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GIS for Environmental Management Solutions

California Sunshine Is an Energy Goldmine

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

By Barbara Shields

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. The LA County Solar Map is an online map service that provides solar value analysis for every commercial and residential building in the county and helps property owners make informed solar installation decisions.

Launched on Earth Day in April 2011, LA County Solar Map (solarmap.lacounty.gov) generation 2 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 the rooftops and color-coded dots indicating the amount of direct sunlight hitting each portion of the 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 capacity to serve many more people as solar demand grows.

Installing Solar Panels on Los Angeles Rooftop

The Benefits

The LA County Solar Map benefits LA County because it

- Supports the county's clean energy goals
- Can be integrated into the county's Energy Upgrade California in L.A. County (energyupgradeca.org/county/los_angeles) home energy efficiency program
- Is a one-stop shop for
  - Solar rebate/incentive program links
  - Licensed solar contractors and installers information

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California Sunshine Is an Energy Goldmine

  - Solar savings calculators
  - Solar news and resources
- Offers credible, impartial data that supports solar product marketing
- Adds scientific accuracy for policy making and grant applications
- Allows other county services to access data
- Opens geospatial data layers to multipurpose analysis
- Provides a tool for reducing building operating costs
- Drives economic development in clean energy

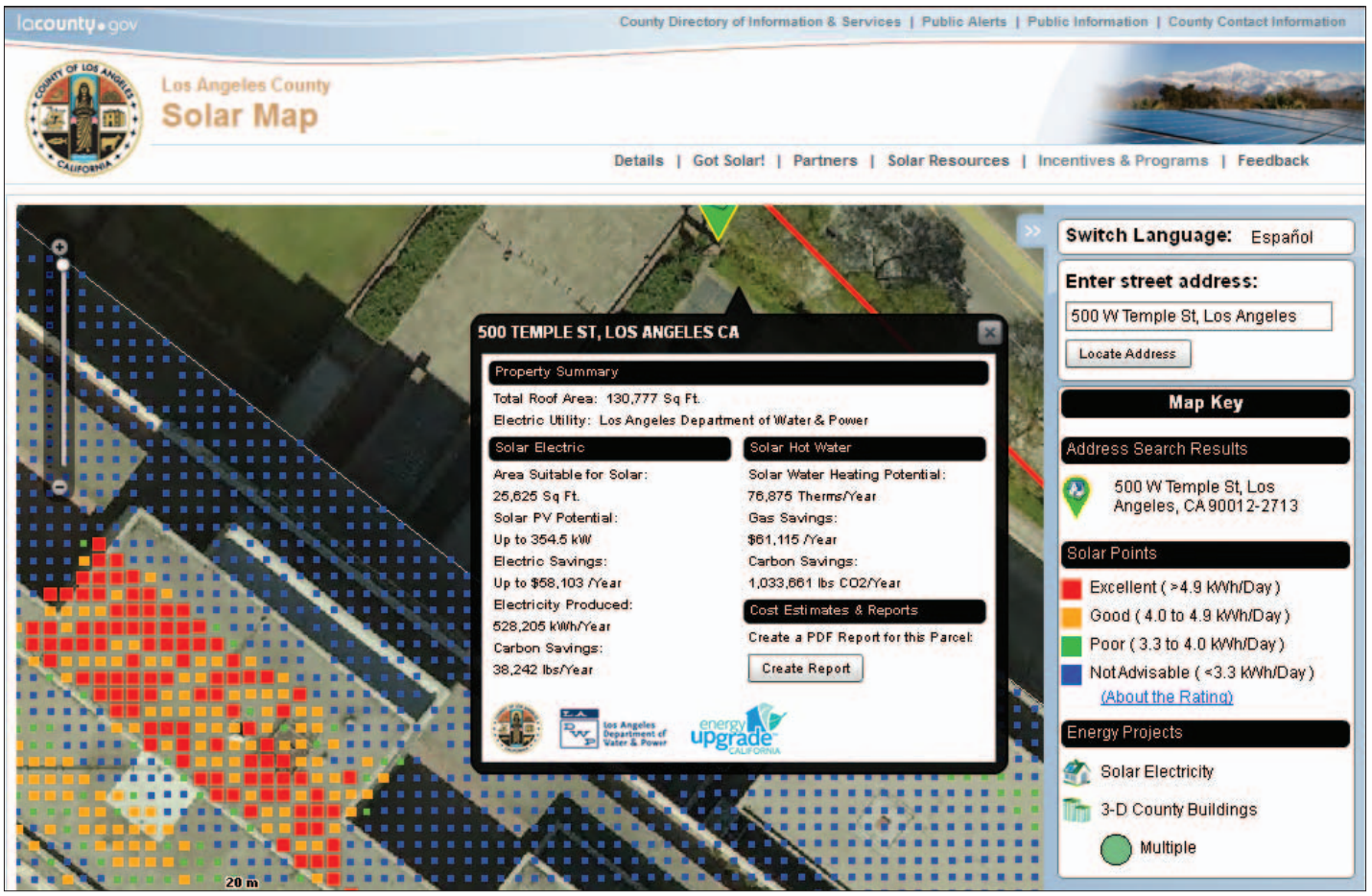
The Story

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. So he partnered with ISD to apply for a County Information Technology Fund grant to implement the project. The chief information officer 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 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 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 boundary information and solar potentials by parcel. Although it was limited in its ability to show the specific locations suitable for solar, it was a major success, with over 5,000 hits on its first day.

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 and more robust. Greninger wanted the updated map to be simpler and more intuitive to use; faster; and able to handle high demand to show rooftop potential, pinpoint optimal panel placement, and quickly answer value questions. Critigen had already



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

developed more than 15 solar maps for cities and counties. Bringing this new knowledge and technology to the solar update project, Critigen created the first third-generation solar map in the world.

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 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 5 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. 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.

It is another sunny day in downtown Los Angeles.

The next iteration of the model includes 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 benefit data 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 area.

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 (UCLA), 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.

Contact Mark Greninger at MGreninger @cio.lacounty.gov.

Learn more about Critigen at critigen.com or contact Ty van den Akker, Ty.vandenAkker @critigen.com.

Learn more about ArcGIS for Server at esri.com/arcgisserver.

HELCOM Powers Up Baltic Sea Map Service

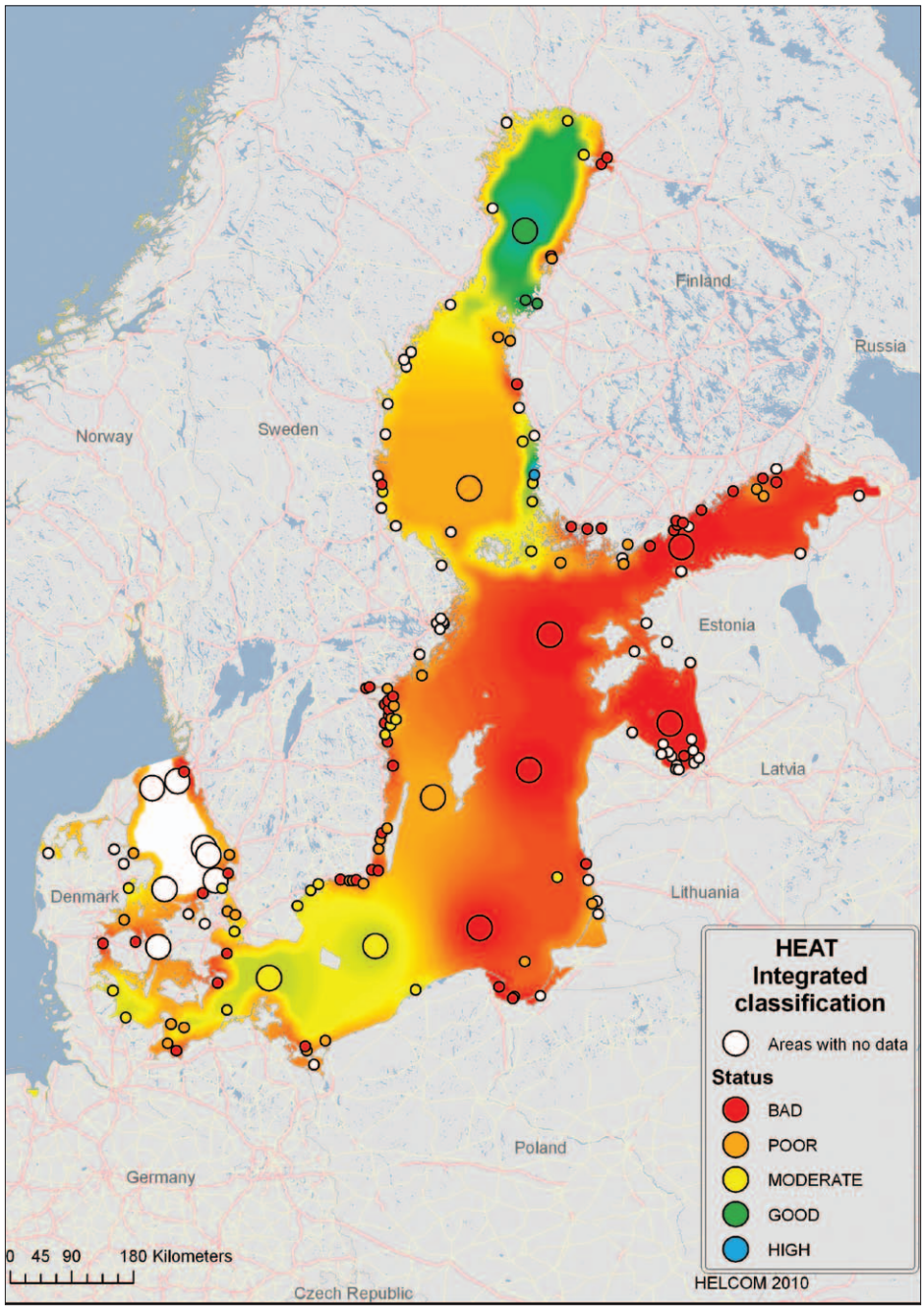
Multiple Map Services Rolled-Up onto One Server Platform

Northern Europe's Baltic Sea has a combination of geographic, climate, and ecologic characteristics that make it highly sensitive to environmental impact. Because it is shallow and an almost enclosed water body, its brackish water remains in the sea for up to 30 years. The environmental situation of the sea and its coastlines has deteriorated due to a long history of discharges from industries and municipalities, runoff from agriculture, and various airborne pollutants. These pollutants, combined with the basin's natural tendency to stagnate, endanger the Baltic Sea's living resources. Much work has been done to reduce pollution in the last few decades, so the deterioration of the sea has slowed.

The Baltic Marine Environment Protection Commission, commonly known as the Helsinki Commission, or HELCOM, is an intergovernmental organization of all the nine Baltic Sea countries and the European Union (EU), which works to protect the marine environment of the Baltic Sea from all sources of pollution. For more than 30 years, the commission has been assessing and reporting on the status of the Baltic Sea. These reports, based on unique compilations of data and analysis, help experts evaluate the impact of human activity on the marine environment, formulate policies, and set priorities to protect the marine environment and ensure that it is used sustainably.

Since 2004, HELCOM has used Esri's software for processing and analyzing data. The commission's GIS-enabled website provided users with access to the organization's various map and data services including maritime accident response, nutrients, maritime spatial planning, coastal fish monitoring, metadata, the Baltic Sea Monitoring Programme, and project data. HELCOM recently migrated its mapping service to Esri's ArcGIS for Server platform, which integrates all these map services into a single map service.

"In the last few years, the Commission's operations have increasingly used GIS," said Minna Pyhälä of the HELCOM Secretariat.



Heat-integrated classification shows the status of eutrophication in locations around the Baltic Sea. maps.helcom.fi/website/mapservice/index.html

"We are trying to simplify complicated scientific information so that authorities, decision makers, and the public are able to understand the current state and problems of the Baltic Sea. We receive a lot of requests for various datasets and maps. Now with the new service, users can search for material themselves and do what they want with it. This reduces our workload dramatically. The map service is also an implementation of HELCOM's data and information strategy, which aims to make all HELCOM data openly available to the public." Now Baltic Sea data is available from one centralized place. This makes it much easier for people to use maps and data to understand the Baltic's ecology, protected areas, pollution, maritime traffic, and fishing industry. Hosted on the commission's server, the GIS platform

The Baltic Sea is the largest body of brackish water in the world.

makes the map and data service more flexible. Users can access data via a friendly table of contents, select and combine data layers of interest, and use various GIS tools such as adjusting layer transparency.

The new map service was built on Esri's ArcGIS for Server and Flex. Flex, an Adobe development platform based on Adobe Flash Player client, is well integrated with ArcGIS for Server. Using it to build the map service made the development process relatively straightforward and applications easy to deploy.

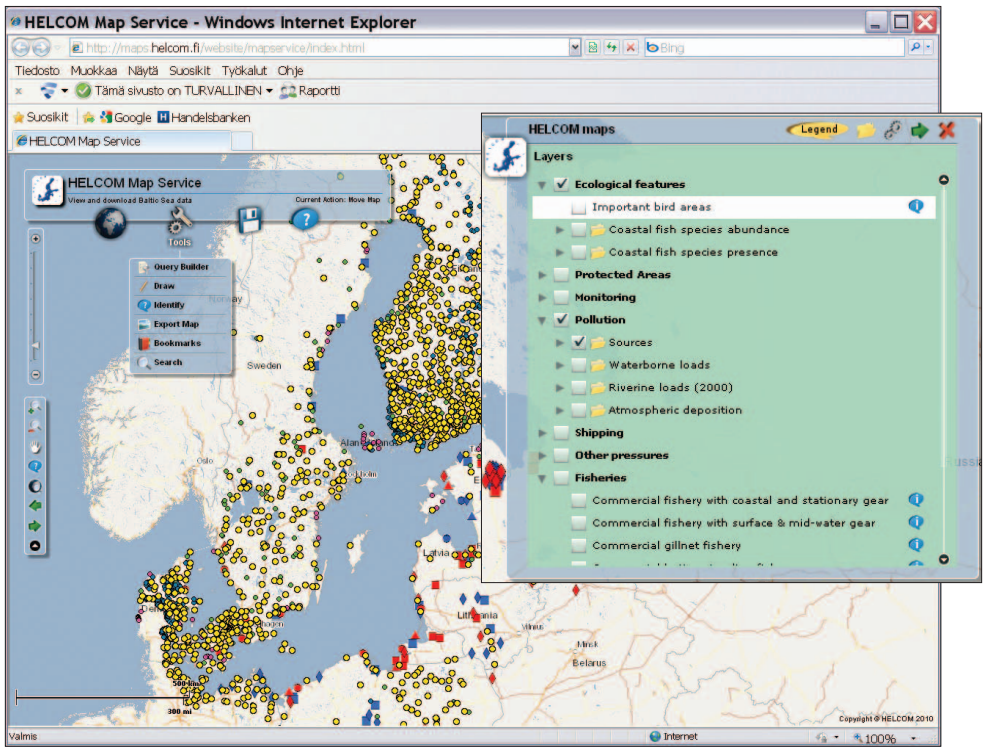
Project researcher Manuel Frias, who developed the HELCOM GIS, explained, "ArcGIS for Server has made our map services visually and functionally better because the service is much faster. It is more user-friendly, providing easy map navigation (zoom and pan), and has a look and feel similar to other popular web map services. Moreover, we can easily tailor applications to include special tools as well as services such as export WMS or KML."

Users who want to use datasets in their own ArcGIS software can either connect to the HELCOM database via a Web Map Service (WMS) or download material in the Esri shapefile format to their own projects. HELCOM's new map and data service provides Open Geospatial Consortium (OGC) compliant WMS so that users can access available layers from within their own GIS mapping environment. The service is designed as a service-oriented architecture (SOA). All transactions between Flash Player clients and ArcGIS for Server occur via a REST-based service end point.

Although copyrighted data and maps cannot be downloaded, more than 200 map layers are contained in the service, of which 99 percent can be downloaded for personal use. In addition, attribute information of map objects can be downloaded in CSV format via the search function, which means that data can be further used and edited in a spreadsheet.

Datasets hosted by other organizations can similarly be linked via WMS and displayed in HELCOM's map and data service.

Pyhälä concluded, "If a service has a live link to our database, you can be sure that you always have the latest version of our data available."



HELCOM Map Service integrates many map services into one so that the user can visualize data layers to show relationships, understand the cause and effect of pollution, and locate important bird areas. Navigation tools offer greater interaction and wider analysis.

Map Rallies Support for Open Space Initiative

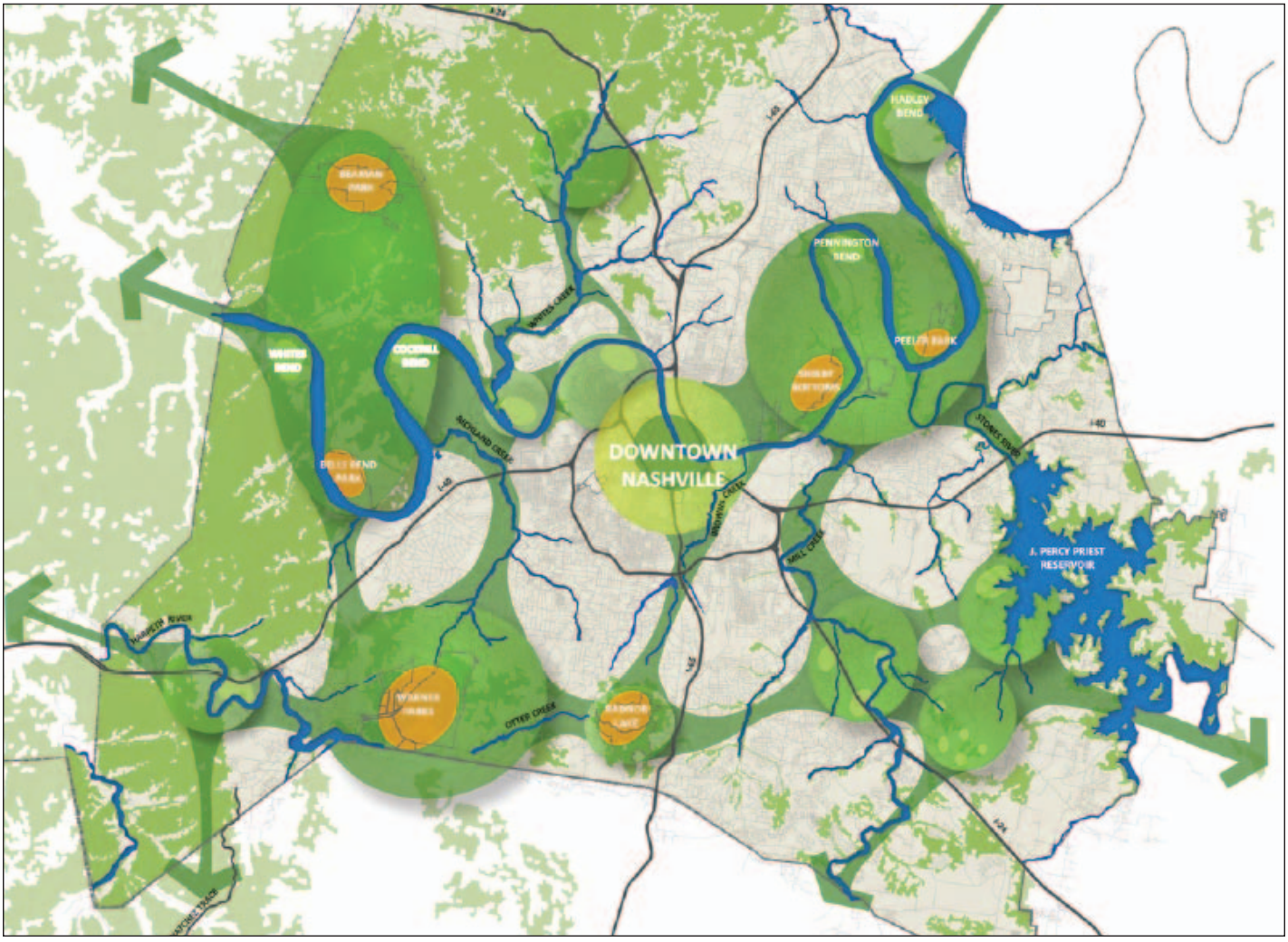
Proposed Green Infrastructure to Connect Community, Forests, Land, and Water

Nashville, Tennessee, experienced a major flood in May 2010. The public needed to understand the value of natural systems and regulated floodways, floodplains, open water, and the Mill Creek watershed as well as how conservation opportunities could mitigate future flood hazards.

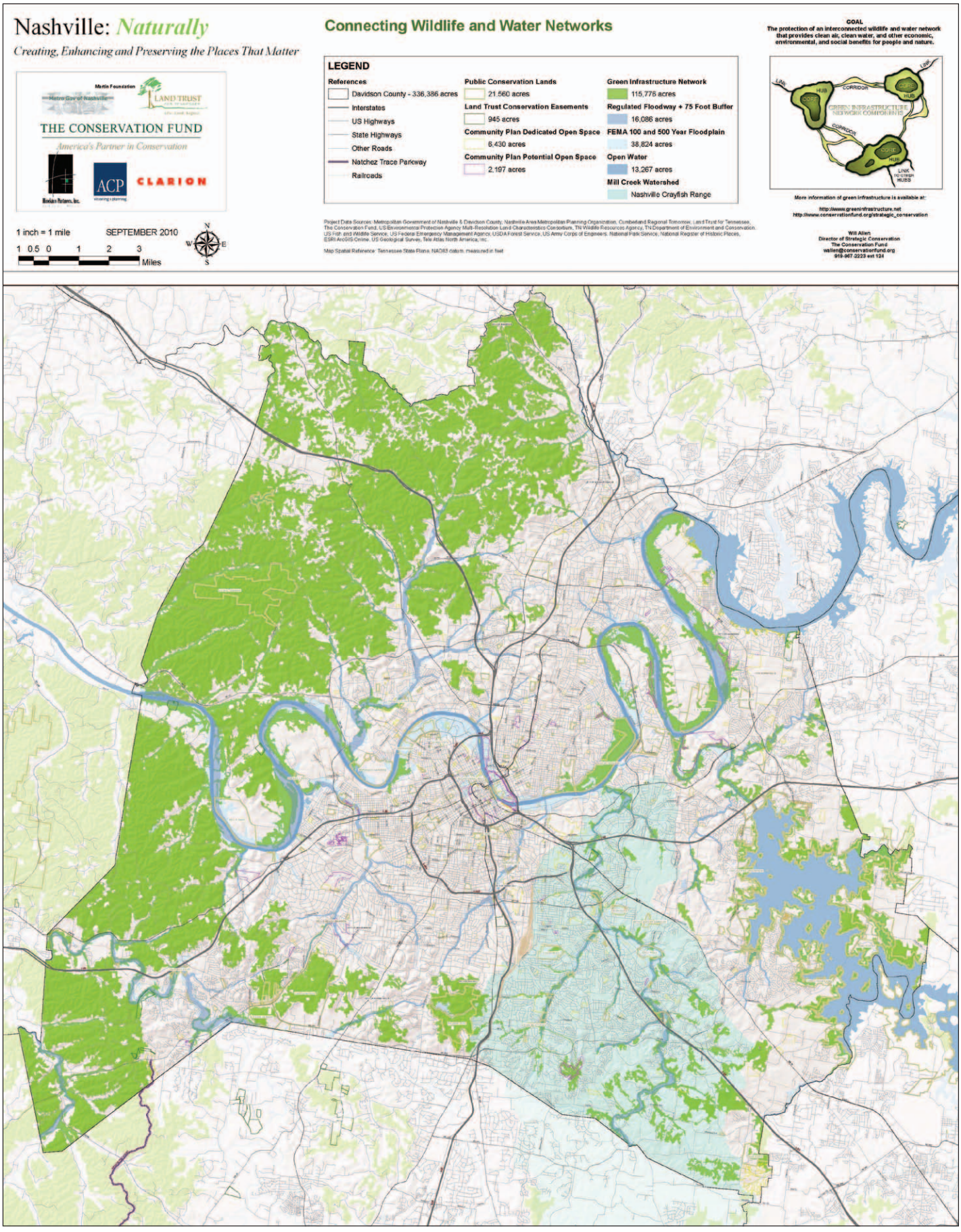
Nashville-Davidson County citizens worked with Nashville: Naturally to set resource priorities and identify four key themes to be included in an open space plan: water and wildlife networks, recreation, farming, and historic/iconic concerns.

Map designers created a green infrastructure network GIS layer for representing an interconnected network of land and water areas that are needed for clean air, clean water, and other economic, environmental, and social benefits for people and nature. These areas were designated as the most suitable for protection. To show the connection of water and wildlife networks, designers used ArcGIS ModelBuilder to model how hubs and core forests, wetlands, and aquatic systems are linked by corridors. The map combines data from more than a dozen disparate sources and creates inventories of existing open space, flood-sensitive areas, and the green infrastructure network. Mapmakers highlighted Davidson County within the context of surrounding landscape by using the ArcGIS Online shaded relief map service and adding transparency to the green infrastructure network layer. Applying a transparency mask outside the Davidson County boundary served to lighten but not remove the areas outside the county.

More information on the green infrastructure network design approach is available at www.greeninfrastructure.net.



The Open Space Vision for Floodwater Management



Map by Will Allen and Jazmin Varela, The Conservation Fund, Chapel Hill, North Carolina, USA

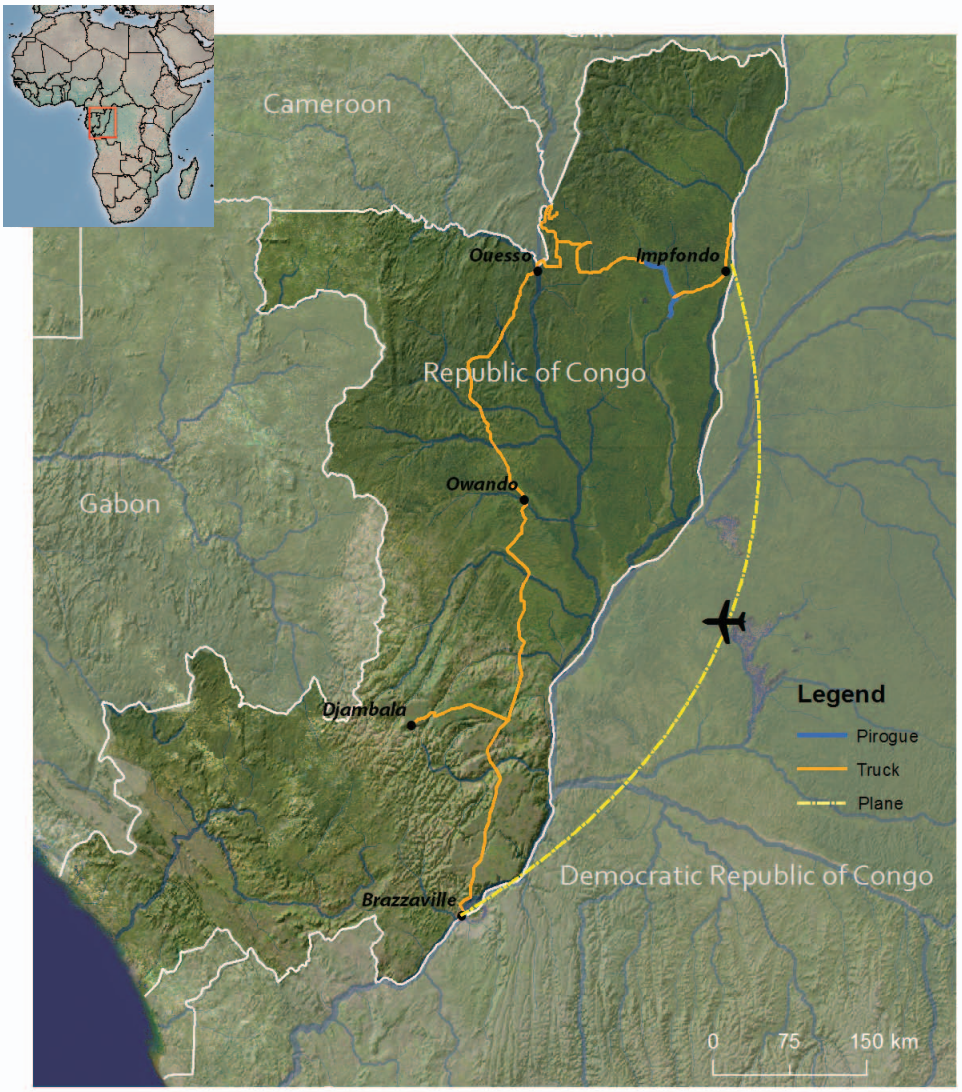
Water Sampling in a Rain Forest

Scientists from the Woods Hole Research Center (WHRC) embarked on an expedition to collect water data from the Congo River Basin, the world's second-largest river system and one of utmost importance for understanding the global carbon budget. Greg Fiske, WHRC's geographic information system manager and researcher, was part of the team. He was there, armed with vast quantities of spatial data, to ensure that the team stayed on the route during the expedition and to contribute to the sampling goals.

Supported by the National Science Foundation, the project, known as the Global Rivers Project, is a collaboration of several institutions around the world and focuses on six globally significant river systems: the Congo, Yangtze, Brahmaputra, Ganges, Kolyma, and Fraser. Fiske contributes his GIS skill and expertise to work with a selection of scientists, including geologists, geochemists, hydrologists, engineers, and remote-sensing experts, to explore the relationship between river chemistry and large-scale land-cover characteristics.

Within the Republic of Congo, the team traveled by four-wheel-drive truck on a southwest–northeast transect, covering 1,400 kilometers (roughly the distance from Massachusetts to North Carolina) through rough terrain, poor roads, insects, and days of soggy weather countered by days of stifling heat. November is the rainy season in the Congo, which was the main reason the trip was planned for that time. High-flowing rivers and wetlands at their peak created an ideal contrast between the sampled water chemistry from this trip and that from previous excursions taken in the dry season.

One of the key measurements was dissolved organic carbon (DOC), which is a generalized term for those organic components dissolved in marine and freshwater ecosystems. It is a key indicator of land disturbance and land-cover changes worldwide. As a doctor may take a sample of your blood to divulge information about the health and well-being of your internal systems, so too can scientists characterize the conditions of the land within a watershed by taking detailed chemical samples of rivers and streams. And DOC isn't alone. Scientists have an elaborate quiver of water chemical metrics that may define land-related changes within our world's major watersheds. In addition to DOC, water samples were analyzed for a variety of other constituents including dissolved and particulate forms of nitrogen and phosphorus, as well as temperature, salinity, pH, and a selection of dissolved gases.



The Global Rivers Project Congo expedition trekked more than 1,400 kilometers through rough terrain.

As with any statistical modeling, diversity is important in the sample set. GIS was used to find easily accessible major waterways where the areas of contribution (upstream watershed) covered the most diverse set of land-cover types available in the Republic of Congo. Latitude-longitude coordinates for each sample point were captured using a Garmin GPS and mapped regularly.

The Congo River Basin has the largest swamp forest in the world. It is where the team spent the majority of time collecting data. Team members traversed these forests in a pirogue (wooden dugout canoe), sampling water along the way. Despite the hardship of the journey, they were happy to encounter a variety of land-cover types: grasslands and croplands in the south, sparse forest areas in the nation's midsection, dense humid forests in the north, and finally swamp forests in the northeastern area of the country.

The team's goal was to collect data on each land-cover type in the basin as well as

samples from tributaries feeding those areas. In preparation for the trip, Fiske loaded spatial data onto his laptop, which the team used for indicating specific land-cover types that were important to analysis. He also created some GIS scripts to assess the upstream area and produce a selection of land-cover metrics within that area based on key remotely sensed GIS layers.

At the end of each day, Fiske uploaded the geocoded water sample data to his laptop running Esri's ArcGIS software. He overlaid water sample and land-cover type attributes on the remote-sensing data so the team could immediately see the results of its work and affirm that it was in the appropriate location. GIS brought together, on the fly, the sample points/locations and the spatial data. GIS displayed an area's tree cover, its biomass/carbon, high-resolution natural color imagery, and more. For the Congo area, important data layers include the percentage of swamp forest and seasonal inundation. (Other watersheds around the world may need different GIS data layers.)

Fiske also made good use of the ArcGIS Hydrology toolbox for a lot of the work on the project. This made work in the field easier. Between these tools and the custom scripts, at the river's edge, the team could click a button and query the GIS about the size of the upstream contributing area or the percentage of tree cover or other key land-cover types.

The challenge that made mapping difficult, and sometimes made fieldwork impossible, was the intense rain and the river waters. Fiske and other members of the team were constantly concerned about dropping gear into the river or losing it to the water in the bottom of a flooded pirogue. Sensitive gear was protected in waterproof bags and Pelican hard cases. Data was backed up on a USB-powered Passport external hard drive that was well secured in a watertight case.

The team had other duties besides data collection. As part of the National Science Foundation grant, some project funding is designated for outreach and education. The team visited schools in two communities in the Congo River Basin on this trip and distributed art supplies to the students. The children were asked to put pen to paper and describe, through art, the importance of their local river. Their pictures and drawings will become part of the My River, My Home exhibition, joining nearly 100 other pieces from students in Siberia and Canada. The exhibition will travel to galleries, and a virtual collection will be posted on the WHRC website.

In addition, the team worked with local people and trained them to collect water samples and metrics. This would allow the scientists to retrieve critical time-series information on the tributaries of the Congo. Because WHRC staff and partners worked with local students, teachers, and community leaders who live in the towns and villages within watersheds, they built partnerships for sustainable solutions.

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Over the side of a pirogue, researchers collect water samples in the swamp forest.

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Water Sampling in a Rain Forest

Upon returning to the United States, the team provided data and samples to associates who would use them to further study the attributes and relationships within the basin. Collectively, the members hope to reveal just how important dissolved organics and other key elements can be in detecting the impacts humans have on the land of the Congo River Basin. Their findings will provide the basis for understanding the health of a watershed and directing future watershed management.

Fiske is currently the GIS adviser for the Global Rivers Project. Using tools such as Esri's cloud map service ArcGIS.com, he has been able to share data with others and distribute commonly used base layers. He chose the Esri service because it is free and user-friendly, so even those with no GIS experience can use it. He posts project-wide base layers, such as stream networks, sample locations, and watershed boundaries, to Esri's GIS map service ArcGIS.com so that scientists and others can download maps and data directly into their own GIS projects. It is essential that the various river projects all use the same version of these layers. ArcGIS.com is also used to make maps of sample locations and other important layers that are shared among colleagues.

Fiske and others are also designing spatial models to show correlations of certain land-cover types and water chemistry variables in hopes of being able to extrapolate the rules defined by the Congo analysis to other portions of tropical Africa—places that would be much more difficult to go to and physically sample.

Expedition member Paul Mann greets students at a local school and talks to them about their river.

Donation Map Supports Orangutan Lands in Borneo

Orangutan Foundation International has launched a donation map application on its website orangutan.org. The map service, created and powered by Esri, is one of the foundation's fund-raising tools.

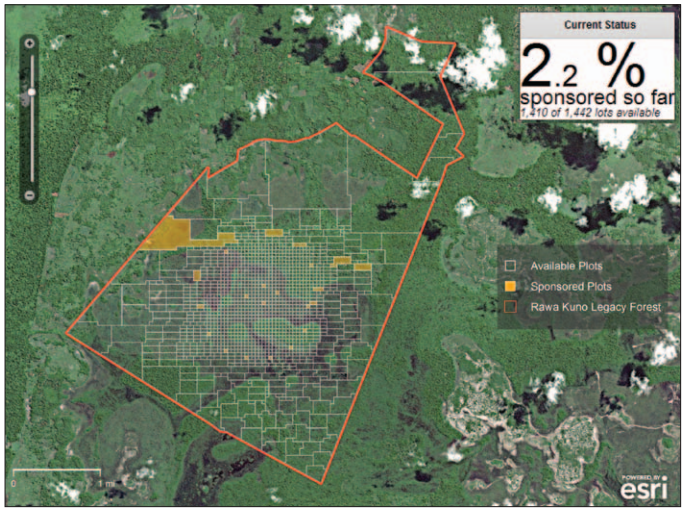
The map provides an interactive means for people to donate that connects them geographically with the habitat. It shows parcels of habitat in the Rawa Kuno Legacy Forest in Indonesian Borneo where orangutans live. The user selects a parcel to see its size and the donation amount assigned to it. Parcel polygons are filled when a donor claims it for support. The user can then click an Add to cart button and proceed to check out.

Orangutan Gary checks to see if a human primate has sponsored his jungle neighborhood.

To create the application, Esri developers used ArcGIS for Desktop and ArcGIS for Server. ArcSDE was used in the editing. The site is hosted in the cloud on the Society for Conservation GIS (SCGIS) server and can be seen on ArcGIS.com. Donation tools are only available by accessing the donor map via the Orangutan Foundation International website.

"Esri set up the application for us, and it is run on the Esri cloud service for SCGIS," explained Binti Brindamour, who manages the Orangutan Foundation International website. "We did not need to do really much of anything. This was easy."

Orangutan Foundation International uses ArcGIS to map intact forest and prime orangutan habitat, as well as areas of logging and agriculture, to identify and plan for areas where management is most needed.



Donors can use the Orangutan Foundation International map to select a parcel to support orangutan habitat.

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Conference of the Parties (COP) 17
November 28–December 19, 2011
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Cop17durban.com

Federal GIS Conference
February 22–24, 2012
Washington, D.C., USA
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Esri Developer Summit
March 26–29, 2012
Palm Springs, California, USA
esri.com/devsummit

World Environmental and Water Resource Congress
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