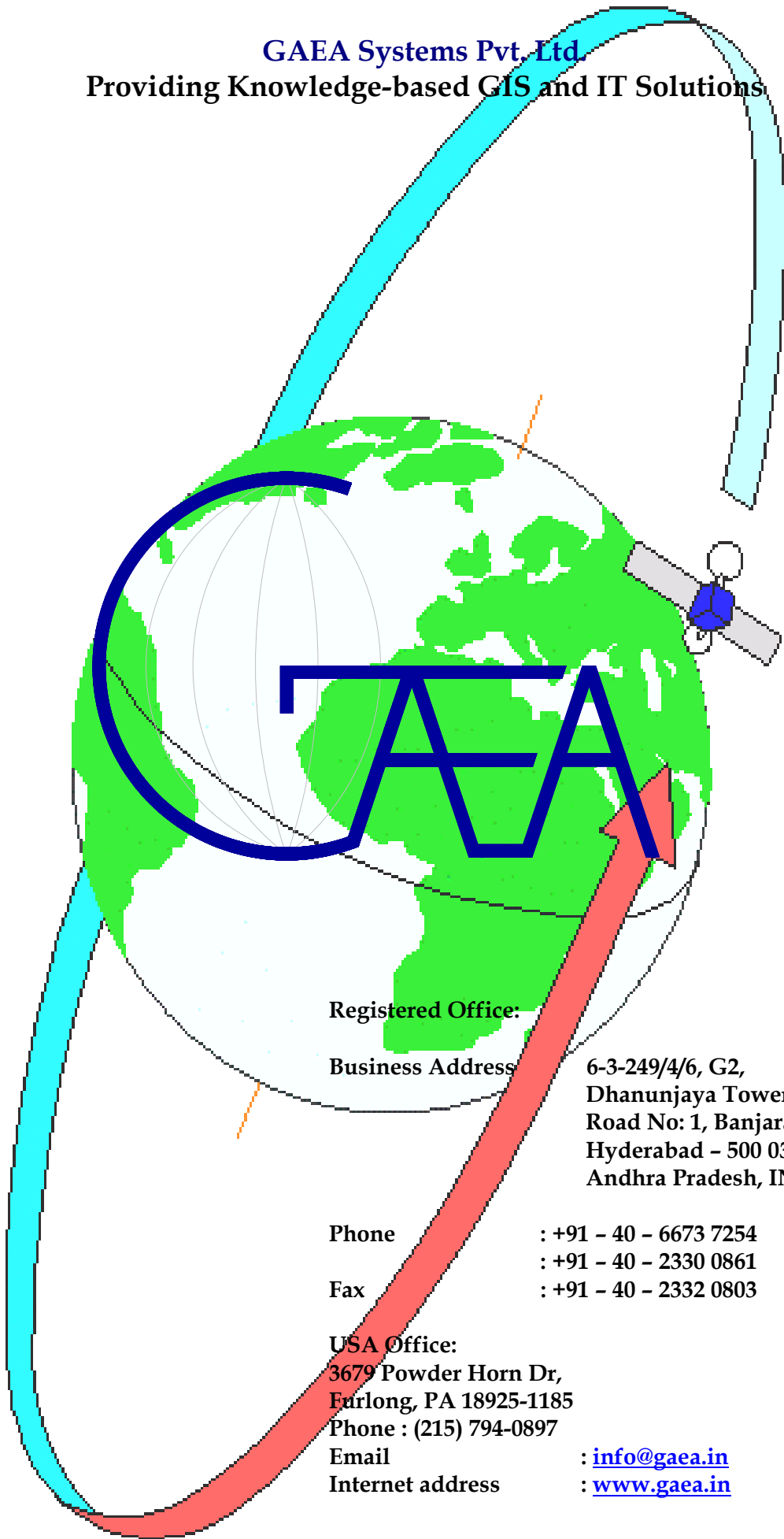


**GAEA Systems Pvt. Ltd**  
**Providing Knowledge-based GIS and IT Solutions**



**Registered Office:**

**Business Address**

**6-3-249/4/6, G2,  
Dhanunjaya Towers  
Road No: 1, Banjara Hills  
Hyderabad - 500 034  
Andhra Pradesh, INDIA**

**Phone** : +91 - 40 - 6673 7254

: +91 - 40 - 2330 0861

**Fax** : +91 - 40 - 2332 0803

**USA Office:**

**3679 Powder Horn Dr,  
Furlong, PA 18925-1185**

**Phone : (215) 794-0897**

**Email** : [info@gaea.in](mailto:info@gaea.in)

**Internet address** : [www.gaea.in](http://www.gaea.in)



## **GIS Based Parking Management System** *(Office of Parking Management, Denver, USA)*

Today, supervisors access the GIS to view daily performance summaries. Within a specific area, the performance of each beat is colored, for example, beats above the standards are in green, beats 80 to 100 percent of the standard are yellow, beats at 60 to 80 percent of the standard are orange, as shown in Exhibit 1, and finally, beats less than 60 percent of the standard are red.

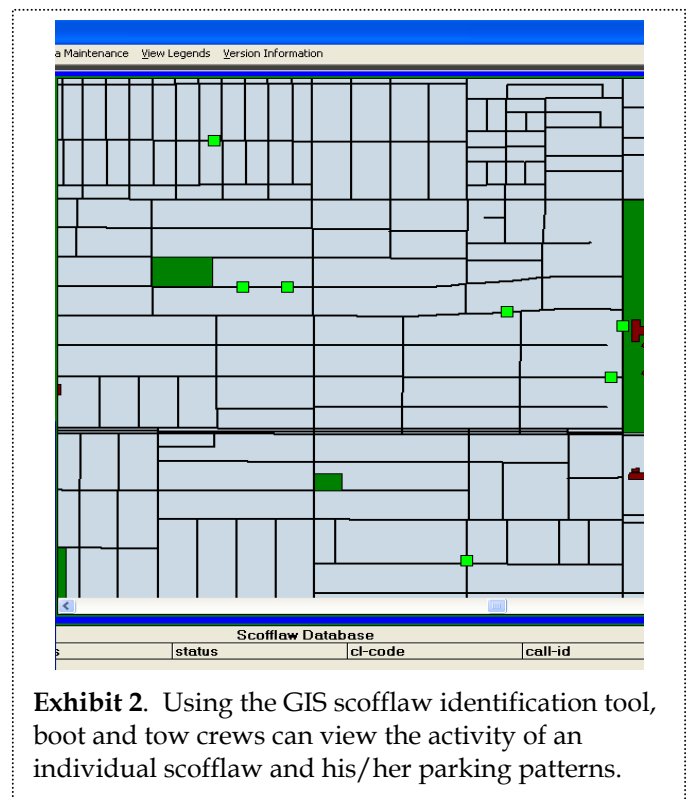
Supervisors can also see the block faces where the issuance deficiencies are occurring within each beat. If the deficiencies are the result of a VCA problem, the supervisor can take the appropriate action. Deficiencies may be a result of an ineffective patrol strategy. The GIS maps the VCAs pattern to help the supervisor evaluate the VCAs performance. The supervisor can then use the tool to counsel the VCA on how better to manage his/her beat. If the deficiencies indicate that the beat requires partial or total redesign, the GIS can easily accommodate the revisions. Previously, re-mapping a beat could take hours to manually plot on a map. Today, revising a beat requires little more than entering new criteria into the system. New beats can also be created when new meters are installed or regulations are lifted in a particular area.

Even in the most efficient parking program, targeting scofflaws is challenging. It is important for City to communicate to the public that it is serious about regulations and enforcement. Booting and towing programs send the highly visible message to others that the City is serious. Denver has taken booting and towing one step further through the use of the GIS application.

Prior to the GIS application, Denver could only produce text reports of their heavy hitter parking scofflaws. The report offered little help in identifying the violation patterns of given scofflaws. With the use of GIS scofflaw identification tool, scofflaws and parking patterns are mapped out which allows boot/tow crews to target specific areas.

The GIS scofflaw identification tool shows the geographic frequency and time distributions of citations issued to individual scofflaws, as shown in Exhibit 2.

The boot crew supervisors and dispatch staff use GIS maps to assess the nearest crew prior to mobilizing for boot application. The citation patterns are mapped based on the time and day citations are issued. Based on this information, the GIS provides the City with suggested search areas and the time and day of the week that successful scofflaw enforcement will be most probable.



**Exhibit 2.** Using the GIS scofflaw identification tool, boot and tow crews can view the activity of an individual scofflaw and his/her parking patterns.

These map outputs demonstrate the citation distribution pattern of a given scofflaw based on the citation age, day of the week, and time of the day. They also include the general vehicle identification information necessary for boot crews. Based on identified patterns the system can help direct the boot crew to the highest priority location at the most probable time and day of the week. The scofflaw tool also generates report maps to highlight trends such as areas with a

## GIS Based Parking Management System (Office of Parking Management, Denver, USA)

high frequency of escaped boots or vandalism. Based on any apparent trends, program managers may choose to immediately tow scofflaw vehicles found in the identified areas, thus minimizing the risk of an escaped boot or a vandalized vehicle.

### GIS technology

The screenshot shows the 'Data Viewer' application window. At the top, it says 'AD HOC REPORTER' and 'Data Viewer Ad Hoc Report & Map Generator'. Below this are several filter tabs: Agency, Street Name, Badge Number, Date, and Meter ID. Under 'Agency', there are sub-tabs for Squad, Beat, Plate State, and Time. A 'Select Violation Types' list on the left shows options like 057, 066, 070, 1, 101, 102, 103, 104, 106. The 'Selected Types' list on the right shows '101'. Below the lists is a 'Locate Violation Type:' field with the value '5136'. To the right of the filters are buttons for 'Execute Query', 'Clear Query', and 'Zoom to Selected'. Below the filters, it shows 'No. of Records: 809 (89 are not Geocoded)' and 'Criteria: Agency: 05/Violation Code: 101 Date: 5-NOV-2007'. The main area is a table with columns: ISSUE\_DATE, ISSUE\_TIME, TICKET, VIOLATION, METER, LOCATION, PLATE, STATE, AGENCY, SQUAD, BEAT, BADGE, XCOORD, YCOORD. The table contains multiple rows of data. At the bottom of the window are buttons for 'Export' and 'Print Grid', and the time '2:43 PM'.

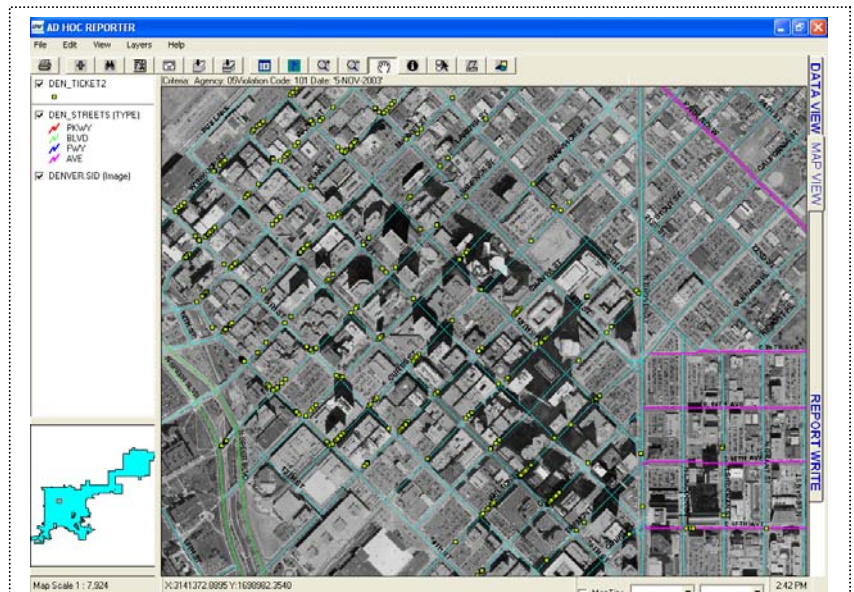
**Exhibit 3.** In order to view the captured GIS data, a user determines the fields for inclusion on the visual report using the Data Viewer Screen. Violation, squad, beat, agency, badge number and date/time are just a few of the fields that a user can request. These can be viewed using an individual category, or combined using multiple criteria.

The GIS web-based application data mines information stored in the Parking management information system data warehouse to provide additional management insight. Simply put, GIS is management information presented in pictures. With GIS, a user can visually see characteristics, data, and information overlapping a base map. Through the features of GIS software, data comparisons can be made, trends identified, and action plans developed.

## GIS Based Parking Management System (Office of Parking Management, Denver, USA)

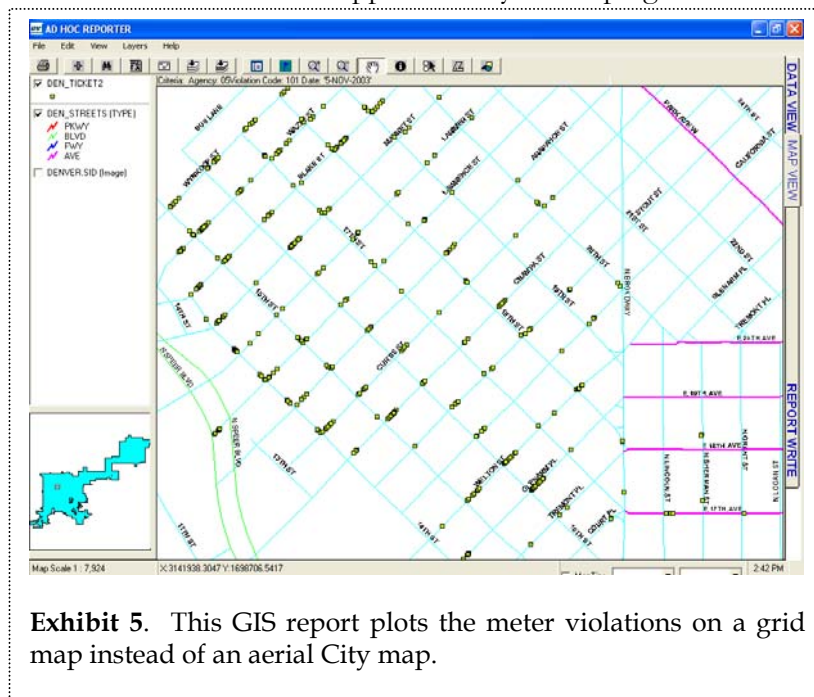
At the conclusion of the VCAs enforcement shift, data is uploaded from the handheld ticket writing device into the parking management software. From there, the data is loaded into the data warehouse where it is then geo-coded in the GIS application and viewed through the Data Viewer, as shown in Exhibit 3.

When a user requests a GIS report, a geo-coding “mapping” application is run against the ticket location field so the longitude and latitude coordinates can be added to the record. Users may query data using the GIS application to plot the points on city map to quickly identify areas that have received certain types of violations, perform beat analysis, and determine problem enforcement areas in order to optimize beat districts. Examples of its use are shown in Exhibit 4 – 6.



**Exhibit 4.** Meter violations are plotted on an aerial City map to allow enforcement management to supervise the VCAs’ activity using a visual report to make adjustments to enforcement routes so that coverage is appropriate in all areas.

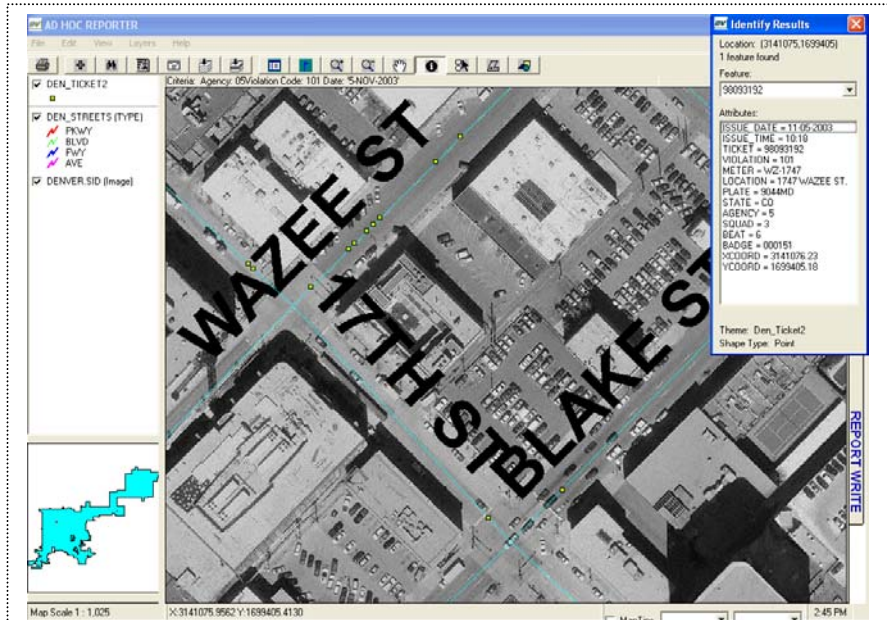
Denver integrated GIS into its parking program in May 2003. Since that time, the City has further enhanced the GIS application by developing a detailed meter database that can be tied to ticket issuance and meter hours of operation. As displayed in Exhibit 7, this inventory has been expanded to include downtown structures such as garages, surface parking and loading zones.



**Exhibit 5.** This GIS report plots the meter violations on a grid map instead of an aerial City map.

## GIS Based Parking Management System (Office of Parking Management, Denver, USA)

Managers and field operators can access the GIS information from their offices, as shown in Exhibit 8, or from the field to create printable maps. A sample map is provided in Exhibit 9.



The City is currently designing a meter management module that will provide the capability for visualizing all meter locations, keeping historical data such as outages and repairs, tracking meter generated revenue data and providing the status of operational meters for meter maintenance.

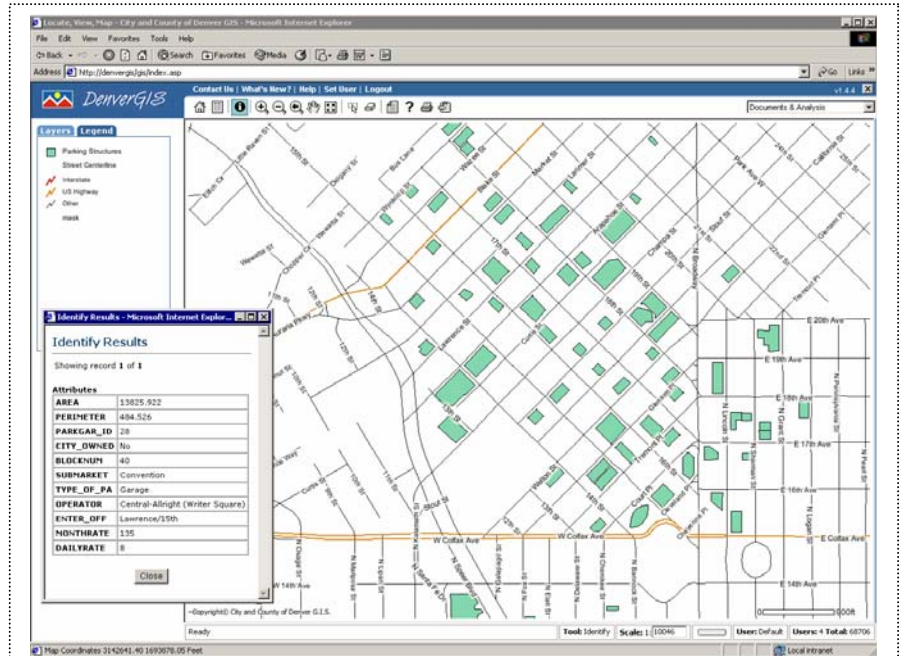
**Exhibit 6.** The GIS application allows a user to 'zoom' in to view a particular location's enforcement activity. This report shows plotted points indicating a meter violation. Additionally, the user can click on a particular meter violation and view detailed information about the meter such as the ticket number issued, issuing agency, badge number and beat.

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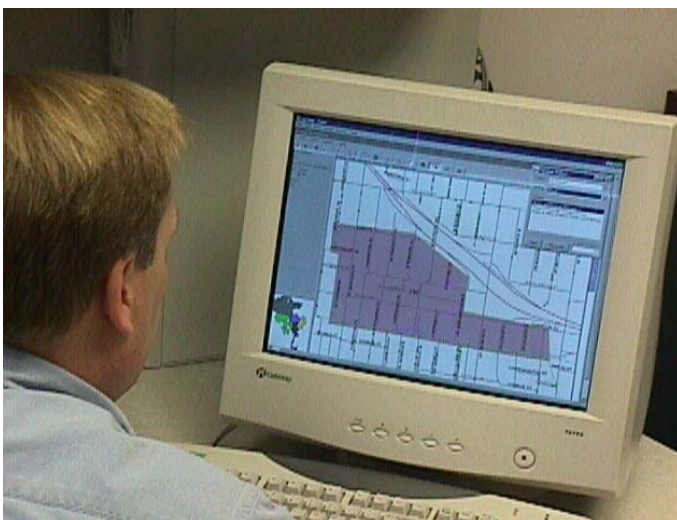
### Measured Benefit of Program

GIS technology provides a powerful tool for collecting, organizing, managing, and analyzing location-based data. GIS has greatly enhanced Denver's ability to target scofflaws, and also its enforcement planning and management efforts. Through the use of the scofflaw identification tool, the City has effectively targeted some of its most egregious parking offenders. Additionally, by analyzing and mapping issuance trends throughout the City, Denver is able to maximize its limited workforce. The process of deploying VCAs has become much more efficient and effective as a direct result of this technology. Likewise, supervision of VCAs in the field is much easier. Ticket supervisors rely on the GIS application to identify which beats are the most productive and hold VCAs accountable for their daily activities through the use of mapping application.

Denver's VCAs currently write 60.3 tickets per day which exceeds the average of 40.8 for other large cities across the country. With this productivity, VCAs pay for themselves in 8 weeks.



**Exhibit 7.** Denver's GIS inventory for enforcement has been expanded to include downtown structures such as garages, surface parking and loading zones.



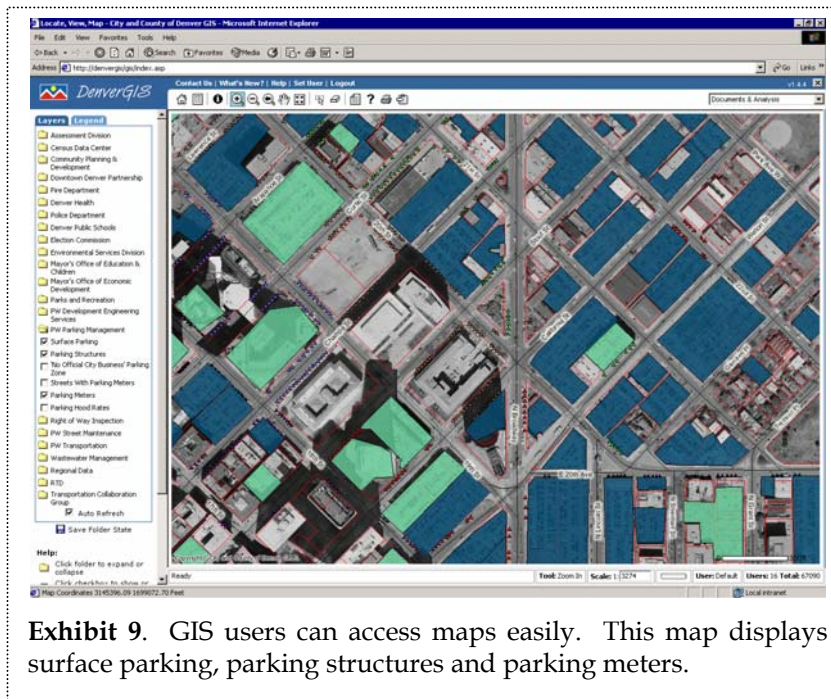
**Exhibit 8.** Supervisors can access the GIS data from their offices to evaluate their VCAs' performance.

It is also important to note that GIS is one of the reasons the City rolled back meter rates by \$.50/hour and ended Saturday enforcement for the next year. Increased scofflaw and VCA productivity will safeguard the revenues despite these concessions.

## GIS Based Parking Management System (Office of Parking Management, Denver, USA)

### Innovation and Creativity

Over the last decade GIS has been used for land management and public works applications by both the public and private sectors. Denver's parking management program recognized that this type of technology had considerable applicability to their efforts.



**Exhibit 9.** GIS users can access maps easily. This map displays surface parking, parking structures and parking meters.

Denver's GIS tool is the next step in parking program knowledge management and information dissemination. It utilizes the most modern technology to solve a problem that is prevalent in many cities. Using the GIS system allows the City to track changes in scofflaw trends much faster and more efficiently than they would if they were only relying on manual entry by ticket writers. It also gives the City's boot/tow crews a practical visual reporting tool to target the heavy

hitter scofflaws and show the citizens that the City is serious about enforcement.

The ability to query and map numerous data sets through the use of this application allows for greater accountability and oversight of enforcement practices. Designated users will be able to map tickets issued by geographic zone (beat, police district, quadrant, etc.), blockface, and/or regulatory zone within a blockface. By analyzing enforcement trends, Denver is now able to quickly identify issuance fluctuations within areas and/or by regulation that require follow up and warrant the need for further investigation.

### Adaptability

Essentially, all large-city parking programs face the same issues – a static supply of curb space, high volume demand for its uses and volumes of location-based data. Additionally, these cities have limited resources to analyze the data and limited resources to regulate and enforce regulations over a wide area. GIS would be an invaluable tool all of these cities.

While limited resources plagued the City of Denver, the parking management program was determined to create efficiencies to streamline the flow of information and enhance their parking program to ensure curb turnover for short-term parking by City patrons, target scofflaws who repeatedly ignore the traffic regulations and laws, and generate additional revenue for the City.

While the GIS application would ultimately save resources and generate revenue for the City, Denver had neither the time nor the money available to develop the solution. The creation of a

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public-private partnership allowed the City to utilize their resources to the fullest and to enhance their strong technology-based program.

Implementing the GIS program has made Denver a pioneer in the parking industry. The program has a flexible and scalable foundation from which further GIS application modules can be developed. It could easily be adapted in other parking programs through a similar partnership and is well worth the effort as proven by Denver's success.

**Technologies: MapObjects, VB, Oracle, Oracle Discoverer.**