eNCOMPASS Online soon after the event for analysis purposes. Willis Re staff also provided earthquake ShakeMaps from USGS and displayed this data on top of a world topographic map from Esri.

One of the powerful analytic functions of the solution is the tsunami impact footprint. Using a mapcentric view of risks in a portfolio makes it much easier to identify insurance risks impacted by the tsunami. Using ArcGIS, risks in the tsunami zone can be easily identified, extracted, and exported for offline loss estimation.

Finding the correct location of policyholders was more difficult. Often, insurance companies hold policy data aggregated in various levels, such as administrative boundaries. Instead of providing point data for each policy at the street address level, many insurers only hold policy location information by postal codes, counties, or municipalities. This is often true in Japan, as well as many other countries. Poor addresses are the result of incomplete data capture, poor addressing systems for a particular country, or perhaps high purchase costs for geocoding to high resolution in a particular country. While many insurers believe that the cost of creating the geocodes surpasses the benefit of doing so, not providing accurate address-level information means that there is not much to work with when estimating damage. Willis Re worked with clients in Japan to find the most accurate location information it could. Coupled with data on flood inundation, Willis Re was able to begin providing the services required to assist people in rebuilding their homes and businesses. Next time, hopefully, the process will be easier.

After the various catastrophes this year, Willis Re observed an increase in the appetite for better address data to use in tools, such as eNCOMPASS Online, to facilitate decision making. Insurers have begun capturing policy data, including the address, not just a postal or ZIP Code, and passing this up to the broker. Nigel Davis, executive director of product development at Willis Re, says, "Unfortunately, a disaster tends to emphasize the importance of having better data."

Remote Sensing Versus Near Sensing

Another aspect assisting in collection of more accurate data is a phenomenon called volunteered geographic information. "Suddenly, we have all these people on the ground who are connected by virtue of their personal devices: laptops, smartphones, digital assistants—you name it," says Davis. "Instead of remotely sensed data, we are getting 'near-sensed' data from people who are using social media to report on events as they happen via text messages or photos they take on the ground."

If these on-the-scene reports contain a location—and many do—this information can be harnessed. Location-aware social networks have a huge potential to enable people in a community to help themselves during a crisis. Spatial analysis makes crowdsourced data actionable. While one Flickr, Twitter, or Facebook post may not be critical, if there are many posts, a heat map from data collected on the ground pertaining to property damage, hazards, evacuations, power outages, and help and services can be collected from the best source of data—those affected. Visualizing this data as hot spots or trends gives an idea of the density of reports coming from a single area. This can assist in allocating resources to those who need the help most or aid the validation of whether incidents reported are corroborated by others, adding increased clarity to a situation. More than just dots on maps, hot spots organize lots of data and quickly provide a better understanding of the data. Reports can also be filtered by date to see daily trends. Providing this information in a spatial context can connect individuals and optimize the use of trained resources.

"GIS can help brokers find all the Flickr posts within 100 meters of an insured property, for example, to get real understanding of damage and claims from those actually in the area," says Davis.

From Crowd to Cloud

The Internet is a natural platform for geospatial analysis. Many participants can easily move from data sharing to creating shared services in this environment. The technology makes it possible: collaborative computing, service integration, mashups, user-contributed content, and distributed data management are some of the many ways that access has been opened to many new users and applications. While the technology opens the gates, it takes more than technology to create applications that are useful. Access to authoritative data and committing the platform resources allow communities to use the technology in the manner they need to accomplish their tasks.

For more information, contact Nigel Davis, executive director, Team Leader Platforms and Delivery, Global Analytics, Willis Re (e-mail: davisn@willis.com), or visit **www.willisre.com/Risk_Quantification/Risk_Management/Analytics**. To learn more about how GIS helps insurers, visit **esri.com/insurance**.

Enterprise Solution a Sweet Reward for Australian Sugarcane Farmers

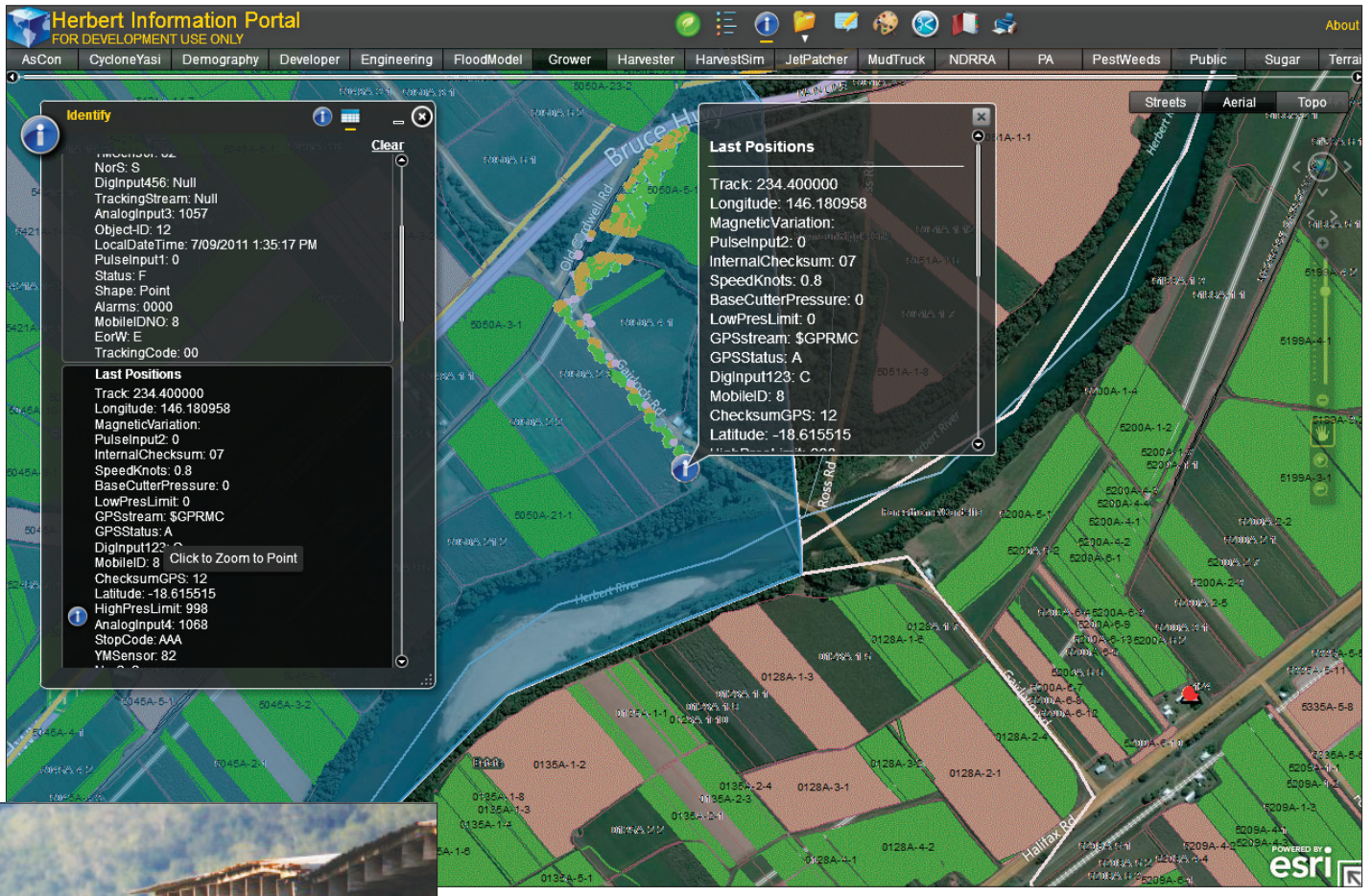
Technology Supports Sustainable Development of Local Industry

Highlights

- The web-based enterprise system lets partners and local farmers easily access information.
- With GIS, managers can access integrated and real-time data.
- ArcGIS promotes efficiency, productivity, and improved environmental outcomes for sugarcane growers.

The roots of cooperative sugarcane cultivation in the Herbert River catchment basin in North Queensland, Australia, can be traced to the early 1880s, when six small-area landowners formed the Herbert River Farmers Association. Shaped by the social and economic conditions of the day, the landowners believed that both the sugarcane industry and local residents would be better served by cooperative farming rather than the plantation model that had flourished in the area for the preceding 20 years.

Two years later, Colonial Sugar Refining Company (CSR), the primary sugarcane processing company in the region, offered agreements to the newly formed association to centrally mill its cane. In 1891, CSR subsequently subdivided its Homebush Estate into small farms, which it leased to local farmers with an option to buy.



Herbert Information Portal showing harvested areas and cane harvester movements.

Technology has come a long way for sugarcane farmers in the Herbert River catchment basin of North Queensland, Australia.

Though farming methods in the Herbert River catchment have changed greatly during the succeeding 130 years, its cooperative nature has grown even stronger with the founding of Herbert Resource Information Centre (HRIC). Established in 1996, this nonprofit organization supports the sustainable development of the sugarcane industry in the Lower Herbert River catchment through technological innovation and is responsible for building community networks between local industry, government, and residents.

Shortly after its formation, HRIC conducted a mapping project of the Herbert River floodplain. The results of the project proved difficult to disseminate to both the HRIC coalition and the local farming community. Members decided to implement a GIS that would allow HRIC to better analyze local sugarcane farming and distribute its findings. Consequently, HRIC launched Herbert Information Portal (HIP), a collaborative GIS using Esri software.

Today, HIP has evolved into an enterprise system built on ArcGIS for Server and ArcGIS for Desktop and extensions. The GIS is web based so that HRIC partners and local farmers have easy access to information. HIP supports most of the critical business processes in the region's sugar industry supply chain by acting as the catalyst for implementing precision farming technology, from improved harvesting and transport management to more efficient milling operations. Applications include Cane Mapping and Management, Real-Time Cane Harvester Monitoring, Sucrogen Rail Safe Integration, and Cane Yield Monitoring systems. These applications use GIS to promote efficiency, productivity, and improved environmental outcomes for HRIC partners and sugarcane growers.

Because the Herbert River catchment basin is sandwiched between two environmentally protected areas—Wet Tropics World Heritage Area and Great Barrier Reef Marine Park—the cane-growing industry uses the tools provided by HRIC to improve productivity while monitoring and reducing impact on the environment.

"Though initially established as a technology center," says Raymond De Lai, HRIC manager, "we quickly realized that the most significant value that HRIC could provide to our partners was the opportunity to build and enhance relationships among people and organizations. We are strongly focused on building trust, commitment, and cooperation through a shared vision among our partners and the wider community."

The partners in the HRIC project include local government representatives from Hinchinbrook Shire Council; the CSR group that refines and transports the processed sugarcane; and Terrain Natural Resource Management, a nonprofit agency that builds regional consensus for natural resource management. Also included in the management coalition are representatives from the Bureau of Sugar Experiment Stations and Herbert Cane Productivity Services, which provide research, development, and extension services to the sugarcane industry.

"For us, the advantage of a partnership approach to an enterprise GIS is the sharing of its cost, risk, and—of course—the benefits," says De Lai. "Any one of our HRIC partners would find it very difficult to fund their own system. Together, we are able to buy into a large enterprise GIS infrastructure, data management processes, capacity building, and a relationship with our partners that provides benefits beyond GIS projects."

The mutual support and interaction between HRIC and the community is essential because sugarcane production in the area is a complicated process that includes a number of well-coordinated steps, from planting to harvesting. The process is underpinned by the automatic collection and transmission of spatial data to HIP for analysis and decision making.

"Our sugarcane growing and harvesting procedures require a high level of interdependence within the community because the process is not vertically integrated, except for the milling and transport," says De Lai. "We rely a great deal on the growers to provide regular updates on the status of their fields."

Because sugar production can be increased with better management of harvest scheduling and decision making based on regional variations in soil, irrigation, and climatic conditions, the growers have fitted their harvesting equipment with onboard computers, electronic logbooks, base-cutter height sensor kits, and yield monitors. Data is automatically collected by the sensor systems installed on the tractors and other field equipment and transferred to HIP for processing and analysis with ArcGIS.

When analyzing yield variation within a field, the system suggests how growers may be able to reduce their costs through varying farm inputs. By closely managing irrigation and monitoring climatic conditions, the optimal harvesting time can be determined to maximize the sucrose content in the sugarcane. An increased sucrose yield increases the profitability of the harvest.

Since harvesting is the costliest activity on a sugarcane farm, it is important to keep the cane harvesters in constant operation during the cutting season. This is facilitated, in part, through the use of Twitter, the social networking site. Farmers Tweet the status of the harvester in their field so that the owner of the subsequent field knows exactly when the equipment will arrive to begin the next job. It is expected that this concept will be used for other projects in the near future, such as identifying the location of cane trains and broadcasting the estimated times of arrival.

"Using enterprise GIS has allowed us to integrate our various data inputs and provide real-time access for managers and decision makers," De Lai concludes. "In development terms, we are doing things now in hours and days that would previously have taken us weeks and months. Technically, we can put in place anything we envision at the moment. Our challenge is to identify the business models that are sustainable and support those opportunities through GIS."

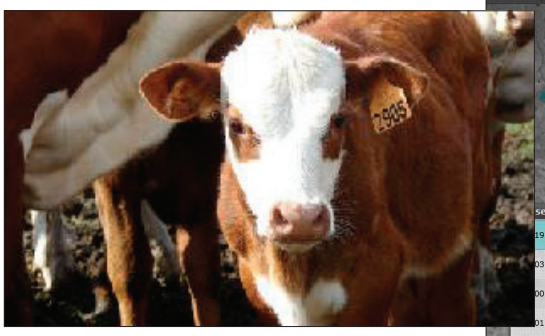
For more information, contact Raymond De Lai, HRIC Center manager (e-mail: rdelai@hinchinbrook.qld.gov.au).

Uruguay Streamlines Livestock Traceability

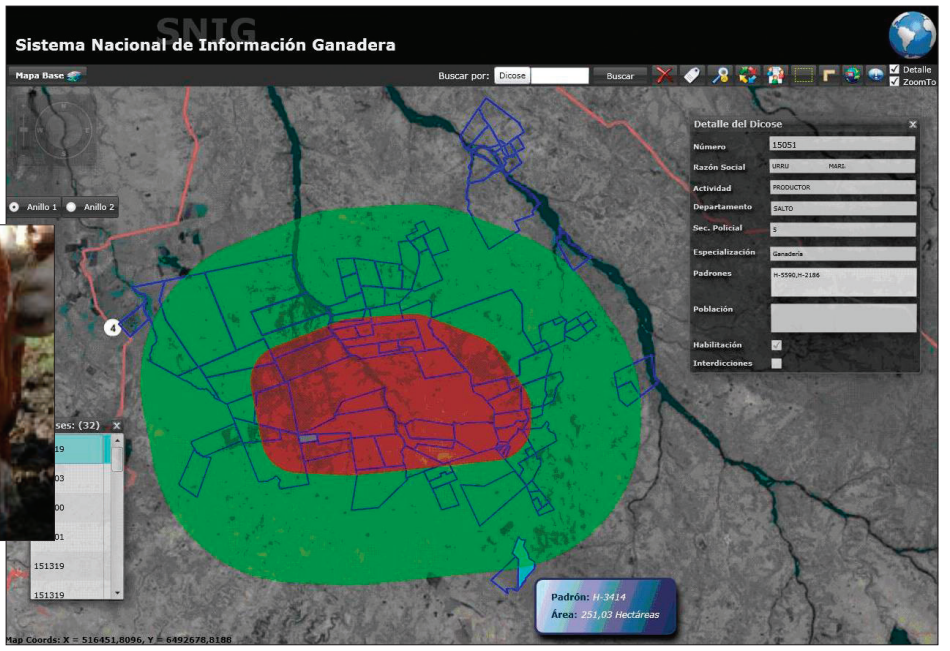
By Pablo Rebufello, Pablo Piperno, and Gustavo Drets

Highlights

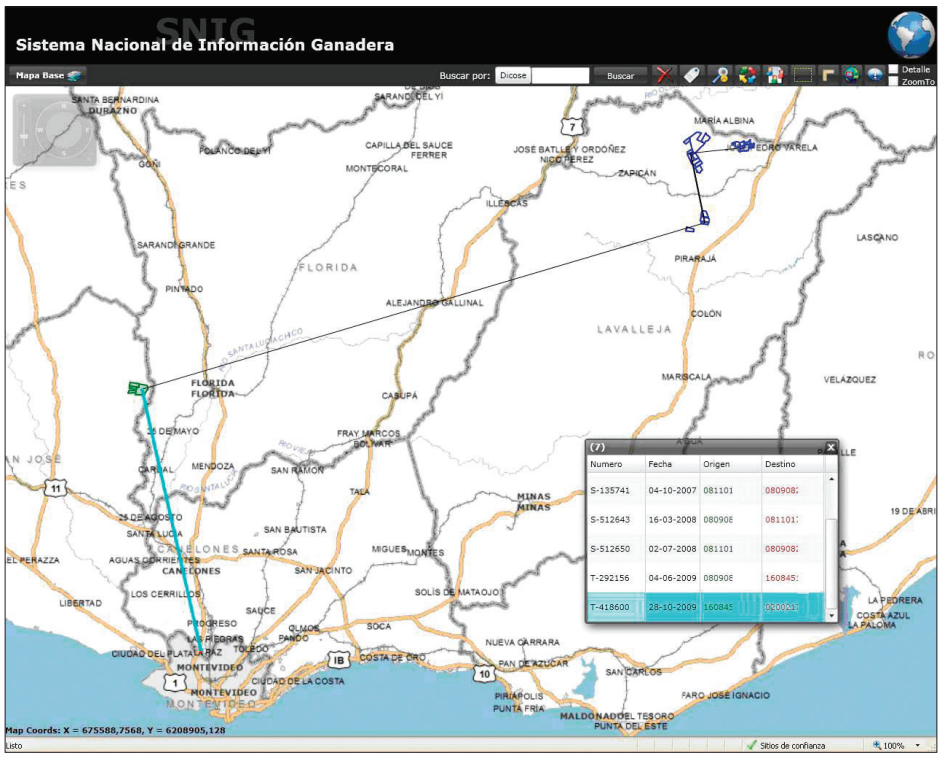
- ArcGIS for Server supports the full livestock chain (breeders, veterinarians, brokers, industry, police, etc.).
- GIS helps keep track of 11.5 million livestock with individual electronic identification.
- The web portal, used for cattle trading and managing sanitary zones, was built with ArcGIS API for Silverlight.



A traced calf, showing the RFID tag.



Result of two distance searches for neighboring lands of a farm. A sanitary emergency is one of the possible uses for this tool. In the picture, neighbors pertaining to the first ring are shown. Note that when a farm has lands within the red ring, all its parcels are shown, even if they fall outside the ring.



Path of an RFID-identified animal. Each line segment shows a different transportation of the animal.

Uruguay is a small country of three million people and more than 11.5 million livestock. Eighty-five percent of its surface area is devoted to grazing. The quality of its livestock and its exceptional sanitary conditions, as well as its derived products, have allowed the country to earn a place among the major exporters of the world.

The Ministry of Livestock, Agriculture and Fishery (MGAP) of Uruguay created the National System of Livestock Information (SNIG), a multipurpose system that gives support to operational and strategic decisions for this important branch of the economy. SNIG was developed for tracing livestock. This traceability system, which is compulsory and has national scope, encompasses more than 75,000 participants in the agricultural and industrial sectors, including all the breeders, intermediaries, livestock auction locations, and slaughter plants in the country.

In a gradual process that began with the individual radio frequency identification (RFID) and registration of all calves born after 2006 and culminated in July 2011 with the identification of the rest of the livestock population, SNIG incorporated more than 11.5 million animals in its database, making Uruguay so far the only country with full livestock population traceability.

Each livestock transaction, both by transportation and ownership change, must be preauthorized and recorded in real time. This allows SNIG to receive information about 350,000 operations carried out annually, verify that the actors are registered and do not have any sanitary or legal prohibitions, and establish and register the origin and destination of each movement. This information is stored in a centralized database and managed through a web portal either from different offices of MGAP distributed throughout the country or from the farms, possible because most of the country has 3G/GPRS coverage.

In short, this allows SNIG to store updated data on each bovine animal in the country—who the owner is, where the animal is, where it was, and if it was in contact with other animals—from birth until it is sent to slaughter.

SNIG was designed by a consortium of companies, including Ingenieros Consultores Asociados (ICA), a GIS company and Esri international distributor. ArcGIS for Server was chosen as the technology platform because it provides the functionality to handle a significant amount of data that can be easily integrated in web solutions of the system. ArcGIS API for Silverlight 2.1 proved to be an excellent development platform for this application. In other words, for the huge volumes of data involved, ArcGIS for Server was the perfect solution due to its horizontal and vertical scalable architecture.

To obtain geographic data providers, agreements were established with the Uruguayan Spatial Data Infrastructure Commission and other institutions. The General Directorate of the National Cadastre provides GIS information for 200,000 rural parcels. Additionally, the Ministry of Transportation provides GIS information concerning roads, administrative divisions, locations, and 20 other layers of reference.

The developed web application gives different involved actors (breeders, brokers, industry, veterinarian services, police, etc.) information related to their activities, providing transparency to the system. Each participating actor has different privileges that give authorized access to distinct data and functionality. For example, breeders may access maps of their farmlands and data on activities or animal species through their respective registration numbers. Veterinarian services may access maps showing rings of neighboring farms, data used in case of animal diseases.

The quality of services and increasing development have enabled SNIG to fulfill an important role in the construction of an integrated vision from both external and MGAP information systems.

About the Authors

Pablo Rebufello works for ICA as a software development manager and GIS specialist consultant. He is also a professor of GIS at the University of República Oriental del Uruguay. Pablo Piperno is an architect with a degree in information systems. Gustavo Drets is a senior GIS consultant at ICA.

For more information, contact Pablo Piperno (e-mail: ppiperno@ica.com.uy) or Gustavo Drets (e-mail: gustavo@ica.com.uy) or visit **www.ica.com.uy** and **www.snig.gub.uy**.

USDA's APHIS: Sustaining National Food Supply and Security

Highlights

- APHIS developed the GIS-based, enterprise-wide Integrated Plant Health Information System.
- GIS helps USDA manage operations so that APHIS can quickly respond when the nation's agriculture and forests are threatened.
- ArcGIS has helped USDA achieve its goals by improving standardization, accuracy, consistency, and data exchange.

With an increasing global population, rapid changes in weather patterns, and greater pressure on international agricultural production and safety, the United States Department of Agriculture (USDA) has expanded its focus on national agricultural issues to encompass a more global perspective. Today, USDA not only analyzes and sustains the needs of the American farmer and consumer through domestic initiatives but also assures the quality of US agriculture to foreign trading partners to protect it from restrictions. Over the years, GIS technology has become an essential tool at USDA to support its efforts.

Says Todd E. Schroeder, USDA Animal Plant Health Inspection Service (APHIS) director of Business Systems Management, "We have known for some time that while there are immeasurable benefits derived from the increase in domestic and international agricultural trade, it also poses some risks because of the possibility of the accidental introduction of foreign species that can imperil a country's food production capabilities. With our recently implemented enterprise GIS, we are now able to better track potential problems and take remedial action when necessary."

USDA began its use of GIS more than 25 years ago with the development of land-cover and agricultural basemaps from its existing collection of aerial survey data. An enterprise-level GIS license followed, implemented at APHIS. This agency's responsibilities are broad and include protecting and promoting US agricultural health, regulating genetically engineered organisms, administering the Animal Welfare Act, and carrying out wildlife damage management activities. In the event that a pest or disease of concern is detected, APHIS instigates emergency actions with affected states or regions to quickly manage or eradicate the outbreak. This aggressive approach has enabled APHIS to successfully respond to potential pest and disease threats to US agriculture.

To meet its responsibilities, APHIS has implemented GIS-based projects across the country to address various agricultural and natural resource issues. These projects include monitoring the Asian long-horned beetle and emerald ash borer, alien pests that have destroyed millions of hardwood trees, and the development and implementation of the Citrus Health Response Program, which helps the agency advise the US citrus industry and protect it from invasive species.

To be successful, APHIS relies on joint efforts between growers, federal and state regulatory personnel, and researchers. This allows the agency to sustain the sharing and consolidation of data resources in its various initiatives and inform and enhance the decision-making process. Due to the collaborative nature of its work, APHIS needed a nationwide GIS to provide a clear and complete picture of American agriculture and the natural resource landscape that would help the agency maximize the benefit from its various initiatives and meet the goals of USDA. In addition, stakeholders needed real-time data that is secure and easily accessible to be used for planning and operations.

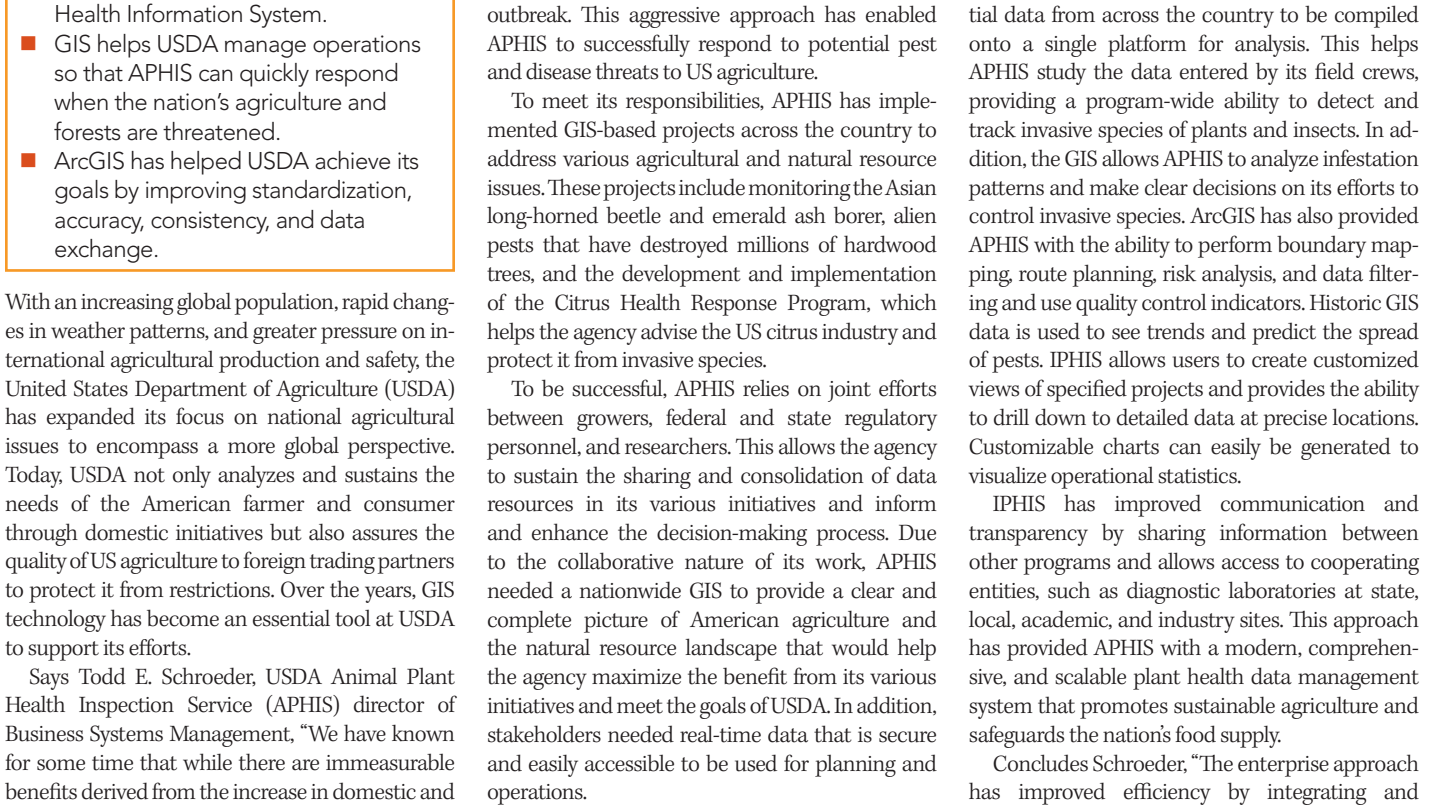
In 2009, APHIS developed the GIS-based, enterprise-wide Integrated Plant Health Information System (IPHIS). The application is currently being implemented state by state for use by all plant health responders. IPHIS provides a real-time system that allows users from any APHIS-supported project to see plant health activities in their district, share data about regional pest infestations, and view national quarantine areas. The system tracks infestations and diseases that impact plants and documents the response. The IPHIS system, with its underpinning GIS technology, helps USDA manage operations, increase efficiencies, and track scientific progress more accurately so that APHIS can quickly respond when the nation's agriculture and forests are threatened.

The IPHIS system's GIS software includes ArcGIS for Server, ArcGIS API for Flex, ArcObjects, and basemaps (street, imagery, relief) from ArcGIS Online (arcgis.com), allowing disparate geospatial data from across the country to be compiled onto a single platform for analysis. This helps APHIS study the data entered by its field crews, providing a program-wide ability to detect and track invasive species of plants and insects. In addition, the GIS allows APHIS to analyze infestation patterns and make clear decisions on its efforts to control invasive species. ArcGIS has also provided APHIS with the ability to perform boundary mapping, route planning, risk analysis, and data filtering and use quality control indicators. Historic GIS data is used to see trends and predict the spread of pests. IPHIS allows users to create customized views of specified projects and provides the ability to drill down to detailed data at precise locations. Customizable charts can easily be generated to visualize operational statistics.

IPHIS has improved communication and transparency by sharing information between other programs and allows access to cooperating entities, such as diagnostic laboratories at state, local, academic, and industry sites. This approach has provided APHIS with a modern, comprehensive, and scalable plant health data management system that promotes sustainable agriculture and safeguards the nation's food supply.

Concludes Schroeder, "The enterprise approach has improved efficiency by integrating and leveraging our existing plant health IT systems and isolated GIS programs, reducing redundancy throughout our network. As a vital part of IPHIS, GIS has helped USDA achieve its goals by improving standardization, accuracy, consistency, and data exchange. In addition, it allows decision makers and scientists to manage current USDA activities and develop and implement long-range plans."

For more information, contact Todd Schroeder, director, Business Systems Management, USDA-APHIS (e-mail: todd.e.schroeder@aphis.usda.gov).



APHIS users see a comprehensive view of local activities and have the ability to drill down to detailed data at a specific location. Customizable charts provide operational statistics.

Predicting Prehistoric Site Location in the Southern Caucasus

By Christopher M. Nicholson, Charles P. Egeland, and Boris Gasparian

Highlights

- ArcGIS Spatial Analyst extension modeling focused on the identification of areas with the potential for site preservation.
- Site suitability analysis enters geographic variables into a GIS model.
- Survey efforts in other areas and time periods can benefit from predictive modeling.

The southern Caucasus mountains (which includes the modern republics of Armenia, Azerbaijan, and Georgia), nestled between Africa, Europe, and Asia, has served as an important thoroughfare for human populations throughout the Paleolithic period (about 2.6 million to 12,000 years ago). Although the region has a rich record of Paleolithic research, many of the sites have not been analyzed with modern archaeological methods. Therefore, the identification of new sites in the region that can be excavated and analyzed with modern techniques is imperative. Relative to sites of later time periods, those of Paleolithic age are typically rare and nondescript.

With Esri university site licenses, researchers from the University of North Carolina, Greensboro, and University of Wyoming, with the National Academy of Sciences, Republic of Armenia, utilized ArcGIS for Desktop with Spatial Analyst to predict the location of Paleolithic sites in northern Armenia. The ArcGIS Spatial Analyst modeling focused on two issues: the definition, in a very broad sense, of potential survey regions and the identification of areas within the survey region with good potential to preserve sites of this remote age.

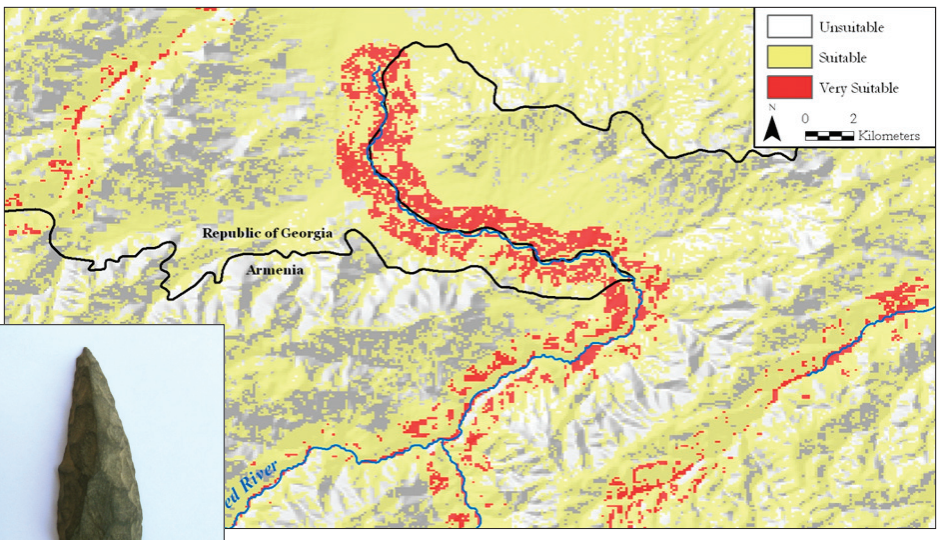
Ancient Pathways and Modern Survey Regions

One of the major sources of Eurasian populations throughout the Paleolithic period was Africa. Therefore, a theoretical migration route between northeast Africa and the Paleolithic site of Dmanisi (Republic of Georgia) was constructed. Dated to about 1.8 million years ago and preserving both stone tools and the fossil remains of extinct animals and *Homo erectus*, Dmanisi is the oldest well-accepted evidence for a human presence outside Africa. A simple cost path analysis (CPA) model was employed, which determines the path from a source to a destination while taking into account impediments to travel. Assuming that humans would have selected a path that minimized the cost (energy) of travel, the goal of the CPA was to identify a least cost path (LCP). This function was performed in ArcGIS 9.3 using Spatial Analyst. The cost raster was represented by modern terrain (a digital elevation model), which created the "cheapest" cumulative route relative to cost.

Based on this, the cheapest route runs northeast across Syria into western Turkey and skirts along the northwestern border of Armenia. Once in the Lesser Caucasus of northern Armenia, the LCP passes north before terminating at Dmanisi. Given its reliance on modern terrain, the CPA was not meant to predict the precise location of Paleolithic sites but rather to isolate potential survey regions. That the CPA matched well with the distribution of known Paleolithic sites in Armenia supports the idea that the region was an important corridor for the movement of Paleolithic human populations.

Site Suitability and Site Location

The next step was to identify specific areas in or near the LCP for focused pedestrian survey. It was soon evident that northern Armenia's Debed River Valley was deficient in Paleolithic sites, despite the fact that numerous sites have been documented in surrounding areas.



Raster map of site suitability scores for the Debed River Valley. Left: Middle Paleolithic stone artifacts from Bagratashen.

Given this and the river's location near the modeled LCP, a site suitability analysis was run. Site suitability analysis enters variables into a GIS model that geographically displays areas that are most (and least) likely to preserve sites based on suitability scores (the higher the score, the more conducive an area is to site preservation). The location of previously identified Paleolithic sites in Armenia was used to identify predictive variables for site location. The variables most closely associated with site location were slope, aspect, elevation, land cover, and proximity to rivers. Using a linear scale transformation (LST), numerical values for each variable were assigned based on the number of sites that occurred in a particular category. The LST values for each variable were then summed using the raster calculator and averaged to remove potential outliers. This resulted in a suitability score that ranged from 0 (lowest suitability) to 100 (highest suitability). In general, the highest suitability scores were associated with areas located near rivers, with low slope and relatively open vegetation.

The calculated raster values were reclassified into three suitability categories: Unsuitable, Suitable, and Very Suitable. These values were then used to produce a raster map to visualize the potential location of Paleolithic sites in the Debed River Valley, which in turn served to focus survey efforts.

Conclusion

Guided by the site suitability analysis, preliminary pedestrian survey during the summer of 2009 in the Debed River Valley identified 25 new Paleolithic sites spanning nearly two million years. Notable among these sites are Bagratashen 1, which contains a very well-preserved Middle Paleolithic (~100,000 years ago) stone tool assemblage, and Haghtanak 3, which preserves stone tools that are similar to those of nearby Dmanisi. There are, in fact, several areas with high suitability scores that have not yet been surveyed.

About the Authors

Christopher Nicholson is the interim director of the Water Resources Data System at the University of Wyoming. Charles Egeland is an assistant professor of anthropology at the University of North Carolina, Greensboro. Boris Gasparian is a researcher at the Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia.

For more information, contact Christopher Nicholson (e-mail: cnichol5@uwyo.edu, tel.: 307-766-3741) or Charles Egeland (e-mail: cpegelan@uncg.edu).

Visualizing the Results of High-Impact Student Field Experiences

By Matthew North, Associate Professor of Information Technology Leadership, Washington & Jefferson College

Highlights

- GIS enriches high-impact higher education learning experiences.
- Field data collected by undergraduates is easily incorporated into ArcGIS.
- Visualization of field measurements enhances comprehension of spatial concepts.

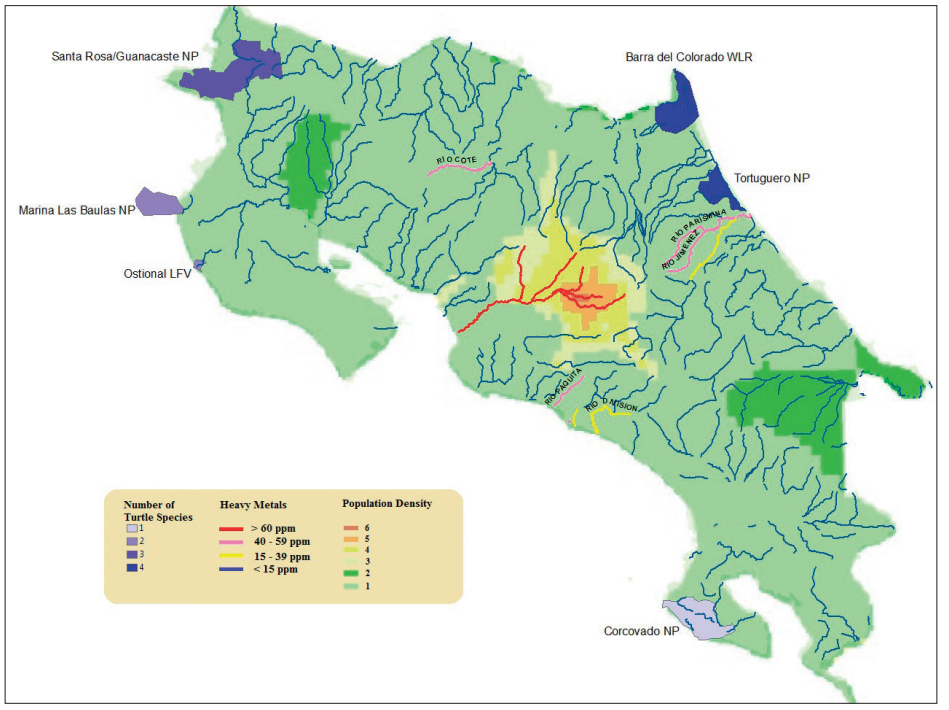
Since the 2007 publication of an Indiana University study on the value of engaged student learning, institutions of higher education throughout the world have increased their focus on what are now referred to as high-impact learning experiences. Dr. George Kuh, the study's principal author, defines high-impact learning as instructional practices that measurably increase student retention and engagement. Such experiences can range from internships or mentoring interactions to hands-on laboratory or fieldwork. Kuh offers 10 specific types of high-impact learning available to educators. These include collaborative projects, undergraduate research, common intellectual experiences, and community-based learning. Regardless of their exact structure, the evidence is clear that high-impact opportunities enhance both early comprehension and durable knowledge in students. Kuh says:

> "The results clearly show that colleges and universities should do everything possible to encourage undergraduates to participate in at least two high-impact activities, one in the first year and one later in their studies. Such experiences will better prepare students for a productive, satisfying lifetime of continuous learning."

With the emphasis now placed on high-impact practices, professors face a sometimes daunting task of developing and offering engaging, impactful learning experiences for their undergraduate students. GIS can serve as an excellent tool to enhance such lessons and complement high-impact experiences in a variety of fields and disciplines.

A recent summer research project offered an opportunity to couple high-impact learning practices with ArcGIS through an Esri educational teaching and research lab kit. One professor and two undergraduate students at Washington & Jefferson (W&J) College, a small, private, four-year school just south of Pittsburgh, Pennsylvania, were afforded the chance to travel to the country of Costa Rica, where they participated in a water quality and contamination research study. Together with their faculty mentor, the students traveled to various regions of Costa Rica to sample river water downstream from population centers and industrial activity. Water samples were collected at numerous river sites and tested for mercury and other contaminant metals, as well as petrochemicals, that could be washed into river systems as a result of urban residential, manufacturing, or commercial agricultural activity.

This project alone was a high-impact experience for the two students who were fortunate enough to participate in the field; however, once back on campus, the data collected and the field experience design have resulted in opportunities for numerous additional students, as well. ArcGIS has played a central role in enriching learning for students. Through the use of joins and relates in the software, students have been able to integrate the field data collected in Costa Rica into existing GIS data in a lab setting to explore spatial relationships. For example, they can investigate the relationship between the prevalence of various river contaminants and their proximity and impact to such areas as sea turtle nesting grounds. In turn, students are able to use GIS to model and analyze upstream zoning, environmental mitigation, and compliance enforcement efforts as they relate to contaminated rivers. This hands-on approach, using authentic data, has markedly improved students' comprehension and retention of spatial skills and competencies.



Using ArcGIS for Desktop in the lab, authentic Costa Rica field data was joined with existing GIS layers. Rio Parismina and Rio Jimenez (labeled) do not flow from heavily populated areas yet show elevated levels of heavy metals. These rivers flow toward a nesting area for multiple sea turtle species.

Water Quality Closer to Home

Further, the use of authentic field experiences and ArcGIS analysis has been successfully replicated in less expensive and less travel-intensive ways closer to home. Southwestern Pennsylvania, where W&J College is situated, is the current heart of Marcellus shale natural gas exploration and development. Hydraulic fracturing, or "fracking," as it has come to be known, is a primary process used in the extraction of shale gas—a process that yields thousands of gallons of contaminated water each day at sites throughout the Marcellus formation region. Much of this water finds its way into natural waterways in the college's immediate vicinity. Students are now able to learn about, research, analyze, and report on issues in the area they call home, adding a sense of personalization and urgency to their college experience. Some of these students come from families that earn their livelihood in the natural gas industry, so an inherent opposition to gas drilling is not prevalent, especially prior to lab exercises. As students have collected and analyzed water quality data, an appreciation for the impacts of fossil fuel exploitation has been observed, opening the door for meaningful and informed conversations about meeting the world's energy demands while caring for an increasingly taxed planet.

Through high-impact learning experiences such as these, a generation of college graduates armed with an understanding of competing forces and the ability to use tools such as ArcGIS to make informed decisions is what is needed to strike the delicate balance required for future energy and environmental stability.

About the Author

Dr. Matthew North is an associate professor of information technology leadership and an affiliated faculty member with the Environmental Studies Program at Washington & Jefferson College in Washington, Pennsylvania. He has published works on GPS and GIS technologies and is the author of *Life Lessons & Leadership*, Agami Press, 2011.

For more information, contact Matt North (e-mail: mnorth@washjeff.edu). The author offers sincere thanks to Dr. Robert Hijmans of the University of California, Davis, for the use of GIS data from the DIVA-GIS project (www.diva-gis.org).

Drawing a Line Through the North Woods and Waters

Maintaining Boundaries and Managing Shared Resources Along the Canada-United States Border

Highlights

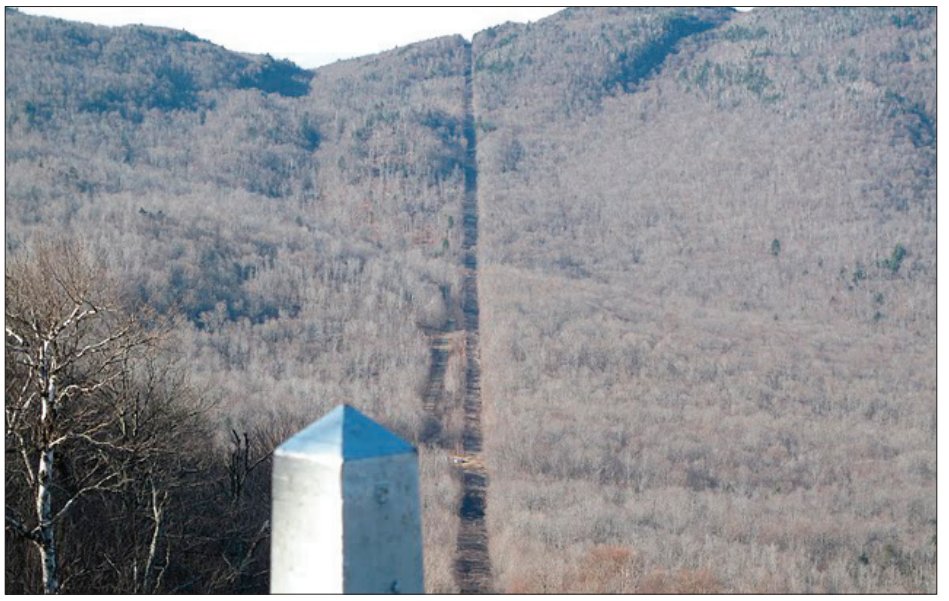
- ArcGIS integrates imagery from both countries, resulting in full coverage for the entire boundary.
- The GIS includes several custom forms and toolbars to assist field-workers.
- GIS is a common language and a shared framework for interpretation, regardless of national sovereignty or borders.

The Canada-United States boundary represents more than 100 years of collaboration to maintain the longest shared border in the world, from the Atlantic to the Pacific to the Arctic. Since 1908, both countries have appointed an expert geographer or surveyor to lead the International Boundary Commission (IBC) in maintaining an accurate boundary, consisting of a 20-foot cleared vista marked by more than 8,000 monuments.

"The average citizen would be pretty amazed to learn that there's actually a lot of work that goes into maintaining a boundary," says J. T. Moore, lead engineering technician for the US section of IBC. "When most people think of the US-Canada border, they say, 'If you know where the line is, why do you have to go out there and take care of it?'"

As defined in the treaty that established IBC, Canada and the United States are mandated to maintain an effective boundary to ensure safety and security and prevent local misunderstandings while being open to tourism and trade. IBC says this effort is as essential today as it has been throughout history for effective law enforcement, land administration, customs and immigration, and the management of transboundary resources.

To maintain the boundary, IBC field party chiefs work with seasonal field crews, which may consist of woodsmen, machine operators, and masons, as required to keep the vistas open and the boundary monuments in good condition. Some of the original monuments were made of separate pieces so workers could transport them to remote locations by foot, mule, or horse. Today, remote border points are marked with stainless steel monuments installed via ATVs, canoes, and occasionally helicopters.



The Canada-United States boundary represents over 100 years of IBC collaboration and consists of a 20-foot cleared vista marked by more than 8,000 monuments.

The work often involves camping out for extended periods and spending weeks at a time on boats to maintain reference markers. Water boundaries are marked when possible, but in most areas, such as the Great Lakes, freezing conditions make it impossible.

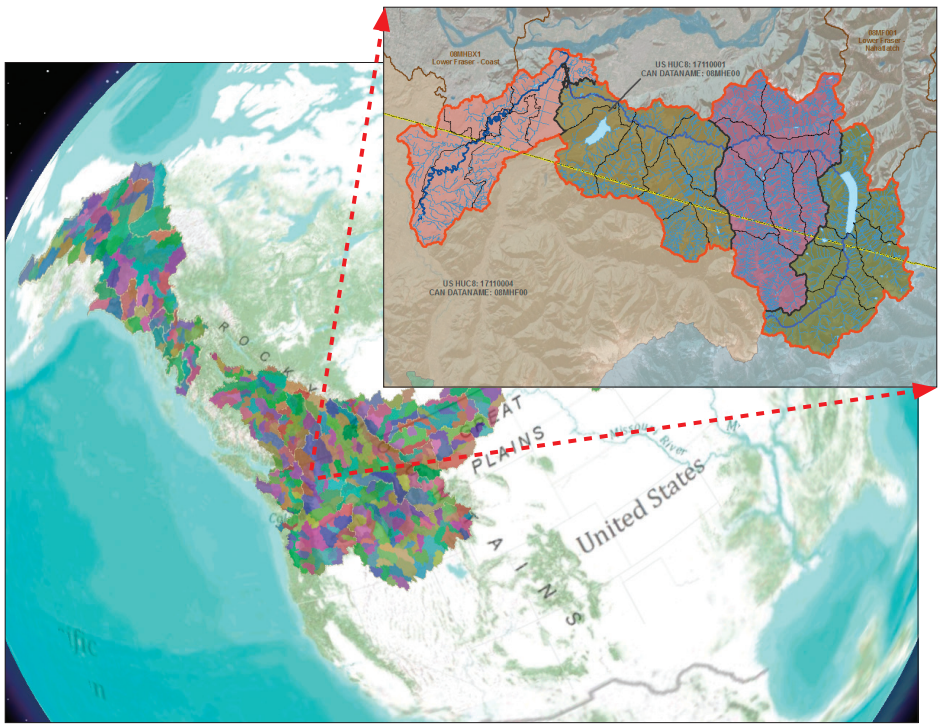
Unlike the US-Mexico boundary, the US-Canada border is never determined by geographic features such as bodies of water. Land boundaries have specific coordinates, and water boundaries are defined by a series of straight lines and turning points set in reference to monuments on the shores. Over the last 100 years, some rivers and streams along the boundary have shifted due to both natural and human forces, such as alterations made by loggers to better transport lumber. For example, the boundary that once followed the course of Halls Stream between Quebec and New Hampshire remains fixed, but because its course has shifted gradually, IBC now maintains a cleared vista with monuments in some areas near the stream.

In 2007, the Canadian section of IBC took the lead in creating a GIS using ArcGIS for Server, working closely with Esri to build a geodatabase that will work for both countries. The project involves compiling thousands of coordinate values, paper maps, and surveyors' field notes into a manageable, searchable, shareable system.

Using the new GIS, IBC is increasing accuracy and efficiency in many areas, from calculating vegetation growth to determine optimal maintenance cycles to having quick access to landownership records so staff can inform residents of surveys and monument maintenance. The GIS includes several custom forms and toolbars developed with Esri Canada Limited that enable field-workers to report survey data, work completed, photos, and other information related to their visit to a boundary point. It also leverages the ArcGIS 10 for Server Image extension to compile data supplied by agencies in both countries, resulting in full imagery coverage for the entire boundary.

"Our imagery is high resolution, so we can see how things are growing, how things are changing, and what's exactly on the vista in certain areas," says Moore.

Considering the legal and safety issues involved where boundaries meet, IBC has an ongoing relationship with the US Border Patrol and the Royal Canadian Mounted Police. With the boundary data in a GIS, IBC will be able to provide government officials with more accurate data that they



Bridging the gap—Example of harmonized hydrographic data between Canada and the United States compiled by the International Joint Commission.

can apply in their own systems to better track and manage incidents and take informed precautionary measures.

"The maps you see from organizations like the US Geological Survey or Natural Resources Canada will stop at the US-Canada border," says Moore. "We are mapping both sides of the boundary, and because IBC is the only agency that provides official maps of the boundary, this has a big implication for law enforcement on both sides."

Water Knows No Boundaries

Roughly 40 percent of the US-Canada border is covered in water, making the impact of either country's environmental policies inescapably intertwined. Under the Boundary Waters Treaty of 1909, the United States and Canada established the International Joint Commission (IJC) to help prevent and resolve disputes about the use and quality of boundary waters and to advise both countries on water resources. IJC's many boards and study groups bring together stakeholders at the local level in an effort to examine and resolve problems before they become national or international issues. Along the Red River, for example, representatives from Minnesota, North Dakota, and Manitoba serve on the International Red River Board of Control to ensure communication regarding anything that involves this sensitive water system.

In recent years, government organizations and conservation groups from both countries have advocated an even more holistic international approach to managing and protecting the vast watersheds they share. As an important step toward a more collaborative conservation effort, the United States and Canada are in the process of harmonizing and evaluating boundary water data. Beyond tracking the location of the international boundary, which is provided by IBC, this project involves sharing hydrographic datasets essential to managing and modeling future impacts to these water resources. It is being undertaken by a transboundary hydrographic data harmonization task force headed by IJC and composed of representatives from Environment Canada, Agriculture and Agri-Food Canada, Natural Resources Canada, the US Geological Survey, and the US Environmental Protection Agency. The harmonization process is being carried out by GIS professionals at a US Geological Survey office in Salt Lake City, Utah, and an Agriculture and Agri-Food Canada office in Winnipeg, Manitoba.

Says Michael Laitta, GIS coordinator for IJC, "This was the first time that an outside organization such as the IJC was able to bring the pertinent technical and administrative people to the table to address these data disconnects that these stewarding agencies really didn't have the mandate to address. The IJC is acting like a bridge. We're enabling agencies to have a constructive discourse and interpretive interactions with their sister organizations. The task force enables us to work at the federal level. Everyone involved is changing their data based on our recommendations to reflect what is really happening on the landscape between US and Canada."

While both nations had already made concerted efforts to compile accurate data as new technologies were introduced, there were many discrepancies, and each had developed different standards. From Maine and New Brunswick to Yukon and Alaska, there were substantial differences in drainage density, toponomy, and even the names of bodies of water.

"By harmonizing our data, we're removing administrative brick walls," says Laitta. "We can provide state, provincial, and local governments, as well as our IJC boards, with a fundamental geospatial structure upon which to hang all sorts of water quantity models, water quality models, ecosystem evaluations—you name it. Most importantly, we're using GIS as a fundamental common language and a shared framework for interpretation, regardless of national sovereignty or borders. Esri tools have enabled us to do that. The questions governments ask are inherently geospatial. They are associated with an area, not a point."

As geospatial technology is becoming more prevalent and accessible, IJC is leveraging ArcGIS to offer a collection of international datasets online, giving local governments and the public access to detailed, authoritative information about a variety of factors along the boundary waters. Thanks to this binational, multiagency collaboration, data users in Canada and the US can now access elements of these harmonized datasets through the USGS *National Map* (**nationalmap.gov**) and the Canadian GeoBase (**www.geobase.ca/geobase/en/index.html**). The ability to provide seamless, binational data at such a meaningful scale is unprecedented and marks a major milestone in 60 years of data development by the US and Canada.

For more information, contact J. T. Moore, lead survey engineering technician, US section of the International Boundary Commission (e-mail: moorej@ibcusca.org); visit **www.internationalboundarycommission.org**; contact Michael T. Laitta, physical science adviser/binational GIS coordinator, International Joint Commission of Canada and the US (e-mail: laittam@washington.ijc.org); or visit **www.ijc.org**.

From Costa Rica to Korea

Highlights from Esri's 2011 Regional User Conferences

It was a busy season for Esri regional user conferences (UCs). This year, all four regional UCs were held within eight weeks of one another.

Each of these regional UCs provided an opportunity for users in a particular corner of the world to learn about the latest updates, share ideas and best practices, and network with other users in their position or industry.

"We appreciate seeing each and every one of our users at their regional conferences," says Esri president and cofounder Jack Dangermond. "These conferences are a great complement to the Esri International User Conference each year. Many of the new concepts presented in San Diego are practically applied in a smaller setting at these regional UCs. I enjoy meeting familiar and new faces each fall at the conferences."

2011 Esri Latin America User Conference

The 2011 Esri Latin America User Conference (LAUC) was held September 28–30 in San Jose, Costa Rica, a country known for its pursuit of sustainable development of, respect for, and preservation of the environment. Hosted by Geotecnologías S.A., Esri's international distributor in Costa Rica, this conference provided many opportunities for the more than 550 attendees from 19 Latin American countries to learn about GIS alongside their peers and industry leaders.

The central theme was "Geomatics Applied to a Green World," which led to the presentation of more than 40 papers in many subjects that approached the issues of mapping, disaster prevention and mitigation, surveying, sustainable forestry, mining, and urban planning, among others, throughout Latin America.

The Latin American Award for Excellence in GIS was awarded to six different organizations from the region. Instituto Costarricense de Electricidad (Costa Rica) received the award for implementing a multiuser GIS that operates at a national level. Additional recipients included Agip Oil Ecuador (Ecuador), Departamento de Indicadores (Panama), Instituto Geográfico Militar (Chile), PERU LNG SRL (Peru), and Transmilenio S.A. (Colombia).

The conference also showcased the work of a young student, Maria Paula, who gave a presentation on how ArcGIS is used to analyze solutions to mitigate waste, preserve the environment, and improve the quality of life of the Osa Peninsula in southern Costa Rica.

"The recent LAUC was a resounding success if judged by the large number of participants and the high quality of presentations by users," says Merrill Lyew, international regional manager, Latin America. "The variety of workshops, seminars, and minitheater technical conference sessions before and during the conference was impressive, as was attendance at the meetings, which were always at capacity."

Further post-LAUC information can be found at **geotecnologias.com/lauc2011**. Save the date for the 2012 LAUC, to be held October 31–November 1 in Buenos Aires, Argentina.

2011 Esri European User Conference

More than 3,000 attendees from 60 countries around the world, including at least 33 European nations, saw each other in Madrid, Spain, as Esri España, Esri's international distributor in Spain, hosted the 2011 European User Conference (EUC) October 26–28. This was the largest-attended Esri regional UC in history. Attendees were treated to a wealth of information, as well as unique opportunities to sample Spanish culture.

"It was an honor for Esri España to host the greatest GIS event in Europe," says Alfonso Rubio, managing director of the distributor. "More than 3,000 GIS specialists from many different European countries shared their experiences to improve skills and the art of geographic knowledge. Esri España thanks all who attended."

Special preconference seminars brought developers from Esri to collaborate with users on how to build applications with ArcGIS Runtime, work with Esri CityEngine, give professors a way to leverage web GIS, and more.

More than 120 papers, representing users and partners from 18 different industries, were presented at the EUC. There were also more than 30 companies exhibiting, including platinum sponsors HP, IBM, and Microsoft.

Entrepreneurs aiming to enhance their projects and ideas with GIS were treated to a special track during the technical workshops to learn how their businesses can benefit from using ArcGIS.

Esri's Jack Dangermond and Andres Muñoz present a demo at the European User Conference in Madrid.

Attendees enjoyed a special gala celebrating 20 years of Esri España at the historic Palacio del Negralejo. The Fiesta del GIS treated guests to a traditional Spanish feast fit for a king and included music and flamenco dancing.

Conference proceedings are available by visiting **esri.com/euc**. The 2012 Esri European User Conference will be held October 15–17 at Oslo Kongressenter in Oslo, Norway.

2011 Esri Middle East and Africa User Conference

This year's Esri Middle East and Africa User Conference (MEAUC), held in Beirut, Lebanon, and hosted by Esri international distributor Esri Lebanon sal, attracted more than 500 GIS professionals from 21 countries in the Middle East, Africa, Europe, and Asia to connect, collaborate on, and create solutions in the GIS space.

Two industry-intensive tracks—one in defense and one in utilities—were offered for attendees to enrich their GIS experience and understand GIS trends in their specific industries.

"This regional event for users of Esri technology facilitated the coming together of GIS users, developers, hardware vendors, and solution providers from across the region to listen to and exchange ideas, knowledge, and experiences," says Philip Burden, CEO of Esri Lebanon. "On behalf of Esri Lebanon, I'd like to send a thank-you to all the attendees at the 2011 MEAUC in Beirut."

Several awards were given out over the course of the events, including awards to each of the paper presenters. In addition, Best Map in the Map Gallery was awarded to the Lebanese Army (Lebanon), and the Top Paper Award went to Dr. Chadi Abdallah, researcher at National Council of Remote Sensing, Lebanon.

"I want to congratulate the Esri Lebanon team on this successful event. It was well organized and managed, and I was impressed by many ideas in it," says Zeina Bathich from the Chamber of Commerce, Industry and Agriculture in Saida and South Lebanon.

The exhibition also attracted attendees to the booths of 33 exhibitors from around the globe.

For more postconference information, visit **esri.com/meauc**. The 2012 Esri Middle East and Africa User Conference will be held in the United Arab Emirates; the date and venue are to be determined. Visit the Esri Events (**esri.com/events**) page for the most updated information.

Seventh Annual Esri Asia Pacific User Conference

The Seventh Annual Esri Asia Pacific User Conference (APUC) was held November 15–16, 2011, in Seoul, Korea. Hosted by Esri Korea, Inc., Esri's international distributor in that country, the APUC welcomed more than 1,500 attendees from 19 countries around the world.

With content focused on cloud computing, sessions at the APUC engaged users and brought their GIS thinking into the cloud.

"We were very excited about the high level of enthusiasm showed by the participants—such active participation and growing interest in GIS," says Jay Yoon, president of Esri Korea. "The seventh Asia Pacific User Conference offered a great opportunity for attendees across the Asia-Pacific region to extend their networks and learn how others are using location intelligence in innovative ways."

The Special Achievement in GIS Award was given to two organizations—Gwangju City for its City GIS project, which improves administration and citizen engagement within the city, and the Korea Rural Community Corporation for the Rural Agricultural Water Resource Information System, which provides professional management of water resources.

Wan-young Song, manager of Daewon Aerial Survey, says, "I'd been looking forward to attending the conference. It's wonderful that Asia-Pacific distributors and international users come together and network and share their visions and ideas [in Seoul]. It was impressive to hear Jack's presentation in person, as well as presentations from Esri's technical staff. I also participated in the Map Gallery and took first place. So honorable!"

Proceedings will be available mid-December to early January by visiting **esri.com/apue**. As of this printing, the date and location of the 2012 APUC have not yet been determined. Visit the Esri Events (**esri.com/events**) page for the most up-to-date information.

Users enjoy the Plenary Session at the Latin America User Conference.

Keep Up with the Next Generation of GIS at the Esri User Conference

Think you can skip 2012's Esri International User Conference (Esri UC)? Think again. As geospatial technology rapidly becomes more powerful and accessible, your organization can't afford not to stay up to speed.

Whether you're a GIS professional, IT leader, or executive, the Esri UC reveals the new and innovative ways Esri technology is helping people solve problems in every industry and in every corner of the world. Beyond extending your GIS to bring efficiency to new areas within your organization, it's easier than ever to bring your geospatial data online and offer powerful ways to view and analyze it in the cloud.

At the opening Plenary Session, you'll get an overview of what's new in ArcGIS 10.1. This release will significantly advance the basic platform, thanks in large part to suggestions from users themselves. One of the most important aspects of this release is that users will be able to deliver any GIS resource—such as maps, imagery, geodatabases, and tools—as a web service. It will be easier than ever to expand access to your authoritative maps and geospatial information.

Technical sessions are offered for every experience level, whether you need to master the latest capabilities or develop basic ArcGIS skills. To get a crash course on specific topics before the Esri UC, arrive a few days early to take advantage of in-depth preconference seminars in a variety of key areas, such as implementing an enterprise GIS and developing web and mobile applications.

As always, the Esri UC also provides you with many opportunities to find solutions to your specific challenges and meet people with valuable practical insights:

- **The Esri Technical Support Island** offers one-on-one assistance with your ArcGIS concerns. Bring your data to get hands-on help right at the conference.
- **The GIS Solutions EXPO** connects you with those offering products and services that can take your work to the next level.
- **Esri Industry Islands and Showcases** provide access to Esri experts and GIS users from your field and information related to your specialized needs.
- **Special interest group meetings** put you in touch with other GIS professionals from your region or area of expertise.

With so many recent advancements in geospatial technology, the Esri UC is a must-attend event for those who want to maximize their GIS investment. It's the one-stop resource for gaining the skills, contacts, and inspiration that will help you make the most of GIS in the coming year.

Learn more and register at esri.com/uc.

The Esri International User Conference in San Diego, California, attracts thousands.

The Horn of Africa Drought Crisis *Map Includes On-Site News and Images*

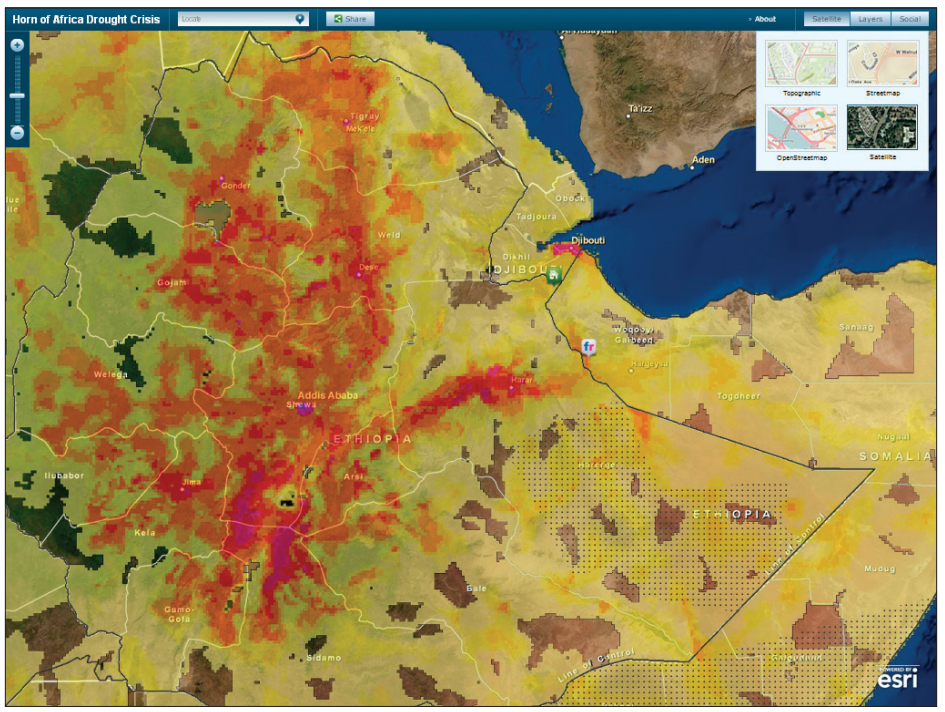
Drought Map Tells a Tale of African Famine

Drought is severely affecting crops, grazing land, and the livelihood of 12 million people living in east Africa. The *Horn of Africa Drought Crisis* map created by Esri tells a story of famine, conflict, and humanitarian aid. People have left their towns and villages to seek food, water, and medicine provided by nongovernmental organizations (NGO). The map's purpose is to raise people's awareness of these famine refugees and the organizations that serve them.

The *Horn of Africa Drought Crisis* map is a web application built using ArcGIS API for JavaScript and powered by ArcGIS for Server hosted in the Amazon cloud. Esri cartographers purposely kept the map very simple, focusing on famine in three countries—Ethiopia, Kenya, and Somalia. The map is not designed as an authoritative resource; rather, it is meant to make the crisis personal to its readers.

The map's operational layers include refugee camp locations and conflict area data provided by Famine Early Warning System (FEWS) as points and population density for Africa in 2000 provided by the United Nations Environment Programme as polygons. A layer of crowdsourced data from the NGO Bettermap project (bettermap.org), as well as social media input from YouTube, Twitter, and Flickr, provide camp descriptions and video, commentary, and photos directly from these locations.

The 2011 drought has caused a dramatic surge in the camps' populations. The operation layer provides static, decade-old population counts, while data in the social layer provides real-time information that confirms human migration. The refugee complex in Dadaab in Kenya's North Eastern Province has three camps that were built for a capacity of about 90,000 people. The operational layer reveals that the population of the area surrounding the complex in 2000 was about 40,000 people, which is dense, on a scale where a population of more than 50,000 people is rated overly crowded. The social data layer shows that in July 2011, the refugee camp reported a population of 525,674 people. Readers can readily infer the enormity of human migration and the strain on refugee services.



Horn of Africa drought symbolized in red also indicates areas where famine is widespread.

Map details become more poignant to readers as they click icons to see pictures and videos of afflicted areas. By clicking a YouTube icon near Dadaab, one can listen to a story about the refugee complex told by Father Orobator, a priest working for Jesuit Refugee Service, and see photos of the camp. The video shows the camp's distribution center filled with sacks of flour and a woman walking from it with two sacks balanced on her head. Photos of grossly underweight children arriving at the center, as well as photos of children being taught in a refugee school, show the need and the mission of the camp. These postings change regularly to stay current.

Clicking a black globe icon on the map opens a text box that describes the area, the need, who is afflicted and how, and which NGO is providing support to that area. One can also see that areas designated "conflict/at risk" have few human relief services, implying the massive movement across borders toward areas where relief is offered.

Esri mapmakers worked with Esri Eastern Africa Ltd., Esri's distributor in Nairobi, as well as with FEWS. The Bettermap project is built on the Ushahidi platform that allows media mapmakers to gather and distribute data via short message service, e-mail, and the web and put it on a map or timeline. Esri has published a host of other media maps for important events, such as the unrest in Libya, floods caused by Hurricane Irene, and the Gulf of Mexico oil spill. People such as journalists can configure the basemap, layer visibility, and map extent; create social media settings; and then share their configured maps to tell their own stories about an event.

Esri's cloud service ArcGIS.com provides a virtual space for the map group Horn of Africa Drought/Famine Crisis Response to share data layers for this map that users can consume. These group members have created other maps for famine projection and agriculture land status.

See the *Horn of Africa Drought Crisis* map at esri.com/news/maps/2011/horn-of-africa-drought-crisis-map.

GIS Day 2011 Celebrates in Style!

Organizations all over the world united on November 16 in a celebration of geospatial intelligence. Since 1987, GIS Day has been celebrated on Wednesday of Geography Awareness Week. Over 80 countries participated in 2011's GIS Day celebrations, spreading the wealth of spatial thinking to communities around the globe.

The dynamic nature of GIS makes each year's GIS Day an exciting opportunity for organizations to share their challenges and successes from the year and catch up on innovative new applications. Events celebrate the many uses of GIS; from emergency management to facility management and mining to forestry, the diverse array of GIS applications makes this occasion a perfect chance for interdisciplinary communication and holistic advancement of technological aptitude. In addition to encouraging conversation across disciplines, GIS Day helps introduce the many uses of GIS to new markets.

US Bureau of Land Management

This year, the Bureau of Land Management (BLM) Butte Field Office held its inaugural celebration of GIS Day by inviting junior high- and high school-aged students from Acadia, Montana, to learn about careers in GIS and the natural resource community. The Butte Field Office manages over 300,000 acres, with GIS playing an integral role in overseeing everything from forestry to cultural paleontology. For its first GIS Day celebration, the Butte Field Office adopted an educational approach focused on inciting youth interest in GIS technology. Volunteers from BLM treated students to a short presentation on how the Butte Field Office uses GIS for natural resource management and analysis and educated them on the benefits of pursuing a career in GIS. Students were encouraged to participate in a free-form ArcGIS workshop and had the opportunity to work with ArcPad on GPS units.

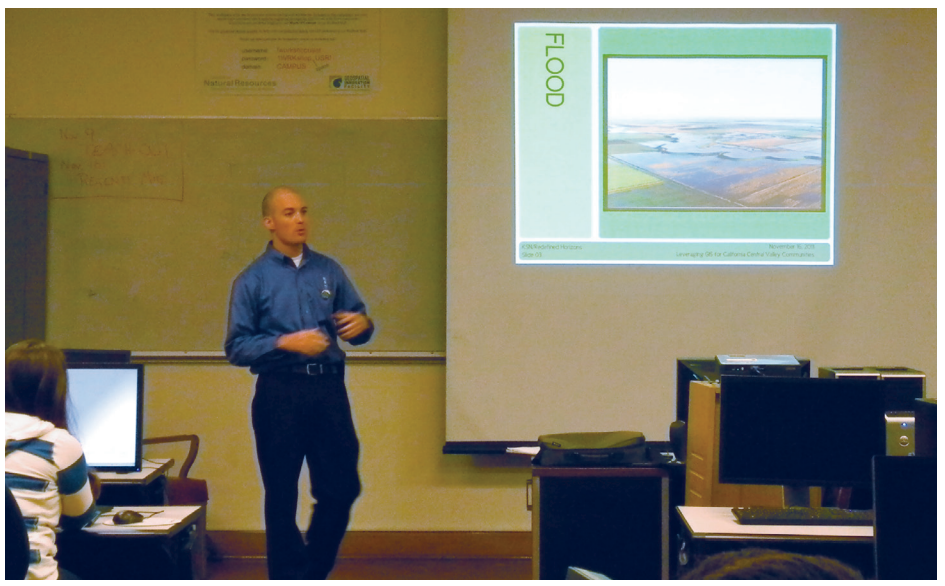
"Allowing students to jump right into ArcGIS has proved very educational for them," says Bradlee Matthews, GIS specialist for the Butte Field Office. "Their creativity really shines."

Republic of Panama

In the Republic of Panama, Geoinfo celebrated GIS Day with a series of activities held at the Ciudad del Saber Convention Center with more than 450 attendees. Participants included government agencies—the National Authority for Government Innovation and the Panama Canal—as well as private corporations and educational institutions. The day started with guest speakers covering advances and technological innovations in the GIS industry. Other important topics of discussion included the upcoming Metro transportation system in Panama, the 311 line for government innovation, and Esri tools available to users. In the afternoon, a series of nine tracks were presented covering a variety of topics, from A Basic Understanding of GIS and Its Technologies to more specific topics, such as GIS Implementations in the Panama Canal. Presentations were followed by a Map Gallery contest, with winners selected by public vote and GIS expertise. The event concluded with traditional Panamanian dances, and a closing speech from the company's president, Alan Richard Winstead.

Pinal County, Arizona, students learn about the use of GIS during emergencies.

The Republic of Panama celebrates GIS Day.



GIS Day at the University of California, Berkeley.

University of California, Berkeley

In the Golden State, the University of California, Berkeley's (UC Berkeley) Geospatial Innovation Facility partnered with the Bay Area Automated Mapping Association to host a free conference event for local GIS users and anyone interested in learning more about GIS. Held at UC Berkeley's Mulfort Hall, the conference featured presentations and posters from students and professionals and provided an opportunity for discussion and networking for participants. In addition to the informative aspects of the conference, attendees had a chance to work through an exercise using GIS. The event was also supported by the Northern California Region of the American Society for Photogrammetry and Remote Sensing. All the organizations involved are passionate about promoting GIS as a tool for solving real-world problems and enhancing research.

Belize City, Belize

Total Business Solutions Ltd. (TBSL), Esri's distributor in Belize, hosted its first GIS Day Expo. Consistent with the theme "Discovering the World Through GIS," TBSL, in collaboration with Belize Telemedia Ltd. and Belize Tourism Board, focused on educating students and adults on the important role GIS plays in their daily lives. The GIS Day Expo began with an official opening ceremony for various guests, from distinguished members of the business sector to eager and bright-eyed primary and secondary school students. Speakers discussed how to interpret and analyze information in a new and dynamic way. Loretta Garcia-Palacio, managing director, TBSL, welcomed the students and invited guests and gave a brief overview of TBSL's initiatives aimed at promoting the use of GIS in Belize. "It is important to introduce our students to this type of technology at a very young age," says Garcia-Palacio. "GIS is a new way of spatial literacy for Belize. The world is going through a geospatial revolution—everybody is now pointing to a map. And we don't want our students to be left behind."

Pinal County, Arizona

In Pinal County, Arizona, government employees visited Florence K–8 School to educate over 250 students about the use of GIS for emergencies. Now in its fourth year of celebrating, Pinal County puts on GIS Day events that spark growing community interest and expand public participation. County workers introduced students to the Public GIS website and provided tutorials on tools and functions for querying information. This year's event also featured a county Command and Communication vehicle and the Pinal County Sheriff's cruiser to ignite students' imaginations and demonstrate the functionality of GIS in vehicles. Additionally, the town of Florence demonstrated the maintenance of utility data and emergency hydrant locations using GPS and mapping with GIS software. There was also an open house and a map gallery containing aerial photographs of local historical features and state geography.

If your organization is interested in planning an event for GIS Day 2012 (November 14), make sure to check out Esri's generous resources and support. With helpful sample agendas and presentations, white papers, and details about previously held events, Esri can help you take your event to the next level. Esri also offers promotional materials to get the word out about your celebration. With e-mail signatures and postcards, as well as a variety of printable flyers, invitations, and posters, it's easy to ensure that your event is well publicized. In addition to assisting with the planning and promotion of your event, Esri also offers a wide variety of GIS Day paraphernalia to make your event memorable. See **gisday.com/support** for more details.

Subscribe to Esri Publications

To **subscribe** to Esri publications, visit **esri.com/subscribe**.
To **unsubscribe** from Esri publications, visit **esri.com/unsubscribe**.
Requests for back issues, missed issues, and other circulation services may also be sent via requests@esri.com; 909-793-2853, extension 1-2778; or faxed to 909-798-0560.
To **update your mailing address**, visit **esri.com/coa** or use any of these e-mail, phone, or fax options.
Outside the United States, contact your international distributor to subscribe, unsubscribe, or change your address. For a directory of distributors, visit **esri.com/distributors**.

Esri Receives Jane Goodall Global Leadership Award

Esri received the 2011 Jane Goodall Global Leadership Award for Excellence in Conservation Science for its decades of work supporting conservation, sustainability, and related education. Esri president Jack Dangermond accepted the award on September 24 during the Jane Goodall Institute (JGI) program, A Conversation with Jane Goodall, held in Hollywood, California. The evening's festivities commemorated Goodall's extraordinary accomplishments over the past 51 years while honoring the work and achievements of individuals and organizations that embody the institute's mission by taking informed and compassionate action on behalf of all living things. The event marked the fifth annual presentation of the Jane Goodall Global Leadership Awards—but this year was the first time world-renowned conservationist and primatologist Goodall presented an award for excellence in conservation science.

Jack Dangermond and Jane Goodall.

"You and I are living in a world where we're going to have to move from simply conserving places to actually being proactive and creating healthy places," Dangermond said to the audience upon accepting the award from Goodall. "What has inspired me about Jane's work is that she is sensitive to not only listening in the forest but also to villagers and leaders and bringing them together to come up with future visions. I'm very committed to helping you, Jane."

The Jane Goodall Global Leadership Award for Excellence in Conservation Science recognizes companies or organizations dedicated to developing innovative research and technology to protect and restore the natural world and improve the well-being of all who live in it.

"Esri's innovative research and GIS technology for land use, sustainable development, wildlife preservation, and humanitarian relief is worthy of the highest acclaim," says Dr. Lilian Pintea, JGI's vice president of conservation science. "Building on Dr. Goodall's groundbreaking research, science is the core of JGI's work. Thanks to Esri's technical assistance and support over the years, Esri's GIS software and data have been used in numerous JGI programs."

JGI's efforts in Africa, aided by the use of GIS, include helping 21 communities better manage their land in Tanzania through participatory village land-use planning, working to expand the Tchimpounga Natural Reserve in the Republic of Congo, and developing a conservation plan in the eastern part of the Democratic Republic of the Congo to protect 35,000 chimpanzees and 4,000 Grauer guerillas. More than 5,000 nongovernmental organizations use Esri software in their work to create a more sustainable planet.

Esri's activities also include donating GIS software to conservation organizations around the world; training hundreds of conservationists to use GIS software; providing a free mapping service for data, as well as maps and applications valuable for environment, habitat, and species analysis; and hosting the Society for Conservation GIS.

Founded in 1977, JGI (**www.janegoodall.org**) continues Goodall's pioneering research on chimpanzee behavior—research that transformed scientific perceptions of the relationship between humans and animals. Today, the institute is a global leader in the effort to protect chimpanzees and their habitats. It is also widely recognized for establishing innovative community-centered conservation and development programs in Africa and Jane Goodall's Roots & Shoots, the global environmental and humanitarian youth program, which has groups in more than 120 countries.

For more information, visit **www.janegoodall.org**.

URISA's Professional Development Options

The Urban and Regional Information Systems Association (URISA) recently surveyed its chapter members to learn more about their most pressing work challenges. Not surprisingly, trying to squeeze education and professional development dollars out of already tight budgets is a serious challenge.

There is no doubt that keeping up with technical advances through training courses is vitally important. Earning certification from Esri and the GIS Certification Institute demonstrates commitment to the profession to both current and potential employers.

Also important, and often overlooked, is nontechnical education. To advance into roles with more responsibility, GIS professionals must develop management and leadership skills. URISA offers some options to consider.

Rather than sending all their staff off-site to receive training, a number of organizations make the most of their limited training budgets by licensing URISA-certified workshops for presentation at their locations. Full-day workshops on topics such as GIS program management, GIS strategic planning, addresses and IS/GIS implementation, asset management, and cartography and map design are regularly peer-reviewed and improved, while new workshops are being proposed and evaluated. The extensive workshop list and information about licensing is available online at **www.urisa.org/workshops**.

URISA Connect virtual events delve into such topics as asset management, addressing and return on investment, and GIS maturity models.

The URISA Leadership Academy (ULA) is a five-day, intensive program that teaches GIS leadership. Offered annually, the next ULA will take place in Savannah, Georgia, June 11–15, 2012. It is a unique and highly valued educational program taught by GIS leaders.

URISA's educational options are extensive and evolving. Check them out at **www.urisa.org**.

"Crossing Borders"

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

Geography Education in the United States

Governors, Secretaries of State Support AAG Resolution

Former US secretaries of state George P. Shultz, James A. Baker III, and Madeleine K. Albright have endorsed an Association of American Geographers (AAG) resolution calling on Congress to "include authorizations and appropriations for geography education consistent with other core academic subjects for K–12, as part of a reauthorized Elementary and Secondary Education Act (ESEA)." The resolution issued by the AAG also supports geography programs such as the Teaching Geography is Fundamental Act and urges the Obama administration to include geography education as part of its proposals for improving science, technology, engineering, and mathematics (STEM) education.

A bipartisan group of 12 current governors, other key individuals, and major national organizations and corporations have also signed on to the resolution. The supporting governors are Haley Barbour (R-Mississippi), Martin O'Malley (D-Maryland), Rick Scott (R-Florida), Pat Quinn (D-Illinois), Sam Brownback (R-Kansas), Mark Dayton (D-Minnesota), Mary Fallin (R-Oklahoma), Peter Shumlin (D-Vermont), Gary Herbert (R-Utah), Earl Ray Tomblin (D-West Virginia), Paul LePage (R-Maine), and Lincoln Chafee (I-Rhode Island).

In endorsing the document, Secretary Baker stated, "During my time as secretary of state, I witnessed firsthand how important it was that Americans understood geography and the world around them. Since then, as countries have become even more interconnected, that need has grown. As a result, I support the efforts by the AAG to promote geography education in our schools, and I encourage the White House and Congress to do the same."

Secretary Albright asserted, "Geography played a leading role in nearly every policy decision I was involved in as secretary of state. Young Americans with an understanding of peoples, places, and cultures have a clear advantage in today's rapidly changing global economy, and I am encouraged that the AAG is working with Congress and the administration to build support for geography education at the K–12 level."

We at the AAG are delighted to have the support of so many influential national leaders and organizations as we champion greater federal funding for and attention to geography education. Geography is the only one of the 10 core academic subjects identified in the ESEA that does not have a specific funding authorization in the national program designed to support its teaching. As Congress works on reauthorizing the ESEA, this oversight must be addressed.

Other endorsers of the AAG resolution on geography education include the National Association of State Boards of Education; the American Geological Institute; former United Nations ambassador and governor Bill Richardson; the National Council for Science and the Environment; the US Green Building Council; and numerous geography-related organizations, including NCGE, Esri, NGS, the Coalition of Geospatial Organizations, URISA, GITA, AGS, and GISCI.

We urge the Esri user community members to express their own views regarding the need for geography education to their congressional representatives, both at home in their districts and in Washington, D.C. The ESEA is currently being considered by key congressional committees *(see the URL below for more information)*. If you wish to contact your local media regarding the need for geography education, a press release regarding the recent major endorsements of the AAG resolution is available for downloading from the AAG website. The AAG Resolution Supporting K–12 Geography Education, with a full list of endorsing organizations and individuals, is available at **www.aag.org/AAGEducationResolution**.

Doug Richardson and John Wertman
drichardson@aag.org

NATIONAL GEOGRAPHIC™

"Geo Learning"

A column by Daniel C. Edelson,
Vice President for Education, National Geographic Society

A Role for Old-Fashioned *Geographia* in Education

The word *geography* comes from the Greek *geographia*, which means "writing or describing the world." I frequently hear people say that the word *geography* is outdated because modern geography is about much more than just describing the world.

I tend to be sympathetic to that view because I believe that the power of modern geography is in its approaches to solving problems and answering questions. However, I think that describing the world is an essential component of geography, and it should have a central part in geography education.

Young people learning to notice patterns in nature.

I have been thinking about this a lot lately because I have been thinking about the challenges of teaching young people about human impacts on the environment. I have become convinced that the biggest challenge in teaching about the environment is students' lack of familiarity with their environment. How do you teach children about changes to the environment if they do not know what the environment is currently like?

But how, you might ask, is it possible to not be familiar with one's environment? In the modern world, there are two ways in which children are unfamiliar with their environment.

First, the environment they live in is increasingly circumscribed. Middle-class youth in our society live largely in enclosed, interior spaces. When they need to travel through external spaces, they tend to do so in enclosed vehicles that are piloted by an adult. Today's typical K–12 students go to school in a car or bus that picks them up very close to their homes and delivers them to the front door of their schools. They typically spend their afternoons in their school or another building, which they are transported to, again, in a bus or a car, until they return home by the same modes of transportation.

Second, they have little opportunity or motivation to notice their environments. They are isolated from the external environment by various forms of cocoon, and they are not responsible for navigating by themselves, protecting themselves, or caring for any aspect of the environment.

I do not want to romanticize the past, but I do want to point out that only two generations ago, most Americans still depended directly on their environment for their livelihood and were not isolated from the external world by fully climate-controlled, protective buildings and vehicles. I also cannot ignore the fact that most people on earth still live that way.

Middle-class American children no longer have much need to be aware of their environment. They are isolated and protected from it, particularly during the part of the day set aside for education.

The result is that we have created an excellent environment for young people to learn math, language arts, and abstract science and social studies, but we have created a terrible environment for young people to learn about their world. I worry about my own middle school daughter, who is studying earth science right now in a classroom that seals her off from any direct interaction with the natural processes that she is studying.

Worrying about how to teach children about a world from which they are so isolated eventually led me back to the original concept of *geographia*. Before students can understand the world, they need to observe it. To observe it, they need to experience it, of course, but they also need to notice it. It's not just about looking; it's about seeing. And teachers have known forever that the best way to get students to be good observers is to engage them in documentation and description.

At National Geographic, we have begun exploring ways to turn students into old-fashioned geographers—in other words, describers of their world. One of the strategies we have been using is engaging students in what different people call *citizen science*, *public participation in research*, and *volunteered geographic information* initiatives. In these projects, participants collect and share geographic information with each other and, in some cases, conduct investigations or solve problems with the information. At National Geographic, we've adopted our own term for these projects. We call them *community geography* projects, and with support from the National Science Foundation and Esri, we're developing a web-based GIS and social networking platform to support community geography initiatives.

I like to use Project BudBurst as an example of how these projects foster noticing. Project BudBurst is an educational outreach initiative of the National Ecological Observatory Network that focuses on phenology (seasonal changes) in plants. The concept behind BudBurst is very simple. You pick a specific tree or shrub and monitor it throughout the year, recording your observations in a database that is shared among thousands of people monitoring other trees and shrubs throughout the United States. You note when flower and leaf buds appear and open. You also note when they fade, turn color, and fall off.

It's safe to say that virtually every student in every classroom in America knows that plants have seasonal cycles. But how many of them know the specific cycle of any specific types of plants? And how many know how these cycles change from place to place and year to year? And how many know what the natural variability of those cycles is in a specific location or a specific year?

It is only when people are familiar with these kinds of patterns and cycles that they can begin to understand what it might mean for human activities to change the environment.

So, ironically, the key to achieving the understanding and problem solving that we associate with modern geography is to start with the observation, documentation, and description that are characteristics of traditional geography.

Information about National Geographic Education's Community Geography initiative is available at **natgeoed.org/community-geography**.

Esri Partner Offerings

Esri has relationships with more than 2,000 partners globally that provide customer-focused, geoenabled solutions. These partners have extensive experience providing GIS solutions and services throughout core industries. Partner-provided solutions and services range from custom-built applications to complete ArcGIS system implementations. For a complete list and description of Esri Partners and their offerings, visit **esri.com/partners**.

Rail

Bartlett & West, Inc.
www.bartwest.com
Solution or Service: Rail GIS Services
For more than 20 years, Bartlett & West has provided services to the rail industry, specializing in GIS and technology solutions to help further the industry and its use of geospatial data. Today, with a focus on Positive Train Control and other advanced needs of geospatial data, the company is developing solutions to increase efficiency and improve decision making within operations while supporting the rail industry with its information needs. In addition to serving the rail industry, Bartlett & West provides engineering solutions to government agencies, municipalities, private industry, and individual clients.

Architecture/Engineering/Construction

Carlson Software, Inc.
www.carlsonsw.com
Carlson GIS 2012
Carlson GIS 2012 opens surveying, civil design, and land planning project information to all those who need it, connecting CAD-based designs and maps to the rest of the world via many different import/export options, as well as direct links. The newest aspect of Carlson GIS provides the tools to embed images from Esri Map Services directly within CAD files, helping users make planning and design decisions based on up-to-date information. The software gives users the ability to create a projection file (*.prj) based on their existing coordinate systems, which can then be used to correlate all their drawings with the ArcGIS system. With Carlson GIS 2012, Carlson survey and design data can be converted into a host of other formats and used outside the traditional CAD environment.

Government, Utilities, Emergency Management, Environmental

Wind Environmental Services, LLC
www.windenvironmental.com
Wind Image Extension for ArcGIS
Wind Image extension for ArcGIS is a tool for processing and importing geotagged photos into ArcGIS. Wind Image provides the most complete set of photo management tools available for ArcGIS. Once the photos are processed into the geodatabase using Wind Image, embedded photos can then be viewed natively in the full suite of ArcGIS products. Additionally, Wind Environmental is an industry leader in mobile GIS, providing training and assistance for implementing and managing field data workflows of any size, assisting clients to build a complete GIS solution every step of the way.

Land Records

Mobile311, LLC
www.mobile311.com
ConnectGIS—ArcGIS for Server Web Hosting
ConnectGIS is the easiest way for users to get GIS data online and looking great. The process is simple: Users send their data, and Mobile311 puts it online. The ConnectGIS viewer is easy to use and is a proven sixth-generation product used by municipalities throughout the United States. Included are a parcel comparable value tool; on-screen user markup; and various search, printing, and data export options. The software has been refined to be very intuitive for the non-GIS user, as well as provide powerful capabilities for GIS professionals. A self-hosted version of ConnectGIS is also available.

GIS Services

Futura Systems, Inc.
www.futuragis.com
Mapping, Staking, OMS Services
GIS from Futura Systems uses 100 percent Esri technology as its GIS platform for mapping, analyzing, and managing assets, outages, work orders, and customer information. Futura is a complete solution for cooperatives with a geodatabase. Users enter their data a single time, eliminating time-wasting redundancy and building greater accuracy throughout their operation. Futura offers multiple solutions with one database and a totally integrated GIS for staking, asset management, damage assessment truck viewer, and outage management system.

Municipalities, Counties, Public/Private Sector

Midland GIS Solutions
www.midlandgis.com
www.integritygis.com
Integrity GIS
Midland GIS Solutions has developed Integrity, an ArcGIS for Server web solution for cities, counties, government entities, and private and public organizations. Integrity lets users manage, analyze, and maintain infrastructure through a secure, user-friendly website that can be tailored to their exact specifications. By increasing operational awareness and efficiency, Integrity helps more than 20,000 monthly users save valuable time, money, and resources. With Integrity, users can update attributes and other map features directly from their websites, allowing collaboration with colleagues, field crews, and regulatory agencies. Integrity's capabilities include asset management, web-based map editing, tracking tax and sales histories, charting and reporting, sewer analysis, work scheduling, property record card creation, sign inventories, and much more.

"Managing GIS"

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

URISA
The Association For GIS Professionals
www.URISA.org

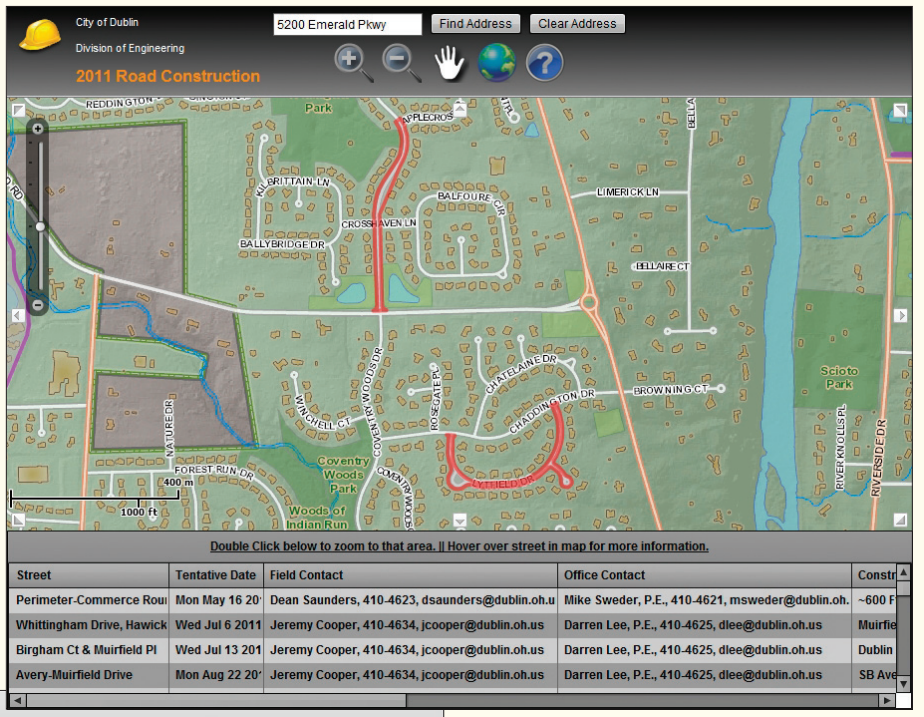
Zen and the Art of GIS Communication

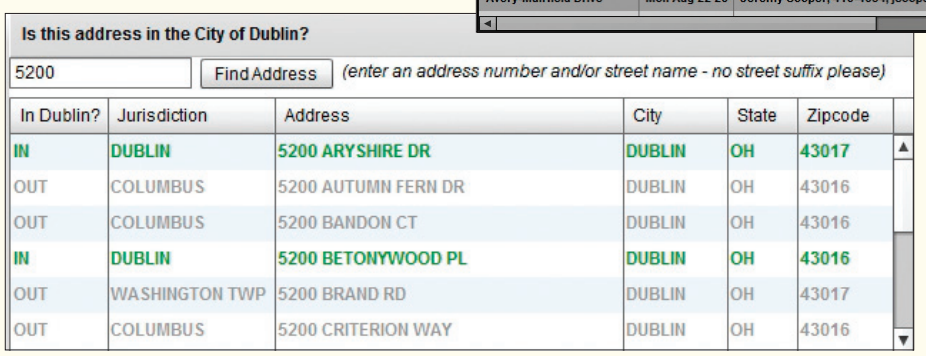
By Brandon B. Brown, GIS Administrator, City of Dublin, Ohio

I work in a basement. I bet many of you probably do, as well, or at least don't have windows. How do you figure out if it is raining outside at lunchtime? I go to **isitraining.in/Columbus** (enter your own city—it's awesome), and it gives me a simple answer in giant letters: Yes or No. Congratulations, you just "did" GIS. But notice that when you go to the site, there is no map or GIS logo, and it is not a rich Internet application full of flashy things. Even if it does some amazing spatial analysis and data gathering, to the consumer, it simply answers the question.

While this example is of something that is lighthearted and fun, albeit extremely practical, the take-home lesson for our profession is that we can have even more impact effecting change and influencing the world if we hone our skills as spatial communicators.

As the world's population is becoming more geographically literate (knowingly or unknowingly), expectations of us as spatial knowledge providers have risen. To meet these demands and facilitate spatial thinking, we must not only be able to deliver accurate, timely data but also provide it in a way that is easily found, consumed, and understood on any device.





An example of a tool designed to quickly answer a question.

The following are selected Zen-based sayings, with our interpretation of them as strategies that we follow toward GIS communication enlightenment in our work at the City of Dublin.

In all things, success depends on previous preparation, and without such previous preparation there is sure to be failure.

As we set out to develop new web applications, we quickly found that we had not scheduled enough time to focus on building our base. There were so many questions, each with many answers. How many servers should we have? How many services? Should services be cached or dynamic? What about security? How do we best ensure good performance? We were thoroughly confused.

To move forward, we had to find a balance between learning and doing while overcoming our fear of making a wrong choice. Using this balance and newfound courage, we focused on planning and building not only a technical infrastructure but also a cartographic infrastructure. To guide service creation, we considered how we wanted to visually present and group our data to create consistency among our applications, maximize server resources, and minimize service management. These activities have allowed us to spend more time focusing on what we are trying to communicate with our final products.

Water which is too pure has no fish.

When we began developing services and applications, we were excited to have web applications that finally utilized our live data. This was the highly detailed, accurate, and up-to-date data we had been trained to collect and maintain, and of course, we wanted our customers to see it.

We found a problem, though. For most of our applications, the level of detail maintained in the main data store was simply not necessary, and using it was having a negative impact on application performance. The lower performance drove away customers. We were left with a clean pond with no fish.

To speed things up and bring users back, we had to let go of the idea that the "pure" data was the best data. We do this by utilizing a presentation-tier data store. The data residing here has been cleansed of unnecessary fields and indexed, and it's had its geometries generalized. For example, there is no requirement to serve our street centerline as intersection-to-intersection segments, so we simply merge them by street name and functional class, creating a much more responsive feature class.

For annual street maintenance, there is a very simple way for residents to gauge the impact of projects on their neighborhoods.

Eliminate what does not matter to make more room for what does.

There is great development and sharing going on in the GIS community, especially when it comes to widgets for web applications. We quickly ran into the trap of adding cool new tools to applications for no other reason than that they were cool new tools. We found that this quickly confused and alienated our customers. We now follow a strict rule that if a tool is not required for an application, it does not exist in that application.

Simplicity can also pay great dividends when applied to basemap creation. Removing decision points from the customer, such as when to turn on/off certain layers, eases the user experience. We manage layers and symbology for over 15 layers utilizing scale levels, leaving the customers' focus on more important aspects of the application.

The application level is the most visible area where we try to enforce simplicity. We do have a business case for having a traditional web GIS application. When creating it, it was done so with this strategy in mind, and even though it is full of data and tools, we try to minimize the clutter. More effective are what we call "maplications"—our version of focused applications.

No snowflake ever falls in the wrong place.

To effectively communicate, we must act as the gentle wind acts on a snowflake and guide our customers to the place they need to be. Rather than directing customers to the GIS home page, we try to incorporate our maplications into the appropriate city web page. We see the maplication as just another supporting piece, like an image or chart, to an existing story. Our goal is to have appropriate applications appear contextually during any customer experience with the city's web presence. For example, if they are visiting the main website, they may find more intricate data and tools than if they are visiting our mobile site. If they are on the road construction page, they will find the road construction maplication rather than a list of street names and dates.

See with your eyes, hear with your ears. Nothing is hidden.

While we try to guide our customers to the appropriate application and then guide their experience by making some decisions for them, sometimes it backfires. For this reason, we have placed a higher value on budgeting time to spend with customers during the design process and after release. We watch, we ask questions, and we encourage criticism.

During these sessions, we try to remove ourselves from our GIS role and think even more like the customer. A helpful question we ask ourselves is, "Would my mother understand this?" We also try to get input from customers that do not know much about GIS.

No flower ever sees the seed.

We try to create applications that help people become spatial thinkers and better decision makers. If we do our job correctly, they will be greeted by an application that is inviting, informing, and easy to use. They may never know they are using GIS.

This is hard for us as GIS professionals; for years, we have been trying to explain what we do and all the great benefits of our robust systems. Now, we are trying to train ourselves that we will probably be most impactful if we can remove jargon and buttons and if we can just roll with it if people call a map a picture or an intricate GIS web application a map. Of course, if they ask, feel free to blast them with a stream of acronyms and technical jargon that would make the GIS forefathers blush.

Conclusion

Our customers' demands are simple—they want to be able to find without looking, understand without learning, and do it all fast. We can satisfy these demands by building our base, releasing some of our long-held notions about data and techniques, create reusable resources, show only what is needed, tell a story, and listen to feedback. Good luck, and GIS be with you. Now, it's time for lunch—I wonder if it's raining.

About the Author

Brandon Brown is the GIS administrator for the City of Dublin, Ohio, where he has worked for the past eight years. Previous experience includes three years as an analyst/programmer at the Auditor's office of Lucas County, Ohio, and a short but wonderful time at Livingston County.

For more information, contact Brandon B. Brown, GIS administrator, City of Dublin, Ohio (e-mail: bbrown@dublin.oh.us).

ArcGIS for Server Disseminates Geospatial Services

Esri's ArcGIS for Server adds geographic data and analysis to web applications that serve organizations and communities in a variety of ways. To submit your ArcGIS for Server site address and view other websites powered by ArcGIS for Server, visit **esri.com/serversites**.

2011 Lancaster Sound Arctic Whale Survey
oceansnorth1-1519752832.us-west-1.elb.amazonaws.com/Baffin_Expedition_Flex
The Pew Environment Group's Oceans North Canada led an Arctic science expedition off Greenland's west coast with the goal of reaching Lancaster Sound to study one of the greatest whale migrations in the world. This interactive map shows origin locations and satellite data from the expedition.

Henderson Crime Search
maps.cityofhenderson.com/public/police/crimesearch.html
The City of Henderson, Nevada, Police Department crime mapping database provides public access to crime information within Henderson's city limits. The mapping database contains 90 days of crime information.

City of Surrey's Mapping Online GIS System
cosmos.surrey.ca/Geocortex/EssentialsExternal/web/Viewer.aspx?Site=City%20Map
The City of Surrey, British Columbia, created a feature-rich application with tools and data for investigating four different maps—a city map, a developer map, a real estate map, and a utilities map of the city.

West Virginia Infrastructure Project Portal
gis.wvinfrastructure.com
Developed by CDM through the West Virginia Infrastructure & Jobs Development Council, this application provides access to statewide water and wastewater project information and tools to support enhanced project management.

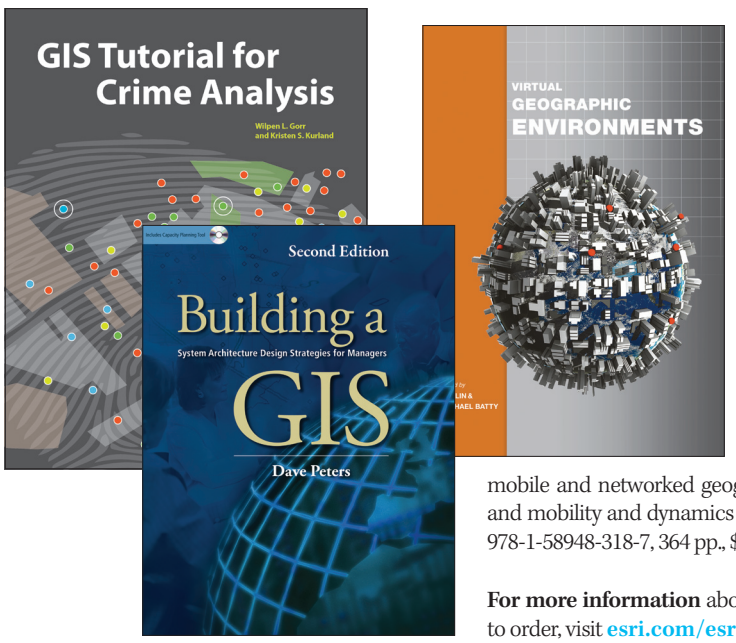
New Topics from Esri Press

Crime Mapping, System Design Strategies, and Virtual Geographic Environments

GIS Tutorial for Crime Analysis
By Wilpen L. Gorr and Kristen S. Kurland
This workbook uses ArcGIS 10 for Desktop to teach how to automate production of crime maps and build a crime mapping system. Written by seasoned GIS Tutorial authors, the book offers law enforcement professionals, including crime and intelligence analysts, as well as students, a definitive resource to develop a systematic approach to crime, threat, and hazard mapping and analysis. It includes independent exercises to introduce key GIS skills, such as data preparation and template building. For the college curriculum, instructor resources are also available. ISBN: 978-1-58948-214-2, 296 pp., $79.95.

***Building a GIS: System Architecture Design Strategies for Managers*, Second Edition**
By Dave Peters
Building a GIS promotes the effective planning and implementation of a GIS infrastructure using a time-tested approach to system architecture design. Written for IT experts adopting GIS technology, GIS professionals new to system design, and executives who need to manage change, the book describes performance models, developed over many years, to help guide design decisions. The second edition has been restructured to better align the concepts. It also includes an updated capacity planning tool (CPT), which automates system design analysis tasks that GIS managers and technical architects can use to better assess options before committing resources. The CPT is available on the book's DVD, along with exercises and video presentations that help readers further hone their expertise. ISBN: 978-1-58948-307-1, 172 pp., $59.95.

Virtual Geographic Environments
By Hui Lin and Michael Batty
Republished by Esri Press, this collection of papers—originally presented at an international conference on developments in visualization and virtual environments in geographic information science—describes the importance of virtual geographic environments as the basis for GIS in design. Edited by professors Hui Lin and Michael Batty, the book discusses online virtual environments and Web 2.0 technologies; virtual cities and virtual landscapes; user interfaces, public participation, and geovisualization; mobile and networked geographic environments; and mobility and dynamics in visualization. ISBN: 978-1-58948-318-7, 364 pp., $49.95.



For more information about Esri Press books or to order, visit **esri.com/esripress**.

New Training and Certification Offerings from Esri

Training

Value for Your Training Budget
Virtual Campus web courses provide self-paced, on-demand training that organizations can take advantage of to prepare staff for upcoming projects and support professional development plans. A Virtual Campus annual user license provides the best price option for organization-wide access to the full catalog of Esri web courses for one year. An annual user license includes more than 40 courses on ArcGIS 10 software topics, as well as dozens of courses on previous ArcGIS releases.

Web courses for ArcGIS 10 feature an updated, streamlined interface that enhances the learning experience. These courses also feature software demonstrations, graphic slideshows, and interactive activities designed to reinforce key concepts. All courses include hands-on exercises that provide students with practice applying the software to complete common GIS tasks and workflows.

Find out more about Virtual Campus annual user licenses at **esri.com/aul**.

Featured Training
Web courses are available through the Esri Virtual Campus at **esri.com/training**. Instructor-led classes are available at Esri Learning Centers nationwide and direct to desktops in multiple time zones via the instructor-led online classroom. Learn more about instructor-led training options at **esri.com/instructorled**.

Automating Spatial Analysis with ArcGIS 10
Learn how to create geoprocessing models and Python scripts to automate, reuse, and share your key analysis workflows.
- **Building Models for GIS Analysis Using ArcGIS 10**—Web course
- **Introduction to Geoprocessing Scripts Using Python**—Instructor-led course
- **Performing Analysis with ArcGIS for Desktop**—Instructor-led course
- **Python Scripting for Geoprocessing Workflows (for ArcGIS 10)**—Web course

Designing and Producing Maps with ArcGIS 10
These courses teach how to create well-designed maps that feature your authoritative GIS data.
- **Creating and Publishing Maps with ArcGIS**—Instructor-led course
- **Creating Map Books Using Data Driven Pages**—Free training seminar
- **Getting Started with Cartographic Representations (for ArcGIS 10)**—Web course
- **Working with Annotation Using ArcGIS 10**—Web course

Certification

Sample Questions Now Available for ArcGIS Desktop Associate and Professional Certifications
Individuals who want to evaluate their readiness to take the ArcGIS Desktop Associate or Professional technical certification exam have a new tool at their disposal. More than 30 sample questions for each certification are now available online through the Esri Virtual Campus. After completing the sample questions, users will be able to immediately see how many they answered correctly and get an explanation of each correct answer. The sample questions are available for free at **esri.com/skillsreview** for the following:

- **Esri Technical Certification: Sample Questions for ArcGIS Desktop Associate**
- **Esri Technical Certification: Sample Questions for ArcGIS Desktop Professional**

Sample questions are intended to provide a general idea of how certification exam questions are structured, help users evaluate their proficiency with some of the skills measured by the exam, and identify skill areas that may require additional study. These sample question sets have not been designed to predict performance on an actual certification exam.

GI Bill and Esri Technical Certification Exams News
Several Esri Technical Certification exams are now covered under the GI Bill. Qualified candidates can purchase their exam and then submit a form for reimbursement under the GI Bill Licensing and Certification benefits program. For more information and links to the US Department of Veterans Affairs Licensing and Certification benefits web pages, see the Taking and Re-Taking Exams common questions at **esri.com/certification/questions**.

For More Information

Training website:	**esri.com/training**
Find a course:	**esri.com/coursecatalog**
Training Matters blog:	**esri.com/trainingblog**
Training on Twitter:	**twitter.com/Esritraining**
Subscribe to the training newsletter:	**esri.com/trainingnews**
Esri Press books:	**esri.com/esripress**
Esri Technical Certification website:	**esri.com/certification**
Esri Technical Certification exam registration site:	**pearsonvue.com/esri**

More *ArcNews*—Online-Only Articles

The Winter 2011/2012 issue of *ArcNews* Online (**esri.com/arcnews**) presents the following special online-only articles, including new supplemental podcasts:

4-H Club GIS Programs Support Science and Technology Training

Abu Dhabi DOT Deploys Enterprise GIS

Belgium, Spain, Utah—Spot the Design!

Michał Zugajewicz is director of Enviro Solutions in Warsaw, Poland, and a specialist in information technology applications in forestry. We can do little better than quote Zugajewicz from the Indoor Kart World Championship in Belgium: "As a captain of Team Poland, I am proud of the final result (we advanced to the Great Final in Nations Cup) and of the Esri T-shirt that gives me power to fight with the best drivers in the world!"

Diego Portillo, GISP, GIS coordinator, United Power, Inc., Brighton, Colorado, vacationed in Spain. The photo of him wearing his Esri T-shirt was taken on the boat going to Puntal Beach in Santander.

Andy Johnson, Monsen Engineering, Salt Lake City, Utah, was visiting Arches National Park in Utah, where this shot of him in his T-shirt was snapped in front of Delicate Arch. Winds were gusting at 50 miles per hour. He says, "I'm lucky I got this shot at all!"

Wear an Esri T-shirt in a unique location and send a photograph to *ArcNews*. Photos will be considered for use in *ArcNews*, the expanded T-shirt section at *ArcNews* Online, or both. Upload digital photos at *ArcNews* Online or send via e-mail (tmiller@esri.com). Digital images are preferred, but prints or slides can be sent to *ArcNews* T-shirt Feature, Esri, 380 New York Street, Redlands, California 92373-8100 USA. See *ArcNews* Online at **esri.com/arcnews**.

Diego Portillo going to Puntal Beach.


Michał Zugajewicz in the paddock.


Andy Johnson in Arches National Park.

Esri Corporate Headquarters

380 New York Street
Redlands, CA 92373-8100 USA
Tel.: 909-793-2853
Fax: 909-793-5953
E-mail: info@esri.com
Web: esri.com

Esri Technical Support
Tel.: 888-377-4575
Fax: 909-792-0960
E-mail: support@esri.com
Web: esri.com/support

Online Discussion Forums
Web: esri.com/forums
Esri-L: esri-l@esri.com
ARCVIEW-L:
arcview-l@esri.com

FTP: ftp.esri.com

Esri Desktop Order Center and Software Information
Tel.: 1-800-447-9778
(USA only)
Fax: 909-307-3049

Esri Customer Service
Toll Free
Tel.: 888-377-4575
Fax: 909-307-3082 and
909-793-4801
E-mail: service@esri.com
Web: esri.com/customerservice

Esri Store
Web: esri.com/store

Esri Developer Network
Web: edn.esri.com

Esri US Regional Offices

Boston
Danvers, MA
Tel.: 978-777-4543
Fax: 978-777-8476

California
Redlands, CA
Tel.: 909-793-2853, ext. 1-1906
Fax: 909-307-3025

Charlotte
Charlotte, NC
Tel.: 704-541-9810
Fax: 704-541-7620

Denver
Broomfield, CO
Tel.: 303-449-7779
Fax: 303-449-8830

Minneapolis
St. Paul, MN
Tel.: 651-454-0600
Fax: 651-454-0705

Olympia
Olympia, WA
Tel.: 360-754-4727
Fax: 360-943-6910

Philadelphia
Chesterbrook, PA
Tel.: 610-644-3374
Fax: 610-644-3379

San Antonio
San Antonio, TX
Tel.: 210-499-1044
Fax: 210-499-4112

St. Louis
St. Charles, MO
Tel.: 636-949-6620
Fax: 636-949-6735

Federal Office Washington, D.C.
Vienna, VA
Tel.: 703-506-9515
Fax: 703-506-9514

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

Esri Distributors Worldwide

Esri Australia Pty. Ltd.
Brisbane
Tel.: 617-3218-4100
Fax: 617-3211-1310
E-mail: connect@esriaustralia.com.au
Web: www.esriaustralia.com.au

Esri BeLux N.V.
Wemmel, Belgium
Tel.: 32-2-460-7480
Fax: 32-2-460-4539
E-mail: info@esribelux.com
Web: www.esribelux.com

Esri Bulgaria Ltd.
Sofia
Tel.: 359-2-964-0850
Fax: 359-2-962-6365
E-mail: info@esribulgaria.com
Web: www.esribulgaria.com

Esri Canada Limited
Toronto, Ontario
Tel.: 416-441-6035
Fax: 416-441-6838
E-mail: info@esricanada.com
Web: www.esricanada.com

Esri Chile S.A.
Santiago
Tel.: 56-2-481-9000
Fax: 56-2-481-9099
E-mail: info@esri-chile.com
Web: www.esri-chile.com

Esri China (Beijing) Ltd.
Beijing
Tel.: 86-10-5763-2288
Fax: 86-10-5763-2299
E-mail: info@esrichina-bj.cn
Web: www.esrichina-bj.cn

Esri China (Hong Kong) Limited
Hong Kong
Tel.: 852-2730-6883
Fax: 852-2730-3772
E-mail: info@esrichina-hk.com
Web: www.esrichina-hk.com

Esri Eastern Africa Ltd.
Nairobi, Kenya
Tel.: 254-20-271-3630
Fax: 254-20-271-3633
E-mail: sales@esriea.co.ke
Web: www.esriea.co.ke

Esri Finland Oy
Espoo
Tel.: 358-207-435-435
Fax: 358-207-435-430
E-mail: info@esri.fi
Web: www.esri.fi

Esri France S.A.
Meudon Cedex
Tel.: 33-1-46-23-6060
Fax: 33-1-45-07-0560
E-mail: info@esrifrance.fr
Web: www.esrifrance.fr

Esri Deutschland GmbH
Kranzberg
Tel.: 49-8166-677-0
Fax: 49-8166-677-1111
E-mail: info@esri.de
Web: www.esri.de

NIIT GIS Limited (Esri India)
New Delhi
Tel.: 91-11-4057-0700
Fax: 91-11-4057-0933
E-mail: info@esriindia.com
Web: www.esriindia.com

Esri Italia Sp.A.
Rome
Tel.: 39-06-406-961
Fax: 39-06-406-96333
E-mail: info@esriitalia.it
Web: www.esriitalia.it

Esri Japan Corporation
Tokyo
Tel.: 81-3-3222-3941
Fax: 81-3-3222-3946
E-mail: esri_general@esrij.com
Web: www.esrij.com

Esri Korea, Inc.
Seoul
Tel.: 82-2-2025-6700
Fax: 82-2-2025-6701
E-mail: info@esrikr.com
Web: www.esrikr.com

Esri Lebanon sal
Beirut
Tel.: 961-1-844944
Fax: 961-1-844400
E-mail: info@esrilebanon.com
Web: www.esrilebanon.com

Esri Muscat Co LLC
Muscat, Oman
Tel.: 968-24693723
Fax: 968-24693719
E-mail: info@esrimuscat.com
Web: www.esrimuscat.com

Esri Nederland B.V.
Rotterdam
Tel.: 31-10-217-0700
Fax: 31-10-217-0799
E-mail: gisinfo@esri.nl
Web: www.esri.nl

Esri Northeast Africa
Cairo, Egypt
Tel.: 202-2271-9350
Fax: 202-2271-9354
E-mail: info@esrinea.com
Web: www.esrinea.com

Esri Polska sp. z o.o.
Warsaw
Tel.: 48-22-390-4700
Fax: 48-22-390-4701
E-mail: esripol@esripolska.com.pl
Web: www.esripolska.com.pl

Esri Portugal—Sistemas e Informação Geográfica, S.A.
Lisbon
Tel.: 351-2-1-781-6640
Fax: 351-2-1-793-1533
E-mail: market@esri-portugal.pt
Web: www.esri-portugal.pt

Esri Romania S.R.L.
Bucharest
Tel.: 40-21-231-1422
Fax: 40-21-231-12-77
E-mail: esri@esriro.ro
Web: www.esriro.ro

Limited Liability Company Esri CIS
Moscow, Russia
Tel.: 7-495-988-34-81
Fax: 7-495-455-4561
Web: www.esri-cis.ru

Esri South Africa
Midrand
Tel.: 27-11-238-6300
Fax: 27-11-238-6310
E-mail: info@esri-southafrica.com
Web: www.esri-southafrica.com

Esri South Asia Pte. Ltd.
Singapore
Tel.: 65-6742-8622
Fax: 65-6742-1922
E-mail: connect@esrisingapore.com.sg
Web: www.esrisa.com

Esri España Geosistemas S.A.
Madrid
Tel.: 34-91-559-4375
Fax: 34-91-252-3455
E-mail: informacion@esri.es
Web: www.esri.es

Esri Sverige AB
Gävle, Sweden
Tel.: 46-771-984800
Fax: 46-261-50580
E-mail: info@esri.se
Web: www.esri.se

Esri (Thailand) Co. Ltd.
Bangkok
Tel.: 66-2-678-0707
Fax: 66-2-678-0321
E-mail: krairop.l@cdg.co.th
Web: www.esrith.com

Esri Bilgi Sistemleri Muhendislik ve Egitim, Ltd.
Ankara, Turkey
Tel.: 90-312-233-5050
Fax: 90-312-235-5682
E-mail: mtankut@esriturkey.com.tr
Web: www.esriturkey.com.tr

Esri (UK) Ltd.
Aylesbury
Tel.: 44-1296-745-500
Fax: 44-1296-745-544
E-mail: info@esriuk.com
Web: www.esriuk.com

Grupo Esri de Venezuela, C.A.
Caracas
Tel.: 58-212-285-9394
Fax: 58-212-285-0714
E-mail: esriven@esriven.com
Web: www.esriven.com

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

Career Opportunities at Esri

Esri is actively recruiting smart people with all levels of experience who get the job done. These positions represent openings at our headquarters in Redlands, California, as well as our regional offices, and offer you a great opportunity to work with the best in our profession. We provide exceptional benefits, competitive salaries, profit sharing, a collaborative team environment, and much more. Join Esri and make a difference.

Software Development and ArcGIS Product Development

Web Developer—Be a key member of the team that designs and implements information websites and delivery channels for the ArcGIS product family.

Map Stories Design Product Engineer—Use your creativity and technical skills to tell stories about the world by developing websites and applications for broad use in the GIS and web mapping communities.

Applications Engineer—Work with Esri's chief scientist to assist in the design, creation, and maintenance of GIS tools and workflow automation methods, primarily for the oceans/marine industry.

GIS Services

Product Manager—Linear Referencing—Guide a team that is charged with defining, building, and releasing software products focused on linear referencing systems and highway data management.

Geospatial Analyst (Washington, D.C.)—Use your knowledge of database design and development to support Esri customers in the conception, construction, and implementation of GIS databases, applications, and production systems.

Educational Services and Technical Support

Training Solution Sales Representatives (multiple locations)—Leverage your consultative sales experience to strengthen the success of Esri technology in government agencies.

Support Analysts—Server (Redlands, California, and Charlotte, North Carolina)—Provide high-quality support to end users of Esri software to solve technical problems quickly and effectively.

Sales

Account Executives—Electric and Gas (multiple locations)—Support existing client relationships, advance relationships with partners, and cultivate new business with electric and gas accounts.

Account Manager, Department of Energy (Washington, D.C.)—Consult with and advise federal agencies on the application and benefits of Esri's enterprise range of software solutions.

Presales and Solution Engineering

Technical Engineer—ArcGIS for Desktop—Be involved in pre- and postsales support presenting Esri's latest solutions and help guide direction of upcoming software releases.

Solution Engineer—Commercial (multiple locations)—Apply your experience in retail, real estate, financial services, or Fortune 500 companies to demonstrate the business benefits of GIS.

Solution Architect—Support the Esri sales team worldwide by defining solutions and patterns that demonstrate the business value of our geospatial technology.

Marketing

Industry Solutions Specialists, Health Team (multiple openings)—Oversee marketing strategy, business development, and customer advocacy for the human services, public health, or hospital and health systems market.

Public Works Industry Solutions Specialist—Leverage your years of experience to coordinate and help manage marketing efforts related to products and services within this market.

Marketing Media Analyst—Use your expertise using Esri software in the media industry to build and deliver maps showing the benefits of GIS to the media.

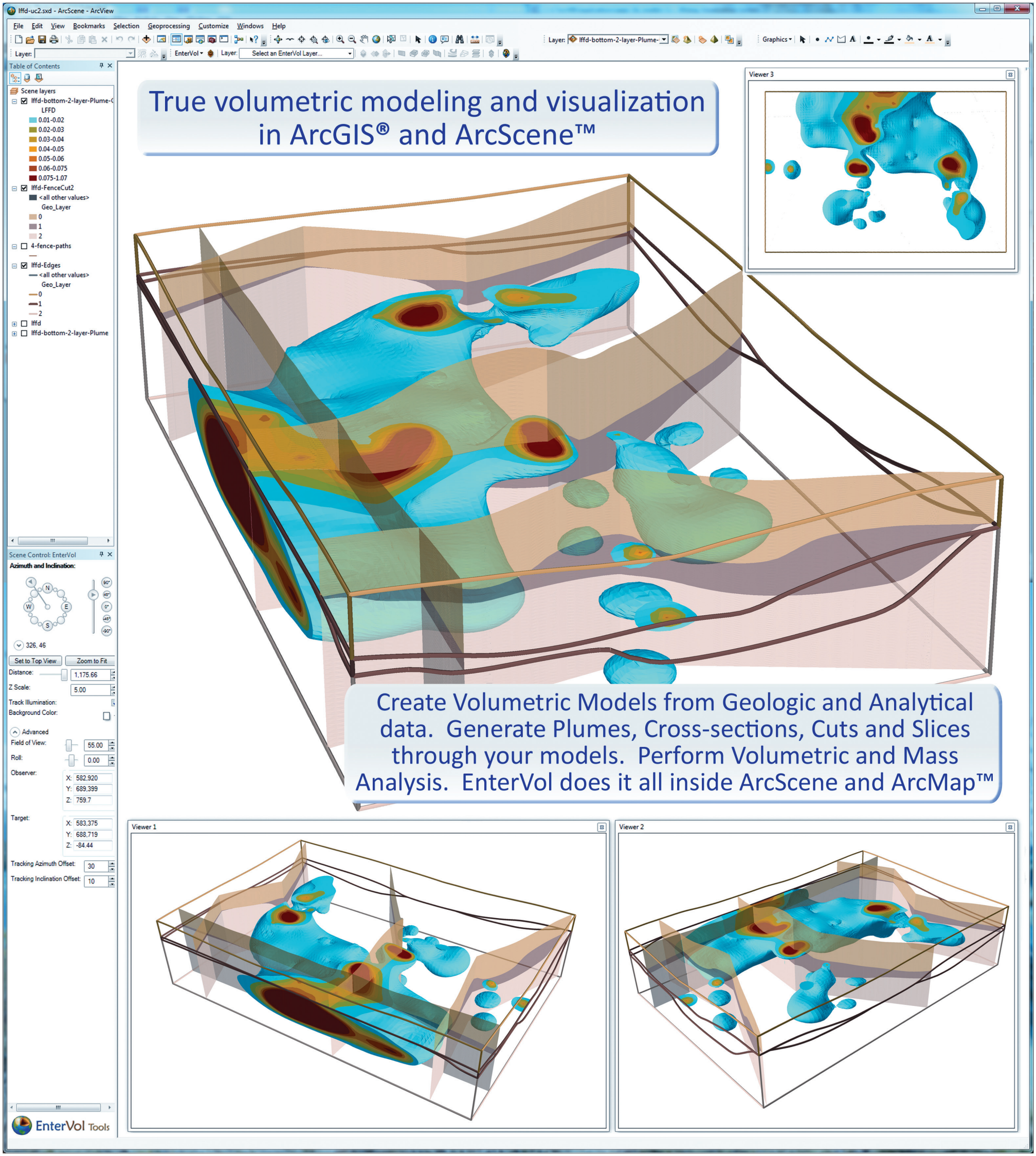
Follow @EsriCareers on Twitter.

To learn about Esri-related career opportunities outside the United States, contact your area's international distributor (esri.com/distributors).

esri.com/careers

EnterVol™ for ArcGIS

C Tech Understands Your Volumetric World



True volumetric modeling and visualization in ArcGIS® and ArcScene™

Create Volumetric Models from Geologic and Analytical data. Generate Plumes, Cross-sections, Cuts and Slices through your models. Perform Volumetric and Mass Analysis. EnterVol does it all inside ArcScene and ArcMap™

www.entervol.com and **www.ctech.com** **Ph: (808) 447-9751** or **sales@ctech.com**

Subscription Additions and Address Changes or Deletions

E-mail: requests@esri.com
Fax: 909-798-0560
Subscribe on the web: **esri.com/subscribe**
Subscribe outside the US: Contact your local distributor.
Unsubscribe on the web: **esri.com/unsubscribe**
Update information on the web: **esri.com/coa**
To request other publication services: see page 40.

PRINTED WITH SOY INK

128027

380 New York Street
Redlands, CA 92373-8100

Presorted
Standard
US Postage
Paid
Esri

Discover solutions to national challenges with geospatial technology.

Join us in February to find out how.

Esri Federal GIS Conference

February 22–24, 2012 | Washington, D.C.
esri.com/fedcon

Federal employees attend at no charge.