Geographic Information Systems
A Tool for Improving Community Livability

This brochure from the Local Government Commission helps to show local government policy makers how communities around the nation are using GIS software to create more livable, vibrant, resource efficient communities. The following pages highlight six ways communities around the country are using GIS tools to enhance livability. Prepared with support from The Robert Wood Johnson Foundation Leadership for Active Living project and the Environmental Systems Research Institute, it includes more than 20 short case studies, a list of questions to consider when choosing a GIS tool, a listing of free GIS data sources and links to more online GIS resources.

What are Geographic Information Systems (GIS)?

GIS is a computer software tool that – among other tasks – can help policy makers make more informed and more effective decisions by relating data to place. First developed in the 1960s, GIS is now being used by more than 500,000 communities throughout the world.

GIS can take an overwhelming amount of information – tabular, spatial or graphic – and display it in a way that makes it meaningful to local government staff, policy makers and the public.

For example, the City of Redlands' police department uses GIS to place crime information on a city map, which allows them to identify areas where criminal activity occurs most often and to target their limited police resources on the hot spots. Contact: Sheila Harbert, Crime Analyst, Redlands Police Department, (909) 798-7654 x1.

GIS can also help communities understand and discuss complex problems. Because it allows us to display information in layers – each layer related to a particular issue – we can better comprehend how the issues interrelate.

For instance, using GIS on a regional scale, we might more clearly see the connections between issues such as transportation, jobs, housing, open space protection, air and water quality, and health. At the neighborhood level, GIS can illustrate available sites for new development, the availability of parking, access to transit, power supplies, sewer and water lines, complementary services, demographic and economic information, housing affordability,

Using a GIS tool at a Sacramento-area planning workshop. (photo: Leon Freddett/Robert Faseler, SACOG)

and other factors that might be important to a planning department or a potential new business.

In Georgia, the Atlanta Neighborhood Development Partnership (ANDP) developed a GIS program to determine the match between salary levels and housing affordability. Overlaying income and salary data and the cost of housing on a map has provided the information needed to advocate for more mixed income housing near employment centers. For more information on this initiative: www.andpi.org/mici.html, or contact M. von Nkosi, MICI Director, (404) 522-2637 x56.

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Making neighborhoods more friendly to bicyclists and pedestrians

The City of Chico's general plan was prepared using GIS to identify the location of existing and future neighborhood centers so that a business serving daily needs (such as grocery stores) will be within walking distance of every resident. For more information: Brad Pierce, (530) 895-4749, bpierce@ci.chico.ca.us

Portland Metro used GIS to develop a color-coded map that the public can use to find a bicycle route to a chosen destination. You just go online, enter a street address, and receive a map of the best bicycle routes. For more on the "Bike There!" map: Richard Bolen, (503) 797-1582, bolen@metro.dst.or.us.

The Southern California Association of Governments (SCAG) and the City of Oakland, CA are using a GIS application called Ped-GriD (Pedestrian Geographic Resources Information Database) to identify urban locations that have the potential to increase pedestrian use.

In 1998, SCAG planners used Ped-GriD to develop a Non-Motorized Transportation Plan that established a regional framework of locations with the best potential for pedestrian activities. Planners analyzed the locations of pedestrian-oriented facilities (schools, libraries, post offices, senior citizen centers and more), bicycle and multi-modal transportation nodes, as well as vehicular, bicycle, and pedestrian routes. With this information, transportation and land use planners were able to determine where to allocate funds for pedestrian-oriented infrastructure improvements, where to bolster transit services, and where to nurture compact, mixed-use development. For more about SCAG's use of Ped-GriD: Joe Carreras, Department of Planning and Policy, (213) 236-1856 or carreras@scag.ca.gov.

In Oakland, Ped-GRid was used to create "collision maps" to determine where the biggest disparities between pedestrian demand (pedestrian density) and supply (pedestrian facilities) exist. These maps also represent pedestrian/vehicle collisions at different city intersections and streets, using various factors (including time of collision, location, at-risk groups, and driver speeds). The City also solicited community input to identify areas avoided by pedestrians (that do not show up on collision maps). Both of these tools helped planners develop Oakland's Pedestrian Master Plan, adopted in November 2002. Contact: Zach Wald, Oakland Pedestrian Planner, (510) 238-7013 or zwald@oaklandnet.com.

Included in the City of Oakland's Pedestrian Master Plan, this map uses balloons to illustrate actual pedestrian risk as a function of annual accidents per peak hour. The size of the balloon reflects the number of accidents. (photo: Noah Raford, Urbitran Associates)

Old factory facilities were identified as appropriate for redevelopment in the San Francisco Bay Area city of Emeryville, CA.

Facilitating infill development

To foster redevelopment and remediation of its smaller, less contaminated brownfield sites, the City of Emeryville assembled a database to map the geographic distribution of groundwater contamination by parcel. After analyzing the map, city officials discovered that deep groundwater aquifers were untainted and that many areas in the city had only minimal soil contamination and were prime sites for redevelopment. The city packaged their map analysis into two online GIS interfaces that serve as visual references for developers pursuing redevelopment. Contact: Ignacio Dayrit, Project Manager, City of Emeryville, (510) 596-4356, idayrit@ci.emeryville.ca.us

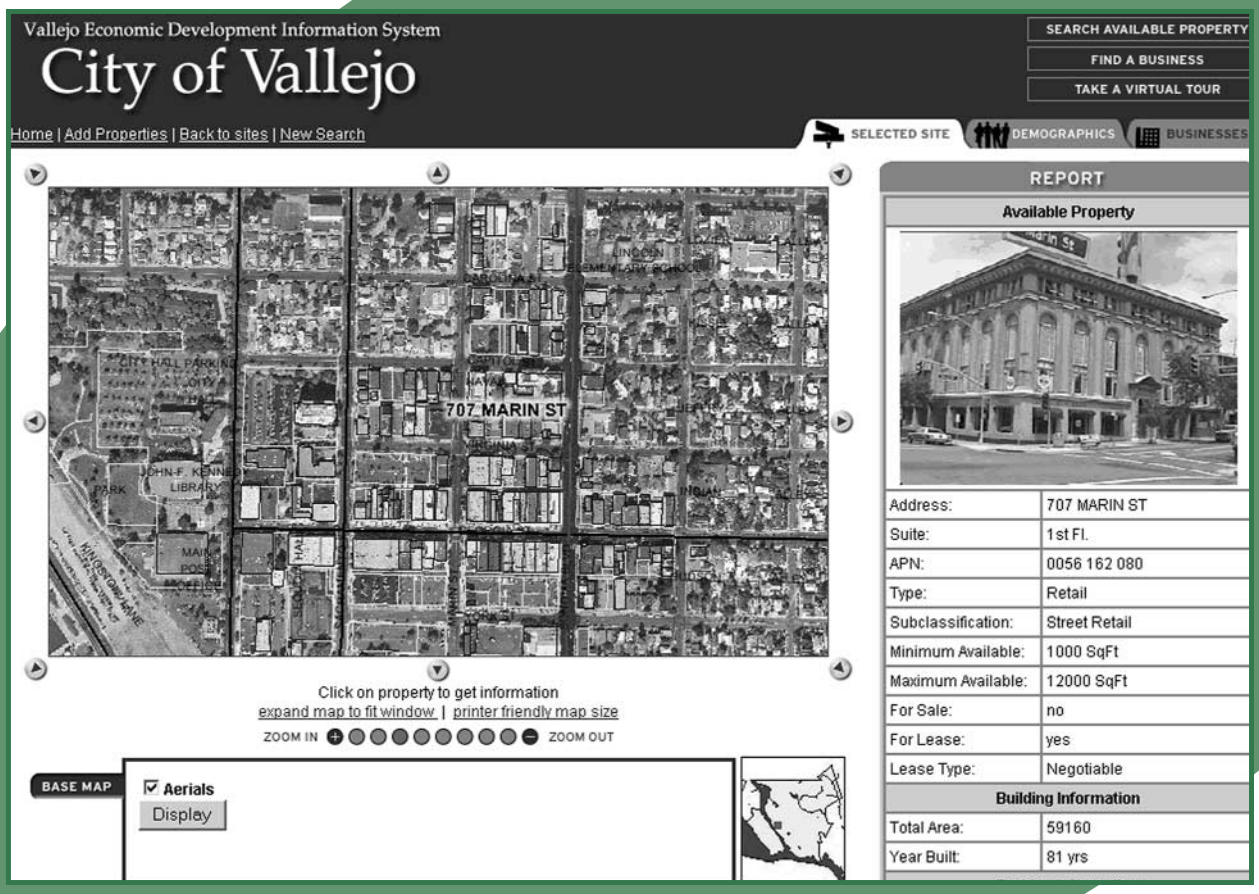
Between 1996 and 1997, 29% of all residential development inside the Portland, OR metropolitan urban growth boundary (UGB) occurred on parcels identified as having a high potential for infill or redevelopment. The designation that directed growth to these already urbanized areas was a product of a GIS-based analysis of vacant land and underutilized properties.

In 1997, Portland's regional planning agency, Metro, directed nearly one-third of new development to vacant lots in the urbanized area, and discovered a further capacity for 24,500 single-family and townhouse units on land classified as "developed" – based on the assessed value – that was actually not developed to its full potential. Contact: Portland Metro's Land-use Planning Department, (503) 797-1839, 2040@metro-region.org.

Improving transit access

Officials in Boulder, CO, are mapping a comprehensive survey of trips and comparing it to transit routes. Every three years, more than 1,000 households are represented in the survey, and respondents are asked to log all trips over the course of a day. The data helps planners determine the best routes, frequency of service and type of service needed to make transit available to all community members. Contact: Randall Rutsch, (303) 441-3266 or rutschr@ci.boulder.co.us.

TriMet, Portland, Oregon's regional transit agency, used GIS to map all of the sidewalks, pathways and stairways that pedestrians must use to access transit. TriMet created a map layer identifying pedestrian access points. Planners used this map layer to decide where to increase pedestrian accessibility and where to locate new bus shelters. Contact: Bibianna Kamler, (503) 962-7536 or kamlerb@trimet.org.



The Vallejo Economic Development Information System (VENDIS) displays properties on a map and also tabulates property attributes.

Developing or improving downtowns and neighborhood centers

American Forests developed an ArcView extension called "CITYgreen" to assess the economic and environmental benefits of planting trees in urban areas. The City of Cincinnati parks department used this GIS software to analyze urban tree canopy and vegetation coverage, storm water runoff reduction potential, and air pollution mitigation. It helped to identify neighborhoods in greatest need of trees, and allowed for trees to be accounted for in GIS alongside other forms of infrastructure. Contact: Cincinnati Department of Natural Resources and Land Management/Urban Forestry, (513) 861-9070 or American Forests, (202) 955-4500.

In northern California, the City of Vallejo is using an online GIS application to spur economic revitalization, and provide enhanced city planning and economic development services. The Vallejo Economic Development Information System (VENDIS) helps users identify available property for sale or lease, and performs detailed searches based on property size, pricing, description, site-specific demographics, photographs and proximity to nearby businesses. This ability to conduct detailed searches online has freed up city staff to work on more complicated economic development tasks. Contact: Bonnie Lipscomb, Vallejo Community Development Analyst, (707) 648-5278 or blipscomb@ci.vallejo.ca.us.

Public participation in community planning meetings using GIS tools can help create revitalized neighborhoods, like this affordable housing development in Santa Monica, CA.

Revitalizing existing neighborhoods

In Seattle, WA city officials created a simplified GIS interface to help residents prepare comprehensive plans for their neighborhoods. With a process known as data publishing, Washington's Neighborhood Planning Office developed the DataViewer CD and distributed it to neighborhood groups and consultants from each of Seattle's 37 neighborhoods. The CD contains data and maps from 10 city departments, and consists of more than 100 different information layers. Neighborhood groups can use it to generate maps that better communicate how they would like their communities to develop. Contact: Jennifer Pettyjohn, Seattle Washington Office of Planning and Management: (206) 386-9041

In southern California, the City of San Diego is using GIS to map and analyze housing, zoning and building code violations. Using GIS in conjunction with hand-held Global Positioning System (GPS) units, staff can quickly identify property owners and measure the distance between incompatible land uses. Contact: Frank Hafner, City of San Diego, (619) 236-5504 or fhafner@sandiego.gov.

In Santa Monica, CA, the City's housing and redevelopment division is using GIS to monitor housing affordability and to illustrate the dispersment of HUD Section 8 housing units throughout the city. Use of these maps has convinced HUD to fund more affordable housing developments in Santa Monica. Contact: City of Santa Monica Housing and Redevelopment Division, (310) 458-8702, SMHousing@ci.santa-monica.ca.us.

For the city of Scottsdale, AZ consultants customized ArcView, a GIS mapping program, to analyze the city's existing and future needs for community facilities (such as libraries, social services, and parks and recreation facilities). They mapped the city's community facilities inventory data and demographic data on population projections, unemployment, poverty, disability and language
difficulties to identify the areas in greatest need of additional facilities. Contact: Don Penfield, City of Scottsdale, (480) 312-7921 or Charlie Deans, Planners Ink, (520) 882-8177.

Comparing and assessing the impacts of alternative growth management policies

The way a community grows determines its future livability. Growth patterns influence a number of important factors including:

- Air quality
- Water quality
- Traffic congestion
- Availability of open space
- Transportation demand
- Housing demand
- Energy consumption
- Infrastructure costs
- Population health
- Economic health
- Visual attractiveness
- The sense of community
- Economic equity

Prior to the invention of GIS, there was no easy way to understand how a single growth decision might impact these multiple, complex, and interrelated factors. Today, fortunately, there are GIS-based tools available to help planners, public officials and other stakeholders understand growth impacts and the complex tradeoffs associated with different land use patterns. These tools make it possible for policy makers to make far more informed decisions than ever before.

What is even more astounding, these GIS-based tools provide immediate feedback. Citizens and policy makers can ask a question like, "What will this project do to traffic congestion in our area?" and immediately receive an answer.

A few of these new tools can help policy makers see how a new development might look after it is built. Some can even take decision makers and citizens on a simulated walking tour of a proposed new development.

The basic analytical methods of GIS tools include:

- Establishing a benchmark measurement of existing conditions to allow decision makers to see where the problems lie. They can then determine whether a new project will help correct these problems or just make them worse.
- Forecasting what will happen if a community or region continues to grow in the same way, then measuring the impact – either positive or negative – of alternative land-use scenarios.
- Comparing several alternative land-use scenarios in order to help select a preferred alternative for adoption and implementation.
- Evaluating policy decisions after they are implemented to insure that they are meeting the original objectives.

GIS-based land-use planning tools can be used to more thoughtfully design everything from specific plans to zoning codes to regional master plans. They are extremely useful for engaging the public in land use decisions and visioning projects.

The versatility of GIS tools

These tools can be used to develop a wide range of planning documents and processes:

- Comprehensive Plans
- Master Plans
- Specific Plans
- Conceptual Plans
- Individual Site Plans
- Public Participation and Visioning
- Zoning Codes
- Transportation Master Plans

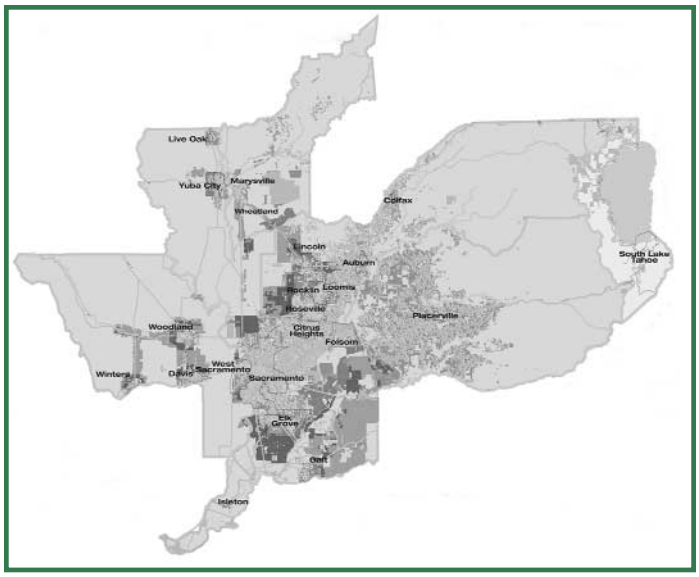
Examples of GIS tools

The following is intended to introduce some of the powerful new GIS-based tools that are changing the way land-use planning decisions are being made. It is neither an exhaustive list nor an endorsement of specific tools.

What If?™ University of Akron researchers used What If?™ to determine the impact of alternative farm preservation policies for Medina County, Ohio, a rapidly urbanizing area near Cleveland. The analysis indicated that if the growth trends experienced over the last decade continue for 45 years, the county's population will grow by more than 150% and the county will lose one-quarter of its agricultural land. It also revealed that a policy of staged infrastructure development could help preserve the county's most valuable farmlands and maintain its rural character. For more information on What If?™: Richard E. Klosterman, Ph.D., (330) 650-9087 or klosterman@what-if-pss.com.

INDEX™ In Atlanta, Georgia **INDEX™** was used to help prepare a brownfield redevelopment plan for a former 500-acre manufacturing site called Atlantic Steel. After failing to meet U.S. EPA air quality attainment levels, federal transportation funding was withheld until steps were taken to improve Atlanta's air quality. INDEX™ was used to measure the environmental benefits of locating growth in a transit-oriented, mixed-use setting rather than a conventional, auto-dependent suburban setting. The tool was also used to help optimize the urban design and to improve the pedestrian environment of the Atlantic Steel site itself. With support from INDEX™ analyses, the redevelopment plan was adopted, federal funding
for transportation-related improvements was obtained, and construction began in 2002. Contact: www.crit.com or Eliot Allen, Criterion Planners/Engineers, (503) 224-8606, eliot@crit.com.

CommunityViz™ A Comprehensive Plan Advisory Committee in Falmouth, Maine, held a community forum and conducted a survey that identified 17 objectives for the town's comprehensive plan. The committee then developed five alternative land-use scenarios, and created quantitative indicators to measure how effectively the different land-use patterns achieved the plan's objectives. These scenarios were programmed into CommunityViz™ and the



The Sacramento Area Council of Governments' "Base Case" map illustrates existing and projected urban growth in the Sacramento region. (photo: SACOG)

committee explored different options for zoning changes in the study area. Based on this study, a new residential master plan was proposed which called for the re-zoning of certain areas. Contact: George Thebarge, Falmouth Planning Director, (207) 781-5253. For CommunityViz™: www.communityviz.com or (866) 953-1400.

PLACE^{3}S In 2003, the Sacramento Area Council of Governments (SACOG) conducted a series of interactive community planning workshops to help the region coordinate transportation and land-use decisions. In the first six months of the study, SACOG staff used PLACE^{3}S and a growth allocation model called MEPLAN, to create a "Base Case" map. This map illustrated what would happen in the region if communities continued with their current growth patterns. PLACE^{3}S software was used in cities and counties throughout the region to demonstrate the effect that alternative land-use patterns could have on future housing affordability, traffic congestion, jobs/housing balance, economic development, open space and more. It is expected that with this information, local policy makers will be able to understand the long-term local and regional effects of current patterns of sprawl and will change their land use plans to better accommodate biking, walking, and transit. For more information on SACOG's workshops: www.sacregionblueprint.org/sacregionblueprint. For PLACE^{3}S: www.places.energy.ca.gov/new or Nancy Hanson, Program Manager, California Energy Commission, (916) 654-3948.

Things to consider

There are many factors to consider when choosing a GIS assisted land-use planning tool. The following section briefly outlines basic questions to consider when choosing a GIS tool.

How much will it cost? The initial cost of these products can range from nothing to tens of thousands of dollars for customized applications. By far the largest cost associated with GIS analysis is data acquisition and management. Sophisticated modeling tools require substantial amounts of data when used at their full potential, and the cost of gathering this data depends largely on the amount of land being studied, and the number of information layers that are needed for a given analysis. Managing and updating existing data also requires training and regular staff time. Local governments should expect to pay competitive wages to trained GIS staff to discourage flight to higher wages in the private sector.

Is technical support available? Technical support is another important factor to consider when choosing a GIS tool because GIS planning tools can be difficult to use without adequate training and continuing support. Some companies provide assistance over the phone, through email, or through on-line tutorials and user forums.

Can this tool produce 3-D renderings? Some tools offer the ability to generate 3-dimensional visualizations of a given land-use scenario. Three-dimensional renderings can complement aerial photographs, statistics, and figures to help decision makers preview the results of proposed zoning and land use regulations. Some tools offer built-in 3-D simulation capabilities while others can be used in conjunction with other software packages such as ArcGIS and ArcView to produce 3-D images.

What geographic scales can this tool work at? Some tools have the ability to evaluate land use from a parcel scale all the way up to a regional scale. This capability can help policy makers understand the impacts of a project both from a local and a regional perspective.

How can this tool help encourage public participation? Many of these tools are designed to make it easier for non-planners to immediately understand and compare the effects of alternative land use plans. Some programs allow users to fill in land uses directly on a computer screen using either drag and drop or an electronic pencil. These changes are typically run through a computer software model providing instant analysis and accurate feedback; an ideal combination for short public involvement timeframes.

How important is regional cooperation and GIS data sharing? Maintaining a centralized regional GIS data base can help integrate city, county and regional land use planning and can help distribute data collection and management costs. Regional councils of governments, air quality management districts, universities, community organizations and municipal planning agencies can all contribute and benefit from GIS data sharing collaboratives.

Free GIS data sources

- TIGER, U.S. Census Bureau: landview.census.gov/geo/www/tiger
- Local, regional and state planning and redevelopment agencies
- State departments of transportation
- ESRI GIS and mapping software: www.esri.com/data
- State and federal employment development departments
- Federal Bureau of Transportation statistics: www.bts.gov/gis/maps
- U.S. Geological Survey: info.er.usgs.gov/research/gis/title.html
- Volunteers, students, civic clubs and pedestrian/bike advocates can help collect data at no cost. This economical alternative also creates a constituency that is actively involved in the planning process.

More GIS resources

- Environmental Systems Research Institute, Inc.: www.esri.com
- Urban and Regional Information Systems Assn.: www.urisa.org
- Place Matters: www.placematterstools.com
- Geography Network: www.geographynetwork.com
- GIS Portal: www.gisportal.com
- Local Initiatives Support Corporation (LISC) – Mapping for Community Changes: Using Geographic Information Systems for Community Development, www.liscnet.org/resources
- Place Making: Tools for Community Action, www.placematters.com/Placemaking/Placemaking_v1.pdf
- U.S. EPA"Projecting Land-Use Change: A Summary of Models for Assessing the Effects of Community Growth and Change on Land-Use Patterns:" www.epa.gov/ecocommunity/tools.htm

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