<u>**Workshop**</u>

GPS and GIS Applications in Support of Urban Codes Enforcement and Neighborhood Audits

U.S. EPA Community Involvement Conference
Jacksonville, Florida

Friday, June 22, 2007 - 8:00am-12:00 pm

Instructor: David A. Padgett, Director
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Length: Approximately four hours

Audience: Introductory (Maximum = 20)

Materials: GPS Units, laptop computers, digital camera, literature, workbooks, etc will be provided.

In many metropolitan areas, the rate at which rural land is being converted to commercial and residential uses has outpaced rates of population growth. Meanwhile, inner-city communities in those same cities suffer from neglect and decay. Many inner-city residents have begun to notice the early signs of urban decay and are taking pro-active steps to stem the tide. This workshop is designed to assist inner-city community organizations, and/or GIS/GPS users working with such organizations, to document and map problem sites. Participants will be led through a process using GIS and GPS to streamline the codes enforcement reporting process to better serve citizens. The first task will be to convert hardcopy handwritten community audit reports collected by volunteers into digital GPS data dictionary format. The next task will be to upload the data dictionary onto a hand-held GPS units. The utility of the data dictionary will be tested in the field during a brief outdoor exercise. Point locations of potential city code violations and nuisances such as dilapidated buildings, abandoned cars, and illegal dumpsites will be collected along with pertinent attribute data. Workshop participants will be instructed in producing GIS maps displaying the problem sites. They will also be instructed in how to produce "hot link" maps using photographs taken in the field. A group discussion will focus upon how the GIS maps and their supporting attribute databases can enhance residents' efforts to locate and monitor the status of problem sites, especially sites not having easily identifiable street addresses. Several examples of community-based efforts employing GIS and GPS technology to monitor potential codes violations will be presented. Lower-cost alternative methods to develop effective problem site maps will be offered. By graphically displaying areas of urban decay, citizens will be able to be proactive in encouraging municipal authorities to take corrective action, and thus maintaining acceptable quality of life in their neighborhoods.

Friday, June 22, 2007
8:00 am – Noon

WORKSHOP AGENDA

8:00-8:15 am -	**Introductions**
8:20-9:30 am -	**Introduction to Global Positioning Systems and Basic Principles of Community-Based Mapping**
9:31- 9:40 am	**Break**
9:45- 10:15 am	**Divide into groups. Each group will prepare its GPS units for a mock neighborhood audit. Each group will have a low-cost GPS unit.**
10:20-11:00 am	**Mock neighborhood audit. Groups will walk outside to collect positions, record attribute information, and take photographs of sites of potential problems and/or assets**
11:05-11:30 am -	**Each group will transfer its data from the GPS units and photographs from digital cameras onto a laptop PC.**
11:35-11:55 am -	**The instructor will demonstrate how to import the data and photographs into a Geographic Information System.**
11:56 am-Noon -	**Wrap-up and Adjournment**

GLOBAL POSITIONING SYSTEMS AND GEOGRAPHIC INFORMATION SYSTEMS IN SUPPORT OF URBAN CODES ENFORCEMENT AND NEIGHBORHOOD AUDITS

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Director

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Abstract: In many metropolitan areas, the rate at which rural land is being converted to commercial and residential uses has outpaced rates of population growth. Meanwhile, inner-city communities in those same cities suffer from neglect and decay. Nashville, Tennessee has in recent years been recognized as one of the fastest growing cities in the U.S., both in terms of sprawl and population increase. Many inner-city residents have begun to notice the early signs of urban decay and are taking pro-active steps to stem the tide. This paper chronicles a cooperative effort among the Mayor's Office of Neighborhoods, the Neighborhoods Resource Center (NRC), and the Tennessee State University (TSU) Geographic Information Sciences (GISc) Laboratory to assist inner-city community organizations to document and map problem sites. The primary objective of the project is to streamline the codes enforcement and reporting process to better serve citizens. "Neighborhood Livability Audits" conducted by inner-city residents under the direction of the NRC produced hardcopy handwritten reports with the street addresses of potential city code violations such as dilapidated buildings, abandoned cars, illegal dumping, etc. Staff at the GISc converted the audit reporting documents into a digital "data dictionary" which was uploaded onto a hand-held global positioning systems (GPS) unit. A pilot study was then conducted during an audit in the Salemtown community using GPS to log problem sites. Initial results indicate that GPS is a viable tool for expediting the audit data collection process. The output was used to produce electronic spreadsheets that were converted into geographic information systems (GIS) maps. The resulting maps

with supporting attribute databases and digital photographs have the potential to allow residents to locate and monitor the status of problem sites, including those without identifiable street addresses. Informed citizens will be better able to encourage the Metropolitan Health Department and other responsible city agencies to take corrective action.

INTRODUCTION

The project described herein demonstrates a community-based application of global positioning systems (GPS) and geographic information systems (GIS) in a neighborhood audit project in Nashville, Tennessee. Inner-city neighborhoods in Nashville have recently begun to see the early effects of blight associated to some degree with urban sprawl (Sprayberry, 2001). There has been an increasing presence of abandoned properties, discarded automobiles, and overgrown vacant lots over the past three decades. Most of the problems are in violation of city codes, but to date, little attention has been paid to them by local government officials. In a pro-active remediation effort, several community organizations are now conducting "community livability audits" in order to document persistent codes violations and then bring them to the attention of responsible city officials.

Codes Enforcement Defined

According to the City of Bosie, Idaho, "Code Enforcement works with citizens to resolve issues which impact the quality of life in everywhere, including complaints, concerning violations of zoning, sanitation and nuisance ordinances. In dealing with these violations, it is code enforcement's goal to help neighbors resolve problems" (2002). The city of San Jose, California, believes "Code enforcement is used to work in partnership with the people to promote and maintain a safe and desirable living and working environment" (2002).

Geographic Information Systems in Codes Enforcement

A recent experiment by Hansen Information Technologies showed how GIS, GPS, and code enforcement can be used together, by providing "an integrated way to manage government activates related to land management" (Donoghue, 2001). Using ArcView GIS applications, as well as other methods such as MapObjects, the Hansen study demonstrated a new approach to tracking existing productivity so that codes enforcement resources could be effectively allocated and deployed.

Neighborhood Audit Practice in Nashville, Tennessee

The Mayor’s Office of Neighborhoods (MOON) and the Neighborhoods Resource Center (NRC) have recently become involved in grassroots efforts to assist inner-city residents in the codes enforcement process. The Mayor’s Office of Neighborhoods helps to improve the quality of life in Nashville's neighborhoods through a more informed, active and involved citizenry and enhanced governmental response to community needs. The NRC uses a wide variety of information available to assist neighborhood organizations with efforts to improve their communities. Typical problems communities face are: improperly discarded solid waste, sewage leaks, overgrown vacant lots, and unsanitary pet residences. Urban infrastructure problems include: cracked or missing sidewalks, potholes, and missing street signs. Visibility at intersections, bus stop accessibility, and speeding cars are also important issues. As population, businesses, and new residential development have increasingly moved to outlying regions, codes violations have become more common in North Nashville, one of the city's oldest Black communities.

Brief History of the Study Area: North Nashville (Subarea 8)
There have been plans for the future of the community traditionally known as North Nashville. For Nashville Metropolitan Government planning purposes, it is also referred to as Subarea 8 (Figure 1). The area is located just a short distance to the north and northwest of downtown Nashville and is one of the city's oldest communities. It is the second smallest of the city's sub areas, covering approximately 4,880 acres or 7.62 square miles, which represents approximately 1.45 percent of Metropolitan Nashville/Davidson County's total area.

Few African-Americans lived in the first developments of North Nashville before 1870. The newly developed area offered housing stock priced out of the price range of most recently freed African-American families. After 1870, many African-American residents settled the area opened up by McGavock along what is now Jefferson Street. As the large number of freedmen settled in the city, education leaders assisted by the Farmers Bureau of Tennessee, founded Fisk University. In 1880 the area around Fisk was home to African-American residents of all social classes. At the request of Fisk University and African-American leaders in North Nashville in the early 1900s, the city constructed the Hadley Park, the first park for African-Americans in Tennessee, in 1912. During the 1920s, the Fisk area maintained its status as a prominent neighborhood for African American residents. That status would remain though the 1950s. The strong neighborhoods of the first half of the 1900s gave way to significant change in the 1960s and years following with construction of Interstate Highway 40 and desegregation. The North Nashville has community struggled to cope with the challenges introduced by changes throughout the last 30 years.

North Nashville (Subarea 8) Demographic Transition
North Nashville experienced population growth until about 1960, reaching a population of 43,705, but thereafter it decreased to 23,765 by 2000. Population and the related housing statistics for 1960-2000 are shown in the following chart (Figure 2). The precipitous drop in household size (from 3.60 to 2.38) was the main reason for the population decrease from 1960 to 1990, although a steady loss of housing units and an increase in the vacancy rate were additional contributing factors during that period. In addition to the overall past decrease in population; there have been other notable demographic changes in the community's population.

The racial composition of the community was 77 percent nonwhite and 23 percent white in 1960. During the 1960s, while the nonwhite population increased about eight percent, the white population decreased by 75 percent, resulting in a 93 percent nonwhite and 7 percent white racial mix by 1970. From 1970 to 1990, racial composition changed little, to 95 percent nonwhite and five percent white. In 2000, it was approximately 95 percent nonwhite and less than five percent white. Countywide, the population was 80 percent white and 20 percent nonwhite in 1970; 75 percent white and 25 percent nonwhite in 1990, and 67 percent white and 33 percent nonwhite in 2000.

PILOT STUDY: THE SALEMTOWN COMMUNITY AUDIT

Salemtown is a community located within North Nashville and is representative of North Nashville's demographic and socioeconomic characteristics. Residents, after making note of a growing presence of codes violations and properties falling into disrepair (Figure 3), consulted the NRC and MOON to assist them in conducting a community livability audit. In order to field test the capabilities of GPS-supported community audits, Tennessee State University (TSU) Geographic Information Sciences (GISc) Laboratory staff converted the North Nashville Neighborhood Audit Form (Figure 4) into a digital data dictionary using Trimble Pathfinder Office software (Figure 5). Each potential codes violation was to be input as a feature called "Problem" with specific descriptions associated with the violations to be entered as attributes (i.e. commercial dumping, waste, dead animals, etc.).

On the day of the Salemtown audit, GISc Lab staff accompanied Nashville Metropolitan Health Department personnel and community volunteers as they canvassed the area recording codes violations on NRC-produced audit forms (Figure 6). The latitude/longitude location of each violation was collected using a Trimble GeoExplorer GPS unit. Various attribute data and characteristics noted on the audit forms were then keyed into the data dictionary. Following the audit, the field data were uploaded and then converted into text file (*.txt) format, which was then converted into shapefile (*.shp) format. A map of the potential codes violations within the pilot area was produced using ArcView GIS software (Figure 7).

RESULTS AND LESSONS LEARNED

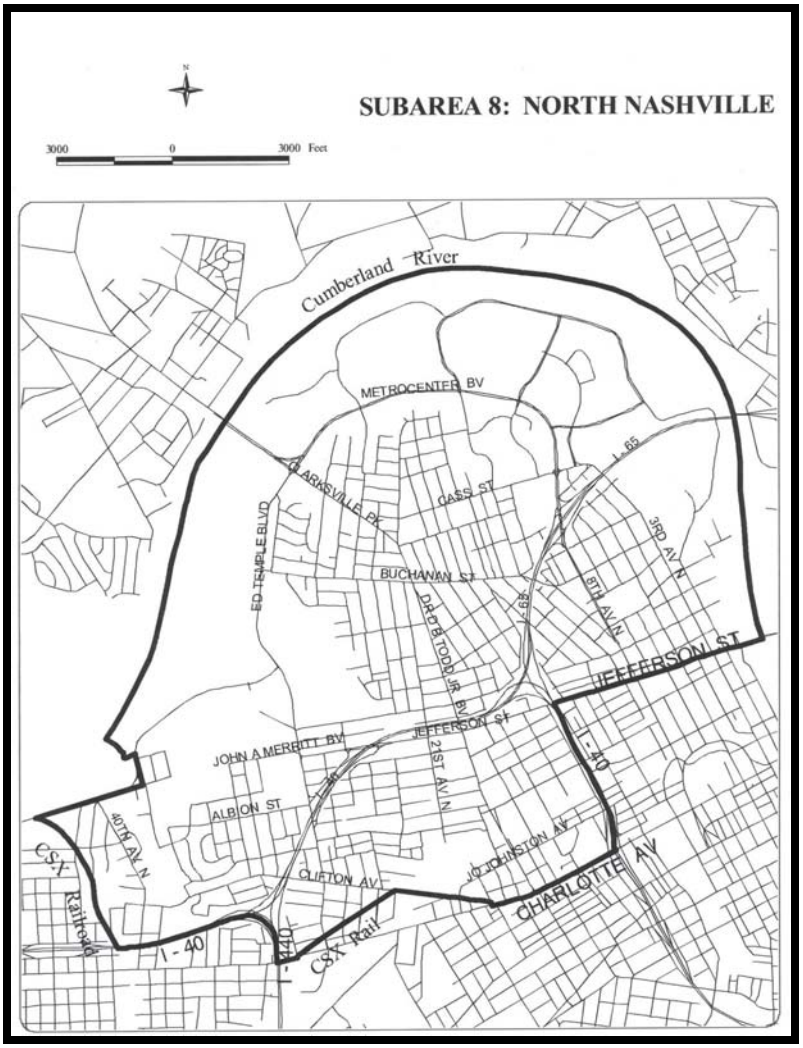
Applying GPS in community audits proved to be a very effective means of recording potential codes violations. With maps clearly showing the locations and status of problem sites, tracking and monitoring remediation efforts can be graphically displayed. The application of GPS is especially effective in locating sites that do not have street addresses. In addition to pop-up tables with attribute data, "hot-links" can be created allowing users to see pop-up photographs of selected sites.

After noting the success of the pilot project in demonstrating the applicability of GPS and GIS in community livability audits, the NRC hired a "Neighborhood Information Intern" to develop such capabilities for future audits.

The early stages of development of the GPS data dictionary proved to be somewhat challenging. It was soon discovered that keeping the dictionary as simple as possible was most effective. Simplification also reduced the numbers of key strokes necessary to input problem site information.

In order to enable community volunteers to become more directly involved in data collection, the NRC and other organizations have opted to use much more affordable GPS devices. The Trimble units used in the pilot study are likely too pricey (approximately $5000 each) for grassroots organizations. Cheaper units are less likely to be capable of data dictionary storage, meaning that audits conducted using them will require additional time for hand-written field notes to be typed into electronic spreadsheets. However, the final audit maps can be just as effective as those produced using more expensive equipment.

FIGURE 1
MAP OF NORTH NASHVILLE AREA



(Nashville/Davidson County Metropolitan Government, 2002)

FIGURE 2
DEMOGRAPHIC TRANSITION IN NORTH NASHVILLE
1960-2000

STATISTIC	1960	1970	1980	1990	2000
Total Population	43,705	38,867	30,176	24,052	23,765
Household Population	40,806	35,544	26,993	21,073	19,731
"Group Quarters" Population	2,899	3,323	3,183	2,975	4,034
Total Housing Units	11,761	11,730	10,941	10,107	9,457
Occupied Housing Units	11,332	11,156	10,105	8,868	8,268
Owner-Occupied Units	4,436	3,732	3,546	2,687	2,511
Renter-Occupied Units	6,896	7,424	6,559	6,181	5,757
Vacancy Rate	3.6%	4.8%	7.6%	12.2%	12.6%
Household Size	3.60	3.19	2.67	2.38	2.39

(Nashville/Davidson County Metropolitan Government, 2002)

FIGURE 3
ABANDONED CONSTRUCTION WASTE IN SALEMTOWN

FIGURE 4
BLANK NEIGHBORHOOD AUDIT FORM

NORTH NASHVILLE NEIGHBORHOOD AUDIT FORM **August 18, 2001**

DATE ________ WHAT NEIGHBORHOOD COVERED? ________________

PERSON FILLING OUT FORM ________________ PHONE ________ YOUR NEIGHBORHOOD GROUP ________________

ADDRESS	PROBLEM (Can circle more than one problem at same address)				Check if elderly owner, etc. (explain)	DESCRIPTION / LOCATION
	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		
	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		
	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		
	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		
	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		
	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		
	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		
	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		

(Source: Neighborhoods Resource Center)

FIGURE 5
GPS DATA DICTIONARY FOR THE SALEMTOWN PILOT PROJECT

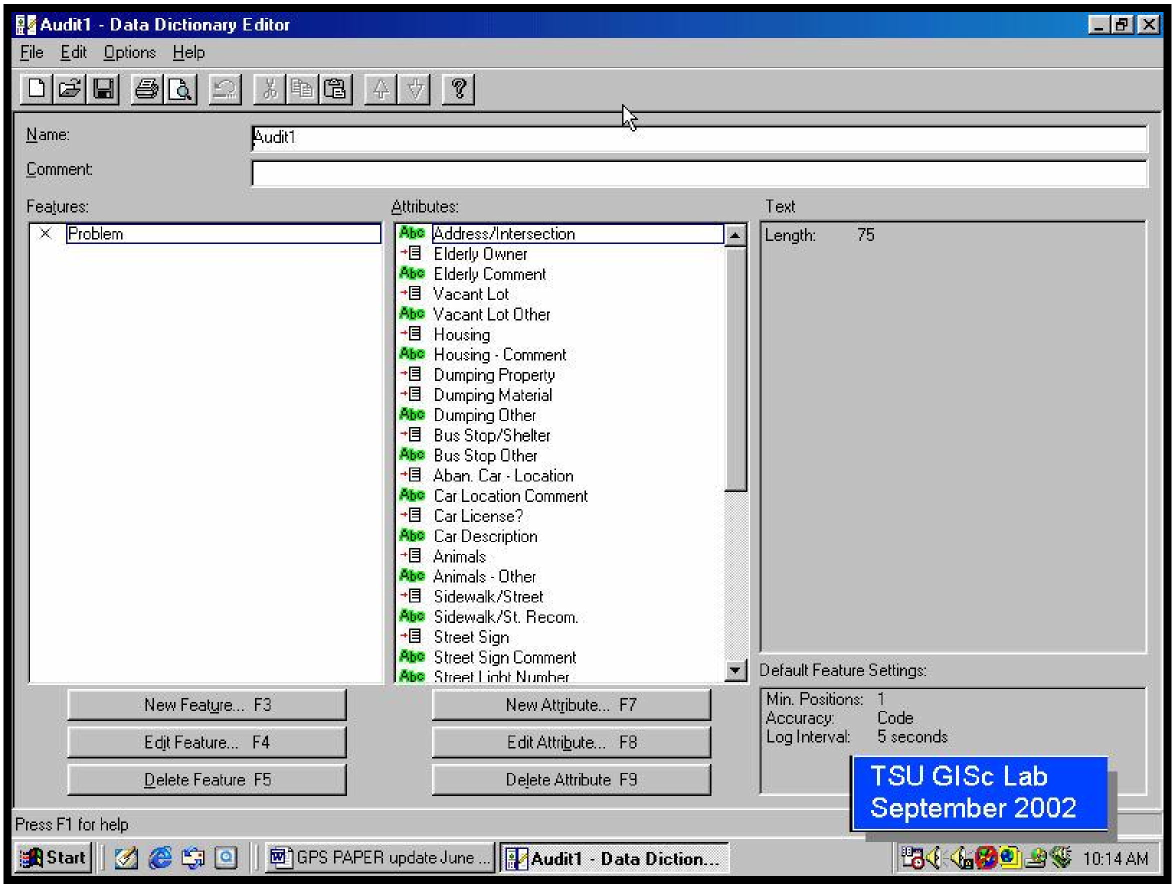


FIGURE 6
COMPLETED AUDIT FORM FOR THE SALEMTOWN PILOT PROJECT

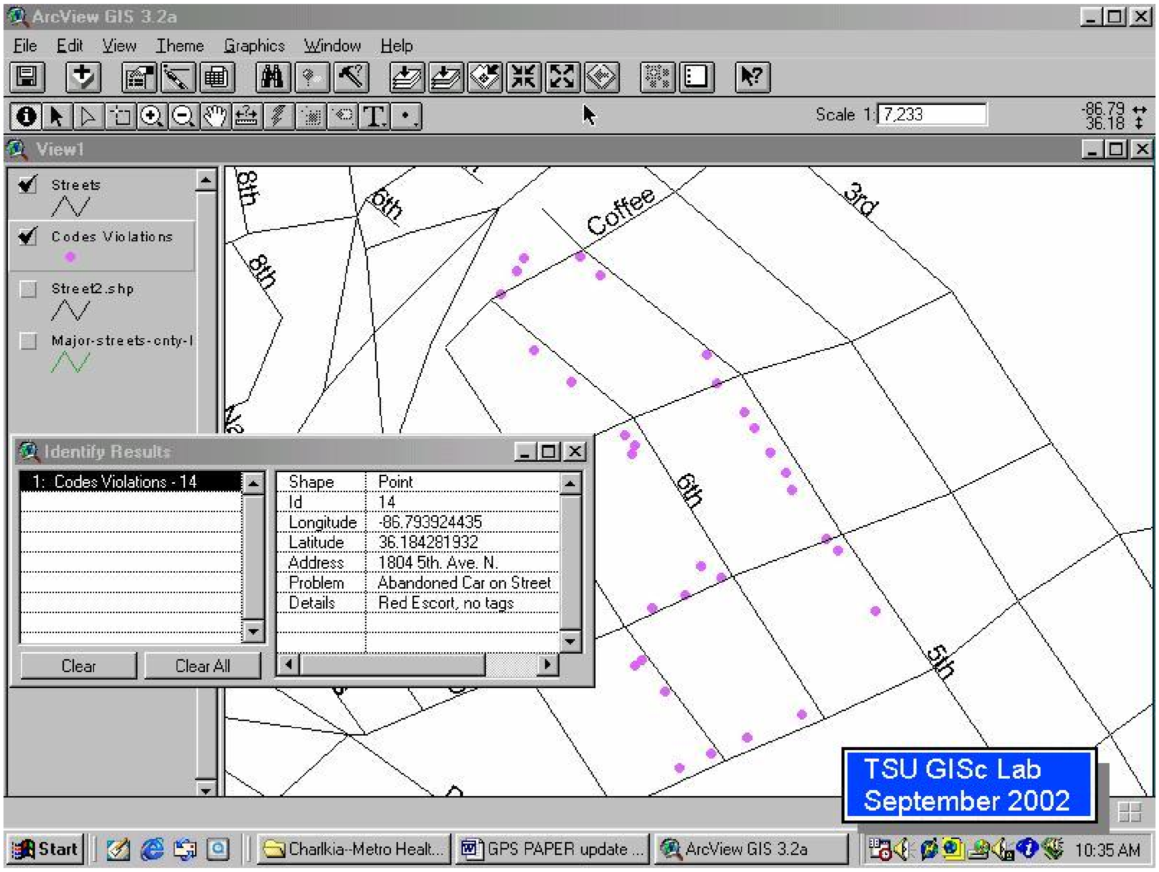
NORTH NASHVILLE NEIGHBORHOOD AUDIT FORM **August 18, 2001**

DATE 8/18/01 WHAT NEIGHBORHOOD COVERED? SALEMTOWN

PERSON FILLING OUT FORM D. PADGETT PHONE 963-5508 YOUR NEIGHBORHOOD GROUP TSU GIS LAB

	ADDRESS	PROBLEM (Can circle more than one problem at same address) 36.1782137 N/86.7945394 W				Check if elderly owner, etc. (explain)	DESCRIPTION / LOCATION
0	8th N ~~[illegible]~~ + Cheatham	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		EAST SIDEWALK WEEDS + TRASH
1	8th Ave N and Hume	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		WORTHINGTON BAG DUMPSTER
2	612 HUME	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		WEEDS
3	608 HUME	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		CADILLAC WHITE NO TAGS ON HOUSE SIDE
4	600 HUME	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		WEEDS
5	1614 5th	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		WEEDS
6	1625 5th	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		TRASH
7	1631 5th	Ovrgrn Vacant Lot Hsng- Unfit / Dilap Trash / Dumping Bus Stops / Shelters	Old/Unlicensed Car in Yard Abandoned Car on Street Animal Cruelty / Dog Pen Odor Rats / Unsanitary Conditions	Broken Streets / Potholes Sidewalk broken / needed Crosswalks / Street Markings Street Signs (missing, etc)	Streetlight out / needed Traffic Problems Illegal Signs / Business Alleys / Right-of-Way		TRASH ON HOUSE SIDE

FIGURE 7
SALEMTOWN AUDIT MAP OF POTENTIAL CODES VIOLATIONS



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ArcUser
April-June 2001

Improving Code Enforcement Services with GIS

By John Donoghue II, City of Riverside

Like all cities, the City of Riverside, California, is concerned with the quality of life in its neighborhoods. The City recognizes that nuisances, such as inoperable vehicles or the accumulation of trash and debris, can degrade and devalue any neighborhood. To protect its neighborhoods, the City adopted municipal codes that govern the use and maintenance of private property. The City's Code Compliance division is responsible for enforcing the City municipal codes.

The division wanted to improve efficiency and the level of service to City departments and constituents. However, the existing code violation database system provided no means for the division to adequately track the existing workload. Any decisions about field resource allocations were made by supervisors based on gut feeling, rather than on an analysis of current and past violation patterns.

Tracking the Workload

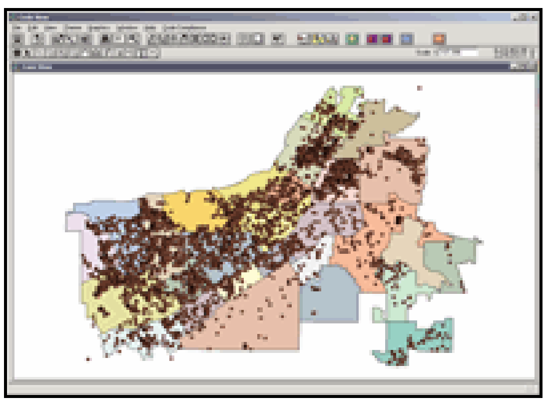
As part of its efforts to improve service, the division implemented the Code Enforcement module of Hansen Information Technologies' citizen relationship management software. The Hansen software provided the division with an integrated way to manage government activities related to land management. The tools Hansen provided allowed the division to begin tracking existing productivity so that resources could be effectively allocated and deployed. Hansen was also chosen because its tools can be integrated with GIS applications such as ArcView GIS.

The division started using Hansen in March 1999. After the division had been using the program for several months without a GIS interface, Cecilia Nordin, the division manager, determined that enforcement area boundaries needed to be rearranged and staff reallocated. This change would provide better enforcement and develop a more proactive approach to resolving code violations within the City but would require securing additional funding to hire and equip the officers who would cover the new areas.

The Need to Map Hansen Data

To convince the City Council, Nordin wanted to use the data in Hansen to justify the need for additional funding. After several months of use, the Hansen database contained a large amount of data. Nordin could generate many reports documenting the number and types of code violations, but she felt something visual was needed to adequately demonstrate this workload to the City Council. She asked the City's GIS team for help in creating an interface for Hansen using ArcView GIS.

The GIS team initially looked at Hansen's GIS interface as a means of quickly connecting Hansen to the City's GIS data. However, Hansen's method was limited and consisted of simple lookup functionality that only enabled a user to show the location of one case at a time. After reviewing the options for integrating Hansen with the City's GIS data, the team decided to develop an ArcView GIS application that would allow an individual who was unfamiliar with GIS to display and query code violation data from the Hansen database.



The Codeview application queries the Hansen database and displays code violations

Overcoming Obstacles

Development of this ArcView GIS application, dubbed CodeView, began in November 1999. Soon afterward, the complexities of working with the code violation data in Hansen became apparent. Developing a suitable method for retrieving data through a live connection to the Hansen database and mapping that data in ArcView GIS was one of the first issues encountered. The division had a large amount of data in Hansen. It was important to map as much of this data as possible so the division's workload would be adequately depicted. There were numerous instances of a single parcel that had more than one code violation. The division staff needed to display a point for each violation on a parcel.

Providing this functionality meant finding a way to handle joining many records from the Hansen database to the City's parcel layer so that each parcel could have zero or more code violations associated with it. In the early stages of application development, this was handled using Avenue scripts. However, this approach proved to be impractical because mapping a fiscal year's worth of data took up to 20 minutes to process.

To overcome these obstacles, the GIS team decided to implement a hybrid approach. A shapefile containing a point for each individual code violation was generated each evening with an automated ARC Macro Language (AML) script. When a user started the CodeView application the next business day, ArcView GIS loaded the point shapefile and joined the points to the live Hansen data using a unique case number attribute. From the user's perspective, the application started and ran quickly with just a brief wait while the points and Hansen data were joined.

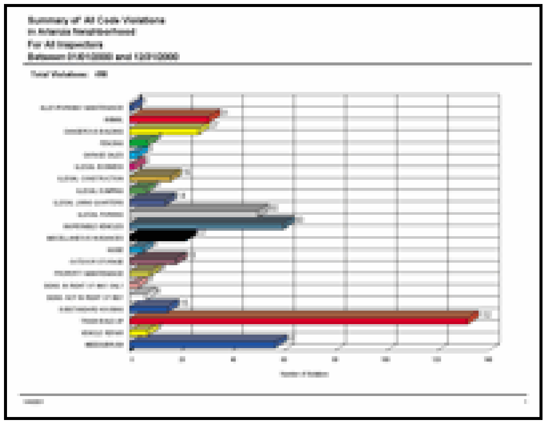
Initially, this process worked well, but over time the Hansen database grew in size and the AML processing time increased dramatically. Eventually, the AML processing was taking four to six hours to run each night, and the procedure was conflicting with other automated processes such as database and server maintenance.

To decrease the time needed to generate the point shapefile, the process was rewritten in Visual Basic using MapObjects. This resulted in several benefits. The compiled MapObjects application ran in less than half the time of the original AML script and ArcInfo no longer had to generate the point shapefile data. While the previous AML process ran as a crontab job on a UNIX workstation, the new MapObjects program could be run as a scheduled task on a user's Windows NT workstation.

The CodeView Application

When the CodeView application was completed, it consisted of a customized user interface that used a simple dialog to help a user query the Hansen database. In addition, the application supported quick load and display of the typical GIS data layers used by the division staff.

Users could query code violation data by selecting attributes such as violation type, assigned officer, and date. Users could also query by choosing a given geographic area, such as a City ward, neighborhood, or inspection area. Complex queries could be created combining multiple attributes and a single geographic criterion.



A typical Crystal Reports bar chart generated by Codeview.

Upon completion of a query, the CodeView application returns a map that displays a point for each violation that meets the user's criteria. It provides the user with the option of viewing a bar graph, generated by Crystal Reports, that shows the total number of violations as well as the number of violations by type. A user-friendly mapping tool was developed that quickly produces maps of the visible area with a scale bar, title, the division name, and standard mapping disclaimer.

While it started as a simple tool to assist the division with mapping the location of its code violations, Nordin quickly saw that the application could be used as a management tool for a variety of functions such as

- Establishing the best areas to target proactive enforcement efforts
- Determining more efficient enforcement scenarios based on workload and area covered
- Studying the workload of each code enforcement officer by a specified geographic area
- Determining the locations of concentrations of certain types of violation within the City
- Evaluating the number and type of each violation within a given geographic area
- Analyzing the distribution of code violations by type, number, and geographic extent
- Comparing the distribution of code violations by area within a specified time frame
- Identifying the location of all code violations within the City limits

Part of the division's efforts to improve customer service involved identifying target areas for enforcement efforts. To determine whether these methods were successful required monitoring the types and numbers of violations that occurred in these target areas over time. To help officers effectively analyze these target areas, the application was enhanced so that officers can delineate a target area on the map and create queries and reports of the code violations that occur within the target area. In addition, officers can save and load the target area's geometry so that reports and maps showing the condition of each target area over time can be generated.

Benefits to the Division

The CodeView application was immediately useful in showing the Code Compliance division's workload in a meaningful and easy to understand fashion. In the application's debut demonstration to the City Council in May 2000, the division was able to show Council members the scope of the code violations in the City. The City Council was impressed with the application's ability to display and report on the code violation problems in their wards and agreed to approve the division's funding request. Council members also thought the application would be useful for preparing maps and charts for their meetings with City constituents as well as for tracking the progress of the Code Compliance division's efforts throughout the City.

When the CodeView application was first shown to Code Compliance officers, mapping the division's workload revealed some surprises. division officer Jerry Jenkins said, "I have been doing this job for years, but this was the first time I was able to see the actual scope of my work efforts." The CodeView application has proven to be instrumental in helping Nordin determine what code violations are most prevalent in different areas of the City. While she and the Code Compliance officers already knew much of this information, the CodeView application provided a method to create maps and reports that could be used to communicate this information to others, especially the City Council.

Nordin is very pleased with the application and says, "It provides a good visual representation of the work we are doing. Moreover, it's also an excellent reporting tool." The division regularly gets requests from other City departments for a history of code violations in a specific area. Before the CodeView application existed, these requests involved manually searching their code violation database for each address in the area. Using the CodeView application, Nordin and other division staff can process these requests in minutes and quickly produce visually appealing code violation summaries.

The CodeView application has enabled the division to realize the benefits of GIS while leveraging the investment made in implementing the Hansen Code Compliance module. The division now sees GIS as a valuable enforcement tool and is currently working with the GIS team to deploy a field-based GIS application to assist with managing weed abatement enforcement.

Future Directions

The GIS team is looking at providing similar applications for other departments using Hansen modules, as well as possibly providing this functionality on the Internet, so City constituents can see what code violations exist in their areas.

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Datums Who Needs 'Em Anyway?

by Mike Price, ESRI

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When was the last time you thought about what datum the data you were using was in? Perform analysis using data sets created in different datums or even display them together and you won't like the results. The same features in two street centerline themes or coverages may appear offset by many meters or feet. Fire hydrant points collected with GPS appear located in parking lots or inside buildings instead of out by the curb. GPS coordinates acquired by hikers show their position half way up a very steep cliff instead of on the mapped trail below. These are all very real examples caused, in large part, by using data sets lacking a common datum.

What's a Datum?

Prior to satellite mapping technology, the best approximation of the shape of the earth was the mathematically calculated geoid, which evolved into slightly flattened spheroids or ellipsoids. Geographic coordinate systems use a spheroid to calculate positions on the earth. A datum defines the position of the spheroid relative to the center of the earth. As surveying technology improved and data acquisition increased worldwide, the mathematical formulas and the related parameters used to describe the shape of our irregular earth continually improved and were expressed in spheroids such as Everest 1830, Airy 1849, Clarke 1866, Clarke 1880, and Krasovsky 1940.

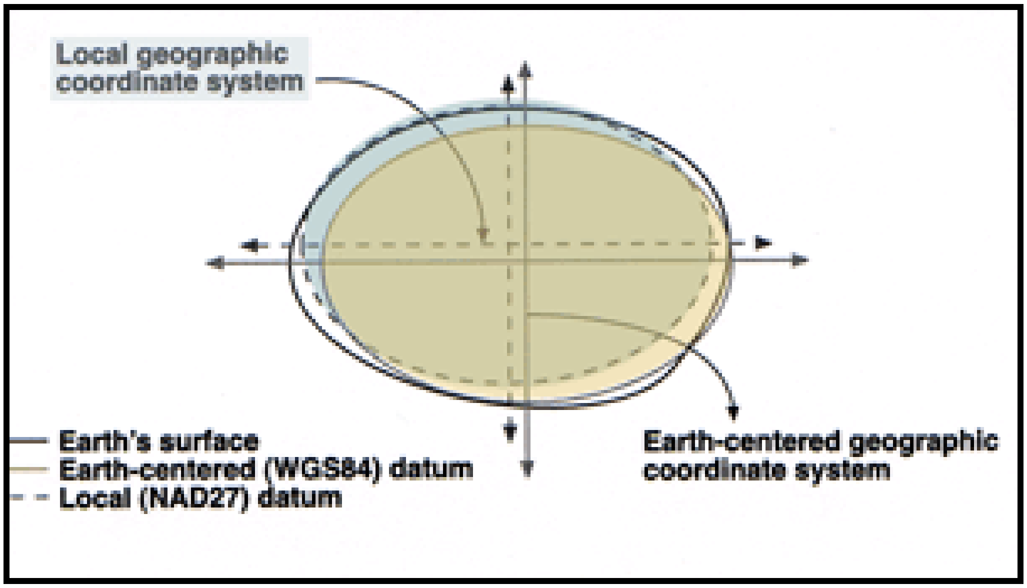
Until recently, a comprehensive knowledge of--or even much interest in--datums was limited to mathematicians, geodesists, and geographers specializing in cartography. Field surveying was performed on a local basis using traditional mechanical, optical, and laser equipment. Typically, local coordinate systems were developed and vertical and horizontal control were derived from a local frame of reference or datum. For those outside the field of cartography, map projections were often an issue, but datums, those absolute global frames of reference, were not.

Developing Datums

As mapping expanded globally, cartographers established coordinate reference frameworks that helped standardize mapping activities across wide areas. The resulting datums were typically limited in extent and were tied to an origin point on the earth's surface. The North American Datum of 1927 (NAD27) is a classic example of an early, local earth-surface-based datum. The spheroid NAD27 uses Clarke 1866 that originates at a surface point at Meades Ranch, Kansas. Many NAD27 control points were calculated from observations taken in the 1800s. The calculations were done manually, in sections, over many years, and errors vary from station to station.

Getting the Big Picture

More than 30 years ago, satellites began acquiring remote imagery. As GPS, a satellite-based location system, matured and became accessible to the public, the need to extend and better define the earth's spheroid and associated datums became more pressing. In 1980, a new spheroid, the Geodetic Reference System (GRS80), was developed from satellite measurements. Instead of defining the earth from surface measurements linked horizontally and related vertically to mean sea level, this new mathematical approximation was derived from a point located out in space.



This spheroid and its associated datums define the earth's shape by measuring and triangulating from an outside perspective and use the mass center of the earth as an absolute origin. Using the GRS80 spheroid, new datums were developed both regionally and worldwide. The North American Datum of 1983 (NAD83) and the World Geodetic System of 1984 (WGS84) are examples of these new datums. Worldwide, all GPS measurements are now based on the WGS84 datum.

In addition to satellite positioning, the development of GIS and the Web have significantly increased public access to and use of spatial data. As GIS use has increased, more nongeographers are manipulating geographic data. The Web has made spatial data in a variety of projections and datums far more widely available.

Both the availability and diversity of data make understanding datums an important issue for GIS users.

Using data created in both old and new datums together can be challenging. Points calculated using early methods seem to shift by tens, even hundreds, of meters when recalculated in modern space. While the math and science behind spheroid definition and datum transformation is complex, GIS users must recognize the importance of improving data collection, registration, and documentation methods so that the analysis of spatial data will continually improve. It is essential to carefully study each piece of spatial data--whether vector, grid, triangulated irregular network (TIN), or image data--to determine the way the data was obtained, how it is displayed in its native format, and that it correctly displays at the largest practical scale.

ArcInfo 8.1 and ArcView 8.1 are designed to recognize, interpret, and correct for spheroid, datum, and projection differences. Traditional ArcView GIS 3.x and ArcInfo 7.x software also accommodate these differences, although not "on-the-fly." In every case, it is important to understand the metadata behind data and to properly record differences in geometric parameters.

The answer to the question "Who needs datums?" is you do. To avoid time-consuming and possibly costly data alignment issues, GIS users need a basic understanding of datums and an awareness of the datums associated with the data sets they use.

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