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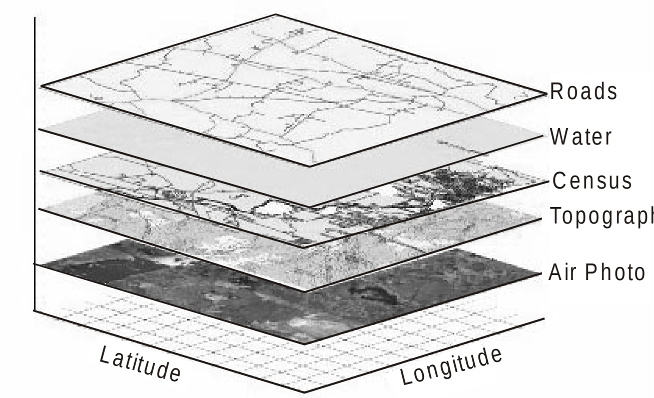
Hazardous Substances & Public Health

Special Issue on Geographic Information Systems

What Is a GIS?

A geographic information system (GIS) is a computer hardware and software system that stores, links, analyzes, and displays geographically referenced information (i.e., data identified according to their geographic location). GIS technology makes it possible to link, or integrate, information that is difficult to associate any other way. GIS technology is capable of performing a wide range of information processing and display operations (e.g., map production, data analysis, and statistical modeling). Thus, GIS is a valuable tool for integrating and analyzing disparate data sets (Figure 1).

Figure 1. A GIS Integrates Layers of Information



What Types of Data Can Be Used in a GIS?

Any variable that can be located spatially can be entered into a GIS. For example, an area feature of the earth (e.g., a lake shoreline) can be linked to the attributes associated with the feature (e.g., salinity or depth of the lake). The primary requirement for the source data is that the locations of the variables be known. Location may be annotated by x, y, and z coordinates of longitude, latitude, and elevation or by systems such as zip codes or census geography (e.g., census tracts). A GIS can also convert existing digital information that is not in map form into recognizable and usable forms. For example, digital satellite images can be analyzed to produce a map-like layer of digital information (e.g., vegetative cover). A steadily growing source of data suitable for GIS applications is readily accessible on the Internet.

How Does a GIS Work?

A critical component of a GIS is its capability to conduct complex spatial analyses and produce visual images (i.e., on a computer screen or paper) that convey the results of such analyses to assist in decision-making. Maps and other graphics are generated, enabling the viewer to visualize, and thereby more readily comprehend, the analytic results or simulations of potential events. For example, ATSDR used data on population, roads, streams, and land elevation—as well as information gathered from interviews with residents—to track the progress of a chlorine gas spill from a train derailment near Alberton, Montana. Through the use of GIS, the local terrain was modeled, the movement of the spill was mapped, and estimates of the size of the potentially exposed population were made. This simulation enabled ATSDR to respond quickly to the public health issues related to the spill. (For additional information on ATSDR's involvement in the Alberton spill, see "Tracking the plumes" in *GIS for Health Organizations (1)*.

References

1. Lang L. GIS for health organizations. Redlands (CA): ESRI Press; 2000.

ATSDR Plays Leadership Role in Use of GIS in Public Health

C. Virginia Lee, MD, MPH, MA, ATSDR

ATSDR was among the first public health agencies to recognize the tremendous potential geographical information system (GIS) technology held for environmental public health activities and research. The agency foresaw many applications for GIS technology that would assist in fulfilling its mission, which is to prevent or minimize adverse human health effects resulting from environmental exposures to toxic chemicals at hazardous waste sites and accidental spills of toxic chemicals. In 1989, ATSDR established a GIS program within the agency to assist in its broad range of public health activities and research (e.g., exposure assessment and mitigation, surveillance, health studies, health intervention and prevention, and community characterization).

GIS came of age at ATSDR and in the public health field during the 1990s, as public health researchers used GIS technology for mapping and spatial analyses of data on diseases and environmental contaminants. During the decade, ATSDR sponsored, with institutional cosponsors and partnerships, the first national conferences held in the United States on the use of GIS in public health. These conferences, conducted in Atlanta, Tampa, and San Diego, were attended by state and local public health and environmental officials, academic researchers, and representatives of other federal agencies using GIS technology. The proceedings of the 1998 conference are available on the ATSDR Web site at http://www.atsdr.cdc.gov/gis/conference98.

In This Issue...

GIS at ATSDR: 2000 and Beyond

During its initial development, the primary focus of the geographic information system (GIS) program at ATSDR was in support of the public health assessment and health consultation program in the Division of Health Assessment and Consultation (DHAC). GIS maps help health assessors identify geographic areas of particular health concern and susceptible subpopulations (e.g., children, childbearing-aged women, the elderly, and minority populations).

In ensuing years, epidemiologists in the Division of Health Studies used it to characterize sites for studies, and the Division of Health Education and Promotion used it to plan and conduct education programs in communities near hazardous waste sites. ATSDR also uses GIS to determine past and future exposure potential, to analyze health data, and to investigate potential exposure to hazardous substances at the local, regional, and national levels.

Moreover, GIS data provide the basis of the population information used in many ATSDR publications. Because GIS maps greatly enhance the ability to integrate and graphically display a wide array of data, GIS maps are used in many agency reports (e.g., public health assessments, health consultations, health studies, educational materials, and agency reports to Congress).

In early 2000, ATSDR expanded its outreach efforts with a satellite broadcast, "Geographical Information Systems in Public Health: Using Mapping and Spatial Analysis Technologies for Health Protection." This program provided information on

neighborhood economic, social, environmental, and health indicators using data from the U.S. Bureau of the Census, vital records, and environmental and public health agencies.

At the federal level, the ATSDR GIS model will make it possible to compare state activities involving economic development, environmental regulation, and public health. On the state level, the model is intended to benefit Brownfields and other distressed neighborhoods through more cost-effective comprehensive and targeted planning of community development, social services, and public health services.

Calendar

November 1-5, 2000. American Evaluation Association Annual Conference at the Sheraton Waikiki in Waikiki, Hawaii. Topics of current interest are discussed in sessions proposed by members, as well as in sessions presented by invited speakers. In addition, a computer-assisted Job Bank is provided at the annual conference. More than 25 training sessions are offered before the conference. For further information contact the American Evaluation Association, 505 Hazel Circle, Magnolia, Arkansas 71753; telephone: (888) 232-2275 or (870) 234-7433; e-mail: AEA@kistcon.com.

November 12–16, 2000. American Public Health Association (APHA) Conference and Public Health Expo, Hynes Convention Center, Boston, Massachusetts. The 2000 APHA Annual Meeting is a comprehensive combination of scientific sessions, workshops, poster sessions, and panel discussions to enhance knowledge and facilitate public health information exchange. More than 900 sessions are planned, and 3,000 scientific papers will be presented. The Public Health Expo will consist of more than 500 booths featuring the most up-to-date products and information for health professionals. Complete information can be found at the American Public Health Association Web site (http://www.apha.org) or by calling (202) 777-2742 or by fax at (202) 777-2530.

November 15, 2000. GIS Day 2000 is an annual event to showcase real world application of GIS technology. The event is principally sponsored by the National Geographic Society, Association of American Geographers, University Consortium of Geographic Information Science, U.S. Geological Survey, the Library of Congress, and Environmental Systems Research Institute (ESRI). The event takes place during Geography Awareness Week (November 12–18, 2000), sponsored by the National Geographic Society, which is promoting geographic literacy in schools, communities, and organizations.

November 17–18, 2000. Health Management Summit 2000. Presented by The Health Management Institute and held at the Sheraton National Hotel, Arlington, Virginia, this 2-day seminar presents information on health management of a population, preventive guidelines, demand management, disease managment, and case management. The treatment of hyperlipidemia will be used as a model. Contact the Health Management Summit, 4435 Waterfront Drive, Suite 101, Glen Allen, Virginia 23060; telephone: (804) 527-1905; fax: (804) 747-5316; or visit the Web site (http://www.namcp.com).

between the estimated risks and population-density and cancer-incidence data. GIS identified areas off the base at which the potential for exposure to substantial levels of environmental contaminants was high. Demographic data indicated, however, that these areas were unpopulated and, therefore, unlikely to result in exposure to humans. ATSDR determined that it is unlikely that exposure to the low level of current air emissions from the base would result in a meaningful increase in the risk for cancer. This evaluation did identify some health outcomes of public health concern that either (a) were not likely to result from exposure to contaminants emitted from the base or (b) required further evaluation to make that determination.

Finally, GIS maps assisted ATSDR staff in communicating this complex information to residents of surrounding areas. At community meetings, residents were introduced to the process of creating GIS maps and were provided the opportunity to discuss individually the information presented in the maps. This interaction produced a better understanding of the conclusions reached by ATSDR in its health assessment.

Assessing Neighborhood Characteristics of Brownfields and Other Distressed Communities

Stephanie I. Davis, MSPH, ATSDR

A new GIS project at ATSDR is underway to link demographic, environmental, and health-outcome data for communities near Brownfields properties (i.e., abandoned or dilapidated former industrial or commercial properties where expansion or redevelopment is prohibitive because of real, or perceived, environmental contamination). The Brownfields Redevelopment Initiative is the realization of a federally organized commitment to help communities revitalize these properties. Future commercial or residential use of Brownfields properties depends on assurances that the levels of environmental contamination that might be present are not harmful to health. The coordination of economic policy, environmental regulation, and public health interests are vital to support this initiative. EPA and other federal agencies, including ATSDR, have committed to strengthen and improve their collaborative efforts on the Brownfields Initiative.

ATSDR is conducting this project in an effort to enhance state and local public health involvement in three pilot states (Georgia, New York, and Oregon) to link the people, the places in which they live, and their health. For each of these states, ATSDR is using its geographic information system (GIS) to identify economically distressed census tracts eligible for the Brownfields Tax Incentive and to attempt to integrate information on economic development, environmental regulation, and populations potentially affected by redevelopment. Eligibility for the Brownfields Tax Incentive has many data components. The principal agencies providing Empowerment Zone and Enterprise Community, zoning, and boundary data for this project are U.S. Department of Housing and Urban Development, U.S. Department of Agriculture, and state and local planning agencies. High-poverty areas and adjoining industrial and commercial areas are identified with 1990 U.S. census data. ATSDR is working with EPA and coordinators of local Brownfields properties to identify assessment demonstration pilot sites that are eligible for the Brownfields Tax Incentive. The U.S. Department of Treasury is providing additional tax incentive advise.

On the population and public health front, GIS is being used to evaluate two ATSDR projects conducted by the Multnomah County Health Department in Oregon and the Monroe County Health Department in New York. These health departments were funded to pilot the ATSDR "Protocol for Initial Public Health Decisions at Brownfields Properties," which is a capacity-enhancing tool for use by local public health departments, economic development authorities, and property redevelopers to examine and properly address public health issues.

The evaluation will indicate how incorporating available sources of demographic and environmental data into a GIS adds to the information that site assessors collect while conducting a protocol. In the future, the project will use a GIS to obtain, integrate, and analyze additional baseline information on

(a) GIS concepts, terminology, and data; (b) spatial statistics and analysis functions; and (c) applications of GIS in public health practice and surveillance. The broadcast was directed toward state health and environmental agencies, colleges and universities, and hospitals throughout the United States. Copies of the video of the broadcast are available.*

ATSDR also expanded the availability of GIS products through the agency's new Internet map server, GATHER. The map server is an important first step in making the agency's GIS products publicly available for all interested individuals and groups.

The increasing availability of health, demographic, and environmental databases containing local, regional, national, and international information—combined with major advances in computerized spatial imagery and spatial statistical analyses—hold tremendous promise for mitigation of environmental exposures and adverse health effects. ATSDR's GIS program will continue to seek innovative applications to use GIS technology in accomplishing its environmental public health mission.

*To order, contact
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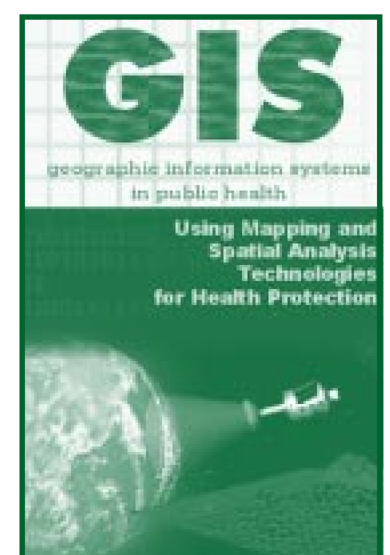

GIS Products and Services Available to ATSDR and Health Departments in Participating States

ATSDR provides a variety of GIS-based products and services to support site-specific activities conducnted by ATSDR staff and the employees of health departments in the 28 states that have cooperative agreements with ATSDR. (Figure 2.) GIS products and services also are available to other local, state, and federal governmental agencies.

Spatial analysis services offered by the Spatial Analysis Activity Group (SAAG) at ATSDR include digitizing maps and other data, database creation and analysis, and map production. SAAG also provides consultation and special support for site-specific projects (e.g., making specialized GIS queries, conducting complex spatial analyses, and identifying, selecting, and obtaining new data files). In addition, SAAG also conducts introductory classes in the use of GIS at ATSDR and provides training workshops in the use of GIS software. Presentations on GIS applications and research are given to a variety of audiences at meetings, workshops, and conferences.

SAAG has produced introductory demographic GIS maps for most Superfund sites and for other hazardous waste sites ATSDR has investigated. The SAAG extracted block-level demographic data from the 1990 census and used GIS to complete basic spatial analyses to generate site-specific demographic estimates. Each resulting GIS map contains the site

Figure 2. ATSDR Has Cooperative Agreements with Health Departments in 28 States (in green) for Site-Specific Activities

location, the area within a 1-mile radius of the site, and population statistics (e.g., the size and distribution of subpopulations that have potentially greater susceptibility because of race/ethnicity, sex, and age). For many sites, information on environmental contaminants and health outcomes has been incorporated into the GIS to visually depict geographic areas of particular public health concern.

Employees of state public health agencies can place requests for site-specific projects in their respective states. Information on requesting GIS services is available from the ATSDR/DHAC technical project officers assigned to state agencies. Others interested in collaborating with ATSDR on GIS projects are invited to contact C. Virginia Lee, SAIDS Section Chief, at (404) 639-6056 (e-mail: cvlee@cdc.gov).

ATSDR's GIS program activities are conducted by the Spatial Analysis Activity Group

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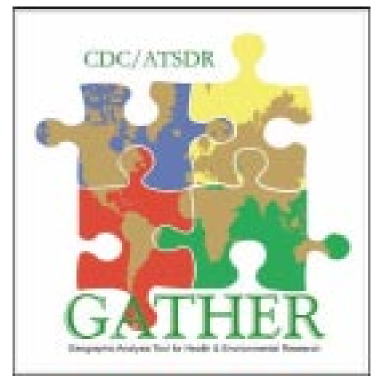
*The Oak Ridge Institute for Science and Education's Research Participation Program provides opportunities for college and university students, faculty, and postgraduates to participate in ongoing research programs at ATSDR.

ATSDR's New Map Server, GATHER, Provides Internet Access to GIS Data and Products

The Geographic Analysis Tool for Health and Environmental Research (GATHER) is a Web site application recently launched by ATSDR's GIS staff. The GATHER map server can be accessed at http://gis.cdc.gov/atsdr. GATHER enables all Internet users to access GIS data in a variety of formats; modify a map view through the display, zoom, and pan functions; query the data; and perform desktop spatial analysis. GATHER users can view, print from their local printer, and e-mail site-specific demographic maps in a format developed by the GIS staff. Each map contains the site location, the area within a 1-mile radius of the site, and relevant demographic data (e.g., number of children aged 6 years or less and the distribution of adults aged 65 years or more).



GATHER accesses a variety of data layers (e.g., census population and housing data, roads, hydrography, schools, and graphic images) to display, at several geographic scales, GIS maps of most Superfund hazardous waste sites (including U.S. Department of Energy and U.S. Department of Defense facilities) and other sites where ATSDR conducts public health activities and research. If the data are available, the site-specific maps contain information on the chemicals of concern. Once a site has been mapped, relevant documents can be accessed by clicking on the icon "*ATSDR DOCS for this site*," which is a link to all ATSDR-published documents for that site.

GATHER is an initial step in making ATSDR's GIS data and GIS products widely available to individuals in affected communities; private-sector groups; and local, state, and federal governmental

"B" Is for Buffering

Buffering is another GIS feature frequently used for spatial analysis. The buffering functionality of a GIS creates boundaries of a geographical area by measuring a specified distance (e.g., 1 mile) from a specific geographic feature (e.g., a hazardous waste site). This buffer area is then mapped and overlaid with other data layers. The result is used by ATSDR to identify areas in which to focus public health actions. For example, populations that might have been exposed to hazardous chemicals can be identified by their proximity to a site's contaminants or plumes. Another powerful application of buffering is the capability to extract features within a buffer area from other geographic data sets to produce, for example, mailing lists or to identify unique characteristics of the population.

"C" Is for Cartography

Cartography is the science of map-making that sets forth the rules used to abstract and symbolize the physical environment. Although a GIS has the capacity to go well beyond map-making, cartography is one of the main components used by GIS analysts to communicate information. GIS analysts compile the relevant data by taking into consideration the appropriate scale, level of detail, classification schemes, and symbolization used in a GIS map. No amount of sophisticated spatial analysis performed using GIS would be effective without incorporating these sound cartographic principles of compilation, organization, and design.

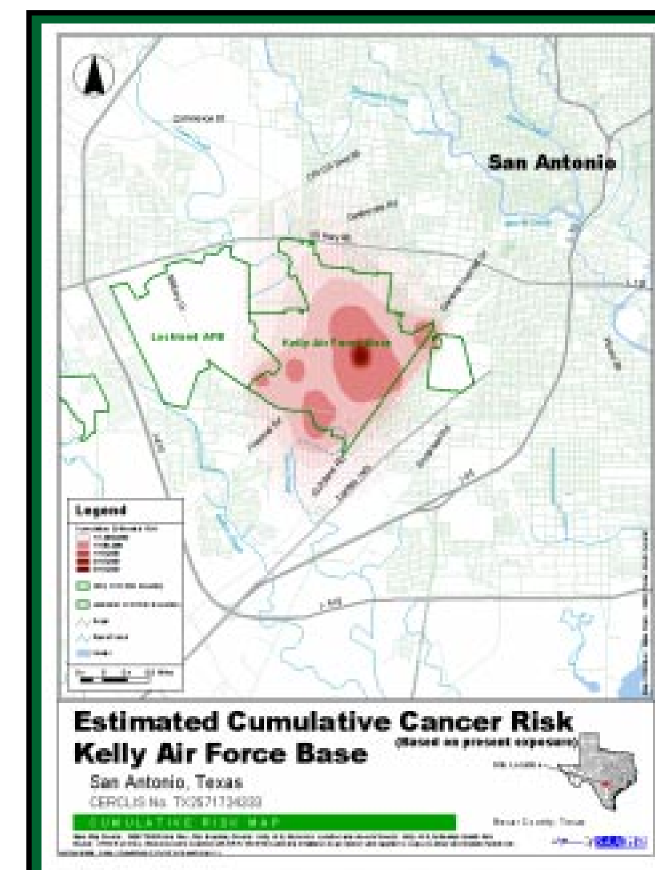
GIS Enhances ATSDR Health Assessment Activities at Kelly Air Force Base

David A. Fowler, PhD, and Andrew L. Dent, MA, ATSDR

Kelly Air Force Base is located in Bexar County, Texas, 7 miles southwest of San Antonio. Currently, the base is primarily used for logistics and maintenance of aircraft engines, weapons systems, support equipment, and aerospace fuels. Several activities formerly conducted at the base have been potential sources of air contamination in the surrounding community, including painting, chrome plating, fueling, and aerospace fuel storage.

In late 1997 and early 1998, ATSDR used its geographic information system (GIS) to assist the Division of Health Assessment and Consultation in conducting a public health assessment at the base. GIS effectively provided the means of determining whether a potential relationship existed between past exposures to hazardous substances emitted from the base and excess cancer rates in the surrounding community.

First, GIS was used to access, build, and manage data derived from an air-dispersion model that estimated the transport and fate of past and present emissions from the base. Then GIS was used to identify areas outside the boundaries of the base in which estimated levels of contaminants were of public health concern. Next, GIS was used to determine whether biologically plausible adverse health outcomes had been reported in these areas. GIS provided a graphical correlation



hazardous waste sites. Significant changes are not expected, except possibly in the reporting of race/ethnicity. Census 2000—for the first time—instructs individuals to check one *or more* categories on the form's race/ethnicity question. ATSDR will continue to refine its GIS-based applications for population estimation to produce more timely and accurate demographic data for communities located near hazardous waste sites.

References

1. Bureau of the Census. Census '90 basics. Washington (DC): U.S. Department of Commerce; 1990. Pub. No. CPH-I-8.
2. Bureau of the Census. 1990 Census of Population and Housing: Summary Tape File 3 Technical Documentation. Washington (DC): U.S. Department of Commerce; 1992.
3. Bureau of the Census. United States Census 2000; Uses for questions on the Census 2000 forms: Appendix B. Washington (DC): U.S. Department of Commerce; 1998. Available at http://www.census.gov/dmd/www/content.htm.
4. Claritas, Inc. PRIZM methodology. Arlington (VA): Claritas, Inc.; 1994.
5. Weiss MJ. The clustered world. Boston: Little, Brown and Company; 2000.
6. Pollard WE, Kirby SD. Geographic information systems (GIS), public health data, and syndicated market research data bases in health communication. Presented at the National Conference on Health Statistics; 1999 August 2–4, Washington, DC; 1999.
7. Heitgerd JL, Burg JR, Strickland HG. A geographic information systems approach to estimating and assessing National Priorities List site demographics: racial and Hispanic origin composition. Int J Occup Med Toxicol 1995;4(3):343–63.

The ABCs of GIS

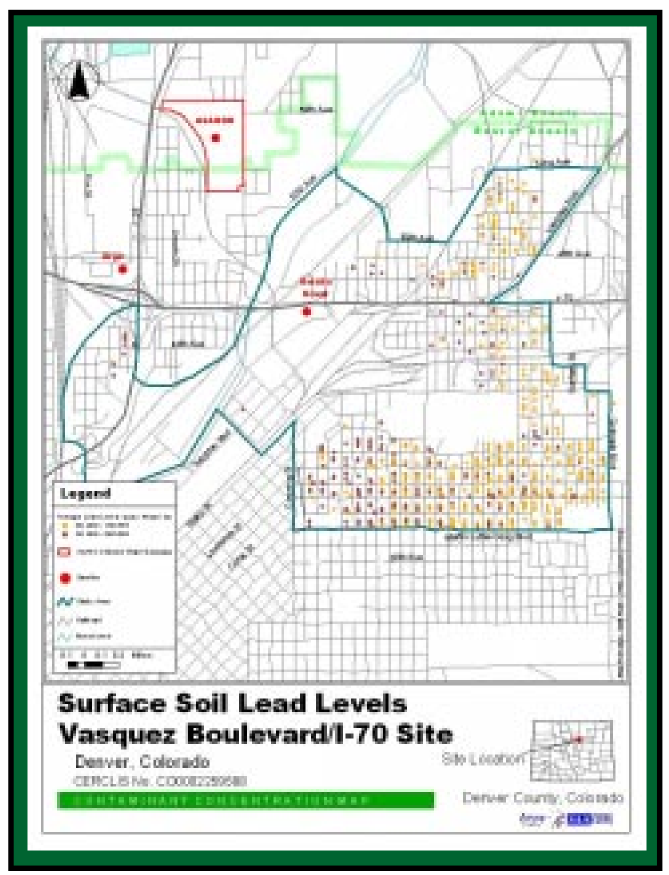
Melissa Massaro, MA, ATSDR

Address-matching, buffering, and cartography are key tools used in a geographic information system (GIS) to analyze information. The following provides a brief explanation of these three "ABCs of GIS."

"A" Is for Address-Matching

Address-matching is a process used by GIS analysts to assign geographic coordinates to addresses, regardless of whether the coordinates belong to a site of concern, participants in a study, or people and businesses in communities surrounding hazardous areas. When applied to street addresses, this process interpolates the exact geographic location on the basis of where the street number falls within the address range on a street segment. The result is the mapping of the address as a point location from which other types of spatial analyses can be performed. In the absence of addresses or where pinpoint accuracy is desired, the global positioning system (GPS) is another process often used to locate points. GPS equipment calculates latitude and longitude coordinates by using signals transmitted from satellites in orbit.

Address-matching is used to map the distribution of lead concentration in soil samples taken from residences near smelters in the Denver area.



agencies. The next release of GATHER will enable users to create buffer zones around a map feature, and ATSDR plans for future versions of GATHER to include a linking feature that will enable users to view a wider range of site-related materials.

ATSDR Uses GIS and Demographics to Characterize Communities at Risk

Janet L. Heitgerd, PhD, ATSDR

The demographic characterization of a population living near a hazardous waste site provides ATSDR with essential information needed to assess and address public health issues in local communities. ATSDR uses this information to (a) estimate the size and demographic characteristics of the population that potentially has been exposed to hazardous substances, (b) identify sensitive populations in the area (e.g., children, childbearing-aged women, and the elderly), and (c) provide insight about the social context of the area.

The ability to link population and housing data to the geographic location (e.g., a point defined by longitude and latitude) of a hazardous waste site through geographic information system (GIS) technology improves ATSDR's capability to estimate current population numbers. This results in a more accurate characterization of site demographics in a shorter period of time. It also helps the agency to develop communication and health education efforts for the local community and to identify potential environmental justice issues at a site.

GIS and U.S. Census Data

ATSDR relies principally on data from the U.S. Department of Commerce, Bureau of the Census, to characterize community demographics. Decennial census data are the most complete source of residential population information for the United States and its territories (e.g., Puerto Rico and the U.S. Virgin Islands). Demographic data are currently available from the 1990 census, and data from Census 2000 are expected to be released in spring 2001. The Bureau of the Census estimated that 248.7 million persons resided in the United States in 1990. By 2000, this estimate was expected to be more than 275 million.

Understanding the population distribution across the nation's landscape and using this information in a GIS requires knowledge of census geography (i.e., the political and statistical areas the Bureau of the Census uses to tabulate and report demographic data). Most U.S. residents know the country's geographic/political areas (e.g., states, counties, cities, and Native American reservations), but many are less familiar with the geographic/statistical areas developed by the Bureau of the Census, and which form the basis ATSDR uses to analyze and report population and housing data for small geographic areas (e.g., census tracts and census blocks) (Table 1) (*1*,*2*).

U.S. census data describing residential population and housing provide the most complete picture of our nation and its subareas. Basic population and housing data (e.g., age, race/ethnicity, and sex) are reported for all census geographic levels (e.g., state, city, census tract, and census block). Additional demographic data, including socioeconomic information, are available at the block group level and at the larger geographic levels (*3*).

ATSDR incorporates U.S. census population and housing data into a GIS application, which generates demographic maps for the areas near active hazardous waste sites (e.g., those listed by EPA on the National Priorities List). A map of each site contains the location of the site and its surrounding area (within a 1-mile buffer). Using an area-proportion spatial analysis technique in a GIS, demographic statistics from the 1990 census are calculated and the results listed in a site map. ATSDR also records these data in its HazDat database, which contains detailed site-specific information regarding hazardous waste sites. Through GATHER, a site map can be generated that contains these demographic statistics for any hazardous waste site in the comprehensive HazDat database.

GIS maps that overlay data on population, environmental contaminants, and health outcomes are produced routinely for hazardous waste sites. Requests by ATSDR staff for additional current and historical demographic data, such as housing age, length of residence, and socioeconomic status, are easily incorporated into the GIS system. ATSDR also provides GIS-generated demographic statistics in response to requests from other public health agencies, including CDC and the 28 state health departments that have cooperative agreements with ATSDR.

Demographic Data and Segmentation Systems

An issue in using census data to examine area demographics is that the data reflect the population and housing status of U.S. residents on April 1 of a census year (e.g., 1990, 2000), but area demographics can change over time, particularly in smaller geographic areas. Several companies use the most recently published census data to project current-year demographic estimates for the period between official censuses. These projections are then incorporated into a system that segments small geographic areas into categories reflecting the demographic characteristics, lifestyle, and consumer behavior patterns of residents.

To meet the agency's need for updated data statistics, ATSDR licenses with Claritas, Inc., for estimates of current-year demographic data at the block-group level. These data include age, race/ethnicity, sex, income, education, and housing. ATSDR uses the PRIZM segmentation system developed by Claritas, Inc., to obtain additional demographic and lifestyle information about populations living near hazardous waste sites (*4*). The concept behind the PRIZM segmentation system is that individuals are more likely to live near others who share similar demographic and behavioral characteristics. The PRIZM segmentation system divides the U.S. population into 62 neighborhood types, or "clusters," on the basis of residential location (i.e., geodemographics).

PRIZM has copyrighted names for each of the 62 neighborhood types (e.g., "Kids and Cul-de-Sacs" and "Southside City") that it assigns to census block groups, census tracts/block numbering areas, and zip codes. These neighborhood types can be used to analyze and display demographic data in a GIS. The cluster names are meant to catch interest and convey a general sense of the character of an area; however, they should not be interpreted literally. PRIZM contains demographic and market research data that define and differentiate each cluster. The marketing research data include information on lifestyle (e.g., smoking, gardening, and exercise), media habits (e.g., television, newspaper, and radio), financial product usage (e.g., health insurance information), and general product use (e.g., foods and alcohol).

Used successfully as a marketing tool for many years by the business industry, segmentation systems are increasingly used by public health agencies to (a) explore the relationship between community and disease, (b) target health interventions, and (c) develop communication strategies. For example, the Georgia Division of Public Health used cluster information to target mammography programs in factory towns designated as "Mines and Mills" because women in those communities had higher rates of breast cancer (*5*). The Office of Communication (OC) of the Centers for Disease Control and Prevention (CDC) collaborates with the centers that comprise CDC on projects that integrate PRIZM data with epidemiologic and other data for communication planning (*6*). One example of this collaborative work concerns prevention efforts for hantavirus. Using zip code information, OC and the National Center for Infectious Diseases (NCID) identified the PRIZM clusters at which 164 cases of hantavirus had been diagnosed in the United States during 1993 through 1997. Residents of these clusters then can be targeted as the priority audience to address for prevention messages about hantavirus (*6*).

Community Research

In support of ATSDR programs and initiatives (e.g., the Minority Health Program and the Child Health Initiative) to define the issues concerning hazardous substances and special populations, agency staff also use GIS technology and techniques to conduct demographic research on populations living near hazardous waste sites. This research helps ATSDR to understand the health status of these segments of the population. For example, if racial/ethnic minority groups and/or residents of areas designated as having lower socioeconomic status are more adversely affected by close proximity to hazardous waste sites, ATSDR must determine the implications for public health activities in these areas.

In 1995, ATSDR published an article in the *International Journal of Occupational Medicine and Toxicology* about a GIS approach used to analyze the 1990 racial and ethnic composition of the population near 1,200 National Priorities List sites (*7*). Approximately 11 million persons were found to live within a 1-mile buffer of these sites. ATSDR staff are updating this analysis using current-year demographic estimates for race/ethnicity and socioeconomic status and reviewing data for 1980–1999 to better understand the types of demographic changes that occur in areas near hazardous waste sites. Using the PRIZM segmentation system database, ATSDR is also studying the types of neighborhoods in which NPL sites are found. An initial analysis of the data suggest that a concentration of these sites exists in neighborhoods described as "Middle America," "Family Scramble," and "Military Quarters."

Creating Community Profiles

ATSDR is using a wide range of small-area demographic data to create community profiles as a logical first step in its public health activities for communities near hazardous waste sites. Data products from Census 2000 will provide up-to-date, small-area population and housing data. The 2000 TIGER/Line File, the digital database of U.S. geographic features developed by the Bureau of the Census, will include Census 2000 statistical area boundaries. Census 2000 and the 2000 TIGER/Line File are expected to be available in spring 2001. ATSDR plans to publish a report this fall on how the population changes reported in Census 2000 affect the agency's population analysis for areas near

Table 1. Census Statistical Areas

Geographic Area	Definition	Number in 1990
Census tract/ Block numbering area (BNA)	Census tracts are small, locally defined statistical areas in metropolitan areas and densely populated counties. In nonmetropolitan areas, BNAs are equivalent to census tracts. In Census 2000, the term "census tract" will replace BNA. Initially delineated to be homogeneous with respect to population characteristics, economic status, and living conditions, census tracts generally have stable boundaries to facilitate longitudinal population comparisons. Total population size ranges from 2,500 to 8,000 persons, with an average of 4,000. Area size is determined by settlement density. Census tract boundaries are linked to census data in a GIS with a six-digit Federal Information Processing Standards (FIPS) code.	62,276
Block group (BG)	BGs are groupings of census blocks within census tracts or BNAs. The first number assigned to each block identifies the block group of which it is a part. A block group may contain up to 97 blocks, but usually the number is substantially less. BGs generally contain between 250 and 550 housing units, with an average of 340.	229,192
Block	Blocks are the smallest census geographic area used by the Bureau of the Census for data tabulation and presentation. Block boundaries are usually streets and other prominent physical features. Political divisions can also serve as block boundaries. Blocks may be as small as a typical city block bounded by four streets or as large as several square miles in rural areas. The 1990 census is the first in which the entire country is block-numbered. Blocks have a three-digit FIPS code (some might contain a letter at the end of the code). In Census 2000, blocks will have a four-digit numeric code.	7,017,425