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Brownfields and Michigan Communities

Information Resources and Tools to Assist Redevelopment Decisions

Jackson Area Redevelopment Projects

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Brownfields and Michigan Communities:
Information Resources and Tools to Assist Redevelopment Decisions

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Overview

The brownfield redevelopment process often demands more complex information than traditional real estate transactions. Much of this information is pertinent to site identification and remediation. Additional information is needed to address issues important for better public understanding of the process by which brownfields are made clean and productive. Decision makers within municipal government need more information from developers on the site identification and selection process, how properties are characterized as suitable for redevelopment and how various redevelopment options are evaluated.

Community involvement is also addressed in the process of selecting properties for redevelopment, proposed uses of the property and the level of cleanup sought. This report suggests that a number of stakeholder groups — including regulators, lenders, realtors and the general public — are becoming more involved in the prioritization and acceptance of redevelopment plans. Information is also needed to address growing concerns over environmental justice, social equity and quality of life.

This report provides an overview of several current issues in information requirements, information delivery mechanisms and analysis tools, and their use in enhancing multistakeholder participation, particularly with respect to information access, the screening and selection of properties, intergovernmental cooperation, public participation, and the evaluation of the impacts and risks of redevelopment alternatives (including the alternative of no action).

This report also introduces the Brownfield Site Prioritization Weighting and Ranking Model. This model represents a new wave of innovative, information-based decision support systems that can enhance multistakeholder participation. Such systems include enhanced geographic information systems, site prioritization methods and training programs. These decision support systems are information rich and technologically advanced; they marry local investments in data gathering, personnel training and information technologies to provide information to decision makers and the public on evaluating land development options. The Brownfield Site Prioritization Weighting and Ranking Model has been tested in Jackson County as part of the countywide brownfield redevelopment program and may be useful for other communities engaged in brownfield redevelopment.

Introduction: Brownfields and Land Use in Michigan

Over the past several years, the value of redeveloping brownfields as a way to alleviate urban sprawl has become anecdotal. Popular media at the national, regional and local levels report redevelopment success stories on an almost weekly basis. Brownfield redevelopment is now seen as a sustainable land use strategy.

Brownfields are Opportunities
Brownfields are defined as abandoned, idle or underused industrial and commercial properties where expansion, redevelopment or reuse may be complicated by the presence or potential presence of a hazardous substance, pollutant or contaminant (U.S. Environmental Protection Agency, 1997). Brownfields represent a lucrative but largely untapped land resource (Davis and Margolis, 1997; Kirshenberg, 1997; Dennison, 1998; Rafson and Rafson, 1999). The term "land recycling" has gained favor among land use planners, whereas economic development practitioners seek to "turn brownfields into goldfields" (Fleming et al., 2000).

Bartsch and others (2001) further classify brownfields by their past use:

- Industrial — manufacturing, warehouse, assembly, production and waste management facilities.
- Commercial — wholesale and retail facilities, consumer and professional services, secondary services.
- Residential — single-family and multifamily housing.
- Government — Department of Defense and Department of Energy installations, federal laboratories, civil service support facilities.
- Agricultural — farms, farming support operations, agricultural processing facilities.
- Resource extraction and processing — materials and energy extraction/production sites, raw materials processing, waste disposal areas.

In a recent nationwide survey of 150 cities conducted by the U.S. Conference of Mayors (1998), two-thirds of the cities responding estimated that redevelopment of known brownfields could bring from $205 million to $500 million in additional tax revenues and add as many as 236,000 jobs to local economies.

Estimates suggest that more than 430,000 brownfields exist nationwide (Simons, 1998) and from 14,000 to as many as 45,000 in Michigan (Consumers Renaissance Development Corporation, 1998). Until recently, these sites were overlooked by developers in favor of greenfields because of liability concerns, market conditions, local resistance, and the high costs of cleanup and infrastructure upgrade (U.S. Conference of Mayors, 1998; Consumers Renaissance Development Corporation, 1999).

Brownfield Legislation and Legal Requirements
Under state and federal programs such as Superfund, past efforts to clean up brownfield sites and attract new development have been largely unsuccessful. Prior or current contamination, strict environmental compliance and permitting requirements, expensive engineering, liability and neighborhood opposition may stigmatize these sites. Add the factors of legal uncertainty and delays caused by lack of information or financial incentives, and most developers opt for greenfields. In many metropolitan areas, this has helped feed the phenomenon known as urban sprawl.

In 1995, the U.S. Environmental Protection Agency launched its Brownfields Action Agenda in an attempt to level the playing field in the choice between brownfields and greenfields. The EPA's Brownfield Pilot Grant Program has provided significant financial resources and technical expertise to communities nationally. More than 300 communities have benefited from brownfield assessment, cleanup and job training grants, with the creation of more than 5,000 jobs and the leveraging of nearly $2 billion in cleanup and redevelopment costs (Bartsch et al., 2001).

Michigan has been a leader at the state level. The state enacted legislation under the Natural Resources and Environmental Protection Act (1994 Public Act 451, amended in 1995) that instituted risk-based cleanup standards and reduced liability for prospective developers. The Michigan Brownfield Redevelopment Act (1996 Public Act 381 and 1996 Public Act 382) establishes local brownfield redevelopment authorities and provides financial incentives to purchase, remediate and develop contaminated properties. Since 1995, more than $203 million in state funds and $6.5 million in federal funds have been awarded for Michigan projects, with more than 4,000 sites successfully purchased or leased and reused (Szymecko and Voice, 2002). A summary of brownfield financing programs, voluntary cleanup programs and investment incentives resulting from this legislation is provided in Appendix A.

Brownfields and Land Development Issues

During the 1990s, the Michigan governor's office directed state agencies to seek ways to deal with uncontrolled growth that would provide incentives to local communities to work together on land use and environmental quality issues crossing jurisdictional boundaries. One of the land use issues targeted by these agencies was that of formerly used and potentially contaminated industrial and commercial sites, typically located in inner-city areas. Many impediments to fulfilling this objective existed. Michigan is a strong home-rule state, and the vast majority of land use decisions are made at the local level. Moreover, there were few incentives — financial, legal, social or environmental — to develop brownfields within urban environments. Even with incentives, it was often far easier for developers to purchase farmlands and open space than to acquire formerly used properties.

Many barriers to brownfield redevelopment are being challenged through changes in state policy and environmental regulations. Public Acts 381 (Brownfield Redevelopment Financing Act) and 382 (Single Business Tax Credit, as amended) of 1996 work in concert with Part 201 of Public Act 451 of 1994 (Michigan Natural Resources and Environmental Protection Act, as amended) to stimulate redevelopment. Resulting state-supported programs have begun to provide incentives for urban revitalization instead of rapid conversion of farmland and open space. Michigan provides both economic and legal incentives for local governments and prospective developers to redevelop brownfields. Economic incentives, for example, could include tax recapture and reimbursement of some cleanup costs. Legal incentives could include suspension of retroactive liability for landowners not responsible for prior contamination. New funding under the Clean Michigan Initiative provides significant support for such incentives.

Unless new approaches to addressing land use issues work within this framework for decision making, any relief from sprawl and its associated social, economic and environmental problems is unlikely. Innovative approaches that interest and engage multiple stakeholder groups while accommodating private property constraints would be beneficial in Michigan and applicable elsewhere.

For these programs to be successful in the long run, two factors must come into play. First, government and private decision makers need more information on land capability, development incentives, and public goals, interests and preferences. Second, the information system must address environmental concerns such as site contamination, public health and environmental quality to evaluate land use options, shorten the time needed to make decisions, and attract federal, state and private capital to prioritize, revitalize and sustain development in an urban environment.

Brownfield Information Resources and Tools for Michigan Communities

The ultimate goal of brownfield redevelopment is threefold: to return brownfields to productive uses, stimulating local economic growth by getting these properties back on the tax rolls, providing new jobs and attracting other businesses to the vicinity; to protect public health and eliminate blight; and to offer communities alternatives to formerly incompatible land uses, including parks and other recreational areas.

Even with these programs, developers, realtors, siting consultants and economic development specialists are still faced with decisions about which sites to remediate, market and purchase. Conventional wisdom in successful commercial real estate transactions cites three principal factors in decision making: location, location and location. In reality, multiple categories of decision factors pertain to "location" — size of the property; development costs; availability of financing; regulatory compliance; proximity to labor,

markets and competitors; and infrastructure. Separating these factors is even more critical in the redevelopment of brownfield properties.

Additional information on available financial incentives, environmental regulatory compliance, local concerns, and site engineering characteristics and infrastructure must be considered in selecting sites that will provide the greatest return on investment.

Brownfield Decision Support Systems

Michigan State University has conducted research on Michigan's brownfield redevelopment legislation, focusing on the information needs of local decision makers and the effectiveness of information delivery and decision support systems (Thomas, Fridgen and Asher, 1999). The research suggests that new computer-based information technologies, combined with more effective community-based training programs and public participation, can help create effective decision support systems to level the playing field between brownfields and more conventional real estate markets.

Such systems provide access to state, regional and local geospatial databases; several informational and visualization tools, including geographic information systems (GIS); and assumptions useful in city- and county-level brownfield identification, screening and marketing efforts (Thomas, 2002a). These systems also enhance participation by multiple stakeholder groups, decision makers, policy analysts, developers and the public by providing a better understanding of issues, options and alternatives in redeveloping brownfields.

Applications of brownfield redevelopment decision support systems are being tested in Jackson County as part of a three-year investigation by researchers and outreach specialists at Michigan State University. This study focuses on public participation in screening and selecting sites for redevelopment. This research has been augmented in several other Michigan counties in collaboration with the Technical Assistance to Brownfield Communities Program (TAB) at Michigan State University (Michigan State University Hazardous Substances Research Center, 2002). During this investigation, researchers and outreach specialists worked extensively with the Jackson County Brownfield Redevelopment Authority. The brownfield redevelopment authority, which includes local developers, realtors and bankers, was established in 1998 to represent 15 of the 19 townships in the county. Financial support was provided in part by the EPA Brownfield Pilot Communities Program and the Michigan Department of Environmental Quality.

Members of the Jackson County Brownfield Redevelopment Authority and representatives of local governmental units attended a TAB training program consisting of eight monthly training sessions. Participants received instruction in basic brownfield identification and characterization, legal issues, financing, environmental regulations and information resources. The training emphasized public participation in the decision-making process and information and analysis tools to support local decision making.

One of the first projects undertaken by the brownfield redevelopment authority and local units of government was the development of the Brownfield Site Prioritization Weighting and Ranking Model (Thomas, 2002b). The model, which is described in detail below, introduced a two-tiered site screening process using a set of multivariate, weighted criteria to evaluate and rank sites for redevelopment. Local decision makers first applied the criteria. Sites that ranked highest were proposed to the brownfield redevelopment authority, which then used a second tier of criteria to rank all sites. This process provided an opportunity for local units of government within the authority to evaluate available sites and to have a say in final site disposition. Because all sites were screened using a consistent, repeatable method, the selection process was seen as more objective than typical methods of site selection.

The screening process benefited from extensive interaction among planning officials, representatives of local township governments and members of the brownfield redevelopment authority. These projects represent test beds at all levels of government to establish urban land use policy and development guidelines — including smart, sustainable growth, risk management, open space protection and quality of life — that may be applicable to related land use issues in a variety of urban and urbanizing settings.

Study Objectives

The purpose of this project was to build a prototype brownfield decision support system that can be applied to siting decision making statewide. Such a system would take advantage of cutting-edge information technologies for data access and analysis — in particular, visualization techniques employed by geographic information systems (GIS). However, the system must be accessible and affordable to local units of government and developers. The resultant prototype system takes advantage of existing state, regional and local geospatial databases; Web-based tools that inventory brownfield sites; GIS-based visualization models and decision criteria; and extensive public interaction, training and outreach. This information system is then demonstrated using an innovative resource modeling application called Smart Places®.

The study area selected for this project was the Jackson County Brownfield Redevelopment Zone, which includes 15 of the 19 townships in the county. Jackson County, like many areas in Michigan and other states, is being converted to urban use at an alarming rate. In a recent comparison between Michigan and the rest of the United States, the amount of land used per person was up 3 percent nationally and 13 percent in Michigan (Rusk, 1998). According to this study, urbanized land in the United States has grown six times faster than the urban population while most central cities are steadily being abandoned. The Michigan Society of Planning Officials estimates that between 1.4 million and 2 million acres of land will be converted to urban development between 1990 and 2010 (Michigan Society of Planning Officials, 1995). A recent study of land use trends over the next 40 years projects urban growth statewide of up to 178 percent (Public Sector Consultants, 2001).

The Jackson County Study Area

The Jackson study area is an ideal location for testing the brownfield decision support system. Jackson County is located in south central Michigan at the juncture of Interstate 94 and US-127. The I-94 corridor is the main connection between Chicago and Detroit. Although it is geographically isolated from other major population centers in Michigan, it is being influenced by expansion from Washtenaw County to the east, Ingham County to the north and Kalamazoo-Battle Creek to the west. After a period of decline in the 1970s and 1980s, the region is experiencing a rapid rate of economic and population growth.

The Jackson County Brownfield Redevelopment Authority inventoried candidate sites under the EPA-funded Brownfield Pilot Grant Program and Community Partnership Grant. This program provides up to $200,000 for two years for testing redevelopment models, directing special efforts toward removing regulatory barriers without sacrificing environmental protection, and facilitating community-based and coordinated input (Weiss, 1997). Because many of the brownfield sites are located in the city of Jackson, the county and city brownfield redevelopment authorities established a collaborative relationship.

Creating a Brownfield Redevelopment Decision Support System for Jackson

The Jackson County Brownfield Redevelopment Authority and local units of government within the county initiated the development of the Brownfield Site Prioritization Weighting and Ranking Model. The study was conducted as part of a 1999 EPA brownfield pilot grant. The brownfield redevelopment authority needed a method to screen and rank brownfields that would be most attractive to potential developers and effectively use federal and local investments. The brownfield redevelopment authority included most of the townships and villages in Jackson County where sites were located. Active input from the local units of government was needed to ensure an acceptable selection process. A review of the EPA's established pilot grant programs suggested that there were no established methods for systematically prioritizing and selecting brownfield sites for redevelopment (see the Institute for Responsible Management at <www.instrm.org> and the EPA's Pilot Grant Program pages at <www.epa.gov/swerosps/bf/pilot.htm>).

The approach was to design and demonstrate a comprehensive, computer-aided, repeatable process by which to identify, characterize and select brownfield sites for redevelopment. The Brownfield Site Prioritization Weighting and Ranking Model uses a series of multivariate, weighted criteria to evaluate brownfield sites for their redevelopment potential. The use of screening criteria in site selection and environmental impact assessment is well known (Canter, 1996; Ortolano, 1997; and many others). It

was the intent of the study to provide a way to screen a countywide inventory of potentially available sites, reduce the number of candidate sites to those that meet the needs of prospective developers on the basis of projected endpoints and determine which sites will best promote economic development within the community.

A secondary goal was to establish a systematic way to determine which sites should be developed first, with the decision based on their physical attributes, marketability, and community and developer preferences or criteria. A third goal recognizes that managing many sites requires a large time commitment from economic development personnel. A rapid, highly accurate process could help minimize staff time and maximize return on investment.

This process was developed to address three realities associated with local land use decision making. First, nearly all land use decisions in Michigan are made at the local level. Second, siting and development criteria have different applicability at county and local levels based on availability of information and jurisdictional rights, prerogatives and interests. Third, potential end use (whether a site has a prospective project or is being screened to determine a preferred use) may differ by jurisdictional level. Therefore, one of the procedures in designing and applying this system was to break the screening into two tiers. The first would be applied at the local (or multijurisdictional) level and the second at the county level. This procedure enhanced the ability of the brownfield redevelopment authority to work closely with local units of government in providing data and information, decision support tools, and guidance in applying site selection and screening procedures.

Study participants included members of the brownfield redevelopment authority, appointed representatives of each member jurisdiction, and the planning commissions of the charter townships of Blackman, Columbia and Leoni. Guidance was also available through collaborative agreements with Consumers Renaissance Development Corporation, the Environmental Assistance Division of the Michigan Department of Environmental Quality and the Jackson County office of Michigan State University Extension. The participants determined that the success of the procedure would be tested by its ability to prioritize sites within the county brownfield redevelopment zone that maximize the return on investment by being attractive to developers, minimize the need for economic and fiscal resources available to the brownfield redevelopment authority, and foster cooperation between county and local governments.

Results of this project are divided into three parts. The first part discusses community-based information needs for setting brownfield redevelopment goals, evaluating potential end uses of brownfield properties, and developing mechanisms for locating and understanding information resources. The second part presents a decision support toolset that can provide an organizing framework for applying information to brownfield projects within the community. This toolset includes the Brownfield Site Prioritization Weighting and Ranking Model, and this section describes how it was validated in Jackson. The final part discusses brownfield redevelopment issues at the community level. The discussion addresses issues of intergovernmental cooperation, public participation and potential opportunities to incorporate new technologies.

Part 1: Brownfield Redevelopment Goals and Community Information Needs

The first step in developing a brownfield decision support system is to define the broad goals of a brownfield redevelopment program at the community level. This process requires a determination of the types of redevelopment projects that are possible, practical and suitable within a community. Business owners want projects that are successful and profitable. Community leaders want to increase the tax base, reduce blight and provide jobs. The public wants development that increases property values and enhances neighborhoods. Setting realistic goals and determining acceptable potential end uses of a brownfield property are important first steps in determining the information, tools and expertise needed to evaluate redevelopment options. These are followed by systematically building an effective information system that will support the decision-making process. Figure 1 is a conceptual model of a community-level information and decision support system that can be effective in mapping out a brownfield redevelopment program.

Over the past several years, accounts of brownfield redevelopment projects suggest a number of information-related issues that can confound the decision-making process. Such issues include promoting participation by local communities in brownfield redevelopment decision making. One of the difficulties faced by local decision makers and the affected public is a lack of access to information to allow meaningful participation. Moreover, a comprehensive database can be very large and costly to assemble, and the necessary tools for analysis can be technically challenging. Innovative information technologies, however, can provide tools to help local communities better understand pertinent brownfield issues, particularly environmental contamination of formerly used properties, as well as the risks of alternative redevelopment options.

Setting Brownfield Redevelopment Goals

The principal goals in brownfield redevelopment are to return formerly used, functionally obsolete or potentially contaminated properties to some form of productive use and, if such sites do contain environmental contaminants, to remove or reduce the human and ecological exposure to risks posed by these sites. Though techniques for health risk assessment and site remediation have appeared in the literature, little research addresses the needs of local government officials, private decision makers, financial institutions and the general public regarding land capability, development incentives, and public goals, interests and preferences. This information is as important as environmental concerns such as site contamination and environmental risk in evaluating land use options with respect to brownfield inventory, characterization and potential for redevelopment.

Technical means of identifying a brownfield through the application of baseline studies are well established (Szymecko and Voice, 2002), but the acceptance of the designation by affected parties may not be so simple. Unlike most real estate transactions, brownfield redevelopment is plagued by the perceived threat of contamination, its attendant potential health risks, and the threat of legal and financial liability.

Determining Potential End Use of Brownfield Properties

The main goal of a community-based decision support system for brownfield redevelopment is to provide as much information to the developer or decision maker as possible (Figure 2). This helps identify sites that fit the developer's business plan and facilitate permit application, financing and site engineering. Buchanan (1997) suggests that, in a choice between brownfields and greenfields, the prospective developer must be convinced of the locational and financial advantages of the former.

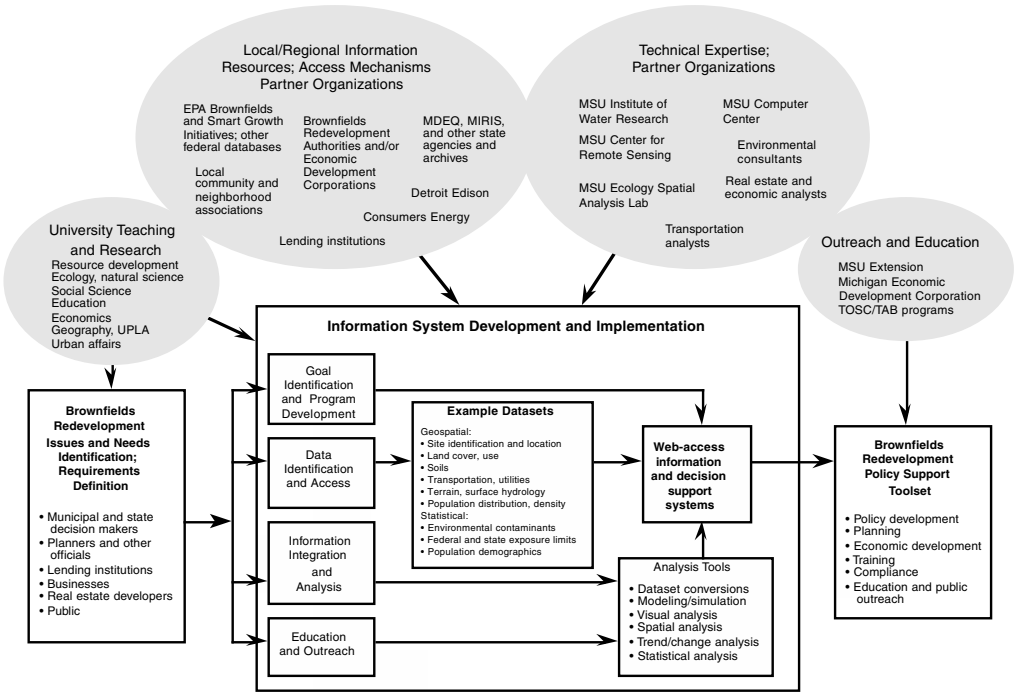


Figure 1. Information resources and functional capabilities of a community-based decision support toolset for brownfield redevelopment in Michigan, including MSU cross-unit collaboration and partnerships with the public and private sectors.

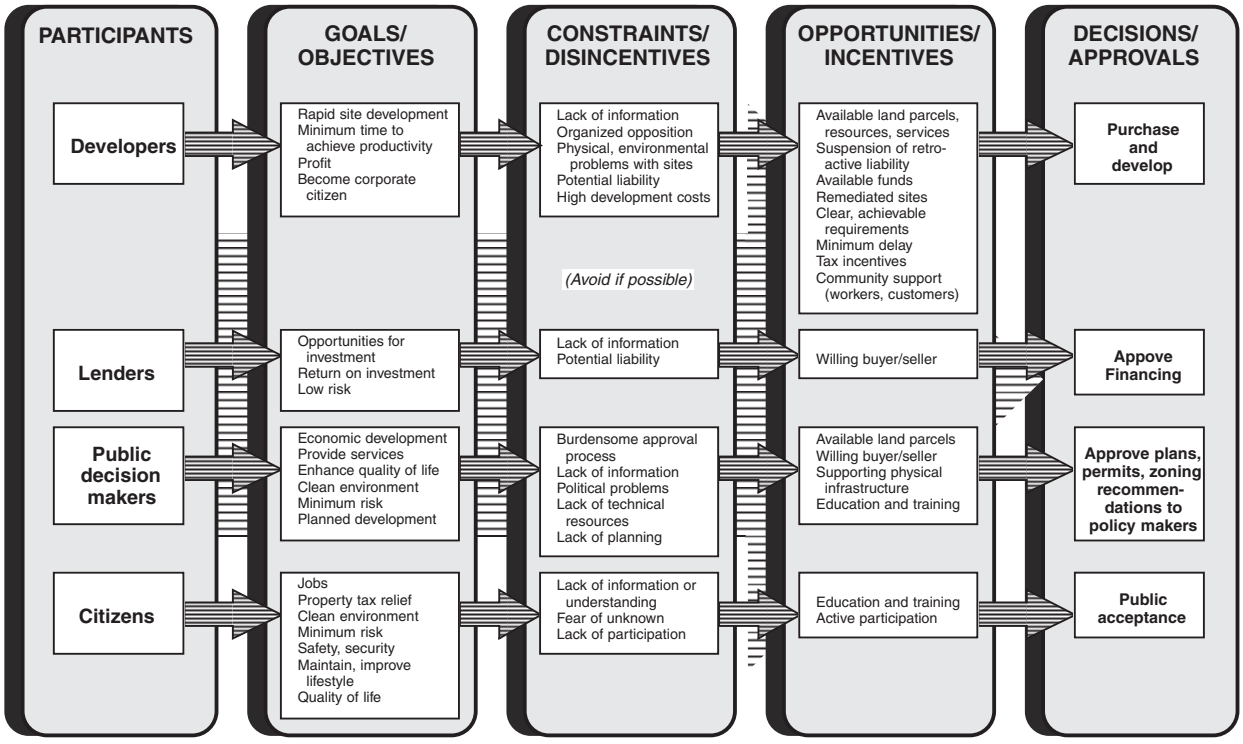


Figure 2. Flow diagram of the land use decision process showing stakeholder groups, levels of participation, and the "filters" of information requirements, potential constraints and opportunities that need to be considered in timely decision making.

In nearly all potential redevelopment projects, the end use of a site is the primary consideration, along with economic and environmental concerns (Simons, 1998; Davis and Margolis, 1997; Moyer and Tremarche, 1997). Information requirements for proposed end uses of brownfields were outlined by Devine (1996). These include an accurate inventory of available sites; environmental compliance status, history of incidents and any enforcement actions; transportation access; presence of linked industries; availability of development incentives; and labor pool characteristics.

Buchanan (1997) lists the fear of liability for contamination as the most critical factor in this comparison. This is also reflected in the previously mentioned nationwide survey of 150 cities conducted by the U.S. Conference of Mayors (1998). Though financial concerns were ranked first among all obstacles to brownfield redevelopment, a variety of environmental and liability concerns ranked second, third, fourth and fifth.

In Michigan, by contrast, environmental contamination and the concern over liability of the new owner have been addressed through the innovative legislation discussed previously. The proposed end use will determine the level of cleanup and associated costs of contaminated properties, but the purchaser of a contaminated property will not become a potentially responsible party (Bartsch et al., 2001). However, the owner is responsible for a basic environmental assessment and is required to institute due care to avoid future contamination.

Greenwald (1996) lists skill level and cost of labor, proximity to customers and price of real estate as the principal determining factors. Greenwald also discounts the influence of tax incentives, claiming that communities in their rush to attract business often trade certain services (such as education and job training) that may be more essential to sustaining a good business environment. In addition, individual commercial and industrial market sectors often apply specific criteria that are most meaningful to achieving their success (*Aftermarket Business*, *Hotel & Motel Management*, and *Shopping Center World* are examples of trade publications reflecting such criteria). The data development process outlined in the *Brownfield Redevelopment Guide for Michigan* (Szymecko and Voice, 2002) could result in additional information about the site and surrounding areas, as well as the community.

Understanding the Complexities of Brownfield Projects Related to Information Needs

Loans to purchase commercial properties often come with strings attached, such as the requirement for environmental site assessments. If such assessments confirm the presence of contaminated soil or groundwater, the stakes are raised accordingly. Complicated application procedures or a lack of important information causes delays. As a result, most developers opt for investment in previously undeveloped areas, guided by their perception of more certain financial rewards in greenfield developments.

Prior contamination, environmental compliance, financial concerns, expensive engineering, liability issues and neighborhood opposition may stigmatize brownfield sites (U.S. Conference of Mayors, 1998). Though the overall potential economic value of brownfields may be great, site analysis is necessary before the value of specific sites can be realized (Dennison, 1998; Kirshenberg et al., 1997; and Rafson and Rafson, 1999).

Brownfield site analysis, therefore, does not allow the use of a single template to guide redevelopment — it must address the highly specific characteristics of each property. According to Devine (1996) and Moyer and Tremarche (1997), specific site characteristics may include environmental compliance status, history of incidents and any enforcement actions; transportation access; presence of linked industries; and availability of development incentives. Greenwald (1996) also lists skill level and cost of labor, proximity to customers and price of real estate as principal determining factors.

Though it may be argued that developers and consultants can obtain all the information they need to locate and clean up sites for redevelopment, the public may not share this confidence. The EPA's Hazardous Substances Research Centers recognized this information gap (2002). Under its outreach program, the HSRC program funds the Technical Assistance to Brownfield Communities Program (TAB) and the Technical Outreach Services to Communities Program (TOSC) to address research on and management of information dissemination issues in hazardous materials. These services are provided to communities seeking the cleanup of waste sites to create better jobs, increase the local tax

base, improve neighborhood environments and enhance quality of life.

Meeting Community-based Information Needs
Michigan State University began looking at the information needed by community stakeholders concerned about brownfield redevelopment issues (Thomas, Fridgen and Asher, 1999). Using funding provided by the Michigan Legislature and the Applied Public Policy Research Program, the MSU research team reviewed the literature pertinent to urban land use and land renewal issues. General information needs were targeted, as well as aspects of land use planning and management, environmental quality, site restoration and remediation, and community education and involvement. General and programmatic brownfield information was obtained from national clearinghouses, such as the EPA's Brownfields Program and Brownfield Pilot Project summary reports at <www.epa.gov/brownfields>. Information on sustainable communities initiatives was listed through links to the Urban Land Institute (www.uli.org), the Redefining Progress Web site (www.rprogress.org) and RP-CINET listserve; specific community programs (e.g., Sustainable Seattle, 1992; Olympia Sustainable City Program, 1991), and many others.

Of particular note was the GIS-based computer model developed in Emeryville, Calif. Known as the "one-stop shop," it provides information on soil and groundwater contamination, assessment findings, planning issues, land use and zoning concerns, and property ownership to potential purchasers and developers. This entire database is available on the Internet at <www.best.com/~rda/oss.htm>.

Michigan State University researchers reviewed information at the Regional Online Brownfield Information Network (ROBIN, <www.glc.org/robin>). The Brownfield Redevelopment Guidebook for Michigan (Szymecko and Voice, 2002, available at <www.egr.msu.edu/brownfields>) provides an extensive list of national, regional and state information resources, government agencies, non-governmental organizations and Internet sites that is invaluable in determining information needs as well as providing resources to local decision makers.

To determine the extent that regional or local needs influence site development, the analysis included a qualitative mail survey of developers actively working with brownfield sites or interested in working on such sites in the future. This survey indicated that critical information needs included the size and location of available sites, infrastructure support services, available financial support and size of customer base.

This search resulted in a set of questions that a prospective developer and community decision maker could ask, a set of indicators and metrics — how to measure and quantify the success of sustainable development objectives — and a list of information requirements to address these questions. An initial set of siting indicators or criteria was prepared for each of four possible end points: industrial, commercial, residential and open space (Table 1).

Developing a Working Database

A regional-level database was compiled for Jackson County in cooperation with the county Planning and Equalization Department and Region 2 Planning Commission. The principal sources for these databases are the Michigan Resource Information System, the U.S. Bureau of Census, the U.S. Geological Service, the U.S. Environmental Protection Agency and other government agencies. Agreements were made with the Michigan Department of Environmental Quality to obtain site-specific data on contaminant levels and locations. Local data were also collected from Consumers Energy Company and the Jackson Public Works Department.

In general, site-specific data requirements include physical data (current and surrounding land cover, surface and subsurface geology and geohydrology, soils, etc.); land use characteristics (energy, water and sewer characteristics; transportation and telecommunication; ownership and property values; zoning and master plans); and demographic and socioeconomic data by neighborhood and block group. Location of contaminants and remediation plans (such as results of Baseline Environmental Assessments, Phase 1/2 or RI/FS) were used when available. These information requirements were incorporated in Table 1.

Table 1. Siting guidelines and metrics used to create a decision support framework for industrial, commercial or service land uses. Additional guidelines can be developed for alternative land uses.

Siting characteristics	Site decision-making questions for developer/community	Possible measurements
Land resource base		
Adequate land area	Is the site large enough?	Cumulative area
Site engineering	Is the site ready for development?	Time; costs
Land use and land cover	What is the existing land use/cover? Are there areas sensitive to development? Are there conflicts with surrounding land uses? Can compatible uses be consolidated?	Location and area extent; proximity to incompatible uses
Terrain and drainage characteristics	Is there a need for site engineering? What are permit requirements? Are there potential natural hazards?	Proximity to physical restrictions
Soils	Can soils support proposed use?	Location and area extent; soil engineering capability
Appropriate zoning	Is the site zoned for proposed use? Does use violate zoning ordinance? Is use consistent with master plan?	Proximity to incompatible uses
Social/cultural		
Trained/trainable work force	Is there an adequate local work force possessing needed skills? What is unemployment rate? What is potential for new jobs?	Percent of work force within 30 minutes of site
Education levels	Does company have to provide job training? Does community have to provide job training?	Education levels in vicinity and region
Population demographics and economic trends	Does proposed use provide opportunities for persons with a variety of social and economic characteristics?	Demographic and economic statistics in vicinity and region
Community education and involvement	Does the community need to be educated about proposed use?	Qualitative - yes/no
Social structure and diversity	Will proposed use add to community fabric?	Qualitative - yes/no
Neighborhood cohesiveness	Will neighbors support or oppose development? Will proposed use add to community fabric? Will proposed use lead to decreases in safety and security?	Demographic and economic status in vicinity and region
Housing	Is housing available for employees? Will additional housing need to be made available? Will residential areas, services need to be upgraded?	Demographic and economic status in vicinity and region

Siting characteristics	Site decision-making questions for developer/community	Possible measurements
Environmental justice	Is proposed use being sited in an area inhabited by persons politically, racially, demographically or economically disadvantaged?	Demographic and economic status in vicinity and region
Economic/financial		
Land values	What is the cost to purchase land or facility? Do land costs attract or repel developers?	Valuation per unit area; cost per unit area
Availability of financial support	Do local lending institutions have adequate financial resources? Are they willing to provide loans for the proposed development?	Survey of local financial institutions
Incentives	Do financial/tax incentives to locate development exist? Are marketing strategies working? What are we willing to do to attract this development? Will development result in additional tax revenues?	Contaminated site qualifying for tax recovery
Customers	Will customer base support proposed use? Will proposed use be accessible to customers?	Demographic and economic status in vicinity and region
Willing seller	Can this site be obtained at a fair price?	Qualitative
Infrastructure: energy and resources		
Proximity to utility services	Are existing services (electric, potable and process water, waste treatment) adequate to meet projected needs? Will services need to be upgraded? If so, at what cost?	kWh; GPM/MGD; age and condition of services; cost/unit
Proximity to transportation	Are preferred transportation resources (roads, rail, air, water) adequate to meet projected needs? Will facilities need to be upgraded? If so, at what cost?	Distance to nearest point of access
Proximity to telecommunications	Are telecommunications (telephone, satellite up-/downlink, Internet/WWW) adequate to meet projected needs? Will services need to be upgraded? If so, at what cost?	Distance, level of technology
Proximity to process resources	Are preferred process resources available locally or in region? What is cost of obtaining them?	Distance to transportation; recovery costs
Environmental quality		
Known levels of contaminants	Are contaminants present at/near site? Who is responsible?	Types; locations; movement and dispersion
Remediation requirements	Are there remediation costs prior to development? Who pays for remediation? Is remediation compatible with proposed use?	Level of cleanup required; time; costs
Willing neighbors	Will neighbors support or oppose development? Will development divide community? Will proposed use add to community fabric?	Qualitative — yes/no
Sustainable communities initiatives	Is proposed use within master plan or community desires?	Qualitative — yes/no
Locations for wastes	Are there disposal facilities within region with adequate capacity and lifespan? What are permit requirements?	Proximity to disposal facilities, transportation routes
Air quality	Is site within or adjacent to incompatible air quality attainment zones? What are baseline conditions? Is there allowable effluent trading?	Area in proximity
Water quality	Is any additional surface or groundwater needed for proposed use? What are baseline conditions? Is there allowable effluent trading?	Area in proximity

Working around Information Constraints

Providing detailed, timely and accurate information is crucial in decisions of land use change, and lack of information remains a major hurdle in brownfield decision making. In a recent survey of state-supported Web sites of available brownfield properties, Thomas (2002a) determined that more than half of the states have some kind of online inventory. Most state environmental agencies maintain online databases on contaminated sites. Results of the study suggest that it is often difficult for potential users to combine these two sources of information on brownfields in an effective way. Details that could be helpful to decision makers (for example, physical site limitations such as wetlands or soils, surrounding land uses and land use controls, permit requirements and available infrastructure) were generally not provided.

A thorough user needs analysis is crucial in decisions of land use change and should be the basis for an effective decision support system. This analysis should consider public participation issues, including the need for timely, comprehensive information, and technologies that can help provide better information to enhance the public participation process.

A resource inventory should be assembled for the database to be useful in a siting decision. Site-specific data must be obtained at the level of detail necessary to differentiate between sites or to choose the most appropriate land use from a suite of alternatives. Supporting documentation must be provided to meet any engineering, environmental, regulatory and financial requirements. Other information in the inventory may include planning and zoning requirements, local municipal resources and services, human skills to be drawn upon and agency contacts (Singer, 2001a). Such a database is likely to be huge, technically challenging and costly.

Assembling a sufficient database requires extensive analysis of user needs, both active and passive. Active user needs analysis in land use planning and management consists of direct interaction with stakeholder groups in various venues, including interviews, public meetings and surveys. Passive analysis consists primarily of literature review of similar programs or materials collected on test programs (but not by project staff). A successful decision support system must include elements of both types of analysis, as well as continual training and outreach.

Part 2: Application of New Tools for Brownfield Redevelopment

The Jackson County project resulted in the development of the Brownfield Site Prioritization Weighting and Ranking Model (shown in Figure 3), a decision support system that taps into the information resources on brownfield site location, suitability and acceptability. This model adds cutting-edge computer technologies to enhance analysis and visualization. Most importantly, the system provides a greater opportunity for multistakeholder review and input in the site location and development process.

The use of decision support systems in the business world is well established (Sauter, 1997), but the application of such methods to land use in general and brownfields in particular is relatively new. According to Sauter, decision support systems, by definition, should aid in and strengthen the process of choice. For the DSS to be effective, designers must understand the human choice process as well as the informational needs of the user, the abilities of the user to process and understand that information, and, ultimately, how and why the information will be used. The integration of expert system technologies (models, visualization tools, etc.) as components of a decision support system is a means of realizing the goal of providing additional support to decision makers.

An effective land use decision support system must provide access to data, the tools or mechanisms to transform data into useful information, and the context from which understanding is derived (Worrest et al., 1994). For example, geographic information systems have been readily adopted by users seeking to learn more about the physical world through the ability of computers to transform huge databases into thematic maps. With the addition of GIS-based models and other analytical tools, decision makers can begin to manipulate data in a true planning environment (Faber et al., 1997; Thomas 1994, 1993; Thomas and Roller, 1993).

Building a Community-based Decision Support System

Michigan State University worked with selected local units of government, community and business leaders, and members of the public in developing the system. This effort was used to determine multistakeholder goals for site redevelopment, identify and locate databases held by existing subcontractors, determine a set of environmental indicators to quantify relevant factors and measure project success, and identify specific brownfield sites to demonstrate the decision support application. The team then incorporated project scenario assessment models and indicators into a GIS-based expert system called Smart Places® to evaluate project objectives, compare siting alternatives and assess the effects of a proposed redevelopment project.

The study used a series of workshops in which criteria and measurement assumptions were developed, refined and then applied on existing brownfields within local jurisdictions. The first step in the process was to determine potential endpoints from which screening criteria could be developed. The second step was to define assumptions used in measuring the criteria in the field.

The site-screening criteria were field tested by incorporating them into a conventional site identification, characterization and evaluation process that would be used by a brownfield redevelopment authority in Michigan. This process typically consists of three distinct activities to decide which sites should be designated for redevelopment, investment and marketing. The initial activity is the site identification and data collection process, or site inventory; the second is the screening and ranking process; and the third is the analysis and evaluation process.

This general approach was followed throughout the process. The multivariate weighting and ranking method in a GIS-based format was introduced to demonstrate the value of adding this information to the decision process. This process is shown in Figure 3.

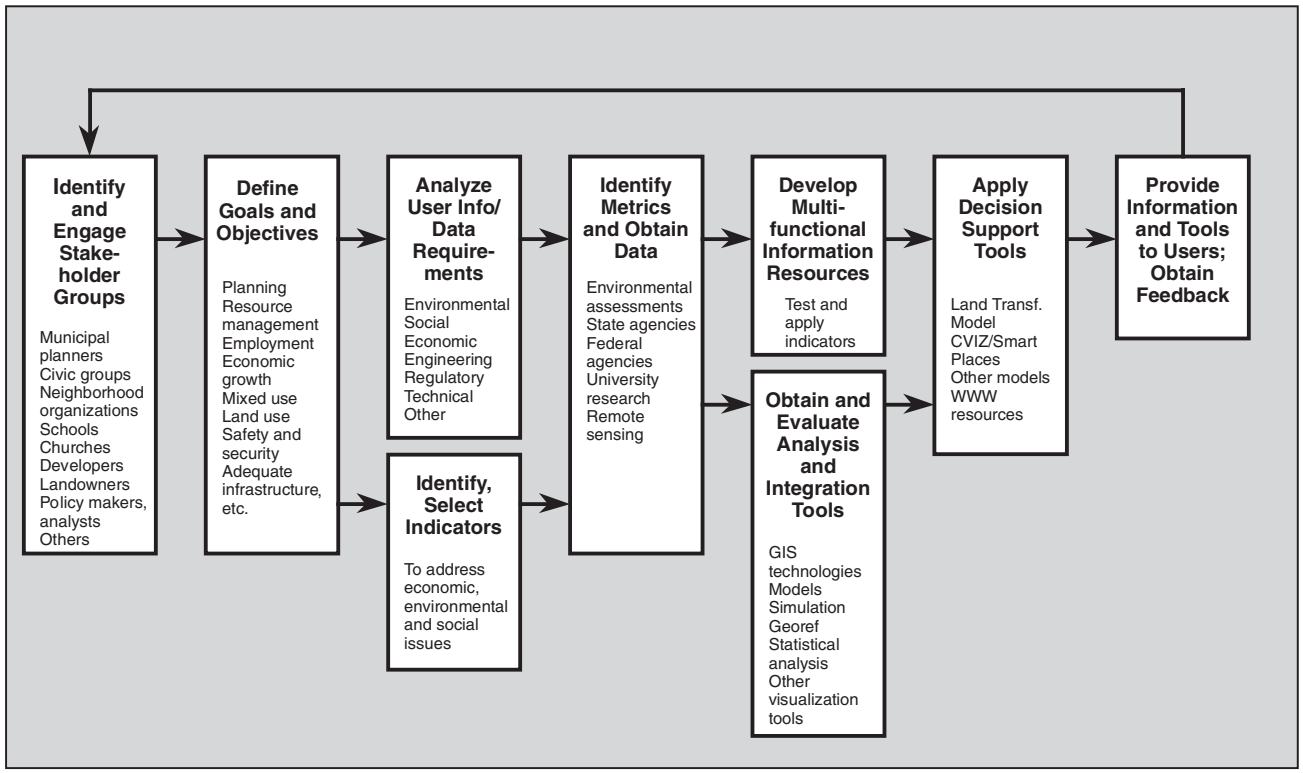


Figure 3. Functional diagram of a computer-assisted decision support system for community planning, capacity building and intergovernmental collaboration in land use planning, economic development, resource management and regulatory compliance.

Developing Site Selection Criteria

The introduction of site selection criteria in community-based brownfield redevelopment programs was proposed as a mechanism to provide site- and region-specific information to the developer and community decision maker in an observable, measurable and repeatable process. During a facilitated public meeting, participants were instructed to develop a process model that could provide guidance to the Jackson County Brownfield Redevelopment Authority in the efficient use of resources in identifying, characterizing and marketing candidate brownfields.

Workshop participants felt that a systematic approach would be helpful in identifying sites that fit the developer's requirements and in facilitating permit application, financing and site engineering. Participants agreed that site-screening criteria needed to reflect several factors generally used in locating commercial real estate, including infrastructure, site characteristics and financial incentives. Additionally, the criteria must take into account local restrictions such as zoning ordinances, master plans and community acceptance.

The wording and relative importance of each siting criterion were developed during the workshop and reviewed by local units of government. The draft criteria were independently reviewed by representatives of public and private sector organizations involved in brownfield redevelopment in Michigan.

The final draft criteria are listed in Tables 2a/2b in decreasing order of relative importance. Participants identified and rated the following criteria pertinent in local decision making (shown in Table 2a):

(1) The status of environmental cleanup (or at least a determination that no public risk exists) was considered the highest ranking criterion, despite the protection from retroactive liability afforded by Michigan law. One note of caution: because comprehensive information on site contamination, environmental assessments and cleanup status is not consistently available, additional assessments of most properties are required.

(2) Land reuse potential was considered next in importance, followed by compatibility with local land use controls such as zoning ordinances or master plans. These two criteria were established to help ensure public acceptance for a potential

Table 2a. Local brownfield site selection, weighting and ranking criteria, and information requirements developed for Jackson County.

LOCAL GOVERNMENT RANKING CRITERIA	Total point value	Rank value	Information source
Site Conditions = 40 points			
Environmental contamination suspected	40	18.00	Assumption based on county-supplied data
Environmental problems unknown	40	10.00	Assumption based on county-supplied data
Environmental investigation partially complete	40	6.00	Results of Phase 1 ESA/BEA
Physical development constraints exist	40	4.00	MDEQ 201/307/UST database
Environmental investigation complete	40	2.00	Phase I/II ESA/BEA results, admin. order release
Utility Infrastructure Capacity = 25 points			
Heavy duty water/sewer, gas, electric	25	12.50	Utility service specs.
Medium duty	25	7.50	Utility service specs.
Light duty	25	3.75	Utility service specs.
Incomplete	25	1.25	Utility service specs.
Telecommunications Infrastructure = 25 points			
High-tech fiber optics installed	25	12.50	Utility service specs.
Proposed, 1-2 years	25	7.50	Assumption based on local/county-supplied data
Proposed, 2-5 years	25	3.75	Assumption based on local/county-supplied data
Basic, upgrades in 5+ years	25	1.25	Assumption based on local/county-supplied data
Transportation Infrastructure = 25 points			
Interstate access/rail/airport	25	12.50	Local data; type; distance
Class A/primary or state highway	25	7.50	Local data; type; distance
Secondary or county road	25	3.75	Type; distance
Local street	25	1.25	Local data; type; distance
Compatibility with Local Land Use Controls = 40 points			
Compliant	40	25.00	Master plan; zoning ordinance; req'd. setbacks
Compliant with reservations	40	15.00	Master plan; zoning ordinance
Not compliant	40	5.00	Master plan; zoning ordinance
Current Use Compatibility with Local Land Use Plans = 30 points			
Compliant	30	25.00	Master plan; zoning ordinance
Not compliant	30	5.00	Master plan; zoning ordinance
Compatibility with Surrounding Land Uses = 25 points			
Compatible as proposed	25	12.50	Master plan; zoning ordinance; req'd. setbacks
Compatible with reservations	25	10.00	Master plan; zoning ordinance; req'd. setbacks
Not compatible as proposed	25	2.50	Master plan; zoning ordinance; req'd. setbacks

Table 2b. County-level brownfield site selection, weighting and ranking criteria, and information requirements developed for Jackson County.

COUNTY BROWNFIELD REDEVELOPMENT AUTHORITY RANKING CRITERIA	Total point value	Rank value	Information source
Environmental Risk and Compliance = 40 points			
Minor contamination, no risk	40	20.00	MDEQ 201/307/UST database; BEA results
Contamination can be removed, minimum risk	40	12.00	BEA results
Contamination can be contained on site	40	6.00	BEA results
Potential future contamination	40	2.00	BEA results
Land Reuse Preferences = 30 points			
Industrial	30	15.00	Master plan; zoning ordinance
Commercial/office	30	9.00	Master plan; zoning ordinance
Open/agricultural	30	4.50	Master plan; zoning ordinance
Residential	30	1.50	Master plan; zoning ordinance
Financial Incentives = 50 points			
Qualify for BRA TIF financing	50	22.50	Assumption based on county-supplied data
Qualify for DEQ/EPA brownfield grant(s)	50	12.50	Assumption based on county-supplied data
Qualify for community devel. block grant	50	7.50	Assumption based on county-supplied data
Qualify for other local financing	50	5.00	Assumption based on county-supplied data
Qualify for industrial facilities tax exemptions	50	2.50	Assumption based on county-supplied data
Labor Resources = 45 points			
Trained work force, short response time	45	22.50	Census; block group labor force/sector
Trained work force, long response time	45	13.50	Census; block group labor force/sector
Job training available	45	6.75	Assumption based on county-supplied data
High unemployment	45	2.25	MESA stats.; U.S. census
Market Conditions = 40 points			
Customer base located within 50 miles	40	20.00	Census; block group population
Proposed use will attract new markets	40	12.00	Assumption based on county-supplied data
Competitors located within 50 miles	40	6.00	Census; block group labor force/sector
Projections, long-term	40	2.00	Requesting firm
Proposed Uses - Ranges of Acceptability			
Industrial	High	120-220	
Industrial	Medium	70-119	
Industrial	Low	<70	
Commercial/office	High	140-200	
Commercial/office	Medium	90-139	
Commercial/office	Low	<90	
Residential	High	90-120	
Residential	Medium	60-89	
Residential	Low	<60	
Agriculture/open space	High	70-120	
Agriculture/open space	Medium	50-69	
Agriculture/open space	Low	<50	

use and lack of conflict with surrounding uses. For example, if a site is not completely surrounded by compatible uses, the point value goes to the lowest adjacent use.

(3) The next three criteria deal with infrastructure. Local decision makers must determine whether existing or planned electric, gas, water, sewer, communications and transportation resources are adequate to serve potential uses or whether systems need to be upgraded at public expense. Additional information about system capabilities (e.g., electric service is 14 kV, gas is 24-inch high-pressure pipeline and so on) must be established at each site. Points are assigned if infrastructure provides relatively immediate access or service with a normal hookup charge. If this is unknown, an incomplete value is assigned. Points are assigned if a transportation system provides immediate access not including new driveways; otherwise, an incomplete value is assigned. For purposes of site comparison, sites within one mile of an interstate exchange would have an advantage as long as the route does not pass through a residential area.

(4) Finally, when a project is proposed at the local level, a final determination will be made whether that use is compatible with surrounding land uses. This could be stated in the master plan or public meetings.

Once a site is evaluated and ranked, the local unit recommends the highest priority sites to the brownfield redevelopment authority. The brownfield redevelopment authority then reevaluates each site using the next tier of criteria (shown in Table 2b):

(1) The brownfield redevelopment authority is primarily concerned with shepherding a project through the redevelopment process. Financial incentives ranked highest because they have a tremendous economic effect on the eventual use of the site. Qualifying for tax increment financing (TIF) or one or more brownfield grants can provide enough money to prepare a site for a client. The client might otherwise find it less expensive to develop a greenfield site. Because of the inability to capture TIF and other taxes and the need to negotiate recapture of school taxes, classification of areas as Renaissance Zones and Economic Empowerment Zones was considered a non-incentive.

(2) The brownfield redevelopment authority will also need to identify and characterize labor resources and conduct a market analysis for a prospective end use. County government is seen as the most capable unit to conduct these analyses.

(3) Environmental risk/compliance and land reuse preferences would then be reconsidered at the county level. Because the brownfield redevelopment authority is the principal fiscal agent for site redevelopment, it is responsible for determining the potential uses that will result in an economic return and ensuring that the site is remediated to the intended use.

Relative importance (assigned weights using an ordinal scale) is suggested by point values assigned to each category heading. Several iterations were required to establish point totals. The values in the figure reflect the relative importance of each criterion to the study area. Ranks and weights of each criterion in Table 2a/2b were chosen to favor the development of industrial and commercial/office uses. The participants believed that danger exists in redeveloping a brownfield site with known contamination into residential use.

The highest cumulative point value that could be attained by a site was 218. Participants determined that industrial sites should fall within an optimal value range of 120 to 218, commercial sites between 140 and 200, residential sites between 90 and 120, and agricultural/open space between 70 and 120.

A further division of the criteria, based on whether criteria were evaluated with a known endpoint, was also considered but not included in the final draft. All participants were aware that the resultant criteria would be advisory only and that the points assigned would be arbitrary. As might be expected, applications of this method in other locations would probably result in different point totals.

Implementing a GIS Toolset

The Brownfield Site Prioritization Weighting and Ranking Model was assembled and configured for the county and tested in Blackman Township. The model runs on a laptop computer with Windows®, ArcView® and Smart Places® software. The model's toolset includes site attributes for the inventoried brownfield study areas and selected environmental, social and economic development indicators (see Table 1). Regional and parcel data were incorporated into ArcView® as they were compiled for each township. Smart Places® scenarios were used to compile the data, integrate siting objectives and constraints, and assess impacts of various land use options. All sample scenarios used in this paper are from Blackman Charter Township.

The Jackson County Brownfield Redevelopment Authority created an inventory of 100 sites from the approximately 4,600 potential sites in the county. These were derived from a larger database that included the Michigan Site Network (www.dtesites.com) and Brownfield Central (www.brownfieldcentral.com), the Michigan Department of Environmental Quality's contaminated sites (Part 201 database), underground storage tank databases (http://deq.state.mi.us) and volunteer site identification (sites nominated by local communities or business owners). Other sources of potential sites include the EPA's CERCLIS (Comprehensive Environmental Response, Compensation and Liability Inventory System) database, the U.S. Department of Commerce/EPA Nationwide Brownfield Exchange and the National Pollutant Discharge Elimination System.

An environmental consultant provided site-specific information for 38 target sites through Phase 1 and Phase 2 environmental site assessments (American Society of Testing and Materials Standard E1527-97, as amended) and basic environmental assessments (Szymecko and Voice, 2002, pp. 20-29). All known and suspected (volunteer) brownfields were mapped in ArcView® GIS, along with site information provided by the online database and the environmental site assessments. As each site was evaluated, it was then added to the GIS coverage for each township.

Although several GIS-based expert systems are available on the market, the goal of this project was not to compare competing software. Smart Places® was selected because it is inexpensive and readily available, is adaptable to many applications and has an established track record as a powerful decision support tool. Smart Places® allows non-technical users to review land use scenarios, sketch recommended changes, and evaluate these recommendations against local or regional objectives and constraints. Such applications can support land use decision makers in comparing the impacts, benefits and risks of alternative land use options or scenarios. As such, it is a tool worth considering in a spatial decision support system. Additional information on system requirements and capabilities can be found at <www.epri.com>.

Using the Smart Places® model, editable land use themes (residential, commercial, industrial, parks and open space, transportation corridors, etc.), analysis categories, and specific measurement and comparison criteria were established. The land use alternatives reflect categories identified in the Blackman Charter Township master plan.

The mapping and evaluation process was also automated in ArcView® using the Smart Places® extension to compile the data, integrate siting objectives and constraints, and assess impacts of various land use options. The system then calculates the total point value for each site and displays the results. After the weighting and ranking process was applied, site-specific information was reviewed to provide a preliminary assessment of the potential economic, social and environmental effects of redevelopment options. If one or more sites are selected for further consideration, the developer might then hire an expert to prepare the required environmental reports.

Applying the Toolset in the Field

Six sites, all considered brownfields, were chosen from each township to validate the Brownfield Site Prioritization Weighting and Ranking Model. Results are shown in Table 3, which is a subset of the sites in Blackman Township. To illustrate the process by which site information is compiled in a decision support system and alternative site development options are evaluated, an example scenario is shown in Figures 4-6. Figure 4 represents a proposed industrial development using Smart Places® and the site selection criteria described in Table 2.

Table 3. Results of screening six brownfield sites in Blackman Township.

	Site 3	Site 4	Site 5	Site 8	Site 12	Site 14
MDEQ ID#	380142	380023	380115	380229	380106	380290
Acres	0.24	10.2	0.5	2.60	19.40	0.93
Zoning	RU-1	I-2	C-2	I-2	I-2	I-2
Contaminant	MTBE, carbon tetrachloride	PCE, TCE, benzene, lead	Unleaded gasoline	DCE, TCE, PCE, vinyl chloride	TCE, DCE, BTEX, vinyl chloride	Gasoline
Cleanup status	Not begun cleanup	Final complete, interim response	Pre-ESA	ESA complete, interim response	ESA	Pre-ESA
Local value	32.75	79.75	69.75	96	76.75	59.75
BRA value	32.75	62.75	59	75	41.75	66.25
Total	**65.5**	**142.5**	**128.75**	**171.0**	**118.5**	**126.0**
Industrial range High 120-220 Medium 70-119 Low <69						
Redevelopment potential — industrial end use	Low; too small	High	Low; zoned	High; part of a larger site	Medium; no tax recapture	Low; too small

First, the basic data layers, indicators and measurement assumptions (described above and listed in Table 1) are built in ArcView® and Smart Places®. The township master plan and the zoning ordinance identified preferred uses for the site in light of its type, size and distribution, along with requisite setbacks, minimum square footage and so on. The options of light and heavy industrial uses and general and office building commercial uses reflected community preferences for proposed land uses.

The site is located on land that is currently zoned industrial (hatched tones); adjacent areas are zoned commercial (darker tones). From the MDEQ contaminated sites database, we learned that the site was previously used for the manufacture of electronic equipment and components. The site is contaminated with polychloroethylene, trichloroethylene, benzene and lead. Several physical limitations exist, including the presence of unstable soils, adjacent municipal water supply wells and wetlands. These factors may affect use of the site without reengineering and a wetland permit issued by the state.

This site was ranked relatively high (96 of a possible 118 points) by the township planning department and was nominated to the county brownfield redevelopment authority for redevelopment incentives (the brownfield redevelopment authority scored the site as favorable for development [75 of a possible 100 points]). The combined score of 171 placed the site high on the list for potential industrial redevelopment. Sites with a relatively high local score in this evaluation are most likely to be nominated for consideration for either industrial or commercial redevelopment. Local decision makers preferred not to recommend brownfields for residential use and are hesitant to recommend them as open space. Sites that did not have industrial or commercial potential were unlikely to score high at the county level.

The next phase of the siting process dealt with restrictions to the proposed development, including physical limitations, engineering requirements, economics and so forth. These were evaluated as shown in Figure 5, along with building size; number of employees; water and sewer; heating, ventilation and air conditioning; road access and parking; and other design criteria. Based on an evaluation of similar proposals and an assessment of environmental effects, a preliminary analysis can then be provided to the developer and to municipal decision makers.

Figure 6 illustrates how several of the selected indicators (water and energy demand, local power plant emissions, vehicle miles traveled, etc.) can be incorporated in a decision process. This information can then be used to provide siting recommendations that would be evaluated against local or regional objectives and constraints as specified in a master plan or zoning ordinance.

Other townships had similar results. In this example, the subtotal scores for the local community and the brownfield redevelopment authority were combined into a total score. The site rankings were then compared with a potential industrial end use. Site 5 was eliminated because it is zoned commercial; sites 3 and 14 were eliminated because they were too small under the local zoning ordinance. Although site 12 had a relatively high local score, the brownfield redevelopment authority downgraded it to medium value for an industrial end use because it could not qualify for tax recapture.

In the next phase of the siting process, additional information supporting criteria assessment was made available to a prospective developer and to municipal decision makers so they could compare similar proposals and assess environmental effects of the proposed action. Potential limitations or restrictions to the proposed development are identified, including physical limitations, engineering requirements, economics and so forth. Several selected indicators (water and energy demand, local power plant emissions, vehicle miles traveled, etc.) were incorporated into the decision process. This information can be used to provide specific siting recommendations that can then be evaluated against local or regional objectives and constraints as specified in a master plan or zoning ordinance.

Figure 4. In the first phase of the GIS-supported site evaluation process, the proposed industrial use of a brownfield site (site 8 from Table 3) is evaluated. The database shown in the chart provides information on site location, previous use, known contaminants and remediation status.

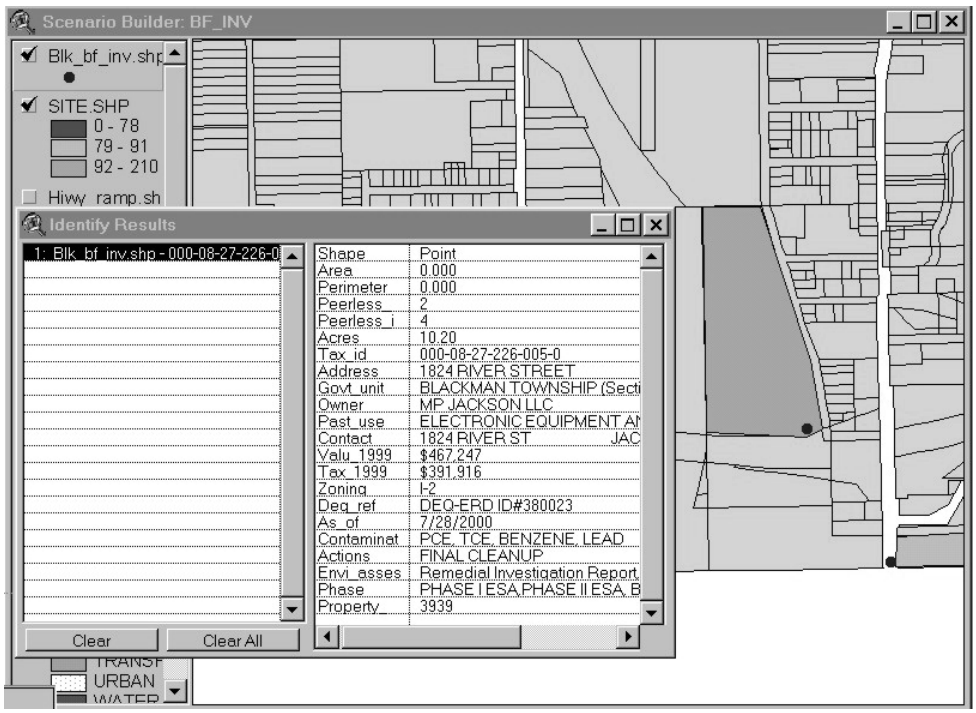


Figure 5. Redevelopment constraints are considered during the second phase of the site evaluation process. Potential redevelopment of site 8 must take into consideration the presence of environmental contamination and wetlands protected under Michigan law. Other physical, economic and social constraints would also be evaluated as part of the decision process.

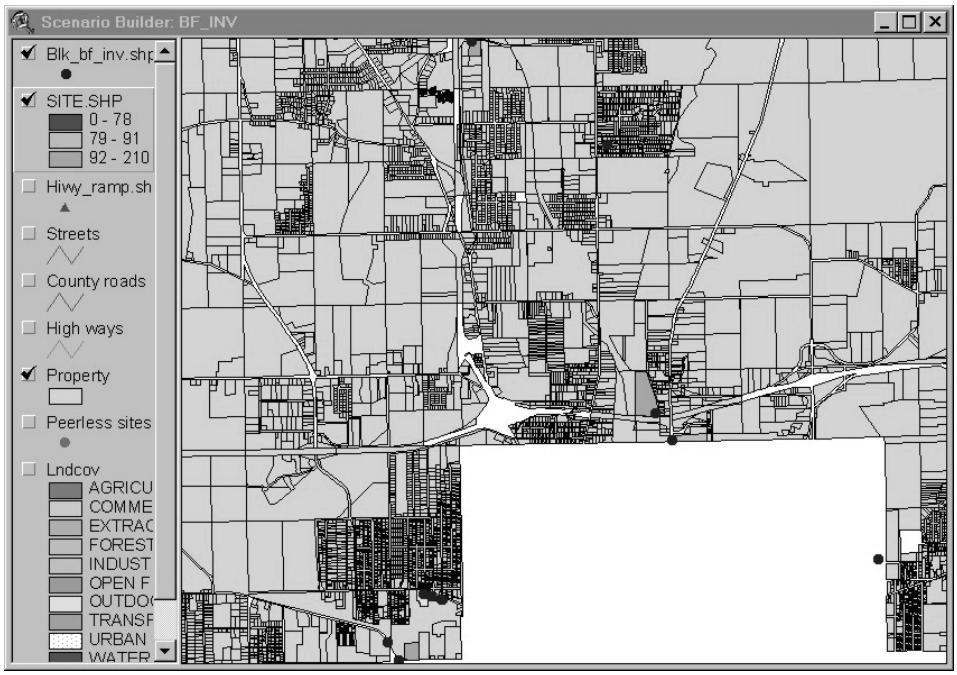
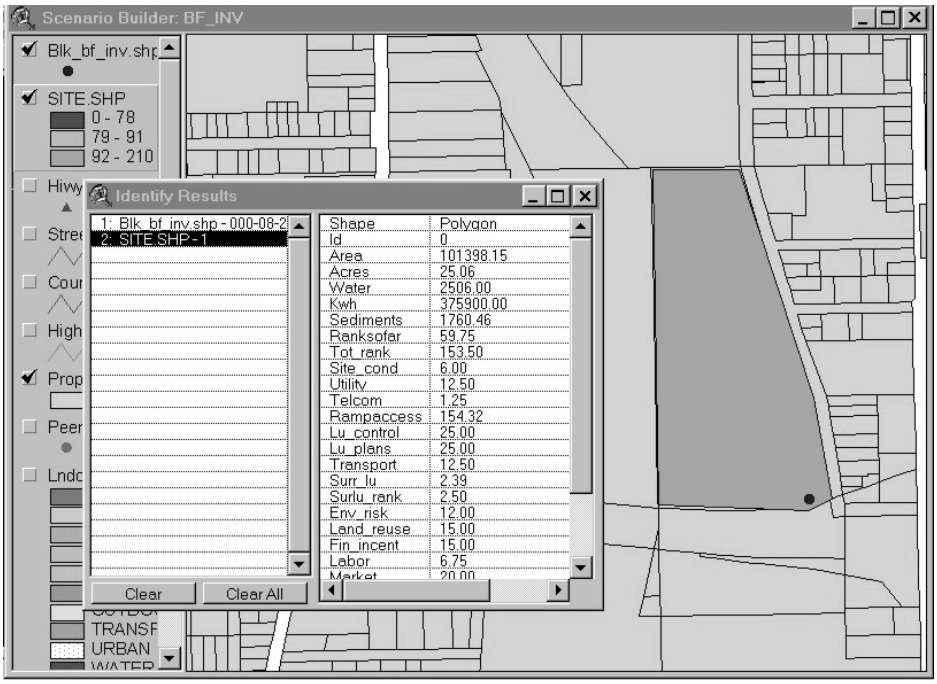


Figure 6. Design criteria for the proposed industrial use of site 8 can also be evaluated. In this example, building size, number of employees, water and sewer, heating and ventilation, road access, parking and other design criteria can be incorporated into the decision process.



Part 3: Discussion and Lessons Learned

The Need for Intergovernmental and Community Cooperation

This report argues for the "rationalistic planner" approach to brownfield redevelopment. The ideal brownfield project or program is one in which the shared objectives of the community, local government and the public sector, and the private sector are met — the win-win scenario (Szymecko and Voice, 2002). Local participation and intergovernmental cooperation are crucial to project success. There are generally two arguments, however, that do not favor an increased role for the community in the decision process. The first argument is that brownfield redevelopment is just a real estate transaction, and the only stakeholders are the owner, the lender and the permitting body. The second argument is that the principal goal of redevelopment is economic, not environmental. In the minds of political decision makers and developers, getting properties back into production can be slowed (or thwarted) by the inefficiencies of public participation.

These arguments are addressed, in part, by local land use controls that demand public participation in proposed redevelopment. Local master plans, zoning ordinances and other land-related ordinances are codified expressions of local desires for growth and development and will ultimately determine whether a development proposal or permit application is approved. This process was observed in the Jackson County project. Though the county brownfield redevelopment authority claimed to represent most of the townships in the county, the selection of brownfield sites to remediate and market was almost entirely the role of the brownfield redevelopment authority. Several township governments, fearing a threat to their decision-making powers, threatened to pull out of the brownfield redevelopment authority.

The two-tiered screening process that developed as part of the Brownfield Site Prioritization Weighting and Ranking Model provided opportunities for local participation (Thomas, 2002b). This process was developed to address three realities associated with local land use decision making. First, nearly all land use decisions in Michigan are made at the local level. Second, siting and development criteria have different applicability at county and local levels based on availability of information and jurisdictional rights, prerogatives and interests. Third, potential end use (whether a site would be developed with a use in mind or is being screened to determine a preferred use) may differ by jurisdictional level. Thus, local units of government could screen and prioritize sites according to local objectives. Sites were then proposed to the brownfield redevelopment authority for additional screening and ranking. This procedure enhanced the ability of the brownfield redevelopment authority to work closely with local units of government in providing data, information, decision support tools and guidance in applying site selection and screening procedures.

The lesson learned in this process is that communities and stakeholders must be given the opportunity to participate actively in the site identification, selection and development process. These entities represent local residents, businesses and interest groups and must balance economic growth with quality of life issues. Most land use decisions are made at the local level, where people within local units of government generally know more about local conditions that may determine whether a site is economically and environmentally viable as well as socially acceptable. This calls for coordination between local units of government (representing local residents) and the regional authorities. On the other hand, regional authorities generally have access to funding programs and tax incentives that can stimulate brownfield redevelopment in a community and help recover the costs of site cleanup.

Providing Opportunities for Public Participation

One of the critical issues in brownfield redevelopment is developing systematic and consistent processes that allow maximum participation by interested stakeholder groups. Though community groups are not typically part of a brownfield transaction, they have a legitimate role in community planning, zoning decision making and the use of public resources (Bartsch et al., 2001). Bartsch goes on to say that community stakeholders have considerable concerns about brownfield redevelopment. Such concerns may include relief of urban blight, job creation, contamination and public exposure, and other environmental issues.

Early citizen involvement can facilitate a brownfield project; its absence may result in opposition and delays. Participants must be able to understand and differentiate between the risks of developing and not developing a brownfield site. Questions about the potential end use of a brownfield property, along with economic and environmental concerns, are at the heart of the brownfield remediation and redevelopment process (Davis and Margolis, 1997; Moyer and Tremarche, 1997; Simons, 1998). Moreover, environmental justice issues related to potential redevelopment are becoming increasingly important (Singer et al., 2001b; Thomas, 2003).

The Jackson County project demonstrated the need for public participation in the redevelopment process. Public input was necessary at both the local and county levels to arrive at an equitable agreement on ranking sites for redevelopment. Another notable example of both failure and success of public participation was recently observed in the redevelopment of the Southwest Detroit Empowerment Zone in the Delray neighborhood. This area along the Detroit River had been heavily industrialized for over a hundred years when the city of Detroit began redevelopment of its brownfield sites in the mid-1990s. The redevelopment strategy focused on industrial land uses. Local neighborhoods, which consisted largely of low-income racial minorities, expressed opposition to this strategy. Though issues of environmental and social equity were exposed at public meetings, the biggest concern was that the public had been left out of the decision process. This disclosure led the city to change its policy and involve local representation in the redevelopment process.

The questions being asked by residents of the Delray neighborhood now include:

- What are the environmental conditions on the site?
- What are the redevelopment options for the site?
- What are the relative risks to local residents if we do not redevelop (and remediate) the site?
- What are the relative risks to local residents while redevelopment is occurring?
- What are the relative risks to local residents from operation of proposed alternative developments?

Equitable participation in the process of converting brownfields into productive uses requires that participants have access to information and tools that address such questions.

Leaving a property unremediated exposes the public to certain health risks, as can cleaning up a site or tearing down a building. Most importantly, the end use of a site can also be potentially problematic. Replacing one source of contamination with another is neither ethically nor morally acceptable. To answer these and related questions, participants need information systems that provide access to financial, legal, social and environmental data; access to tools that help convert data into information relevant to issues of concern; and access to expertise that can provide objective contextual interpretation.

Participation includes outreach and education, much of which can be enhanced with information technology tools. Access to information about potential hazards and risks, particularly through the Internet, can help defuse emotional reactions to uncertainty and allow various interest groups to share information in a non-confrontational manner.

A Community-based Decision Support System Can Enhance Public Participation

The results of this project lead to several observations. First, siting criteria should consider factors that are generally used in locating commercial real estate. Second, the criteria must incorporate local conditions such as infrastructure, site characteristics and financial incentives. Third, the criteria must take into account local restrictions including zoning ordinances, master plans and community acceptance. Finally, representatives of local government entities should calibrate the criteria on existing sites within local jurisdictions.

It is important that local communities have the first opportunity to review sites within their jurisdictions — they are generally more familiar with site characteristics, past uses and community acceptance of potential future uses. Sites with a relatively high local score are most likely to be nominated for consideration for either industrial or commercial redevelopment. Local decision makers preferred not to recommend brownfields for residential use and were hesitant to recommend them as open space, and sites without industrial or commercial potential were unlikely to score high at the county level.

The proposed criteria could be modified to reflect local environmental concerns and impacts of proposed alternatives, goals for economic growth, physical attributes of the site and surrounding areas, transportation and communication infrastructure, ability to provide necessary services and available financial incentives. County objectives could reflect these same criteria but on a regional growth level.

Automating the process in a GIS allows manipulation of the database as new information is available, and it will allow commercial realtors and prospective purchasers and developers to review and compare prospective sites rapidly. This has the advantage of enabling access to significant amounts of geospatial data in a form that is easily manipulated on a computer. This process can be as simple or as detailed as time and funding allow.

Computer- and GIS-based applications such as Smart Places® and CommunityViz® are relatively inexpensive and readily available, are adaptable to many applications and have established track records in communities across the country. These tools can support land use decision makers in comparing the impacts, benefits and risks of various land use options or scenarios and are worth considering in a spatial decision support system. Additional information on system requirements and capabilities can be found online at <www.epri.com> or <www.communityviz.com>.

Understanding of Relative Risks in Brownfield Redevelopment

States' adoptions of voluntary cleanup programs (VCPs) in the late 1980s allowed owners of contaminated sites to negotiate a final level of site remediation with state environmental protection agencies. Because of lingering concerns about public risk, the threat of third-party claims and enforcement action by the EPA remained. This concern was addressed, in part, through the development of risk-based cleanup standards. These standards, developed under a memorandum of agreement between EPA regional offices and state agencies, enabled brownfield sites to be cleaned up to levels consistent with the proposed end uses of the properties (Bartsch et al., 2001).

Advances in remediation technologies and brownfield redevelopment procedures may be meaningless to most stakeholder groups, particularly with respect to human and ecological health risks. The implications of alternative brownfield redevelopment strategies are not always adequately conveyed to decision makers and the public. Technical reports, including environmental site assessments prepared by consultants, may not include risk analysis and management guidelines. Even if such guidelines are presented, they may be difficult for the public to understand. Public reporting, whether written or verbal, must provide context so that decision makers and the public can better evaluate and understand risk posed under the three alternative brownfield actions discussed in the previous section.

To participate effectively in the decision process, stakeholders need some combination of formal and informal education to better understand reports filed by technical consultants. Schilling, Gaspar and Mishkovsky (2000) also suggest that decision makers considering land use controls affecting brownfield redevelopment options will require increasingly more information about relative risk and risk management strategies. The Technical Outreach Services to Communities (TOSC) programs, hosted at several universities such as MSU, provide such a service (Michigan State University Hazardous Substances Research Center, 2002). TOSC programs provide access to information and expertise about environmental contamination and health risks. TOSC also works closely with TAB, the Michigan Department of Environmental Quality, and the Victor Institute for Responsible Land Development and Use at MSU to provide training sessions for community leaders, agency employees, consultants and others.

An example of this coordination is the first Environmental Management and Remediation Certificate Program, which involved more than 20 participants (Randolph and Szymecko, 2001). The program consisted of a series of training sessions led by recognized experts in compliance, planning, financing, risk management and conflict resolution. The study areas included a number of brownfield sites in southeastern Michigan.

Public Acceptance of Information Technologies in Impact and Risk Assessment

New information technologies can be used to provide a better understanding of the impacts as well as the benefits of alternative redevelopment options. For brownfield redevelopment programs to be successful in the long run, three factors must come into play:

- Government and private decision makers need more information on land capability, development incentives, and public goals, interests and preferences.
- The information system must address environmental concerns such as site contamination, public health and environmental quality. Local governments need tools to evaluate various proposals for the use of a specific site, to shorten the time needed to make decisions, and to attract federal, state and private capital to prioritize, revitalize and sustain brownfield redevelopment.

Adopting new technologies for brownfield redevelopment can be challenging at the local level. Despite the fact that brownfield redevelopment authorities have been established throughout Michigan, the integration of computer-based decision support tools in the inventory and comparison of sites is considered somewhat new and innovative (Consumers Renaissance Development Corporation, 1999).

Community adoption of geographic information systems in planning and decision making is a case in point. The use of GIS in most communities has not progressed beyond basic mapmaking. Resistance to new ways of analyzing the effects of alternative decisions may stem more from a lack of knowledge about how such tools can enhance redevelopment than from outright resistance (Singer et al., 2001b).

Incorporating tools such as GIS in local planning is also dependent on the familiarity factor — unless it has been shown to be effective elsewhere, potential users will be reticent to adopt new technologies. Decision support tools and processes cannot make the decisions — this is still the responsibility of local community leaders. On the other hand, if the time required to locate and compare sites, conduct site engineering (including any contaminant remediation) and construct a facility can be shortened by making more timely, accurate information available, this could mean the difference between a decision to purchase or to move elsewhere.

One example of using GIS in brownfield decision support can be found in Commerce City, Colorado (Schilling, Gaspar and Mishkovsky, 2000). This system is used to track environmental conditions at a site and "red-flag" land use restrictions. It is also helping to track real estate transactions. Another example of how new information technologies can begin to address these concerns is the GIS-based computer model used by Jackson County. This system provides access to a site-specific regional database and helps screen a countywide inventory of candidate sites for characterization. The model combines geospatial and socioeconomic data and links them with zoning ordinances, master plan requirements and public input.

Because it provides an opportunity for multiple stakeholder participation, the technology is being expanded to address land use issues other than brownfields (Renando and Thomas, 2000). Because the model operates in a GIS environment, its use allows local units of government to realize greater value from their investment in GIS hardware and software.

Conclusions and Recommendations

The process of brownfield redevelopment often demands more complex information than traditional real estate transactions. In addition to the complications brought about by issues of site identification and remediation, other issues need to be considered. The diversity of interests that might be part of a redevelopment project requires additional information to address issues involving environmental justice, social equity and quality of life. Public participation and intergovernmental cooperation are often necessary for project success, particularly with respect to quality of life and social equity.

An analysis of the needs of local government officials, private decision makers, financial institutions and the general public suggests a great need for information about land capability, development incentives, and public goals, interests and preferences. This information is as important as environmental concerns such as site contamination and environmental risk.

Because of the fear of contamination, local decision makers and the public are interested in the risks of developing a site as well as the risks of not developing it. These stakeholders are increasingly seeking redevelopment alternatives and are beginning to demand a role in the decision process. The lack of timely, understandable information to allow meaningful participation is still a problem. A comprehensive database can be very large and costly to assemble, and the necessary tools for analysis can be technically challenging. Innovative information technologies, however, can provide tools to help local communities better understand pertinent brownfield issues such as environmental and health risk assessment.

Ongoing brownfield redevelopment projects in Michigan and many other states have begun to adopt new information technologies to address some of these shortcomings. Innovative information technologies provide enhanced access to information and tools needed to effectively prioritize brownfield sites and evaluate redevelopment options. The Internet is becoming a more valuable source of data, if not information. Information management tools such as data visualization, geographic information systems, modeling and statistical analysis may be needed to create the contextual information critical to the decision process. Combining data access with analytical tools can help us ask "what-if?" and "if-then?" types of questions.

Until recently, many communities have been reluctant to incorporate tools such as GIS in the brownfield redevelopment decision-making process unless they had been successfully integrated elsewhere. Some of the innovative brownfield projects discussed in this article can provide powerful demonstrations of techniques that can be used in other communities. These technologies are becoming more acceptable to users at local levels.

The project resulted in a prototype hands-on toolset that integrates geospatial information to analyze the environmental and socioeconomic effects of public policy on land planning, use and management alternatives. This toolset uses commercially available computer applications that are proven, inexpensive and readily accessible to multiple stakeholder groups — decision makers at all levels of government, business leaders, lending institutions, real estate developers and the general public. As such, it is valuable in helping local communities integrate methods and tools to address problems of uncontrolled growth and urban sprawl.

The next steps in the project include continued development of the database for each study area and extensive work with stakeholder groups facilitated by MSU Extension representatives in the communities. These community interactions will help build trust and understanding and lead to better land use decisions in which multiple stakeholder groups can participate equally. Project participants within each of the study areas will receive training in the implementation and use of the prototype.

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Appendix A. Programs Arising from Brownfield Legislation

Michigan enacted legislation under the Natural Resources and Environmental Protection Act (Public Act 451 of 1994) aimed at reducing liability for prospective developers. The Michigan Brownfield Redevelopment Act (Public Acts 381 and 382 of 1996) establishes local brownfield redevelopment authorities and provides financial incentives to purchase, remediate and develop contaminated properties (from Bartsch et al., 2001; Szymecko and Voice, 2002).

Brownfield financing programs	Voluntary cleanup programs	Investment incentives
Site contamination/site assessment grants: $45 million in bond proceeds; $35 million for assessment and cleanup of sites where a developer has been identified; $10 million for assessment at sites with redevelopment potential; available until funding exhausted. **Cleanup and Redevelopment Fund:** capitalized annually at $30 million per year (FY97, FY98); also supports Revitalization Revolving Loan Fund program loans to local governments. **Revitalization Revolving Loan Fund:** $4 million in loans to cities for site assessment, demolition and removal actions, with an interest rate of 2.25 percent, repayable over 15 years with five-year deferral of repayment and interest to allow cities to repay loans from tax increments collected by a brownfield redevelopment authority. **Brownfield redevelopment authorities** (170+, including 19 countywide), which have tax increment refinancing and bonding authority, can set up a site remediation revolving fund from tax increments captured after remedial actions are paid. **Clean Michigan Initiative:** $675 million bond issue includes $335 million for cleanup activities; $20 million of this is designated for grants and loans to local governments and brownfield redevelopment authorities for cleanup of sites with redevelopment potential.	**Natural Resources and Environmental Protection Act** (1994, amended in 1995), authorizing completion of a baseline environmental assessment and submitting it to the DEQ prior to or within 45 days of purchase, provides an exemption to liability for existing contamination; non-liable new owners must use due care when redeveloping the property; cleanup standards are land-use based. Covenants not to sue may also be sought. Liable and non-liable parties may pursue DEQ approval of a remedial action plan and response activities. Liability is based on causation.	**10 percent single business tax credit** ($1 million cap) for eligible businesses for innocent party's development costs (not cleanup costs) on a property included in a brownfield plan of a brownfield redevelopment authority; credit carried forward for 10 years. A qualified taxpayer may claim a credit against its SBT if the taxpayer has a preapproval letter issued between Dec. 31, 1999, and Jan. 1, 2003, and project is completed within five years after the letter is issued. If total of all credits exceeds $1 million, SBT credit is based on 10 percent of eligible investment; if total is between $1 million and $30 million, a credit is available for a percentage of the eligible investment (determined by Michigan Economic Growth Authority) but not to exceed 10 percent.

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