Using Geographic Information System Technology to Improve Emergency Management and Disaster Response for People With Disabilities

Alexandra Enders and **Zachary Brandt**
Research and Training Center on Disability in Rural Communities

Disability, as a product of person–environment interaction, is particularly sensitive to catastrophic events and disasters. Disasters are specific to a physical location, as are the resources needed to handle the aftermath of the event. Geographic information systems (GIS) technology provides the ability to spatially coordinate resources from separate systems, which is vital for emergency management. GIS provides the capacity to go beyond surveillance and identification of at-risk people with disabilities to actively address the spatial nature of the person–environment interaction. GIS may provide the basis for further investigation and development of the science of environmental factors in the person–environment interaction. Mapping resources, and not just people, in the environment can change the perception and portrayal of people with disabilities in disaster incidents from people with "special needs" to people and organizations that are community contributors. Disability policy advocates, working at the state level, need to get disability-relevant geospatial data into the critical infrastructure used for emergency planning and response. A map showing the proximity of available resources demonstrates the importance of GIS to people with disabilities by identifying available resources in disaster response and recovery.

Disability is increasingly understood as "a gap between a person's capabilities and the demands of the environment" (Pope & Tarlov, 1991, p. 1). The World Health Organization's *International Classification of Functioning, Disability and Health* (2001) stresses the critical role of environmental factors in enabling people with physical or mental impairments and activity limitations to participate in society (Field, Jette, & Marin, 2005). The social model of disability focuses on interaction with the environment—social, cultural, economic, and physical (Shakespeare, Bickenbach, Pfeiffer, & Watson, 2006). Whiteneck (2005) suggested that "there is much to learn about the actual role of environmental factors in the disability process, and researchers need to develop some theory underlying the concept that helps explain under what conditions barriers actually mean that participation does not occur" (p. 62).

Disasters almost always present conditions where environmental factors interfere with participation, sometimes with dire consequences. However, disaster experiences, because they are so extreme, can add to the understanding of critical factors in the person–environment interaction. Disasters occur in a physical space. Disasters are always local. Disasters disrupt the social, cultural, economic, and physical environment. In the midst of the disruption, environmental factors become visible in ways that would normally be overlooked and difficult to measure in the regular course of day-to-day events. For example, disasters do not respect governmental jurisdictions—hurricanes cross state lines, floods don't stop at the city or county limits, volcanic ash and radioactive fallout carry across oceans, a flu epidemic can be global. A disaster that crosses jurisdictions—more than one town, or county, or state, or country—also reveals variations in administrative responses to the same event. When significantly varied responses are evident in different affected jurisdictions, the differences in policy environments become more obvious. A geographic information system (GIS) can play a role in identifying spatial differences in response patterns. Retrospective analysis, with identification of best and worst practices, can lead to lessons learned, operational systems changes, and broad-based policy realignment.

GIS: Dynamic Tools for Analysis and Coordination

GIS may provide the basis for further investigation and development of the science of environmental factors in the person–environment interaction. GIS provides tools for actively working with the spatial nature of the person–environment interaction. GIS also provides a better understanding of the role and impact of environmental factors. Location is the sin-

gle thread common to all data (National States Geographic Information Council [NSGIC], 2006).

GIS enhances the usefulness of data for decision-making. For example, GIS provides the ability to spatially coordinate resources from separate systems, which is vital for disaster management. Effective planning for response involves acquiring the information, data, and resources necessary to respond. The analytical capabilities of GIS support all aspects of disaster management: planning, response and recovery, and records management.

During a crisis, effective response and recovery includes incident mapping, establishing priorities, developing action plans, and implementing the plan to protect lives, property, and the environment. GIS allows disaster managers to quickly access and visually display critical information by location. This information can easily be shared with disaster response personnel to help coordinate and implement emergency efforts. Mobile GIS allows the command center to stay in touch with personnel at the incident and to gather data critical for making decisions (ESRI, 2006).

Another important consideration is that "first responders, whether fire service, law enforcement, or medical emergency, are essentially at the risk of their information and the systems designed to produce it. To respond intelligently requires significant levels of spatial awareness only attainable through the use of a GIS" (Johnson & Davenhall, 2005, p. 10).

The National Council on Disability (2005), in its report *Saving Lives: Including People with Disabilities in Emergency Planning*, includes a recommendation that GIS be used to ensure that any surveillance systems used to assess risk include people with disabilities. The Research and Training Center on Independent Living at the University of Kansas (2005) included a recommendation in its *Nobody Left Behind Briefing Paper* to develop GIS mapping to identify population density and location of people with disabilities and to find ways to include disability in the GIS systems used by emergency management systems. Wilson, North Carolina, and Cedar Rapids, Iowa, were cited as models.

In an emergency, GIS provides the capacity to go far beyond surveillance and identification of at-risk people with disabilities. Locating people with disabilities is only part of the equation. Because the new paradigm of disability focuses on person–environment interaction, environmental factors in the interaction need equal attention. GIS is a tool for looking at both elements and at the spatial interaction between the two. GIS can be used for mapping disability-relevant resources within the context of overall community resources, population density, physical characteristics of places, transportation capacity, etc. In emergency management, GIS can assist decision-making on critical issues such as whether community members need to evacuate, relocate, or shelter in place. GIS can also identify the location and availability of resources that support the desired outcome.

GIS is a system for management, analysis, and display of geographic knowledge (ESRI, 2005) and can serve as an analytic tool that allows policymakers and program planners to associate resources and people spatially (Hall, 1992). GIS technology consists of a system of hardware, software, and procedures designed to support the capture, management, manipulation, analysis, modeling, and display of spatially referenced data for solving complex planning and management problems (Cowen, 1989). The technology has become increasingly sophisticated in the past decade. A typical product of GIS is a map of key variables and their relationship to a population. The most essential elements of GIS are the data, tied to location, that support the visual images on the map. Maps are only as good as the data from which they are built. The data are key. A map is just a picture of the spatial relationships in the data.

Emergency Preparedness: Importance of Accurate Location-Based Data

Environmental factors, often outside individual control at the time of the incident, play a very large role for not only personal well-being, but, as Hurricane Katrina experiences showed, also for individual survival. In an emergency, the regular infrastructure—the environment—cannot be taken for granted. "If you want to know what might happen to you in a disaster, you have to look at what your local government has planned" (Basler, 2005, p. 2). "The initial and most severe impacts of disasters are local. Citizens, communities and state and local governments have the primary capability to prepare for and to minimize the impacts of disasters" (Harrald, 2006, p. 1). If the functionally defined issues that are critical to an individual's needs are not included in local plans, they are also not likely to be incorporated into local response and recovery activities. For example, an individual who uses a mobility device and relies on accessible public transportation may have developed a good personal disaster plan, but if the local emergency plan does not specifically include accessible transportation alternatives, it is likely that the individual's plan will fail, as it did in many cases in New Orleans during Hurricane Katrina.

Many emergency planners are already using GIS and mapping. Like maps, the plans are only as good as the data available to the planners. Once you are in the midst of an emergency, it is too late to start collecting data that need to be in place prior to the event so it is available to emergency planners for planning, response, and recovery. If you have the data, real-time maps can quickly be generated. Without the data, it takes a long time. Datasets can be edited and updated during an event. Prior to the event, the datasets need to be there, loaded with accurate, current data that are ready to use. However, disability-relevant data are usually not included in the datasets used by emergency planners. Getting disability-relevant data about people and resources (with a location attached) identified, collected, updated, and in a form that emergency managers can use is an important and essential role for human service agencies. Making sure this happens is an important role for both advocates and policymakers.

Proactive Approaches to Data Management

Three weeks after Hurricane Katrina, the Research and Training Center on Disability in Rural Communities (RTC: Rural) received a request from the Federal Transit Administration (FTA) for data on Section 5310 providers within a 350- to 400-mile radius of New Orleans, approximately a 7- to 8-hour drive time. Using GIS, we found 326 Section 5310 providers in 248 ZIP codes within a 350-mile buffer zone of New Orleans. The 350-mile buffer did not include Houston (it's important to look at "on the ground" reality, not just hypothetical lines) so we expanded the buffer to 400 miles around New Orleans and found 491 Section 5310 providers in 365 ZIP codes. This is about 10% of the number of Section 5310 subrecipients in the United States. We were able to provide the data within hours of request because we had the ZIP codes of all the Section 5310 providers already entered into a database and checked for accuracy. If we had not had them entered, it would have taken several days to input the data and check for errors. We mapped the locations within the buffer zone and prepared a map that included a highway data layer to indicate where the resources were in relationship to major highways. We could also have created an actual 8-hour drive-time map, not just a 400-mile "as the crow flies" buffer.

The FTA request appeared to be a retrospective assessment of transportation capacity. However, if the locations of these lift-equipped transportation resources (which are not generally included in public transportation inventory data) had already been included in the emergency management systems databases, the vehicles could have been called upon to assist in the evacuation of New Orleans. Given that school buses sat in flooded New Orleans parking lots, perhaps these accessible resources would also have been underutilized if the vehicles had been included in response efforts. Since the Section 5310 vehicles probably were never included, these transportation resources could not even claim to be underutilized. People who needed lift-equipped vehicles for transportation to, from, or between emergency shelters did not get the rides they needed.

Integrating Disability-Relevant Data Into State Geospatial Frameworks

Geospatial technology is being used to support decision-making for homeland security, emergency management, and disaster response, but it is also being used in such diverse areas as economic development, health and human services, environmental protection and management, facilities management, parcel appraisal and assessment, education, transportation planning, and natural resource management. The data elements needed for emergency management are collected and managed collaboratively in these more routine community functions, often through state framework activities related to the National Spatial Data Infrastructure (NSDI). The goal of this infrastructure is to reduce duplication of effort among agencies, improve quality and reduce costs related to geographic information, make geographic data more accessible to the public, increase the benefits of using available data, and establish key partnerships with states, counties, cities, tribal nations, academia, and the private sector for the purpose of increasing data availability (NSGIC, 2006). According to the NSGIC,

> GIS and geospatial data are rapidly becoming primary tools in government and the private sector because they provide visual, integrated, intelligent, analytical, and cost-effective solutions in support of these diverse areas. . . . In the not-too-distant future, nearly every governmental unit will adopt geographic or location-based database schemes to tie governmental information systems together for improved data administration. (2006)

Framework development is under way in every state as part of the NSDI. GIS applications in many different disciplines have a recurring need for a few themes of data. The framework is a collaborative community-based effort in which these commonly needed data themes (geodetic control, orthoimagery, elevation, transportation, hydrography, governmental units, and cadastral information) are developed and maintained by public and private organizations within a geographic area. The framework is one of the key building blocks, and it forms the data backbone of the NSDI. The framework concept was developed by representatives of county, regional, state, federal, and other organizations under the auspices of the Federal Geographic Data Committee (FGDC, 2006b, 2006c). Local, regional, state, and federal government organizations and private companies see the framework as a way to share resources, improve communications, and increase efficiency.

NSDI, created by presidential Executive Order 12906, is defined as the technologies, policies, and people necessary to promote sharing of geospatial data throughout all levels of government, the private and nonprofit sectors, and the academic community. It provides a base or structure of practices and relationships among data producers and users that facilitates data sharing and use. It is a set of actions and ways of accessing, sharing, and using geographic data that helps decision-makers choose the best course(s) of action (FGDC, 2006a).

Disability policy advocates need to work at the state level in every state to get disability-relevant geospatial data into critical infrastructure used for emergency planning and response. Discussions are needed to determine the disability-relevant data elements that need to be included in geospatial data for use in emergencies, economic development, recreation, home ownership, etc. Some, such as transportation accessibility, are obvious. Most health care system data are also already being included; however, accessibility may not be currently included

as a data element. Information about each state's geographic information systems, including state summaries, models, state GIS coordinators, and contact information, is available at http://www.nsgic.org/states/index.cfm

If disability-relevant data are not included, organized, updated, maintained, and available for use, it is unlikely that people with disabilities and disability-relevant resources will appear on the maps or in the plans for homeland security, emergency management and response, economic development, health and human services, environmental protection and management, facilities management, parcel appraisal and assessment, education, transportation planning, or natural resource management. Incorporating disability-relevant data into the geospatial infrastructure as it is being developed is a unique opportunity to create a universally designed framework. This is likely to be the only type of infrastructure that appreciates the complexity of the person–environment interaction and provides a basis for understanding the many dimensions of community participation.

Matching Disability-Relevant Resources Using GIS: A Case Study

"The storm demonstrated the need for greater integration and synchronization of preparedness efforts, not only throughout the Federal government, but also with the State and local governments and the private and non-profit sectors as well" (Townsend, 2006, p. 50).

Figure 1, a map of "Resource Mapping in States Impacted by Hurricane Katrina," was aggregated from several independent research projects. The data displayed on the map include the geographical locations of 95 Center for Independent Living (CIL) offices, 934 organizations that receive Section 5310 transportation funding assistance, and 481 emergency shelters for Hurricane Katrina evacuees as of September 9, 2005, in Alabama, Arkansas, the District of Columbia, Florida, Georgia, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas.

Overlooked transportation resources are at the core of this case study because "most rural Delta communities have no public transportation services and, at best, have only limited transportation for the elderly and persons with disabilities. . . . Public transportation services are essential for Delta residents and evacuees who lack private automobiles" (Divers-White, 2005–2006, p. 10).

Section 5310 of the Federal Transit Act (49 U.S.C. 5310) authorizes a program of transit capital assistance to address mobility needs of the elderly and persons with disabilities. The primary use of this program is to help local nonprofit organizations provide transportation services to these populations when other public transportation is unavailable or insufficient. While this program is designed primarily to support the purchase of vehicles, federal law allows funds to be used for "purchase of service arrangements" that include programs such as voucher models. Typically, Section 5310 transportation funds are allocated to states, which in turn distribute them to eligible local programs that apply for funding. These funds are often used by local nonprofit organizations to provide transportation for their clientele to and from their service programs. While this agency-driven model provides some transportation in both urban and rural areas, it does not directly address the more general mobility needs of all elders and persons with disabilities in a community. The vehicles may be underused, and nonclients are typically excluded from riding in the vehicles, even if their destinations overlap. Results from a 2004 survey (Seekins, Enders, Pepper, & Sticka, in press) indicated that 75% of vehicles purchased with Section 5310 funds were lift-equipped.

A Center for Independent Living (CIL) is a consumer-controlled, community-based, cross-disability, nonresidential, private nonprofit agency designed and operated within a local community by individuals with disabilities. CILs promote social change, eliminate disability-based discrimination, and create opportunities for people with disabilities to participate in their communities. In 2006, there are nearly 400 CILs in the 50 states and District of Columbia, with offices in about 700 communities. The map shows 95 CIL locations—57 CIL main office locations and 38 satellite offices. The service areas for these 57 CILs cover 516 of the 941 counties in the map area (Alabama, Arkansas, the District of Columbia, Florida, Georgia, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas).

While it is important to know where these resources are located, the most striking feature of the map demonstrates the importance of GIS to people with disabilities for disaster response and recovery. The shaded areas on the map show the proximity of available resources. In 112 counties/parishes on September 9, 2005, there was at least one emergency shelter and one Section 5310 transportation provider with a 75% likelihood of having at least one lift-equipped vehicle. To make the geoanalysis even more local, we also matched these two sets of resources by ZIP code and found that in 96 ZIP codes there was at least one Section 5310 transportation provider and at least one emergency shelter. (Note: Only the county overlap is displayed on the map.)

Lift-equipped vehicles were located within the same county and even within the same ZIP code as emergency shelters. We hoped that local authorities were able to make the connection between individuals who could benefit from the use of a nearby lift-equipped vehicle and the organizations that had the vehicles. However, with repeated and well-documented stories about transportation-related problems (Basler, 2005; Littman, 2006 2005), we fear that the connections were not made between two systems perceived as being unrelated.

How the Map Was Developed

The black-and-white map used here presented technical challenges. The data are complex and displayed much more clearly

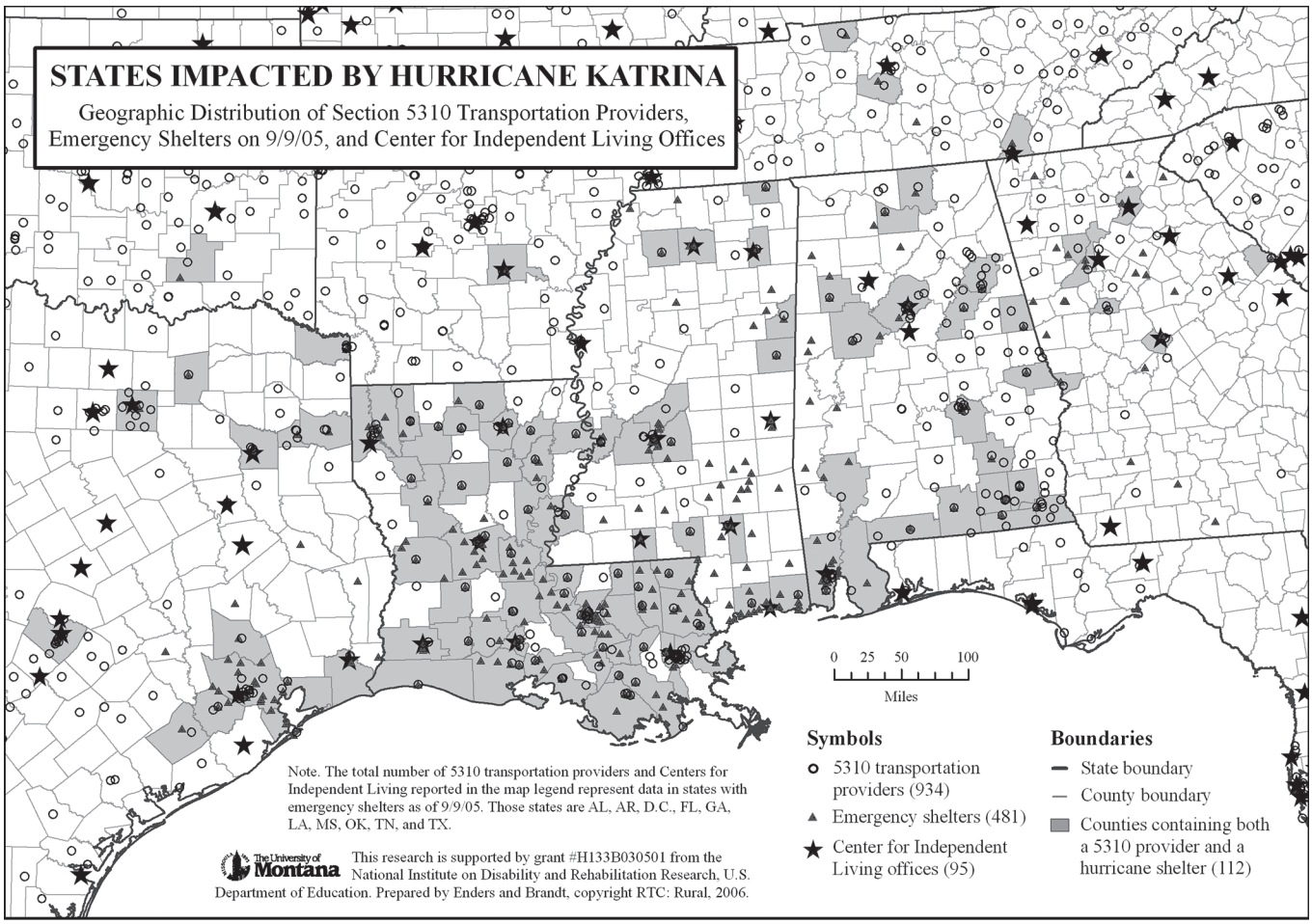

FIGURE 1. Mapping disability-relevant resources.
Note. Copyright 2006 by The Rural Institute, University of Montana. Reprinted by permission.

in color than in this black-and-white version. In the color versions, we also include the CILs' service areas, which show that this region has counties unclaimed by any CIL. The CILs undoubtedly reached out beyond their service areas after the incidents. However, without established local CIL presence, the organizations were probably not able to be as effective in providing assistance as a developed local CIL would have been.

Population density, an essential element, also cannot be readily added to an already complex black-and-white map. County-level data on people with disabilities, with a rural–urban breakdown for each county on the map, as well as basic county characteristics (housing stress, persistent poverty, etc.) are located at RTC: Rural's Web site, http://DisabilityCounts.org. A population data layer is essential to any GIS analysis, and while we do not display it here, it should never be overlooked in actual planning activities.

ESRI software ArcGIS 9.1 was used to make the map. In addition to the Census TIGER shapefiles for state and county boundaries, three other sets of shapefiles were used, two of which had already been created for previous projects.

Center for Independent Living Offices

RTC: Rural conducted a comprehensive survey in 2004 of all U.S. CIL offices. A physical address for each CIL office was among the data recorded. GIS address matching was then used to create a point layer shapefile for all of the main CIL offices. Because complete addresses were not available for all CIL satellite office locations, ZIP code matching was used. A join was applied in ArcGIS to a ZIP code point layer shapefile to create the satellite office location point layer shapefile. The ZIP code shapefile was obtained from the ESRI data disks supplied with ArcGIS 9.1.

Section 5310 Recipient Transportation Providers

RTC: Rural conducted a national survey in 2004 of agencies and organizations receiving Section 5310 transportation assistance. To develop the sample, a list was compiled of all the Section 5310 transportation providers in the country. The data

came directly from lists in 46 states, the District of Columbia, 24 districts in Texas, and 7 districts in Florida. Data from the insular territories and from North Carolina were not collected because their Section 5310 funds are not distributed in the same way as the other states. ZIP code information from all known locations was compiled in Access and checked for accuracy. Then 4,835 ZIP codes were joined in ArcGIS to a ZIP code point layer shapefile to create the Section 5310 transportation recipients shapefile. The ZIP code shapefile was obtained from the ESRI data disks supplied with ArcGIS 9.1.

Emergency Shelters

Staff of the Research and Training Center on Independent Living (RTC/IL) obtained Centers for Disease Control Emergency Operations Center data on the locations of 481 emergency shelters (as of September 9, 2005) for Hurricane Katrina evacuees in Alabama, Arkansas, the District of Columbia, Florida, Georgia, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas (retrieved from http://www.hemophilia.org/NHFWeb/Resource/StaticPages/menu0/menu9/menu133/Evacuation-Centers9-9-05.pdf). Most of the addresses on the list were incomplete. As part of a project sponsored by the National Institute on Disability and Rehabilitation Research (NIDRR), RTC/IL staff completed the addresses and ZIP codes for 459 sites and entered this information into an Access database created by RTC: Rural. These 459 sites were joined in ArcGIS to a ZIP code point layer shapefile to create part of the emergency shelters shapefile. However, because several shelters can have the same ZIP code, only 296 ZIP codes were needed to display the 459 shelters. Of the 22 shelters that did not have a ZIP code entered, 12 had a place name we could use to join in ArcGIS to a place name point layer shapefile. However, only 11 place names are displayed as points on the map because two of the place names matched shelters having the same place name. The county name of the shelter location was used for the remaining 10 shelters and joined in ArcGIS to a county centroid point layer shapefile. These three newly created shapefiles were then merged into one "shelters" shapefile. The ZIP code shapefile was obtained from the ESRI data disks supplied with ArcGIS 9.1. The county and place shapefile was obtained from the U.S. Census Bureau, 2000 data.

Conclusion

According to John Hager, "So much of emergency preparedness for people with disabilities depends upon changing the way people think about preparing for an emergency or disaster. It is about underlying attitudes and getting the mainstream public to take into account the considerations of people with disabilities" (Interagency Coordinating Council on Emergency Preparedness and Individuals with Disabilities, 2006).

An unexpected benefit of using GIS and visually documenting the spatial connection among resources is the recognition that disability-relevant resources are just that—resources. More than one person reviewing the maps commented that the maps demonstrate that disability issues not only are related to "needs" but also show that the disability community brings resources to the table—resources that should be identified and included in documenting critical infrastructure. These resources should be fully integrated into regular resource datasets and not kept in separate disability-only databases. In disaster incidents, mapping both the environment and the population can change the perception and portrayal of people with disabilities from being people with "special needs" to being people who contribute to the community. Being perceived as part of the solution and not just as part of the problem may be reason enough to embrace the use of GIS technology.

"Space is a social artefact that is shaped by the interplay of structures, institutions, and people in real historical settings" (Gleeson, 1999, p. 2). As much as environment influences disability, people with disabilities have played an important role in defining space. Curb cuts and accessible entrances have visibly changed U.S. cityscapes. If lessons learned from the 2005 hurricanes lead to increased accessibility of transportation, housing, and emergency shelters during, before, and after disasters, they will show that person–environment interaction is a two-way street. People with disabilities are change agents and system resources. People influence environments, and environments influence people.

This small mapping activity demonstrates the necessity of having current data collected, organized, and available for analysis (i.e., geocoded in an accessible database), which can be useful for immediate response. It is too late to collect data when the water rises and the earth shakes. The map, based on research and data from four projects at two NIDRR-sponsored research and training centers, is an example of how and why disability-relevant data need to be included in each state's framework for geospatial data. We have shown that shelters, accessible transportation, and service providers may all have been in close proximity, but because the information about them may only have been available in separate and nonintegrated data systems, these resources were not tied together. The map, while only a simple proof of concept, attempts to show the human side of the equation—that needless suffering and deaths occur because human and material resources are not coordinated before, during, and after a catastrophic event. This activity points to the need for more translational research, which uses proven methods from one field—in this case GIS—and the data, ideas, insights, and discoveries from a variety of research projects to suggest practical ways to improve emergency management strategies. This article points to a few existing tools and emerging infrastructures that can be used to integrate people with disabilities and disability-relevant resources into all levels of emergency planning and management. The challenge is to ensure that planning measures are universally designed for all, are useful in the community, and promote equal access, dignity, choice, and security in response and recovery. In a commentary on disability and disaster, 1 month after Hurricane Katrina, Michael Berube (2005) noted that

> disability was invisible as such, even when we were looking right at it. Individual persons with disabilities were depicted as objects of charity, or horror, or pity; but disability as a category of human identity, disability as a social and political fact, disability as a factor in public policy remained inconceivable.

Goethe said "Knowing is not enough; we must apply. Willing is not enough; we must do." He also said "before you can do something you must first be something." If people with disabilities are going to remove the "blanket of invisibility that cloaked the iconic dead woman in a wheelchair outside the Superdome" (Berube, 2005), they will need to be included in the data, shown on the maps, and recognized as active participants within an evolving environment.

ABOUT THE AUTHORS

ALEXANDRA ENDERS, BS, is a senior research associate/policy analyst at the Research and Training Center on Disability in Rural Communities at the University of Montana. Her policy analysis focus is on the infrastructure issues—transportation and telecommunications—that determine the availability, accessibility, and usability of the vehicles of modern participation. **ZACHARY BRANDT** was a GIS research assistant at the Research and Training Center on Disability in Rural Communities at the University of Montana and a master's degree candidate in the Department of Geography. He recently has become a planner at the Missoula Office of Planning and Grants and provides planning, program development, and implementation services. Address: Alexandra Enders, Research and Training Center on Disability in Rural Communities, 52 Corbin Hall, University of Montana, Missoula, MT 59812, e-mail: enders@ruralinstitute.umt.edu

AUTHORS' NOTES

1. This study, based on research and data from four projects at two rehabilitation research and training centers, was funded by Grant H133B030501 from the U.S. Department of Education, National Institute on Disability and Rehabilitation Research to the University of Montana Research and Training Center on Disability in Rural Communities. Catherine Rooney at the University of Kansas Research and Training Center on Independent Living, and student assistants Jessica Clevenger, Chiaki Gonda, and Dara Van Auken, collected the addresses of the emergency shelters as part of Grant H133B000500-04B from the U.S. Department of Education, National Institute on Disability and Rehabilitation Research. The opinions expressed are those of the authors and do not represent those of the agency.
2. We wish to thank Mike Sweet, Ken Wall, and Eric Eidswick, who are involved with Montana's Geospatial Framework, for their helpful comments and advice and for suggesting ways that data could be used to integrate people with disabilities in the community.

REFERENCES

Basler, B. (2005). Defensive strategies: A disaster plan for those who need it most. *AARP Bulletin Online.* November. Retrieved April 25, 2006, from http://www.aarp.org/bulletin/yourlife/after_katrina.html

Berube, M. (2005). *Disability and disasters* [weblog]. Retrieved April 25, 2006, from http://www.michaelberube.com/index.php/weblog/disabilityand_disasters/

Cowen, D. (1989). *NCGIA core curriculum in GIS.* Santa Barbara: University of California, National Center for Geographic Information and Analysis.

Divers-White, B. (2005–2006). Pulling together: Rural and urban communities respond. *Rural Voices, 10.* Retrieved April 25, 2006, from http://www.ruralhome.org/manager/uploads/VoicesWinter2005-2006.pdf

ESRI. (2005). *Key GIS concepts.* Retrieved April 25, 2006, from http://www.esri.com/software/arcgis/concepts/overview.html

ESRI. (2006). *GIS for disaster management.* Retrieved April 26, 2006, from http://www.esri.com/industries/public_safety/business/disaster.html

Federal Geographic Data Committee. (2006a). *National spatial data infrastructure.* Retrieved April 18, 2006, from http://www.fgdc.gov/nsdi/nsdi.html

Federal Geographic Data Committee. (2006b). *Framework commonly asked questions.* Retrieved April 18, 2006, from http://www.fgdc.gov/framework/frameworkfaq#q3

Federal Geographic Data Committee. (2006c). *NSDI framework overview.* Retrieved April 18, 2006, from http://www.fgdc.gov/framework/

Field, M., Jette, A. M., & Marin, L. (2005). *Workshop on disability in America: A new look.* Washington, DC: National Academy Press.

Gleeson, B. (1999). *Geographies of disability.* New York: Routledge.

Hall, S. (1992). *Mapping the next millennium: How computer-driven cartography is revolutionizing the face of science* (1st ed.). New York: Random House.

Harrald, J. (2006). *Hurricane Katrina: Recommendations for reform. Testimony for the Senate Homeland Security Government Affairs Committee March 8, 2006.* Retrieved April 18, 2006, from http://www.gwu.edu/~icdrm/publications/PDF/Harrald%20HSGAC%20testimony_rev.pdf

Interagency Coordinating Council on Emergency Preparedness and Individuals with Disabilities. (2006). Emergency Preparedness NOW spotlight interview—John Hager, U.S. Department of Education, Assistant Secretary. *Emergency Preparedness NOW, 2.* Retrieved April 24, 2006, from http://ems-mx4.sradev.com/dhs/test/interview.htm

Johnson, R. (2000). *GIS technology for disasters and emergency management, an ESRI white paper.* Retrieved April 24, 2006, from www.esri.com/library/whitepapers/pdfs/disastermgmt.pdf

Johnson, R., & Davenhall, B. (2005). *Improving emergency planning and response with geographic information systems.* Redlands, CA: ESRI. Retrieved April 6, 2006, from http://www.esri.com/library/whitepapers/pdfs/emergency-planning-response.pdf

Littman, T. (2006). *Lessons from Katrina and Rita: What major disaster can teach transportation planners. Journal of Transportation Engineering, 132,* 11–18.

National Council on Disability. (2005). *Saving lives: Including people with disabilities in emergency planning.* Retrieved April 5, 2006, from http://www.ncd.gov/newsroom/publications/2005/saving_lives.htm

National States Geographic Information Council. (2006). *About NSGIC.* Retrieved April 18, 2006, from http://www.nsgic.org/about/index.cfm

Pope, A. M., & Tarlov, A. R. (1991). *Disability in America: Toward a national agenda for prevention.* Washington, DC: National Academy Press.

Research and Training Center on Independent Living. (2005). *Nobody left behind: Objective three, part 1. Focus area: Assurance and policy development recommendations [briefing paper].* Lawrence: The University of Kansas. Retrieved April 24, 2006, from http://www.nobodyleftbehind2.org/findings/pdfs/object3part1.pdf

Seekins, T., Enders, A., Pepper, A., & Sticka, S. (in press). Transportation for elderly and persons who experience disability: Allocation and use of Section 5310 funds in urban and rural areas. *Journal of Public Transportation*

Shakespeare, T., Bickenbach, J. E., Pfeiffer, D., & Watson, N. (2006). Models. In G. L. Albrecht (Ed.), *Encyclopedia of disability.* Thousand Oaks, CA: Sage.

Townsend, F. F. (Ed.). (2006). *The federal response to Hurricane Katrina: Lessons learned* (p. 50). Washington, DC: The White House, Office of the President.

Whiteneck, G. (2005). Conceptual models of disability: Past, present, and future. In M. Field, A.M. Jette, & L. Marin (Eds.), *Workshop on disability in America: A new look.* Washington, DC: Institute of Medicine.

World Health Organization. (2001). *International classification of functioning, disability and health.* Geneva, Switzerland: WHO.