6-6-1999

From the Field: Observations on Using GIS to Develop a Neighborhood Environmental Information System for Community-Based Organizations

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Abstract: *This paper describes and analyzes an application of a geographic information system (GIS) to create a profile of environmental hazards and resources in an older, inner-city neighborhood in Cleveland. The client, a community development organization, sought the profile as the basis of new organizing and community planning efforts concerning environmental quality and environmental health issues. The objective was to obtain and assemble spatially referenced environmental data existing in the public domain and map that data according to the service area of a neighborhood-based development organization. The study describes and analyzes the utility and data management capacity issues that would likely be experienced by community-based organizations using GIS in applications at the neighborhood level. This paper describes and analyzes the use of GIS to develop a profile of environmental conditions in an urban neighborhood. The project client was a community-based organization (CBO) seeking a baseline set of environmental information displayed spatially. This information would serve as a basis for community planning to develop strategies to address environmental quality concerns in the neighborhood.*[1] *We designed our project to result in a product useful for the client, to explore the issues raised in relevant literature, and to generate working hypotheses for a broader study of the use of GIS by CBOs to address environmental quality issues. The purpose of this paper is to examine the application of GIS at the neighborhood scale by and for a CBO. Through this examination we can understand better the obstacles and opportunities to make GIS a more relevant and effective technology for use by and for CBOs as GIS projects diffuse into broader society.*

Community-Based Organizations and GIS

Several reasons inhere why we should be interested in the use of GIS by community-based organizations. Community-based organizations have a long history of mobilizing resources and residents to improve the quality of life in urban neighborhoods in the United States (Silver 1985; Keating, Krumholz & Star 1996). Early community-based organizations worked to improve living conditions for immigrants living in tenements in the nineteenth century American city. These organizations included settlement houses, school cooperatives, playground advocates and child health associations (Boyer 1983; Krueckeberg 1983). In the middle twentieth century, community-based organizations gained increased in importance as federal urban poverty programs required citizen participation in community planning processes (Wilson 1991; Keating, Krumholz & Pylkas 1998). Many of these CBOs focused on social and economic aspects of community development. The role of CBOs has continued to grow in importance over the last several decades as the federal government devolved responsibility for implementation of a variety of programs to address urban problems to the local, sub-municipal and neighborhood level (Wilson 1991). City governments today often view community-based organizations as useful and even preferred vehicles for service delivery and citizen participation (Keating, Krumholz & Pylkas 1998). By 1995, there were more than 2,000 neighborhood-based community development organizations, one type of CBO, in the United States (NCCED 1995).

Community-based organizations are characterized foremost by their close working relationship with neighborhood residents and their programs to benefit neighborhood residents and address their concerns. CBOs may focus on one issue or multiple issues, including crime mitigation, housing rehabilitation, maternal and infant health care, youth programs, job training, tenant advocacy, recreational activities, small business assistance, or neighborhood planning.

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CBOs are non-profit organizations that tend to have small full time staff and depend on neighborhood volunteers for development and implementation of their programs.[2]

Existing community-based organizations and networks can play an important role regarding environmental quality concerns despite a relative lack of experience with environmental issues. CBOs often have the most intimate knowledge of community needs and assets and can better organize community members to address community concerns. Indeed, many community-based organizations today seek information about environmental hazards and assets that affect health and quality of life conditions in their service areas (Bullard & Wright 1992; Heiman 1997). In partnership with environmental advocacy organizations, CBOs might be involved in community-based knowledge production about environmental quality issues, not just knowledge consumption, a key strategy for gaining the social power needed to effect change (Gaventa 1993). A key aspect of knowledge production might include utilization of computer-based technologies, including GIS. GIS could provide a useful tool to increase the effectiveness of organizations working on the front lines of environmental problem solving.

Case Study Framework

What obstacles and opportunities arise for CBOs wishing to use GIS to help them address environmental concerns manifest at the neighborhood level? Our exploration through a field application was guided by two broad concerns that arose in previous work in the neighborhood and which we hypothesized were likely to arise for a CBO considering use of GIS for neighborhood problems: utility and capacity. What is the utility of GIS, that is, why should the organization use GIS, how relevant is GIS to its situation, how can the organization use GIS to address the neighborhood's concerns? Second, what capacities will the organization need to have in order to use GIS effectively? That is, what skills and knowledge will it need, what data will it need, what data is available and at what cost? Will the organization be able to use data effectively once has been acquired? These concerns of utility and capacity have been explored and reported in the academic and professional literature and are reviewed here (Table 1 summarizes this discussion)

Utility

Why should a CBO use GIS? Do the outputs from GIS effectively communicate information that is meaningful (Fischer 1994; King 1993) for the purposes of the CBO and to the residents it serves? Is GIS the most appropriate mapping technology (Aberley 1993) by which to analyze environmental problems as they are defined at the neighborhood scale? In what ways can GIS by used to address neighborhood environmental concerns? Does the technology serve to enhance local communication and participation in democratic decision-making processes (Ramasubramanian 1995; Doheny-Farina 1996)? These questions are discussed in turn.

Meaningful Information. Much evidence exists to support the notion that locality is a key variable in planning and decision making. Residents and community organizations tend to pay attention to events in their own "backyards" more closely than events occurring at a distance away (Kraft & Clary 1991; Groothuis & Miller 1994). They are more likely to preserve and restore those environmental and cultural qualities they consider important (Aberley 1993). Residents and the non-profit CBOs that serve them define problems in terms of their own territory - where they live, where they work. They seek to understand how broad environmental and social conditions affect them in their homes and neighborhoods. Communities can improve their understanding of conditions and problems through participatory processes of mapping what is important to them. Using methods and technologies which they deem appropriate, they create their own spatial representation of their locality, to understand "the complexities and important relationships within their own human and natural communities" (Fischer 1994: 34).

Technological Appropriateness. Spatial representations can be demonstrated or mapped using a variety of techniques, from children's drawings to community-sewn tapestry (King 1993) to computer-based technologies, such as Geographic Information Systems. Ideally, to map information most relevant for a neighborhood organization, information should be organized and presented to conform with the spatial boundaries of place defined by residents and their organizations. Those who seek to use maps should participate in their design, including setting the boundaries and the unit of analysis in meaningful ways (Bertrand & Mock 1995). GIS is potentially a most appropriate technology to tailor spatial representation to neighborhood perceptions because of its flexibility in manipulating diverse geographic units to analyze and present information. Also, it is potentially more useful because it is integrated with databases that can be modified as neighborhood conditions change, generating new maps with relative ease.

Modes of Use. In what ways can GIS be used by CBOs to support decisions, improve service delivery and communicate information to residents regarding environmental problems defined at the neighborhood scale? Experiences from other GIS applications offer insight; e.g., addressing environmental problems at larger scales and addressing non-environmental problems at smaller scales.

The utility of GIS as a database management, analysis and communication tool regarding environmental problems is well developed. GIS has been used to model various types of natural resource systems to support environmental management, including wetlands mitigation programs (Brown

& Stayner 1995), flood plain delineation (Gallagher 1992), prediction of surface water quality (Mattikali, Devereaux & Richards 1996), and determination of bio-regional boundaries for watershed management (Aberley 1993).

GIS has been used to improve environmental aspects of land use planning (Teicholz & Berry 1983; Innes & Simpson 1993), landscape ecology (Haines-Young, Green & Cousins 1993) and land management (Gumbricht 1996; Hallett, Jones & Keay 1996). GIS has also been used to investigate environmental and public health phenomena. These investigations included monitoring air quality (Speed 1990), identifying spatial relationships between cancer risk boundaries, and air pollution (Moore 1995; Gatrell & Dunn 1995), assessing relationships between air pollution and birth and mortality rates (Lloyd 1995), and routing hazardous waste transport (Baaj, Ashur, Chaparrofarine, & Pijawka n.d.).

Overall, GIS has been shown to improve the effectiveness of government organizations at local, regional and state levels (Mills 1983; Watterson 1990; Innes & Simpson 1993; Budic 1993; Budic 1994). Use of GIS to address problems at the sub-municipal level has begun as well. GIS has proven of high utility in charting real property changes (Hintz & Onsrud 1990), in selecting vacant parcels with suitable development characteristics (Simons & Salling 1995), and predicting residential housing prices (Clark 1997). GIS has been used for health-care planning and analysis (Albert 1994) and to evaluate the efficiency of social service delivery (Wong 1993). The use of GIS to address problems experienced at the neighborhood scale is relatively less documented. Will the use of GIS for environmental problems prove as useful to CBOs as the experiences of other organizations working at other scales and for other purposes?

Enhanced Participation in Problem-Solving. Finally, will use of GIS technologies enhance participation in knowledge generation for problem solving? In what circumstances will electronic technologies, including GIS, offer new op-

***Table 1** Relevant Considerations for CBO Use of GIS*

Considerations	Literature
Utility (Why Use GIS and How)	
Does GIS produce information meaningful to the organization's purpose?	Fischer 1994, King 1993
Is GIS technology needed/better able to analyze community problems and facilitate use of community-defined boundaries and spatial representations?	Aberley 1993, Fischer 1994; King 1993, Bertrand and Mock 1995
In what ways can GIS be used by CBOs to improve activities and programs?	See text, "Modes of Use"
Does use of GIS enhance participation in community knowledge generation and problem-solving?	Ramasubramanian 1995; Doheny-Farina 1996; Gaventa 1993
Capacity (What will the organization need to use GIS effectively?)	
Is data available and accessible to address problems identified at the neighborhood scale?	Innes & Simpson 1993; Ramasubramanian 1996; Sawicki & Flynn 1996; Godschalk & McMahon 1992; Sawicki & Craig 1996
Does the CBO have adequate and appropriate hardware and software to use GIS fully to address problems?	Stoecker & Stuber 1997
Do CBO staff have or can they get adequate training and practice using GIS?	Innes & Simpson 1993; Budic 1994; Godschalk & McMahon 1992; Campbell 1993
What role can intermediary organizations such as universities play to enhance CBO capacity and access to data?	Sawicki & Craig 1996; Rubin 1998; Reardon 1998

portunities for citizen participation in science-intensive environmental decision making? (Ramasubramanian 1995; NCGIA, 1996). Such participation is a condition for neighborhood residents and their organizations to gain more influence over decision making processes that affect them. However, an equally likely scenario for the use of new information technologies is that existing inequalities in accessing information will lead to increased social polarization and segmentation (Castells 1989; Armstrong 1995). Great uncertainty exists whether new technologies can be adopted in ways that empower traditionally disenfranchised citizens as they seek to influence environmental decision making and improve conditions in their communities. [3]

Capacity

What will CBOs need to use GIS effectively? Have the necessary data been collected and made available (Sawicki & Flynn 1996; Sawicki & Craig 1996)? What means exist by which to gain access to data? Do CBOs possess technologies to connect to agency databases (Campbell 1993; Stoecker & Stuber 1997)? Does the CBO have hardware and software needed to use GIS (Stoecker & Stuber 1997)? Do CBOs have the skills needed to use GIS effectively, or can they get needed training (Innes & Simpson) and from where (Ruben 1998; Reardon 1998)? These questions are discussed in turn below.

Data Availability and Access. Participation by community-based organizations in decisions that affect their neighborhood is based in part on the availability of and access to information (Desario & Langton 1987; Ramasubramanian 1995). Availability of data relevant to a particular environmental concern defined by the neighborhood residents is key. Much of the environmental information sought by community organizations has been assembled by environmental and health agencies of federal, state and local governments. Is the agency that holds the information willing and able (both technically and legally) to transfer information readily? Given the more traditional focus of CBOs on community development and social services, do residents and CBO staff know what sources of environmental information exist and its significance one obtained? Such knowledge is key to support use of a new technology such as GIS (Godschalk & McMahon 1992; Innes & Simpson 1993).

Access to data might prove a second challenge. CBO GIS users must know how to retrieve data through a variety of media (diskette, ftp, Internet) and be capable of manipulating data into useful formats. A working knowledge of computer operations and other data base management software is required (Campbell 1993). We anticipated that the format in which data is transferred can significantly increase data management and input requirements for small community-based organizations, possibly precluding acquisition and use entirely.

The use of the Internet as a data source is of particular relevance for CBOs. Agency and non-governmental organizations are today offering more and more information via computer-based information technologies (Naisbitt 1994) such as Internet web sites and E-mail list-servers. While most data that are collected and produced by the agencies still remain available only through mail or visits to agency district or regional offices, some agencies (particularly at the federal level) are replacing more traditional access mechanisms such as brochures and telephone information personnel with on-line mechanisms (Coder 1997).[4] . Geographically based information is available by state, by county, and by zip code. CBOs with GIS capabilities could manipulate such data to address problems affecting the neighborhood as they define it. When Internet connections are efficient and the desired information is available, downloading data from the Internet can save time-pressed CBO staff hours of effort, but only with modems with adequate speed to load graphically intensive sites and large databases.

Adequate Hardware & Software Technology. Transfer and manipulation of data depends on adequate technology (hardware and software). How likely are CBOs to have these technologies? A 1996 survey of CBOs in seven Ohio metropolitan areas demonstrates the issues related to hardware capacity. Of 189 organizations responding, only 38 had hardware capacity the researchers considered needed to support Internet access minimally [5], which would indicate even fewer would have hardware adequate for GIS software use. Only three organizations indicated access to and use of the Internet and only five indicated they currently used GIS. While significant obstacles to GIS use exist, the desire for use of GIS was strong: of the 189 organizations, approximately 60 indicated they wanted to obtain GIS (Stoecker & Stuber 1997).[6] The survey also indicated that many CBOs planned to incorporate better computer equipment through their budgeting processes. Such actions should increase their access to and capability to manipulate information, whether available through traditional means or over the Internet, to use GIS to bolster their planning and participation activities.

User skills. Experience from GIS use in local and state level planning agencies indicates that effective use of GIS requires significant training and on-going opportunities to practice and improve familiarity with GIS and data support software (Innes & Simpson 1993; Budic 1994). While GIS as a technology has great power when used by the highly trained and practiced user, users in organizations such as CBOs may not have the advanced skills or time to use GIS to the same potential. The advent of more user-friendly "desk-top" GIS software was predicted to enable more organizations to begin using the technology (Van Demark 1992). Recent work by the National Center for Geographic Information and Analysis (NCGIA) questions whether CBOs will possess skills and access to data needed to make GIS most useful, however (NCGIA 1996).

Role of Intermediary Organizations. From where do CBOs get technical assistance for using GIS? What kinds of technical assistance will be needed? In many communities, intermediary organizations assist CBOs through a variety of programs and financial support. What role can these intermediaries play regarding use of GIS? We were particularly interested in exploring the role that universities (as institutions) and students (engaged in experiential learning classes) might have to support more effective use of GIS by CBOs. The benefits of university/community partnerships to community improvement are well documented. Universities assist CBOs in many aspects of planning and problem-solving, including problem definition and program development, asset mapping, training and technical assistance, program evaluation and organization and leadership training (Rubin 1998). These efforts can lead to more effective planning and problem solving. Common to analyses of effective university-community partnerships are community capacity-building efforts (Rubin 1998; Reardon 1998).

The Client and Study Area

The St. Clair-Superior Coalition, the project client, is a community development organization recognized and partially funded by the City of Cleveland. The organization has five full time staff members who organize neighborhood block clubs, coordinate rehabilitation of multi-family and single family housing, provide marketing assistance to merchants, administer a job search assistance program, and administer a city-sponsored pediatric lead education program. The Coalition works in the St. Clair-Superior neighborhood, located in the north east section of the City of Cleveland near the downtown area (Figure 1). [8]

Land use in the neighborhood is a mix of residential, industrial and retail. The Lake Erie shore area consists of industrial facilities, an electricity-generation plant, several marinas and a city park. An interstate highway separates the residential areas from the lake. The neighborhood's eastern boundary is comprised of Rockefeller Park, which joins at the lake with Gordon Park, the primary access point to the lake. In the western end of the neighborhood, industrial facilities and small residential streets are contiguous, exemplifying many urban neighborhoods settled in the late nineteenth and early twentieth centuries [9]. Discharges of toxic and other smoke and vapors from several dozen industrial facilities are a significant challenge to a healthy resident life in this part of the neighborhood.

St. Clair-Superior is a low-income neighborhood, with 1989 median household income at $15,000. Forty two percent of the residents live at or below the federal poverty level. The neighborhood's approximately 12,000 residents are culturally and ethnically diverse: 56% are African American, 36% are white and 7% are Hispanic.[10] The neighborhood is typical of many older urban neighborhoods, with problems of abandoned housing, vacant parcels, high unemployment and environmental degradation. The neighborhood also, however, has a rich ethnic mix of older Slavic residents and younger African American and Hispanic residents who have begun to work together to restore their living environment.

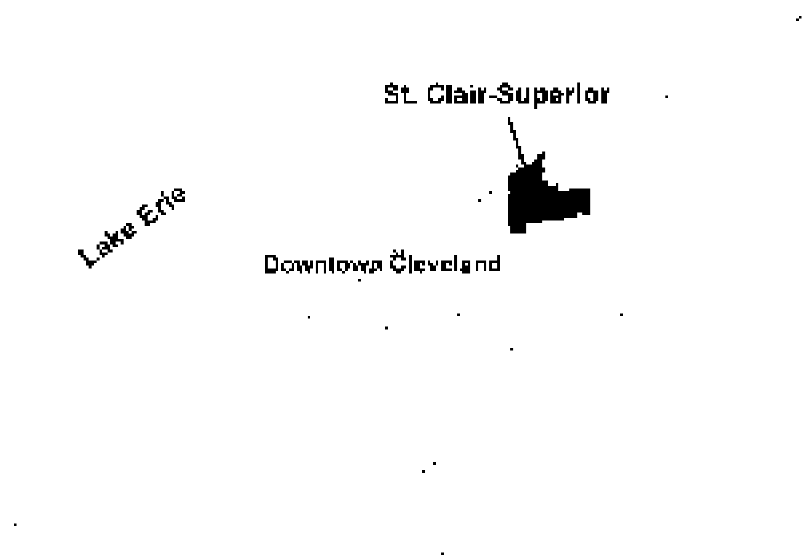
During 1994, the Coalition hired Northern Ohio Data Information Service (NODIS) at the Levin College of Urban Affairs, Cleveland State University, through a Community Development Block Grant from the Department of Housing and Urban Development. A base map, which was created by digitizing the assessor's parcel map for the neighborhood, was completed for the service area of the organization (Figure 2). The Coalition acquired GIS software and a staff member was trained by NODIS in the use of MAPINFOTM. At the time of our project (1996-1997), the organization used GIS to track crime watch activities and participation in storefront renovation programs in the neighborhood. The organization also wanted to expand use of GIS to address the environmental concerns of several street clubs, which included air pollution, vacant land, storage of hazardous materials and access to the lakefront.

Project Design

The Coalition's immediate need was to acquire data to address environmental problems, an activity for which they had little time for a comprehensive approach. Our objectives to meet the client's needs were three: 1) to assemble environmental data to address the Coalition's environmental concerns (described below); 2) to transfer the data and any maps to the client for their continued use; 3) to identify and document data sources, means of retrieval and contact persons at relevant data provider organizations to ensure that information could be updated by the Coalition after the project ended. Our broader objectives were to test the relevance of our research questions and gain insight through a practical and reflective GIS application.

The environmental conditions that shape the quality of life and health status of neighborhood residents today arise from a combination of the environmental legacy of late-nineteenth century development of the neighborhood and present-day environmental policies and practices. The client was most concerned with land contamination on vacant lots and the poor air quality in the neighborhood caused by the presence of several facilities that discharge fumes and particulates on parcels contiguous to residences. We suggested that a broader inventory to develop a profile of the neighborhood's environmental hazards and assets would help set planning priorities. We also suggested that historic data on the development of the neighborhood would serve to address land use change and its legacy relevant to present-day land conditions. Working with the client, we

Figure 1 *St. Clair-Superior Neighborhood, Cleveland, Ohio*



identified the constituent parts of the inventory for the neighborhood: land use by focusing on vacant parcels and those with potential contamination from underground storage tanks (USTs) or past uses, and waterfront change, as well as facilities with Clean Air Act Title V permits to discharge into the air; facilities reporting to the Toxic Release Inventory (TRI); and facilities in the neighborhood storing or using hazardous materials. [11]

The inventory was completed by ten students in an environmental studies class, assisted by the CBO staff. Data was retrieved for the inventory from a variety of local, regional, state and federal agencies using a wide range of techniques, including telephone calls, diskette copies retrieved at agency offices, and the Internet (Table 2). The data was loaded into MAPINFOTM browser tables and mapped. The project inventory was completed over a ten week academic quarter, with six weeks for data needs identification and collection, and three weeks for production of maps and other materials for the client. Each student was required to devote four to eight hours per week to the project. The environmental history, completed by the author and a graduate student, took approximately 50 hours of research time.

For several components of the inventory we describe below the issues relevant to data collection and mapping processes and the effect of using GIS on the CBOs activities. These results are then summarized with their general implications for other CBOs contemplating GIS applications. Table 2 also presents the limiting factor for our particular application and summarizes the likelihood that data is available and accessible more generally for the elements considered in the study.

Gis Application and Results

Historic Land Use and Development

We began searching for historic information to create a general picture of how environmental conditions in the neighborhood changed as the neighborhood developed. This environmental history documented the environmental conditions of the neighborhood through time as these were changed by infrastructure development, industrial production, commercial and residential expansion, and development of public parks.

The flat lake front plain of the St. Clair-Superior neighborhood proved an ideal location for intercity railways carrying iron and coal to fuel Cleveland's industrial expansion of the late nineteenth century. Many large companies, including various iron, steel, brass and other metal companies, several chemical plants, construction and bridge-building companies, soda works, a coke company, a motor production company, and later, two electric generating plants, located or expanded operations in the neighborhood. These facilities were located east and west of present-day E. 55th Street , predominantly along the lake shore, but were also intermingled with the residential and commercial areas developing along St. Clair and Superior Avenues (Figure 2). [12]

The history of mixed land uses makes the presence of land or building contamination in the neighborhood likely. When a parcel is slated for redevelopment by the Coalition, the Coalition completes a careful study of past land uses. The Coalition sought a method to identify areas of the neighborhood with a higher probability of historic contamination, a method that could serve as an early warning system. We focused on one commercial corridor in the neighborhood that has many older buildings and parcels in need of redevelopment. Information about historic location of businesses that might have deposited materials on the lot was taken from a set of business indexes published from 1880 through the 1930s, when the spatial development of the neighborhood was virtually complete. We discovered that few of the historic addresses matched present-day addresses used by the county assessor. Parcel addresses and parcels had changed substantially in the 12 decades we sought to document. Our geocoding of many of the parcels required comparison of several decades of Sanborn maps with the business indexes in order to assign the correct address to the parcel. Using this process, we identified the parcels with historic uses likely to predict contamination of the parcel by metals, chemicals or other hazardous materials. While Sanborn maps are readily available in most communities, the business directories might be less typical. We conclude, however, that the use of GIS to comprehensively map historic parcel land use information proved very time consuming and would not likely be done by a CBO without additional assistance.

A second land use activity focused on vacant parcels now in the City's land-bank program. These parcels are available from the City for purchase for $1 by neighborhood residents, developers and community development organizations. Students designed and carried out a site reconnaissance for several of the commercially and residentially zoned lots. An 8.5" x 11" lot map for each site was generated directly from the GIS parcel map. Each site reconnaissance team used the lot map to record site characteristics taken from the standard elements in a Phase I investigation on a walk-through of the site.[13] A legend of graphic symbols to indicate the presence of a site feature was generated using characters from MAPINFO TM.[14] These symbols were hand drawn by student and resident site reconnaissance teams onto the lot maps and then transferred to the GIS parcel map. The technology facilitated use of the spatial boundaries of a particular environmental problem as defined by the CBO. GIS provided a tool for developing a replicable site reconnaissance process that the Coalition can use in the future on other lots and other CBOs could use as well to encourage participation by neighborhood residents.

Significant shoreline changes accompanied the economic and physical growth of the neighborhood. The early railroad lines required in-fill of the lakeshore; between 1894 and 1895, piers and docks were built all along the neighborhood shoreline to service the many industrial facilities developing along the lake. Between 1898 and 1910 breakwaters were completed to protect the lakefront for warehouses, factories and docks. Refuse piles of industrial and municipal waste grew on the lakeshore during the 1920s and 1930s. In the 1930s a new lake shore boulevard was built upon land "occupied by the city dump..." (Cleveland Press 1933). Over the next 25 years, a series of successively wider and more modern roads was built along the lake, eventually bisecting the pride of the neighborhood, a park donated in 1892 to the City by prominent citizen William Gordon (Kennedy 1896; Orth 1910; Avery 1918). Today, Interstate 90 is the latest iteration of the lake shore road.

As a result of the long history of intensive land use and infrastructure development, Lake Erie is virtually cut off from the St. Clair/Superior neighborhood (and the rest of Cleveland) by the freeway, railroads, industries, and power plants. The only significantly accessible lakefront use is for fishing off the remaining piers and boating from one of the private or public marinas that now line the shore. Figure 3 summarizes the changes to the Lake Erie shoreline.[15] A colorful map delivered to the client shows very clearly how the lakefront had changed. From the environmental history, the residents have achieved a better understanding of the environmental legacy of these changes. A Coalition board member and neighborhood resident acknowledged the power of the map for demonstrating that, despite its apparent permanency, the lakefront has indeed changed, and can indeed be changed again. The Coalition is using the lake front history and the map as a baseline for a neighborhood waterfront planning process to link the neighborhood with the lake once more.

Pollution Hazards

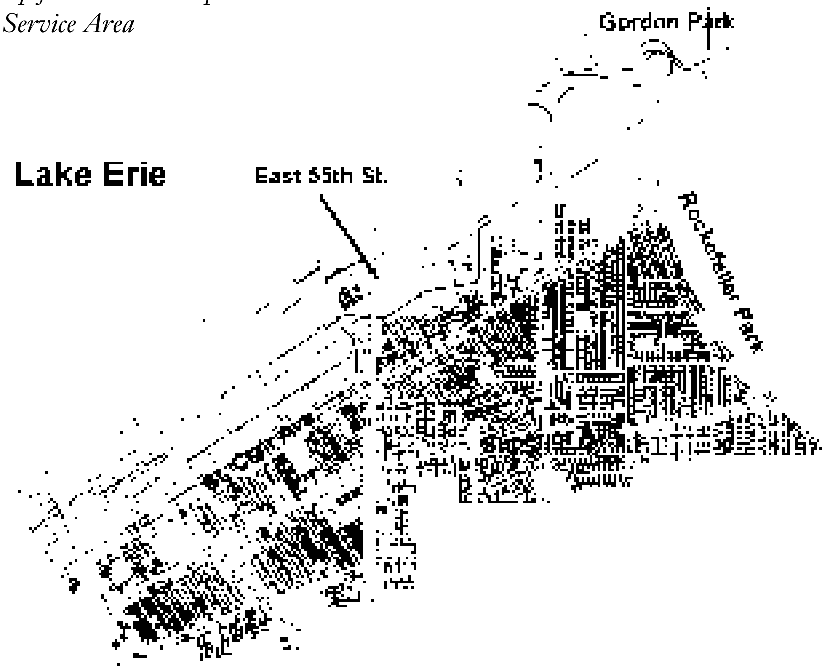
Pollution is a significant problem for the neighborhood because of the close proximity of industrial facilities to residences. The Coalition had on occasion helped residents investigate emissions from factories in the neighborhood; however, it was now interested in a more comprehensive accounting of the location of four pollution hazards; underground storage tanks (USTs), permitted discharges into the air, discharges reported to the Toxic Release Inventory (TRI), and on-site storage or use of hazardous materials. One or more of these problems often characterize older urban neighborhoods. Students identified and worked with a contact person at each administratively responsible agency to identify at what scale or unit of geography their data was available. This process allowed us to identify the level of compatibility of the agency data with our client's service area and how that data might be accessed and reformatted to suit the client's needs.

Underground Storage Tanks. The Coalition sought the location of underground storage tanks in the neighborhood to anticipate presence of contamination when considering parcel redevelopment. Information on the presence of underground storage tanks has been compiled by Ohio's Bureau of Underground Storage Tank Register. We retrieved our data from the State of Ohio and mapped

***Table 2** Summary of Data Issues for GIS Applications by CBOs*

Feature Mapped	Data Source(s)	Data Transfer Mode	Transformation Required	Limiting Factor(s) in Case	Likely Data Availability
Historic land use changes	Sanborn maps; newspaper articles; historic maps at local library; several histories of Cleveland	hand digitizing of maps	assemble maps; reconcile different scales; infer spatial location based on written accounts and historic photographs	time resources; access to digitizer	Sanborn maps widely available, local archives in hard copy likely available
Vacant lots	county assessor tax records	diskette copy retrieved by student	ASCII delimited table to MAPINFO™	hard copy more likely, time for data entry	assessor information widely available in hard copy
	City of Cleveland Land Bank Program	hard copy	data entry	time resources, manipulation of format	highly variable
Underground storage tanks	Ohio State Bureau of Underground Storage Tank Register	data diskette copy through mail	Excel spreadsheet to MAPINFO™	state readiness to provide	state data availability variable
Title V air permits	Ohio Environmental Protection Agency	diskette copy through mail	State manipulation of software- specific tables to ASCII; change to Excel to sort to MAPINFO™	state readiness to provide; data is for location of emission point, not chemical emitted	permit review available through special request , subject to legal review
Toxic Release Inventory	USEPA Envirofacts Warehouse website	Internet	download table to Excel; upload to MAPINFO™	Internet access	federal website and many other providers
Storage of hazardous materials	Cuyahoga County Emergency Management Division	diskette copy	county manipulation of data to ASCII file; upload to MAPINFO	$ charge for data (staff time to prepare)	federal law requires program; data available upon request in most communities

Figure 2 *Parcel Base Map for St. Clair-Superior Coalition Planning and Service Area*



it onto the parcel base map. The Coalition determined that this data, when combined with the visual site reconnaissance, will indicate good locations for future development and an early warning for the need for a formal Phase I investigation. [16]

Permitted Air Discharges. Discharge of pollutants into the air is the most long-standing concern of neighborhood residents. Residents have frequently reported emissions of particulates and the presence of objectionable odors from many industrial facilities. Data on air discharge permits required by Title V of the Clean Air Act were obtained from Ohio EPA's Air Permit Section in Columbus, Ohio. The database consists of each discharge point for which a permit is required (that is, each boiler, mixer, blower, evaporator, stack, etc.). The highly industrialized neighborhood contains 800 of these discharge points. [17] To map the information, we sorted by address, geocoded these to the parcel map, and produced a map of facilities in the neighborhood with Title V air discharge permits. We mapped the facilities onto both the parcel map and the TIGER/Line file base maps. Use of the parcel map seemed more appropriate for understanding the geospatial relationship of the residential lots to the air discharge points, for the problem defined was the fall-out from specific emission points into these lots. This approach also reflects the client's need to address problems within its own service area.

The Coalition is using the air emissions data for additional projects. The emission points will be cross-matched with typical emissions from these types of discharge points (using Standard Industrial Codes) to help prioritize which air discharge permits to request for review at the appropriate agency office to determine which pollutant is emitted and in what amount. As yet that information is not available by other means. The location of the emission points will then be compared to a wind rose to assess the potential affect of the emissions on the neighborhood.

Toxic Release Inventory. Title III, Section 313 of the 1986 Emergency Planning and Right to Know Act (EPCRA) requires certain industrial facilities emitting certain toxic chemicals exceeding a certain amount report any off-site and on-site release or disposal from their facilities to the United States Environmental Protection Agency (USEPA) on an annual basis. USEPA compiles these reports into the Toxic Release Inventory (TRI). TRI data are available through several Internet sites which vary in the level of detail presented. We assessed these and found the USEPA web site Envirofacts to be most useful. [18] Nineteen facilities in the neighborhood report to the TRI. Again, we produced maps using both the parcel and TIGER/Line base maps. The parcel map was more relevant for TRI data concerning location of shipments and on-site discharges, as neighborhood residents would seek to know what was happening on the parcel next door. The TIGER/Line map was used to map the TRI air emissions and included several of the facilities that lie west and southwest of the neighborhood. These facilities can directly affect air quality in the neighborhood because of the predominant west-southwest to east-northeast direction of the wind. A plume analysis would have been most useful here, but was beyond the skills of the CBO staff person and the students involved in the project.

Storage of Hazardous Materials. Many industrial and commercial facilities in the neighborhood store large amounts of hazardous materials used in production processes or maintenance on-site. Each community is required by EPCRA to compile a database of these facilities and make plans for evacuation of nearby population in an emergency (any large release of materials). Information on storage of hazardous materials was assembled from data provided by Cuyahoga County Local Emergency Planning Committee (LEPC).[19] These data were mapped onto the parcel base map. The Coalition will compare these locations with schools, churches, playgrounds and other locations in the neighborhood to assess their proximity.

Case Study Results and Generalized Observations

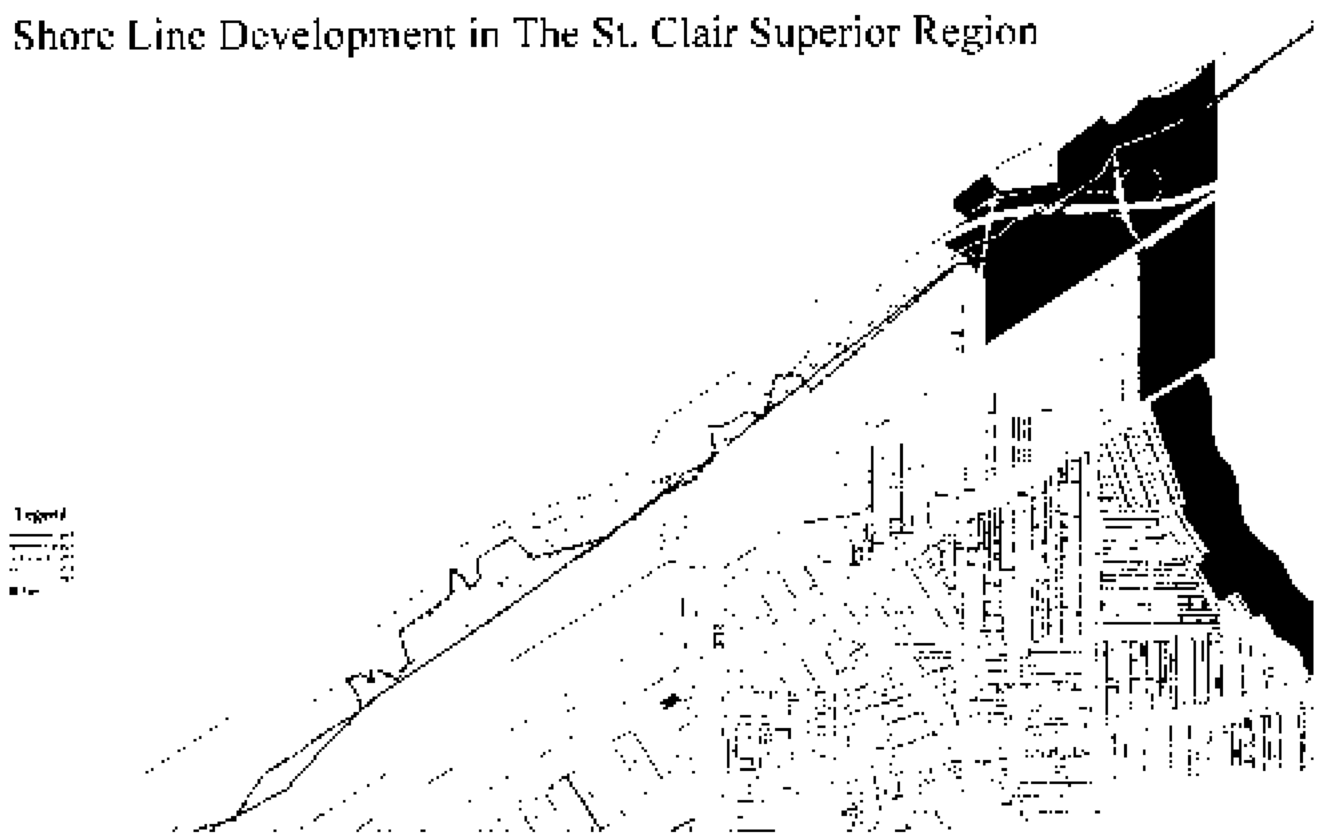
The results form our case study, we believe, hold import for other community-based organizations considering using GIS tools to address environmental concerns in their neighborhoods, for intermediary organizations, and for data providers. In this concluding section we review the eight research question areas summarize in Table 1.

Utility

Meaningful Results. For most of our objectives for the client, GIS proved useful. GIS helped the CBO to analyze the community's environmental problems by improving their knowledge of the spatial distribution of a set of environmental hazards. Prior to our efforts, the CBO did not have a comprehensive and clear picture of the number and location of these hazards. GIS produced information meaningful to the CBO's efforts, particularly in creating and communicating the baseline inventory of conditions. It has improved communication by the Coalition to its board members and residents. Copies of the GIS map are used in environmental outreach by the CBO staff. The Coalition is also now using the maps for continued analysis of air discharges and health concerns of the residents, thereby supporting better decision making.

For urban CBOs more generally, GIS can be used to generate information about a variety of social, economic and environmental concerns. GIS can be a powerful tool to help CBOs understand conditions in the neighborhood to the extent that data about the neighborhood can be collected and mapped by the CBO or obtained from government or non-governmental data providers. Perhaps the most meaningful information generated through use of GIS is that which places the neighborhood as a small area of territory in its city-wide or regional context, allowing neighborhoods to understand how broader environmental conditions contribute to conditions in their neighborhood. On the other hand, for some information, such as values and perceptions residents hold about the neighborhood, other means for communicating information, such as mod-

Figure 3 Historic Changes to Lake Erie Shoreline in the St. Clair-Superior Neighborhood.



els, posters, photo essays, or hand-drawn maps might be more appropriate and needed.

Technological Appropriateness. With the Coalition we were able to define spatial boundaries and select the spatial representation of the neighborhood that fit the problem addressed and the information desired. The client asked that the data be assembled for their service area, which encompassed approximately 1.5 square miles of urban territory. That geographic unit did not correspond to others typically used by the City of Cleveland (Statistical Planning Areas), the State of Ohio (zip code) or the U.S. government (counties, zip code and census tracts) to organize data. We anticipated some difficulties with the match between the structure of environmental data available from various agencies and the client's need given the unusual boundaries. GIS proved useful in resolving these issues of diverse units of geographic analysis.

Because GIS places high resource costs on an organization, CBOs should approach GIS cautiously. GIS will be most useful for two aspects of CBO environmental problem-solving activities: tracking changes in neighborhood conditions over time; and analyzing spatial relationships among socio-economic and environmental concerns on a parcel-by-parcel, block-by-block, or census tract-by-census track basis. These uses depend on the availability of relatively well-developed data. (described below).

Our mapping activities depended on existence of a parcel map for the service area of the Coalition. Planning and management territories are defined according to their particular purpose (Guttenberg 1993). In urban neighborhoods, territory tends to be socially-defined (rather than biophysically-defined) and created to reflect more traditional social planning and service provision needs. GIS was useful because it allowed us to determine larger and smaller scale views of the neighborhood as dictated by each environmentally-defined region. In our project, use of the two base maps (TIGER and parcel) was appropriate, depending on the information we wished to analyze and communicate. For other CBOs, the feasibility of using GIS as we did depends on existence or development of the appropriate base maps.

Existence of a GIS parcel map for a given neighborhood depends either on efforts by county and local governments to create parcel maps for their entire jurisdictions or on the financial resources of CBOs. As more planning and engineering agencies adopt GIS, which appears to be the case (Gallagher 1992; Budic 1993), the likelihood that city- or countywide parcel base maps will be available to CBOs increases. Alternatively, access to a parcel base map might depend on creation of the map by the CBOs themselves, which is a labor-intensive exercise, often requiring that a county assessor's map be digitized by hand (Simons & Salling 1995). This can be cost-prohibitive for many CBOs, which are not likely to have the resources to purchase a digitizer. The federal grant initiatives targeting computer hardware should increase the resources available to CBO, but these funding sources will likely remain highly competitive.

We recommend an alternative strategy. In many communities, intermediary organizations, local governments or universities provide technical assistance and training to CBOs. These organizations could coordinate and house a program that would purchase and maintain a digitizer and plotter and allow CBO staff trained in GIS to use them to create and print parcel-based maps. Such an opportunity would make CBO less dependent on finding consultants to create maps and would provide greater access to technology. This kind of sharing has been pursued in several localities to serve the needs of local governments (Mitschele 1996; American City & County 1997) and could be developed to include CBOs.

Problem-solving Participation. The information we provided using GIS has served to enhance and stimulate participation in environmental problem-solving in the neighborhood. The GIS maps and the inventory document the current status of problems and have helped the Coalition identify priorities. The site reconnaissance exercise was more consistently documented using output from the GIS maps. The maps produced have spurred additional interest in leaking underground storage tanks and air discharges in the neighborhood. We are now working with the Coalition to address information needs for these issues.

The GIS project stimulated a broader effort to build capacity in the neighborhood. In the course of their research on current environmental conditions the students compiled background information on the regulations and laws governing environmental quality conditions, the agencies that are responsible for regulation, and potential financial sources to fund neighborhood environmental improvement projects. Students assembled an environmental resource guide that accompanies the data sets and maps. The resource guide has allowed the Coalition to increase its outreach concerning environmental issues in the community. [20] The resource guide and mapped information also smoothed the transition among Coalition staff members, as a different staff person assumed responsibility for the lead and environmental programs the year following our work.

A standing Environmental Committee of 6 residents was recently added to the Coalition's neighborhood watch and housing committees. This committee is now developing strategies to address USTs, storage of hazardous materials in the neighborhood and air emission complaints. At one meeting, a new committee member held up our initial map of USTs and asked if we knew where to get additional data on which tanks were leaking, a direct link between information generated using GIS and enhanced resident participation.

Based on our experience, the use of GIS can enhance community knowledge generation and problem solving, but only to the degree that GIS is seen as a tool useful to problem-solvers, not as a problem-solving mechanism itself. CBOs that have a well-developed organizational capacity for problem solving and include neighborhood residents in their activities will find the greatest benefit from GIS to improve their analytical capabilities and resident participation. However, we also expect that if GIS is purchased by a CBO that does not have strong problem solving skills it will likely be underutilized.

Capacity

Data Availability and Accessibility. Availability of data to address problems identified in our neighborhood application was mixed (See Table 2). For example, while we found some pollution emission data available on-line, the Title V data, though collected, was not readily available in a useful format. We acquired data on the emission points in the neighborhood, but data on the specific emissions (kind and amount) from each of these points is available only through a request to review the facility discharge permit at the City of Cleveland's Air Division office. Each request must be reviewed by the city's legal department to assure the facility's owner is not involved in a legal proceeding, therefore, access to the permits can take several weeks or months and during a one-quarter class this was not feasible. It is likely that a similar situation exists in other communities, whether the air emission program is administered at the city level, as it is in Cleveland, or at the state level.

Still other data of interest to the Coalition and residents has not been collected and assembled. For example, many residents have concerns about the health effects of emissions from industrial facilities. They reported to us that their neighbors suffer a variety of health problems, including several cancer victims in a family and frequent respiratory problems, including asthma in adults and children. In the case of asthma, data that could be spatially analyzed is not available because asthma, unlike elevated pediatric blood lead levels, is not a "reported" disease. [21] We suspect that this particular gap in data availability is relevant to urban neighborhoods in general, where it is believed that pediatric asthma is more prevalent. A change in federal or state policy designating asthma as a "reported" disease -- would allow CBOs using GIS greater capacity to assess the spatial distribution of asthma in their neighborhoods. More generally, we recommend that USEPA and state and federal public health departments develop mechanisms to collect spatial data on other diseases that can be caused or aggravated by environmental pollutants and make it available for public use as well. Environmental health data, when not collected, stored and accessible, thwarts community-based efforts to improve conditions that support a healthy life for residents.

While waiting for any state or federal policy changes, CBOs and their community partners can devise alternative methods for creating information from data that is available. One Cleveland project, for example, is now investigating the use of known incidences of elevated pediatric blood lead levels as a marker for incidences of pediatric asthma.[22] Limited resources require such creative strategies to utilize available spatially-referenced neighborhood-level data to the greatest degree possible. CBOs can also generate data about the neighborhood by house-to-house surveys of resident's perceptions of the environmental quality in the neighborhood, health problems they experience, etc.

It is likely that many CBOs will find it difficult to mobilize the resources needed for a more comprehensive data assembly and mapping alone, as was documented by Barndt & Craig (1994) and Sawicki and Craig (1996). Here the role of a local university or local government can prove key in assisting an organization. [23]

A wide range of agencies at federal, state and local levels store environmental data. The high data input demands to use GIS to its full potential require knowledge of the various sources of data, which is based on a good knowledge of which agencies are responsible for what information through their regulatory function. These are of particular concern for use of GIS by CBO to address environmental problems or create a comprehensive picture of environmental conditions in their neighborhoods given their more traditional focus on housing and economic development projects and programs. Community-based organizations can learn over time where and how environmental information is available, [24] however, their ability to acquire it would be improved to the extent that data providers can decrease the "transaction" costs for CBOs. Our study well-illustrates the need for "user-oriented" design of data accessibility, including data that will form the basis of GIS as described by Bertrand and Mock (1995). As regulatory agencies at the federal and state level strive to provide more data, greater consideration should be given to whom the end-user of that data may be. The way data are organized and retrieved should be modified to accommodate citizen and community-based organization staff end-users. [25]

We urge environmental agencies that are required to provide data to the public conduct outreach to CBOs regarding the availability and access methods for data that they hold. CBOs have far greater contact with urban residents than most environmental agency staff and we believe that the regulatory agencies could better fulfill their efforts toward community-based environmental protection by such outreach. Universities and local environmental organizations could prove useful partners in this endeavor as well and provide on-line metadata documentation of GIS data in a locality. For example, the NEOEDEN Project, [26] which provides metadata on environmental spatial data on-line, is sponsored by four universities in northeast Ohio.

Hardware/Software. These proved a significant issue for the CBO in our project. The CBO has three computers; only one has a 486 processor. GIS and the Internet require fairly advanced computer speed and capacity, which, according to Stoecker and Stuber's (1997) study in Ohio, are likely to exceed that typically found in CBO offices. Features and capabilities of GIS software vary by manufacturer and version. The CBO we worked with had MAPINFOTM Version 3, but did not have a good spread sheet program, which we found very useful in readying data for MAPINFOTM . The organization did not, and does not at this writing, have Internet access. This set of characteristics is not the best situation in which to develop GIS as a decision-support tool. Internet conditions appear to be similar to those faced by many CBOs, and the presence of GIS is rare. However, in the Ohio study, 65 of 189 CBOs used database and spreadsheet software. These are often critical for preparing data to use in a GIS program.

Finding funds for hardware and software maintenance and upgrades is a key prerequisite for sustained use of GIS for CBOs. Unfortunately at this time, US federal funding is highly competitive. Intermediary organizations seeking to support CBOs could create a hardware exchange program or facilitate donations of less-than-leading edge hardware from corporations and government agencies as they upgrade their hardware and software.

GIS Training and Practice. CBO staff capacity and skills was a key variable in our project, as it was in studies done by Innes & Simpson (1993) and Budic (1994). A staff person in the CBO had been trained in MAPINFOTM by the university prior to our project. The staff person was a community project manager whose activities were split among GIS and other responsibilities. We know that the presence of a GIS-specialized staff person who has the time for improving skills and developing data bases has been a key feature of successful use of GIS in municipal and county planning agencies (Budic 1994); however, it is unlikely that even when a CBO staff person is trained his or her time will be devoted exclusively to GIS. Shortly after our project began, the GIS-trained person assumed the position of Director of the organization. We doubt that the staff person will be able to maintain working GIS skills given the shift in duties. Personnel changes in non-profit CBOs are frequent, raising the possibility that the GIS-trained person may assume other responsibilities or leave. This is a serious detriment to sustained use and improvement of GIS capacity in any CBO.

Mitigation of these problems will be difficult, requiring a comprehensive approach. The resolution of both data management problems and user capacity to make GIS a useful and effective tool for CBOs to address environmental problems depends on creation of an effective information management system in the organization. Information management includes setting priorities, identifying information needs to address these priorities, building capacity to understand and use sometimes highly scientific and technical data, processing that data into information that is meaningful, and communicating that information effectively to improve participation and decision making (Kweit & Kweit 1987; Kellogg 1998). Our project confirms the need for such a system described in the literature. Only when community-based organizations become good environmental information managers will they be able to access, understand and use information as part of their ongoing community development and environmental protection efforts.

Identifying the conditions needed to create this system for community-based organizations is an area in need of further development. From our experience, such a system centers upon adequate and sustained training and technical support for CBOs in a wide variety, including knowledge of basic scientific concepts, including risk and the use of statistics for data analysis, as well as computer skills.

Based on our community-based experience, we suspect that understanding scientific data would be most challenging among CBOs because of their relative shorter experience regarding environmental issues. Understanding the relationship between environmental conditions and human health is particularly challenging, and requires significant familiarity with scientific evidence. CBO staff must also be able to recognize the significance or meaning of data once obtained. In a recent study, Sawicki and Craig (1996) found that CBO staff seeking assistance in obtaining data from a set of information providers across the US often did not know how to read the data. They could not identify its meaning once analyzed, needed help putting data into its broader context, and needed to learn how to use information and analysis to affect policy or its administration.

We suggest here again that universities can have an important role in working with CBOs. Technical assistance concerning environmental problems in urban neighborhoods must include training in basic concepts such as risk and risk assessment, particularly as these structure agency regulatory emphases and data collection efforts.

To effectively use GIS, organization must be able to manage and create databases, which will likely be met with difficulty by smaller CBOs. Regarding existing use of computers for databases, the evidence we have is somewhat encouraging. In Stoecker and Stuber's study (1997), 65 of 189 CBOs indicated they currently use database and spreadsheet software. If the CBO wishes to adopt GIS effectively, the entire staff of the organization should be trained in ways to support GIS. Ideally, more than one staff person would be trained in GIS software use and those trained in GIS would include additional staff members in developing their GIS skills as well. The organization and other staff members can support use of GIS through other data management skills such as Internet or ftp transfer, use of spreadsheets and statistical analysis.

Novice GIS users require frequent technical support. From where can they receive help to answer questions concerning data, data analysis, map creation, and presentation? Universities and other intermediary organizations that traditionally offer technical assistance to CBOs on other matters can be a key locus of assistance. A carefully trained, proficient GIS user, skilled in statistical analysis, in an intermediary organization could provide technical assistance to many CBOs. This kind of program would be modeled on existing efforts to assist CBOs in data acquisition and use. [27] The likelihood and willingness of non-profit, non-university intermediaries in Ohio to perform this role is being assessed through a research project now in progress. Based on our on-going experience in one Cleveland neighborhood, all efforts must build capacity among CBO users in these programs.

Overall, our review of this GIS application found that GIS can be a useful tool for community-based organizations. Its most profound utility lies not in a particular map created, but in its effect on the CBO and the neighborhood. Neighborhood change results from what happens to the residents and staff members as they use GIS. Using GIS can provide a mechanism to stimulate the search for environmental information and for a deeper understanding of its significance. As in the use of any tool, the social change encouraged by its use is the ultimate test of its worth.

Acknowledgments

The author wishes to thank the following people and organizations for their assistance with the project: environmental and urban studies students who assisted in obtaining data off the Internet and from local agencies; the Urban Center at the Levin College of Urban Affairs which supported curriculum development for the class; the staff at NODIS at the Levin College of Urban Affairs who offered assistance in mapping and geocoding; several staff at the USEPA, the Ohio EPA, the Cuyahoga County Planning Commission, the Cuyahoga County Emergency Management Division, and the City of Cleveland who guided us through data organization and retrieval; and the staff at the St. Clair-Superior Coalition, whose guidance provided an invaluable "reality check" for our assessment of the utility of GIS at the neighborhood level. Special thanks to the following students for producing maps: Brian Kimball, Kelly Meintzer, Eric Gerber and Pat Gammons. Many thanks as well to four anonymous reviewers whose comments and suggestions were insightful and helpful in the revision of this paper.

End Notes

1. The project was an outgrowth of faculty service to the organization. The paper describes work down by an undergraduate environmental studies class and two Americorps students working with faculty and neighborhood organization staff.

2. For example, the mean size of Cleveland CBOs is 4.4 full time staff (center for Neighborhood Development 1007); in Ohio, only half the CBOs had more than 2 full time staff members in 1996 (Stoecker & Stuber).

3. Much of this debate concerning issues of GIS use and social power is occurring via the Internet, particularly in a Webster of the National Centers for Geographic Information Analysis (NCGIA), a consortium of several universities and GIS centers. URL: http://www.ncgia.ucsb.edu.

4. For example, the United States Environmental protection Agency (USEPA) is rapidly expanding Internet availability of information on its Envirofacts Warehouse Web site (USEPA 1997). Some EPA division or program sites provide a relatively user-friendly mapping function that allows the web-user to designate an areas on a map and obtain information about that area from the data base.

5. Minimally, adequate was defined as the following: a 3.1 Windows operating system, 386 processor, 8 MB RAM, a 400 MB hard drive and a 14.4 modem (Stoecker & Stuber 1997).

6. Organizations participating in the study included social service providers, settlement houses,. And community development organizations, as well as many other community-based organizations.

7. The organization's remaining funds are assembled from private foundations, federal state grants, and corporate donations.

8. All maps presented in this article were produced by undergraduate or graduate students working on the project.

9. Present-day industrial facilities include paint manufacturing, electroplating, tool and dye manufacturing, motor refurbishing, metal forging, plastic production, and printing.

10. This neighborhood profile is based on the 1990 Census.

11. The author had determined that no facilities in the neighborhood held permits to discharge to surface water.

12. Sources for neighborhood development history included Sanborn Fire Insurance maps, three excellent histories of Cleveland (Kennedy 1896; Orth 1910; Avery 1918), and a historic collection of the Cleveland Press.

13. A Phase I investigation consists of a complete history of property use and visual identification of areas that may be environmental damaged or unsafe, such as soil stains, drains, evidence of USTs, trash piles, wells, foundation remnants, etc.

14. The site features mapped included soil mounds and depressions, soil stains, types of vegetation, gravel and sand, standing water, building foundations, utility lines (gas, electric, etc.), curb cuts, rubbish and storage drums or other containers.

15. The map was created by inserting linear fragments on the basemap using topographic contours, known latitude-longitude points and details from historic narratives for guidance.

16. A formal and legally binding Phase I investigation must be conducted by a person or firm registered with the State of Ohio.

17. We received the large database on diskette from the Ohio EPA headquarters in Columbus. The database was read using spreadsheet software and then loaded into MAPINFO. The browser tables delivered to the Coalition display the types of discharge points.

18. The TRI is organized by zip code, county and latitude/longitude. Reporting data for the zip codes that contain the neighborhood area were downloaded off the USEPA Webster into a spreadsheet program and uploaded into MAPINFO.

19. The county uses a database software package that is incompatible with MAPINFO. At our request, the county data was reformatted to an ASCII file. The students then loaded the database into MAPINFO.

20. The text of the resource guide is available at the following web site: URL http://cua6.csuohio.edu/~wendy/StCir/Title.htm.

21. Physicians finding elevated pediatric lead levels are required by federal law to report the finding to the public health department.

22. This research is based on a hypothesis that houses with conditions associated with elevated lead blood levels (age of structure, disrepair and old lead paint) may also be characterized by conditions associated with asthma (high levels of dust, roach feces, and mold). For additional information about this project, contact Mr. Stu Greenberg, Environmental Health Watch, 4115 Bridge Ave., Cleveland, OH 44113. (216)961-4646.

23. These authors cite numerous examples of university based and local and regional government based efforts to broaden access to data. For example, they describe data access projects such as the NeighborLINE sponsored by the Carnegie Library in Pittsburgh, Census Analysis Project in Minneapolis-St. Paul, and the Cleveland Area Network for Data and organizing at Case Western Reserve University. However, these projects focus primarily on social data. An interesting example of online data access is the RLIS Lite project by the Metro Portland Government, which provides environmental data for the region URL http://www/metro.dst.or.us/metro/drc/data_dic/datadic.htm. Another example is Neighborhoodlink in Cleveland, which provides several dozen public Internet access points throughout the city at public libraries and community centers. URL http://little.nhlink.net/nhlink/.

24. Above all, any data assistance efforts by universities or other intermediary organizations must also include information that will make the project sustainable. University projects must transfer information regarding where and how the data was retrieved, a contact person for future data needs, and how to access the data as part of the assistance efforts. The objective is to transform the knowledge of CBOs to more effectively access data after the university project goes away.

25. For example, our efforts to map TRI and air discharge data reveals a serious challenge to GIS utility for environmental pollution when used by organizations at the neighborhood scale. Pollution data is collected by agencies and organized according to a set of identifies which most often entailed both the street address and an agency provided facility identity number. Because we knew the location of many of the company facilities in the neighborhood, we discovered that the street addresses given in the data bases were corporate headquarters, not the address of the facility itself, making difficult the use of parcel maps to explore relationships between discharge points and residents. In addition, facilities sometime span many lots in a neighborhood, so the street address of the facility tells one little about the actual location of the discharge point. Based on these experiences, we recommend that USEPA and its state

and local agency administrative partners require that TRI reporting facilities include the assessor's parcel number for each emission point in their reporting. Such an identifier would immediately locate each emission or release point to a more specific location, something highly desirable at the neighborhood scale.

26. The NEOEDEN Web site can be accessed at the following URL: http://urban.csuohio.edu/~ucweb/neoeden/index.htm

27. See Sawicki & Craig, 1996, Appendix A; two examples cited of technical support programs beyond data provision by intermediary, non-profit organizations include the Neighborhood Data Center of the Milwaukee Associates for Urban Development and the Neighborhood Partners Data Service, also in the Milwaukee area.

Works Cited

Aberley, D., ed. 1993. Boundaries of Home: Mapping for Local Empowerment. Gabriola Island, BC: New Society Publishers.

Albert, D. 1994. " Geographic Information Systems". In Geographic Methods for Health Services Research, T. Rickets, ed. Lanham, MD: University Press of America. 201-206.

American City & County. 1997. "County, Cities Collaborate on Use of GIS Technology," Vol. 112 (6): 18.

Armstrong, B. 1995. The Social Impact of a National Information Superhighway. Computer and Society 25 (3):10-14.

Avery, L. 1918. A History of Cleveland and Its Environs, the Heart of New Connecticut. Chicago: Elroy MdKendree Publishing Company.

Baaj, M.H., Ashur, S.A., Chaparrofarine, J. & Pijawka, K.D. (n.d.) "Design of Routing Networks Using Geographic Information Systems: Applications to Solid and Hazardous Waste Transportation Planning." Transportation Research Record. 1497: 140-144.

Bertrand, W. N. Mock. 1995. "Spatial Information to Make a Difference: Value Added Decision-making in the Health Sector with Geographical Information Systems." In The Added Value of Geographic Information Systems in Public and Environmental Health, M. de Lepper, H. Scholten and R. Stern, eds. Dordrecht, The Netherlands: Kluwer Academic Publishers. 265-276.

Boyer, M. C. 1983. Dreaming the Rational City: The Myth of American City Planning. Cambridge: The MIT Press.

Brown, C. & F. Stayner. 1995. "Toward No Net Loss: A Methodology for identifying Potential Wetland Mitigation Sites Using GIS." JURISA Vol. 7, 1:38.

Budic, Z. 1993. "GIS Use Among Southeastern Local Governments." JURISA Vol. 5, 1:4.

Budic, Z. 1994. "Effectiveness of Geographic Information Systems in Local Planning." APA Journal Vol. 60(2): 244-263.

Bullard, R. and B. Wright. 1992. The Quest for Environmental Equity: Mobilizing the African-American Community for Social Change. In R. Dunlap and A. Mertig, eds. American Environmentalism: The U.S. Environmental Movement, 1970-1990. Philadelphia: Taylor & Francis.

Castells, M. 1989. The Informational City: Information Technology, Economic Restructuring, and the Urban-regional Process. Oxford: B. Blackwell.

Clark, D. 1997. "Nuclear Power Plants and Residential Housing Prices. "Growth & Change Vol. 28 (4): 496-519.

Cleveland Press, "How Proposed Lake Front Boulevard Skirts Lake Erie Shore Line". May 30, 1933.

Coder, G. 1997. USEPA Public Information Specialist. Personal communication.

Desario, J. & Langton, S. 1987. "Citizen Participation and Technocracy." In Citizen Participation in Public Decision Making. Westport, CT.: Greenwood Press. 3-17.

Doheny-Farina, S. 1996. The Wired Neighborhood. New Haven, CT: Yale University Press. 224 pp.

Fischer, A. 1994. "Power Mapping: New Ways of Creating Maps Help People Protect Their Landscape." Utne Reader 65 September: 32-34.

Gallagher, M. 1992. "GIS on the Job." Planning Vol. 58(12): 20-23.

Gatrell, A. & Dunn, C. 1995. "Geographical Information Systems and Spatial Epidemiology: Modeling the Possible Association Between Cancer of the Larynx and Incineration in North-west England." In The Added Value of Geographic Information Systems in Public and Environmental Health, M. de Lepper, H. Scholten and R. Stern, eds. Dordrecht, The Netherlands: Kluwer Academic Publishers. 215-235.

Gaventa, J. 1993. The Powerful, the Powerless, and the Experts: Knowledge Struggles in an Information Age. In Voices of Change: Participatory Research in the United States and Canada, pp. 21-40. P. Park, M. Brydon-Miller, B. Hall and T. Jackson, eds. Westport, CONN: Begin & Garvey.

Godschalk, D. & McMahon, G. 1992. "Staffing the Revolution: GIS Education for Planners." Journal of Planning Education and Research Vol. 11 (3): 216-226.

Groothuis, P. & Miller, G. 1994. "Locating Hazardous Waster Facilities: the Influence of NIMBY Beliefs." American Journal of Economics and Sociology Vol. 53(3): 335-346.

Gumbricht, T. 1996. "Application of GIS in Training for Environmental Management." Journal of Environmental Management Vol. 46 (1):17-30.

Guttenberg, A. 1993. The Language of Planning: Essays on the Origins and Ends of American Planning Thought. Urbana: University of Illinois Press.

Haines-Young, R., Green, D. & Cousins, S., eds. 1993. Landscape Ecology and Geographic Information Systems. London: Taylor & Francis.

Hallett, S.H., Jones, R. & Keay, C. 1996. "Environmental Information Systems Developments for Planning Sustainable Land Use." International Journal of Geographical Information Systems. Vol.10 (1):47-64.

Heiman, M. 1997. Science by the People: grassroots environmental monitoring and the debate over scientific expertise. Journal of Planning Education and Research 16 (4): 291-299.

Hintz, R. & Onsrud, H. 1990. "Upgrading Real Property Boundary Information in a GIS." JURISA Vol. 2 (1):2.

Innes, J. & Simpson, D. 1993. "Implementing GIS for Planning: Lessons from the History of Technological Innovation." APA Journal Vol. 59 (2), Spring: 230-236.

Keating, W. D., Krumholz, N. & Star, P. (Ed). 1996. Revitalizing Urban Neighborhoods. Lawrence, University Press of Kansas.

Keating, W.D., Krumholz, N. & Pylkas, A. 1998. Neighborhood Collaborative Planning (NCP): American Planning Association Survey: The State of the Art in Planning Education. Cleveland, OH: College of Urban Affairs (July).

Kennedy, J. 1896. A History of Cleveland, Its Settlement, Rise and Progress. Cleveland: The Imperial Press.

Kellogg, W. 1998. "Adopting an Ecosystem Approach: Local Variability in Remedial Action Planning." Society and Natural Resources Vol. 11 (5): 1-19.

King, A. 1993. "Mapping Your Roots: Parish Mapping." In Boundaries of Home: Mapping for Local Empowerment, Aberley, D., ed. Gabriola Island, BC: New Society Publishers. 31-34.

Kraft, M. & Clary, B. 1991. "Citizen Participation and the NIMBY Syndrome: Public Responses to Radioactive Waste Disposal." Western Political Quarterly Vol. 44(2), June: 299-328.

Krueckeberg, D., ed. 1983. Introduction to Planning History in the United State. New Brunswick: Rutgers University.

Kweit, R. & Kweit, M. 1987. "The Politics of Policy Analysis: The Role of Citizen Participation in Analytic Decision Making. In Citizen Participation in Public Decision Making, DeSario, J. & Langton, S., eds. Westport, CT: Greenwood Press. 19-37.

Lloyd, O. 1995. "The Exploration of the possible relationship between deaths, births and air pollution in Scottish towns." In The Added Value of Geographic Information Systems in Public and Environmental Health, M. de Lepper, H. Scholten and R. Stern, eds. Dordrecht, The Netherlands: Kluwer Academic Publishers. 167-180.

Mattikali, N.M., Devereaux, B.J. & Richards, K.S. 1996. "Prediction of River Discharge and Surface Water Quality Using an Integrated Geographical Information System Approach." Internal Journal of Remote Sensing Vol. 17(4):683-701.

Mills, R. 1983. "A Statewide Mapping System for Generalized Planning Analysis." In Computer Graphics and Environmental Planning. E. Teicholz and B. Berry, ed. Englewood Cliffs, NJ: Prentice-Hall, Inc. 15-29.

Mitschele, R. 1996. "Share and share alike : Creating a cost-effective GIS." American City & County Vol. 111 (3): 24-29.

Moore, T. J. 1995. "The Potential Role of Geographic Information Systems Technology in Air Toxics Risk Assessment, Communication and Management." In The Added Value of Geographic Information Systems in Public and Environmental Health, M. de Lepper, H. Scholten and R. Stern, eds. Dordrecht, The Netherlands: Kluwer Academic Publishers. 237-262.

Naisbitt, J. 1994. Global Paradox: The Bigger the World Economy, the More Powerful Its Smallest Players. New York: Avon Books.

NCCED (National Congress for Community Economic Development. 1995. Tying it all together: the Comprehensive Achievements of Community-based Development Organizations. Washington, D.C.

NCGIA 1996. Spatial Technologies, Geographic Information, and the City. Conference Report Available at URL [http://128.111.234.63/conf/BALTIMORE/menu.html.]

Orth, S. 1910. A History of Cleveland Ohio . Cleveland and Chicago: S.J. Clark Publishing Company.

Ramasubramanian, L. 1995. "Building Communities: GIS and Participatory Decision Making." Journal of Urban Technology, Vol. 3(1): 67-79.

Reardon, K. 1998. Enhancing the Capacity of Community-Based Organizations in East St. Louis. Journal of Planning Education and Research. Vol. 17(4): 323-333.

Rubin, V. 1998. The Roles of Universities in Community-Building Initiatives. Journal of Planning Education and Research. Vol. 17(4): 302-311.

Sawicki, D. & Craig, W. 1996. "The Democratization of Data: Bridging the Gap for Community Groups." APA Journal Vol. 62(4):512-523.

Sawicki, D. & Flynn, P. 1996. "Neighborhood Indicators: A Review of the Literature and An Assessment of Conceptual and Methodological Issues." APA Journal Vol. 62(2):165-183.

Silver, C. 1985. Neighborhood Planning in Historical Perspective. Journal of the American Planning Association Vol. 51(2):161-74.

Simons, R. & Salling, M. 1995. "Using GIS to make Parcel-Based Real Estate Decisions for Local Government: A Financial and Environmental Analysis of Residential Lot Redevelopment in a Cleveland Neighborhood." JURISA 7(1), 7-19.

Speed, V. 1990. "GIS Bolsters Air Quality." American City & County Vol. 105(8):48.

Stoecker, R. & Stuber, A. 1997. "Limited Access: the Information Superhighway and Ohio's Neighborhood-based Organizations." Computers in Human Services, Vol. 14(1): 3956.

Teicholz, E. & B. Berry, eds. 1983. Computer Graphics and Environmental Planning. Englewood Cliffs, NJ: Prentice-Hall, Inc.

USEPA (United States Environmental Protection Agency). 1997. Envirofacts Warehouse. [URL: http://www.epa.gov/enviro/].

Van Demark, P. 1992. "Desktop GIS: Wave of the Future." Planning Vol. 58(7): 24-27.

Watterson, W.T. 1990. "Adapting and Applying Existing Urban Models: DRAM and EMPAL in the Seattle Region." JURISA Vol. 2 (2) :35

Wilson, M. 1991. The Role of Community Based Organizations in Contemporary Urban America. In Contemporary Urban America: Problems, Issues and Alternatives. M. Land, ed. Lanham, MA: University Press of America, pp. 335-354.

Wong, David. 1993. "A Spatial Decision Support System Approach to Evaluate the Efficiency of a Meals-On-Wheels Program." Professional Geographer Vol. 45 (3) : 332-341.Figure 1. St. Clair-Superior Neighborhood in the City of Cleveland, Ohio