

healthyGIS

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GIS for Health and Human Services

Mapping, GIS Analysis, and Web Services Help American Red Cross Outreach

American Red Cross Uses GIS for Hurricanes Katrina and Rita Efforts

The American Red Cross is in the business of helping people, providing relief in response to natural disasters for nearly 150 years. Its mission as a humanitarian organization led by volunteers, guided by its Congressional Charter and the Fundamental Principles of the International Red Cross Movement, is to provide relief to victims of disasters and help people prevent, prepare for, and respond to emergencies.

The American Red Cross responded to Hurricane Katrina with tens of thousands of new volunteers bringing aid to hurricane sur-

vivors. More than 177,000 American Red Cross workers from all 50 states were deployed on the scene to provide more than 19 million hot meals and 2.6 million overnight stays in 902 shelters across 25 states. The American Red Cross estimates Hurricane Katrina relief costs will exceed \$2 billion, with assistance including food and shelter, emergency financial assistance, physical and mental health services, and more.

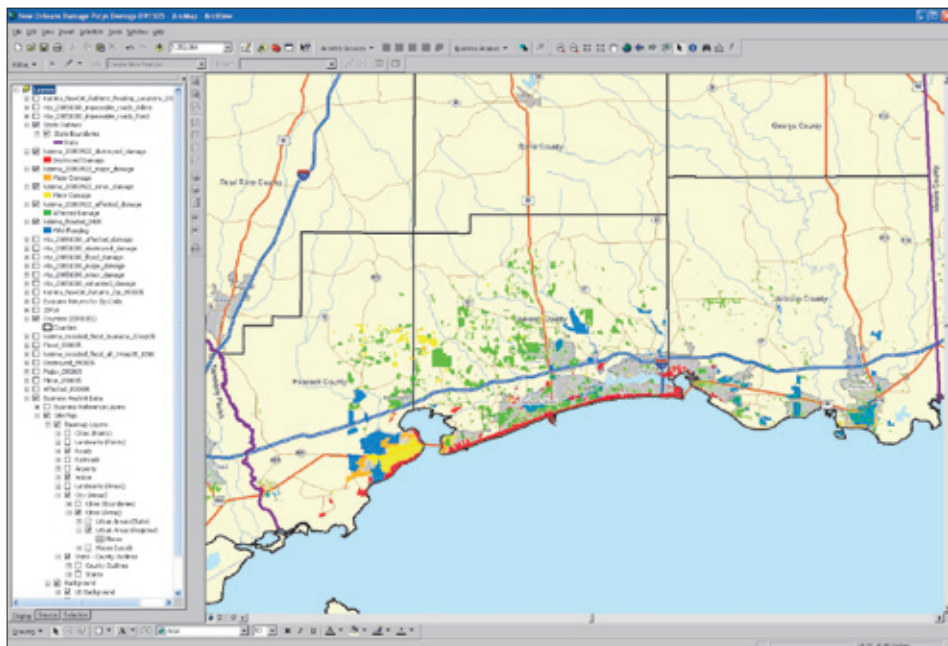
As part of its hurricane emergency management strategy, the American Red Cross used GIS for its many different hurricanes Katrina and Rita relief efforts. Computer mapping, spa-

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tial analysis, and GIS Web services assisted the agency in providing communities and displaced people with food, clothing, shelter, and other essential services. Whether setting up shelters, hotel housing, or emotional support programs or providing meals, the American Red Cross used GIS technology to support senior-level staff at its headquarters in Washington, D.C., as well as staff operating at local forward command centers.

“We use GIS at the American Red Cross to provide information to senior executives who use maps to make better, more informed decisions,” says Greg Tune, lead program manager for disaster assessment and GIS, American Red Cross. “The types of work we do using GIS would have been very slow moving without the technology. What would have involved foldout paper maps and ‘sticky’ notes now is a fully automated, constantly updated process. Perhaps most important, the kinds of mapping and analysis we can do can be targeted based on need or request. We are more responsive and effective because of the technology.”



Mississippi Gulf Coast showing damage polygons from the Federal Emergency Management Agency

continued on page 4

Health and Human Services Events—ESRI on the Road

2006 ESRI Federal User Conference

January 31–February 2
Washington, D.C.
www.esri.com/feduc

Healthcare Information and Management Systems Society (HIMSS) Annual Conference and Exhibition

February 12–16
San Diego, California
www.himss.org

National Association of County and City Health Officials (NACCHO) 2006 Local, State, and Federal Public Health Preparedness Summit

February 22–24
Washington, D.C.
www.naccho.org

Association for Community Health Improvement 2006 Annual Conference

March 14–16
Phoenix, Arizona
www.communityhlth.org

National Association for Public Health Statistics and Information Systems (NAPHSIS) Annual Meeting

June 4–8
San Diego, California
www.naphsis.org/events/index.asp

NACCHO 2006 Annual Conference

July 26–28
San Antonio, Texas
www.naccho.org

ESRI International User Conference

August 7–11
San Diego, California
www.esri.com/uc

For registration and information about ESRI-sponsored events, visit www.esri.com/events.

Join the Health and Human Services User Group

Health and Human Services Public Domain Templates for ArcPad

The Health and Human Services ArcPad public domain templates are located on ESRI's Web page at www.esri.com/arcpadtemplates. The Web page allows users to search and download various scripts and sample codes contributed by ESRI's user community.

The templates vary from tools and applets to forms, all of which illustrate the practical benefits of ArcPad. These templates are not designed as end solutions; rather, they are a starting point for creating a user's own ArcPad project.

Emergency Medical Services—Accident Data Collection Form

This script replicates the basic “ambulance run” form that is used to collect patient information on arrival and during transport. The form is based on a Scantron F-1612-ICEMA apparatus, which is used by most emergency medical technicians.

Mosquito Control Field Inspection Template

This template replaces paper-based inspections of mosquito incidence and collects GPS coordinates for sites. This template includes electronic forms for recording new site locations and collecting information about adult and larvae mosquitoes, types of habitats, and any treatments implemented.

Mosquito Control Field Survey

This template allows ArcPad users to collect information about the locations and habitats of mosquitoes. This template collects attribute data on adult and larvae mosquitoes and their habitats as well as treatments that have been applied.

Mosquito Resistance Testing Template

This template allows ArcPad users to collect information on the testing and evaluation of insecticides. This template is designed to collect insecticide resistance data from a grid pattern of mosquito cages.

Patient Registration

This script allows ArcPad to collect general patient registration information used by a doctor's office, health facility, or emergency room. This is a nonspatial form that accepts all personal information and updates a Microsoft Access database via a wireless local area network.

Smallpox Postevent Surveillance Form

This script replicates the Centers for Disease Control and Prevention (CDC) Smallpox Postevent Data Collection form. Data validation has been incorporated into the script along with the ability to print the form. The script can be easily modified for the direct input of longitude/latitude either manually (by reference) or by GPS.

World Health Organization

Village Mapping/Dengue Fever Surveys

This script enables ArcPad to be used as a custom data collection system for World Health Organization (WHO) health monitoring programs. It includes the WHO village mapping and dengue fever questionnaires. This script allows the direct input of attributes and longitude/latitude into a local database as well as updating an RDBMS via wireless data transfer.

Join the ESRI Health and Human Services User Group

The Health and Human Services User Group is open to individuals who use ESRI technology for their health and human services GIS applications. To join this unique group of health and GIS professionals representing more than 15 countries, please use the online registration form at www.esri.com/industries/health/news-community/hug.html.



From My View...

*By Bill Davenhall
Global Manager
Health and Human Services*

Katrina: a Better Case for GIS?

Katrina will long be remembered by the misery and suffering that so many people endured during the weeklong siege of an entire community by one of the strongest hurricanes to strike North America in many decades. In fact, Katrina was just one of a half dozen hurricanes and typhoons observed during that terrible week. The obvious heroes were those who braved the rising waters to rescue people and pets; less obvious were hundreds of GIS professionals who scrambled to assemble data and software so that rescue and relief efforts could become effective sooner. Some of you reading this were among those unseen heroes.

We saw Web sites launched to locate missing relatives, shelters, and resources. We saw dramatic satellite photos with only watery street outlines and rooftops showing. We even witnessed a daring “data rescue” of land records from a building in New Orleans. These incidents did not happen by accident. Behind the scenes were information technologists struggling to overcome power outages and doing their job without much fanfare.

Having recently traveled to Europe, I witnessed floods that ravaged central Europe; I saw televised maps that estimated village flooding and evacuation routes to help victims and rescuers take evasive action. These were only possible because someone had previously made a decision to have GIS in place.

These recent cataclysmic events raise tough questions. Are health and human services organizations really prepared? Have they identified the essentials such as having the right databases built and accessible in an emergency? Do they have the necessary backup systems of software, hardware, power, and staffing to handle major emergencies or catastrophic events such as the ones we have seen around the world this past year?

We say that “practice makes perfect,” but what we practice for and the energy with which we practice might need to be reevaluated. There is little doubt that we need to learn more about redundancy and incident command practices.

Katrina demonstrated that GIS is an essential information technology that supports the entire spectrum of health and human services. No one had ever practiced evacuating an entire city. And no one ever practiced an evacuation without access to “trusted” technologies such as computers, copiers, phones, cars, and so forth. One thing that did continue to work was the Internet—the main forum of communication during the catastrophe. I received e-mail messages from people using personal e-mail accounts as they fled the region but stayed connected.

If we did learn one thing as GIS professionals, it might be that thinking about the worst case simply is not enough and being ready for the worst case requires a great commitment to build the data, software, staff, and hardware structures and systems that can survive another Katrina-sized hurricane.

I predict the “Katrina effect” will cause many of us to rethink our organizational GIS strategy and take greater responsibility for better preparing our communities.

Hats off to all the health and human services professionals who stepped up to face nature’s intense schedule of calamities in 2005.

As always, second opinions are welcomed.

Bill

Geography Matters to...

Pradeep Gidwani

*Deputy Director
Department of Defense, Health Affairs/
TRI CARE Management Activity/HPAE*
Geography is a vital component of our nation’s security strategy. America’s commitment to provide worldwide humanitarian support, mitigate conflict, and ensure homeland security requires military planners to incorporate geographic dimensions of culture, politics, economics, and human nature.

Daniel Block

*Associate Professor
Coordinator of Neighborhood Assistance
Center, Chicago State University*
...the Neighborhood Assistance Center because everything we do involves place and spatial patterns. Supermarkets are located in a place, diseases occur in a place, and lead contamination occurs in a place. Maps of these places make patterns. The patterns suggest answers, but we need to study the places to truly understand them.

Charles L. Thomas

*Research Biostatistician
Center for Health Care Research and Policy*
... the Center for Health Care Research and Policy because incidence, prevalence, and cause of disease are brought to better resolution upon incorporating mapping and spatial analysis techniques.

Andrew Barnes, MPH

*Senior Project Manager
National Health Foundation*
At the National Health Foundation, we are concerned with improving access to health care for underinsured and uninsured populations. Embedding spatial thinking into our programs and analyses allows us to deliver more holistic solutions and make more informative decisions. Incorporating built and physical environments into health access research creates a better opportunity to identify barriers and discover practical ways to overcome them.

American Red Cross Uses GIS for Hurricanes Katrina and Rita Efforts

The American Red Cross and GIS

ESRI provided on-site staff and resources from its Washington, D.C., office to quickly expand and extend the existing American Red Cross GIS platform. In addition, ESRI specialists at the Redlands, California, headquarters worked closely with American Red Cross personnel to develop a Shelter Locator ArcWeb Services Web site (arcweb.esri.com/redcross) that provided information, such as address, capacity, population, and other descriptors, available to both internal American Red Cross staff and the public.

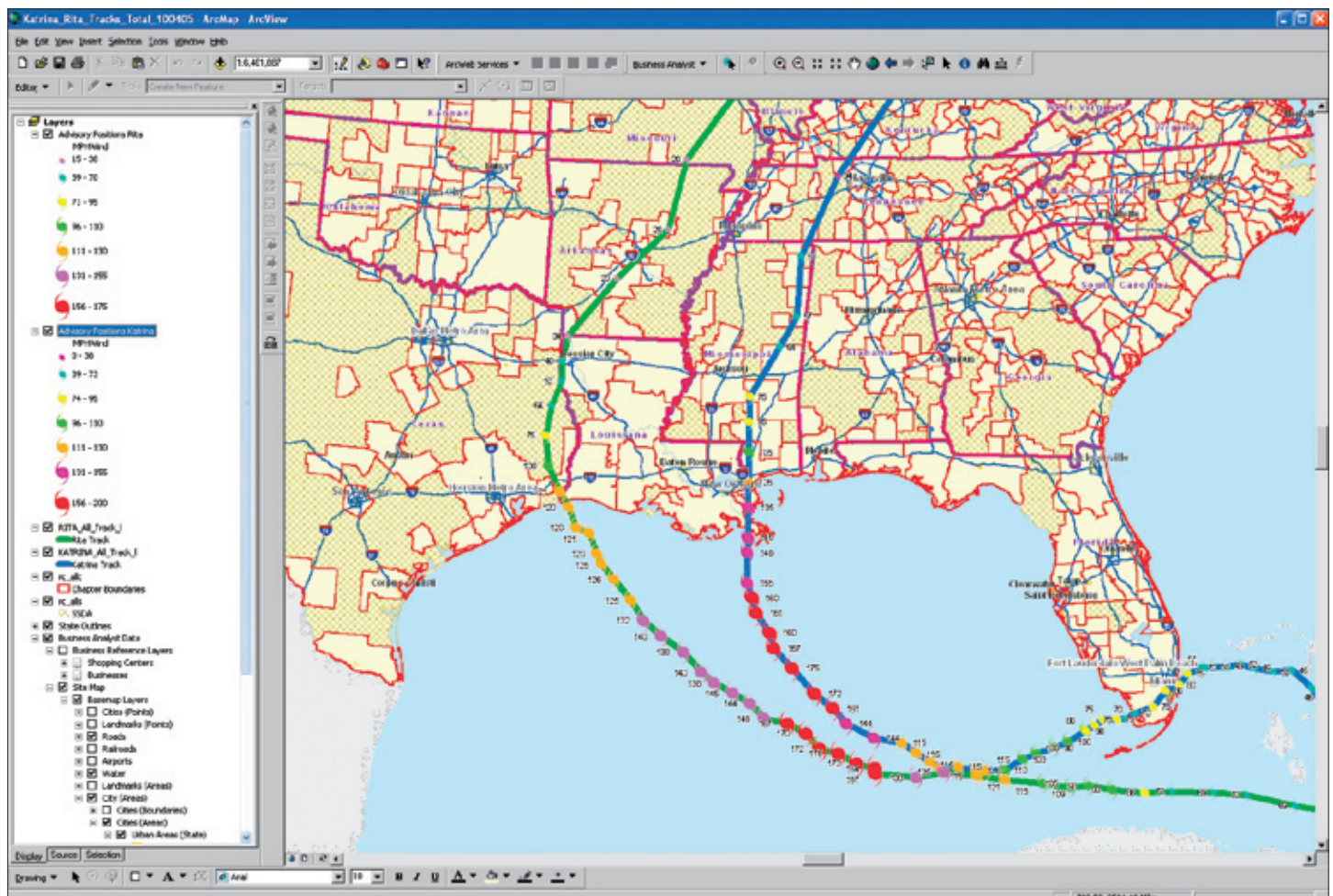
General mapping and GIS support included maps used for preplanning and response. Personnel, equipment, supplies, and other resources were strategically placed and planned for using GIS-generated maps prior to hurricanes Katrina and Rita making landfall. This included identifying counties at risk and

counties that would serve as host sites for shelters, supply centers, and other forward operating facilities. As the hurricane barreled over land, work was done on the fly using ArcView software's ArcMap application to calculate exactly what was happening at various locations. Postevent response included damage assessments; hurricane wind field GIS-generated maps; and maps, charts, and reports depicting the number of people impacted by the hurricane including displaced people. The high volume and demand for maps and GIS analysis resulted in thousands of maps generated and used throughout the American Red Cross.

"We typically start with county-level maps, which is how the American Red Cross tends to start analysis, with larger city layers, including streets, highways, chapter jurisdictions, and other infrastructure, and we add to it," says Tune. "This includes wind fields, damage

polygons digitized from remote-sensing imagery, and extracted demographics. This helps us better understand the population and affected households and other factors involved in shelter, feeding, medical assistance, and other American Red Cross services."

GIS had been deployed by the American Red Cross prior to the impact of hurricanes Katrina and Rita, aiding in its ongoing planning sessions and thousands of relief operations the organization responds to every year. GIS helped the American Red Cross map potential shelters and American Red Cross jurisdictions and identify potential hurricane "risk" and "host" counties among its network of more than 800 chapters. Once identified, the American Red Cross could then better work with local governments and local emergency management in planning sessions that ultimately helped in its Katrina response and will help in future events.



Hurricanes Katrina and Rita storm tracks

The American Red Cross also uses ArcView with ArcGIS Business Analyst, ArcGIS Tracking Analyst, ArcGIS Spatial Analyst, and ArcSDE.

“We’re the information provider,” says Tune. “We take raw data and help turn it into something people can read and understand. Maps with demographics, tables, and other information are what we provide for prestaging and postevent assessments and response. When the storm hits and makes landfall, we’re much better prepared and closer to the action to get our resources in to help the people who have been affected.”

In addition, a separate hurricanes Katrina and Rita internal Web mapping application utilizing ArcIMS was implemented for use by the American Red Cross chapters and staff in the field to view all types of information in customized digital map form. American Red

Cross users could log on to the site and select map layers for shelters, kitchens, damaged and flooded areas, affected ZIP Codes, and evacuate hotels. Data was provided for various dates so that users could access information within a temporal context and view the hurricane impact over time. Viewers could pan, zoom, identify items, and select specific information they would like to map.

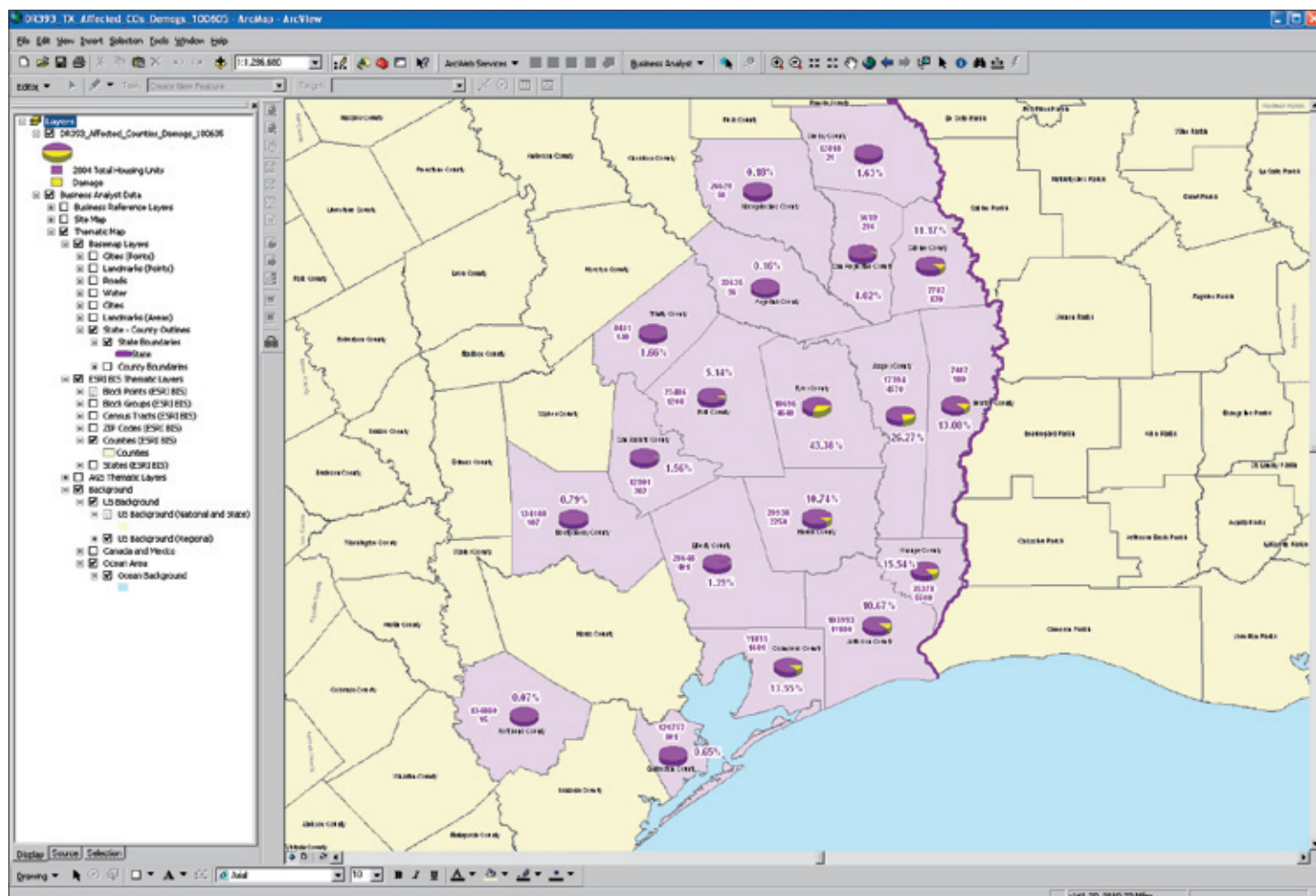
“Emergency response depends on accurate data that can be integrated from a number of sources and translated into actionable, useful information,” says Tune. “That’s the power of GIS. It helps in all phases of an emergency including planning, mitigation, preparedness, response, and recovery. It played a vital role in our hurricane response, and it will play a vital role in the future.”

“Using GIS technology,” says Eric Maier, ESRI commercial account manager, “the

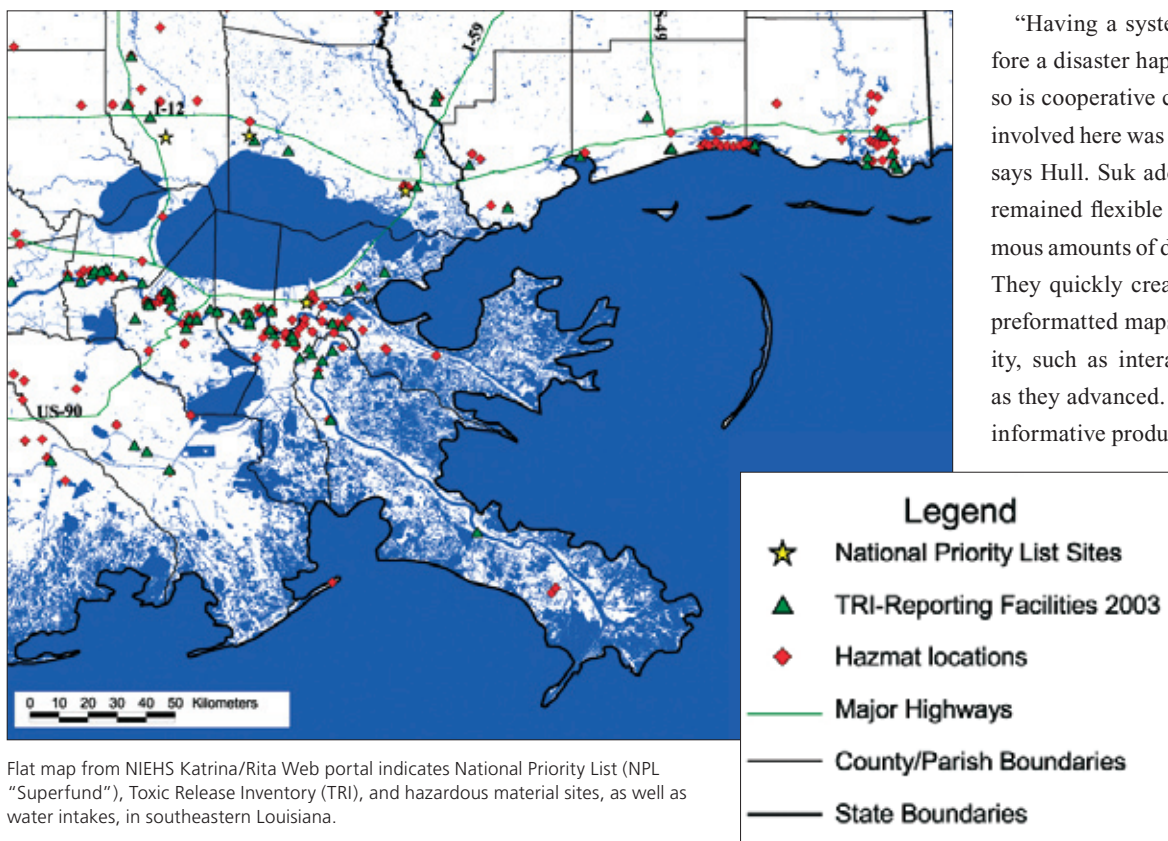
American Red Cross was able to better plan prior to hurricanes Katrina and Rita as well as respond with greater flexibility and precision after the events occurred.”

For more information, contact Greg Tune, lead program manager, Disaster Assessment/ GIS, American Red Cross Preparedness and Response Operations (telephone: 202-303-8659, e-mail: tuneg@usa.redcross.org).

To see the Shelter Locator, visit arcweb.esri.com/redcross.



Texas counties affected by Hurricane Rita with 2004 housing unit demographic (top number) and damaged housing units



Flat map from NIEHS Katrina/Rita Web portal indicates National Priority List (NPL "Superfund"), Toxic Release Inventory (TRI), and hazardous material sites, as well as water intakes, in southeastern Louisiana.

"Having a system such as this in place before a disaster happens is really important and so is cooperative collaboration—and everyone involved here was very willing to do the work," says Hull. Suk added that the group members remained flexible when confronted with enormous amounts of data and the short time frame. They quickly created a basic version offering preformatted maps and then added functionality, such as interactive mapping capabilities, as they advanced. This enabled them to put an informative product online in one week.

Now, as efforts change from emergency response to cleanup and rebuilding, the GIS site continues to be relevant. "I think it is also going to point to needs for new and innovative technologies to help us better predict not only expo-

- Assessing human exposures that occurred in the immediate aftermath of the hurricanes
- Researching the immediate and long-term health impacts associated with these exposures

Data layers included the locations of Superfund and Toxic Release Inventory (TRI) sites; oil production, extraction, refineries, and pipelines; industrial facilities; agricultural operations; schools; and medical facilities for Alabama, Mississippi, and Louisiana (and later, Texas) as well as aerial imagery from the National Oceanic and Atmospheric Administration and the U.S. Geological Survey.

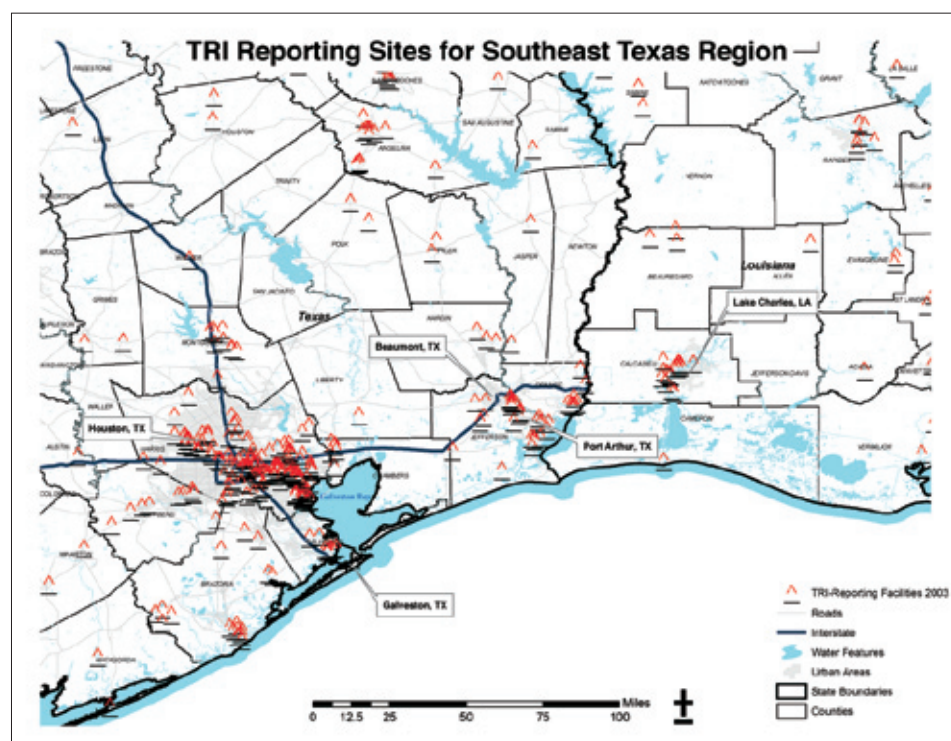
Working with ArcGIS ArcView, the GIS team members used ArcMap to project latitude and longitude points from data they received in text format, assign common projections to all the data collected, and produce both the overview flat maps and detailed grid maps. They used ArcCatalog to update and maintain all the associated metadata.

Just two weeks after the site was up and running, Hurricane Rita arrived. Fortunately, connections between agencies had already

been made and relevant data had already been collected. Adjustments were quickly made to include Rita impact areas based on previous lessons learned.

sures from catastrophes but also exposures in general," says Suk.

For more information, contact hurricanegis@niehs.nih.gov.



Flat map from NIEHS Katrina/Rita Web portal indicates TRI sites in southeast Texas.

North Carolina Implements Statewide Mobile GIS for Public Health Emergency Evaluations

State Conducts Rapid Health Needs Assessment

The North Carolina Office of Public Health Preparedness and Response (PHP&R) is tasked with responding to natural disasters and to natural or bioterrorist-caused disease outbreaks. When emergencies occur, information about immediate health needs must be collected before a plan for action can be prepared. As a result, public health personnel collect information in the field, often under time pressure.

A tool for making field surveys is the Rapid Needs Assessment (RNA), a methodology developed by the Centers for Disease Control and Prevention (CDC) and World Health Organization. Teams must decide what their information needs are and where to survey, then go to the field with questionnaires, inter-

view people, and transfer the information to a central computer. Traditionally, workers fill out paper questionnaires and the data is later entered into a computer database. This preliminary data collection is both the bottleneck and foundation for later action.

PHP&R has divided responsibility for the state's 100 counties among seven Public Health Regional Surveillance Teams (PHRSTs). Each team coordinates with county health agencies and includes an epidemiologist, industrial hygienist, and administrative specialist as well as a nurse consultant, pharmacist, and veterinarian liaison. PHRSTs may be called on to conduct the RNA after a natural disaster. In North Carolina, the disaster would most likely be a hurricane.

Mark H. Smith, Ph.D., epidemiologist for the Guilford County Department of Public Health and PHRST region 5, wanted to find a more efficient way to conduct RNAs. Realizing that the data was location based, he sought a GIS solution. "If necessity is the mother of invention, then the mother of this project is the need to speed up the response time," says Smith.

"The project has its origins in an article that appeared in *ArcUser* about the Pennsylvania West Nile virus program where they collected dead bird data from the field using handheld computers with GPS," adds Smith. "It occurred to me that this technology could have numerous applications in terms of bioterrorism preparation and response."

Pilot Project

Assisted by ESRI business partner Bradshaw Consulting Services, Inc. (BCS), the PHRST

region 5 team, with Smith as project coordinator and hosted by the Guilford County Department of Public Health, began building a pilot mobile GIS application in 2002. ESRI provided ArcGIS ArcView, ArcPad, ArcPad Application Builder, and ArcPad StreetMap software, which PHRST combined with purchases of Hewlett-Packard iPAQ 5550 and 5450 handheld computers and Teletype World Navigator 1653 GPS receivers.

"ArcPad and ArcPad Application Builder allowed us to develop highly customized data collection forms for easy data entry, tie this information to GPS coordinates, and store all data in ESRI shapefiles or in external databases such as Microsoft Access," says Joey Wilson, BCS mobile technologies manager. "Data is analyzed on the desktop using ArcView as well as CDC's Epi Info analytical software." BCS provided hardware/software installation, testing, and configuration; developed customized data collection forms; and designed and delivered several GIS training classes.

Methodology

Smith explained that the RNA involves a two-stage random sample selection methodology requiring a population-weighted random selection of 30 geographic clusters. ArcView is used to select the 30 census block groups, and its point-in-polygon random point generator selects seven household points in each census block group. A generator script is then employed to output the random points onto the handheld computer in ArcPad StreetMap, which then converts the points into stops on a route.

Interviewers use the handheld computers, GPS, and ArcPad StreetMap routing feature to find the interview location. They collect latitude and longitude coordinates for their customized interview form by tapping on the GPS button in ArcPad. After interview completion, teams return to a staging area, upload their data onto a laptop computer, and import it into a statistical analysis program. A completed report soon follows.



Mobile unit with ArcPad installed displays a preformatted questionnaire and allows rapid field data entry.

Benefits

"This application significantly improves traditional paper questionnaire collection methods," says Smith. He explains that GIS technology introduced a new method for randomization in the selection of households and also simplified the mapping process. Overall, it allowed faster assessment, improved mapping and reporting, and increased data accuracy.

The team successfully used the methodology for a statewide bioterrorism exercise in 2003. In 2004, the team responded to two real emergencies, a Legionnaires disease outbreak investigation and Hurricane Charley. The hurricane response resulted in North Carolina being one of the first states to conduct a health RNA without federal help from CDC.

Rapid Response Project 516

The pilot's success led to statewide implementation in 2005 under phase one of Rapid Response Project 516. BCS again participated, presenting three levels of mobile GIS courses to PHRST personnel. In addition, the University of North Carolina, Greensboro, Geography Department developed and conducted a public health GIS training course.

The final exercise emulated a statewide emergency in which 50 people conducted interviews using handheld computers as though they were canvassing a neighborhood after an ammonia spill. Returning to the staging area, they uploaded data to one of seven regional PHRST laptops that wirelessly sent everything to a master laptop. The accumulated data then traveled through a wireless Internet connection to an ArcSDE server in Raleigh, North Carolina, where results were displayed on the Web.

Completion of statewide implementation paved the way for plans to extend mobile GIS to nonemergency county health activities in North Carolina.

"I have already used the technology to do community health assessments that are not really emergency responses, and I feel our approach does give a better representation of the



Mobile unit with ArcPad and ArcPad StreetMap installed displays a map of the survey area.

community," says Steven K. Ramsey, R.S., team leader and environmental health specialist for PHRST region 5. "We also use it as a chance to exercise the same technology and concepts as in an emergency situation, except that we are getting data about current community health care situations."

For more information, contact Mark H. Smith at msmith@co.guilford.nc.us or visit BCS at www.bcs-gis.com.

Notable Links

<http://statecancerprofiles.cancer.gov>

A joint project from the National Cancer Institute and CDC, the State Cancer Profiles Web site is designed to characterize the cancer burden in a standardized manner across the United States. A new interactive mapping component has just been added that generates state and county cancer mortality maps.

www.pphtc.org/resources/ViewListserv.htm

The Pacific Public Health Training Center (PPHTC) is a combined effort of the four accredited Schools of Public Health in California and the University of Hawaii's School of Nursing and Dental Hygiene. The center's goal is to develop and support public health training opportunities that are consistent with Healthy People 2010 objectives. The ListServ page provides access to monthly updates on PPHTC public health news information covering events, training opportunities, resources, and more.

www.cnnngis.org

The California Nutrition Network mapping application is an interactive, Internet-based GIS that allows users to view and query mapped nutrition data. The application contains a rich set of nutrition and other health-related data including nutrition and school health programs; the Women, Infants, and Children Program; grocery stores and other local nutrition resources; demographics (race and spoken language) of general and at-risk populations; and various Department of Health Services regions.

www.jivita.org

Jivita 1—This vitamin A and micronutrient supplementation trial study involves 54,000 pregnant women in rural Bangladesh. Through this study, scientists hope to establish the importance of an adequate intake of vitamin A and beta carotene in improving maternal, fetal, and infant health and survival.

Missouri Health Agency Conducts Operation Blue Ribbon 2005

GIS Emergency Response Field Exercise

The Missouri Department of Health and Senior Services (DHSS) GIS unit sponsored a critical incident exercise June 28–30 in Sedalia, Missouri. Operation Blue Ribbon simulated an *Escherichia coli* (*E. coli*) outbreak at the Missouri State Fairgrounds. The primary purpose of the exercise was to develop and improve the technical skills of GIS users for local public health agencies (LPHAs). The exercise also tested the emergency functions for GIS professionals at the Missouri Department of Health and Senior Services in their mobile command center.

Personnel from six different LPHAs, University of Missouri Extension office, Kansas

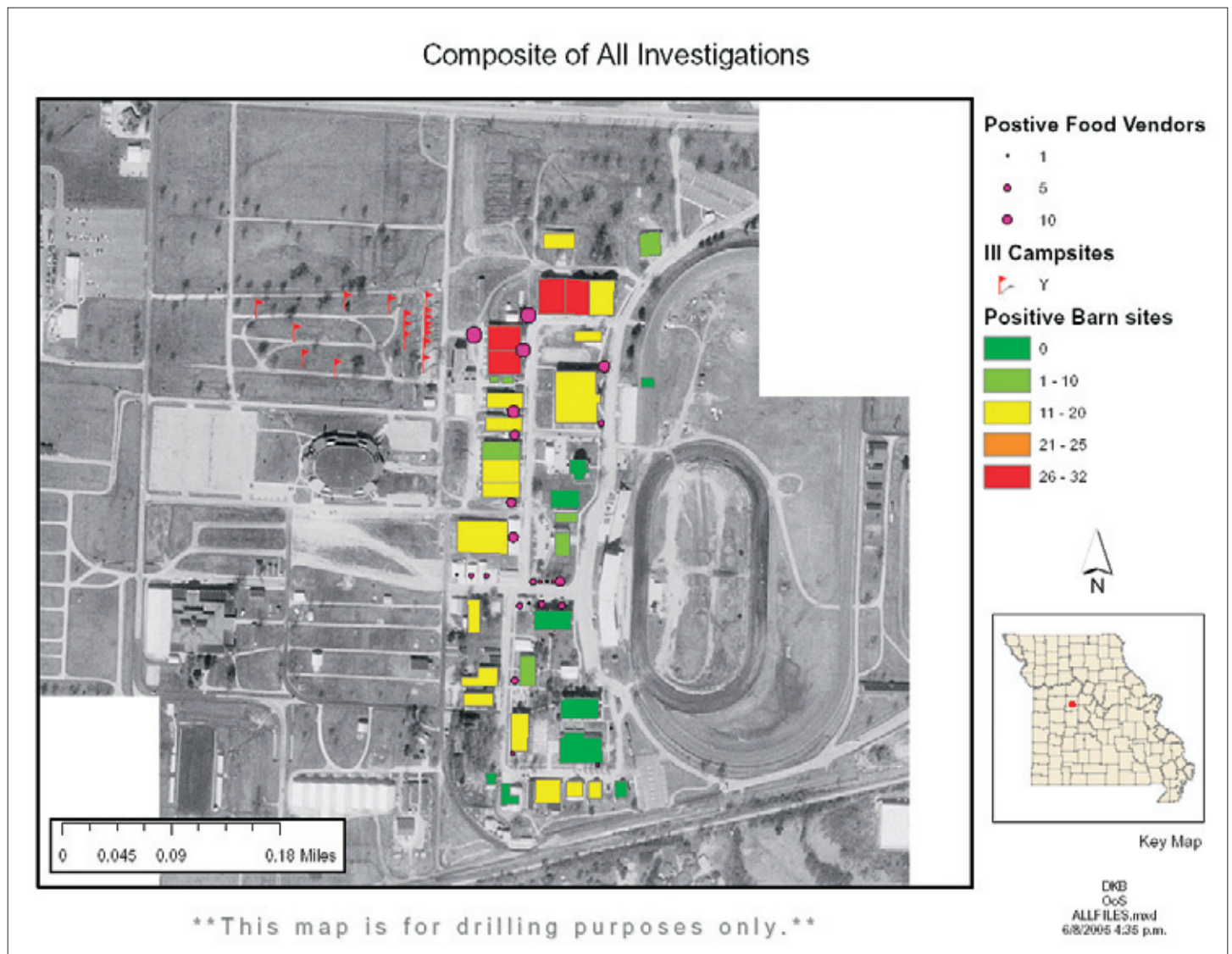
Department of Health and Environment, and Missouri Department of Health and Senior Services attended the exercise. The group was divided into smaller teams, with each team consisting of regional bioterrorism planners, epidemiology specialists, environmental public health specialists, and others. Each team had a designated GIS professional from DHSS serving as an advisor—handing out tasks and providing guidance when needed.

In the simulation, 26 people became ill by the fifth day of the fair, and laboratory tests confirmed the presence of *E. coli* 0157:H7. In the scenario, investigators were already on-site, and the teams were requested to provide

GIS support. Throughout the day, teams faced tasks involving data collection, processing, analyzing, and display.

Tasks included using patients' home addresses to show the effect of the outbreak across the state and finding the best location for a temporary clinic. Another task had teams using their GPS receivers to return to previous sampling sites and collect additional information.

The epidemiological investigation had teams assisting in three main areas: food vendors, livestock barns, and campgrounds. For the food vendors, investigators conducted interviews and had a list of all ill persons and the



Aerial image with mapped composite of all data collected during the Missouri Department of Health and Senior Services Operation Blue Ribbon exercise

places where they ate. Using GIS, team members were able to quickly show which food vendors were of concern to investigators.

While interviewing the affected persons, investigators had each individual mark on a map which barns he/she had visited. These maps were then given to the GIS teams, who had to compile the data and show which barns had more visits by affected people.

Campground investigation team members collected data at each campsite using GPS receivers and recording which campers reported feeling ill. In the final task, teams used GIS to combine food vendor, barn, and campground data. By combining the data, investigators could immediately see specific trouble areas at the fairgrounds.

With the completion of the exercise, teams concluded that the source for the E. coli in the scenario was a contaminated livestock barn. Widespread contamination occurred through airborne transmission. Ventilation fans spread the pathogen to the nearby campground and eating establishments.



Team Yellow members compile investigative data to locate possible contaminated livestock barns.

In addition to analyzing the E. coli outbreak scenario, participants also listened to presentations on the newest GIS/GPS techniques and

concepts. They completed several desktop and field exercises demonstrating these new techniques. Participants also met on the final day to discuss the exercise and share information on lessons learned and difficulties encountered.

Operation Blue Ribbon was conducted as part of the DHSS local GIS program. Currently, 26 local health departments participate in the program in which DHSS GIS professionals provide software, training, and support. Through this program, GIS is being utilized at the local level for projects such as emergency response, disease investigation, and environmental public health.

For further information, contact Debbie Briedwell, GIS specialist, Missouri Department of Health and Senior Services, at briedd@dhss.mo.gov.



Team Blue members use a GPS receiver to find previous sample sites while their advisor looks on.



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