Targeting Programs and Enhancing Revenues with the help of GIS
Montgomery County, Maryland

1.0 Abstract of the Program

The Montgomery County, Maryland Department of Technology Services - Geographic Information Systems (DTS-GIS) team has utilized basic geoprocessing techniques to help County departments to better focus some services on intended clients and enhance the revenue from other services. Geoprocessing analysis has allowed departments such as the Montgomery County Public Libraries (MCPL) to add relevant programs for specific libraries or choose a strategic location for the next library. The Department of Corrections and Rehabilitation (DOCR) is using the results of our geoprocessing work to study inmate offense types and predict post-release inmate home locations in order to design and implement prevention programs for neighborhoods where former inmates reside. In a third project, we have helped the Department of Finance (FIN) to safeguard its proper share of the State Highway Administration's revenue sharing through GIS processing of Motor Vehicle Administration (MVA) vehicle registration records.

2.0 The Problem/Need for the Program

Maryland State Highway Administration (SHA): The Maryland State Highway Administration (SHA) shares some of its revenues with local governments within the state. One of the factors in deciding the amount of revenue to be shared is the number of motor vehicle registrations in each jurisdiction within the County. Certain (smaller) towns and cities have attempted to use the number of parking spaces as a means of determining the revenue owed to them. Often these towns are located in highly developed urban core areas and thus have high numbers of parking spaces for residents as well as daytime workers. Higher numbers of registrations claimed by such cities or towns within the County will lower the revenues shared with Montgomery County itself. Therefore, the County requested, and SHA sent to FIN, reams of printouts for the 700,000 registrations across the County. FIN staff spent close to the equivalent of one person year (2000 labor hours) to tally the registrations for the cities and towns within the County, as well as those for the County itself. The visual inspection of the computer printout is time-consuming and prone to errors. It is also hard to determine the break point if a street spans multiple localities.

Montgomery County Public Libraries (MCPL): In order to fine tune the collections of its various branch libraries to better serve the using public, MCPL needed to know the distribution and characteristics of its patrons. The library card holders database contains the data (home addresses and some basic demographic information) that could potentially provide the answer. MCPL approached DTS-GIS for assistance with making sense of the database.

Montgomery County Department of Corrections and Rehabilitation (DOCR): DOCR was looking into developing programs to assist released inmates in getting back on their feet. To have an efficient program, they needed to know the geographic distribution and demographic characteristics of people incarcerated at the County jail. They approached DTS-GIS to make sense of the inmate home address database.

3.0 Description of the Program

DTS-GIS has been maintaining a countywide street centerline file since the mid-1980's. In the beginning, the database was hosted on the mainframe computer and was patterned after the US Census Bureau's GBF/ DIME (Geographic Base File using Dual Independent Map Encoding) technology. Earlier applications of the file included address-matching voters' addresses for the purpose of assigning election district and precinct codes to voter records. Similarly, the file supported the assignment of students to designated school service areas.

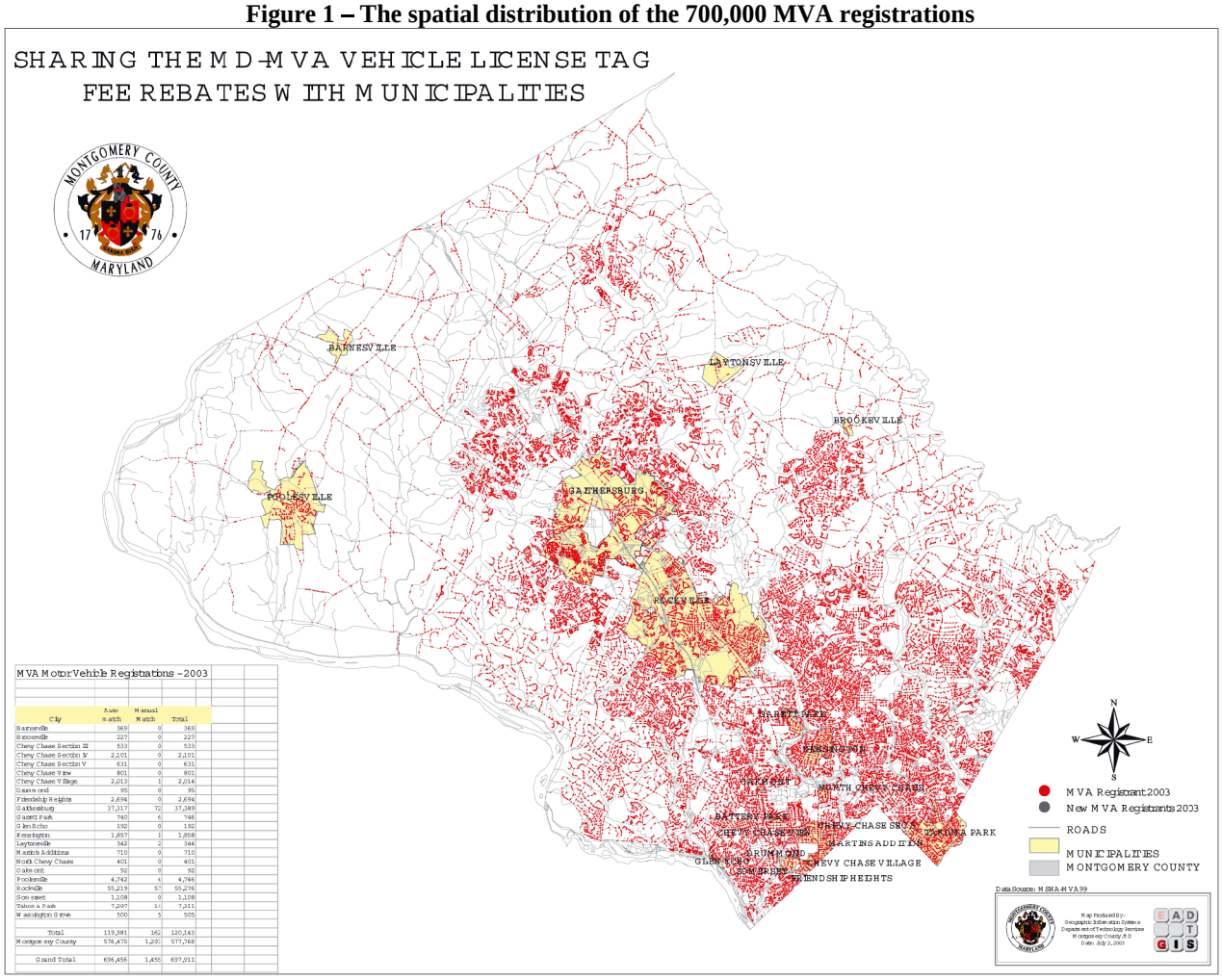
Starting in the early 1990's, the maintenance of the DIME file was migrated to ESRI's ArcInfo GIS software (on Unix workstations). The geometry (i.e., the X- and Y-coordinates that spatially represent the street centerlines) was enhanced from the less accurate 1"=2,000' scale to the more accurate 1"=200' scale. Starting in late 1990's, DTS-GIS embarked on a yet another enhancement project, this time for the public safety communication systems (the E911 call taking, response unit assignment, and travel route recommendation) that was inaugurated in July 2003.

With the street centerline database enhanced and being regularly maintained, the DTS-GIS team was well poised to support the geoprocessing needs of MCPL, DOCR and FIN. All of the requirements raised by these using departments fell into the category of address matching and geocoding. Address matching refers to the operation of matching street addresses in the user data files (motor vehicle registrations, library card holders, or inmate home addresses) to the hundred-block address ranges in the street centerline database. Geocoding is the process of assigning geographic coordinates (and optionally district codes associated with each hundred block) to the matched addresses. The district codes available directly from the street centerline file include Election District/Precinct, School Service Area, Fire Callbox Area, Police Reporting Area, and Census Tract/Block. From the smallest district codes (or "atoms"), higher-level district codes can be ascertained through the use of look-up tables.

Geocoding the MVA Motor Vehicle Registrations

If the addresses in the registration file are perfect, the process of identifying which political subdivisions these addresses fall into and tallying up the totals for all the political subdivisions within the county could be highly automated. However, over the years, the GIS analyst at DTS-GIS has typically encountered a 5 – 7% rate of records that require human intervention. This is where the bulk of the two-week effort is spent. (Figure 1 – The spatial distribution of the 700,000 MVA registrations). Even with this level of effort, it is a tremendous efficiency improvement compared to the old-fashioned way that would take one or two person-years!

Figure 1 – The spatial distribution of the 700,000 MVA registrations



MVA Motor Vehicle Registrations – 2003

City	Auto match	Manual Match	Total
Barnesville	369	0	369
Brookeville	227	0	227
Chevy Chase Section III	533	0	533
Chevy Chase Section IV	2,101	0	2,101
Chevy Chase Section V	631	0	631
Chevy Chase View	801	0	801
Chevy Chase Village	2,013	1	2,014
Dranesville	95	0	95
Friendship Heights	2,694	0	2,694
Gaithersburg	37,317	72	37,389
Garrett Park	740	6	746
Glen Echo	192	0	192
Kensington	1,857	1	1,858
Laytonsville	342	2	344
Martins Additions	710	0	710
North Chevy Chase	401	0	401
Oakmont	92	0	92
Poolesville	4,742	4	4,746
Rockville	55,219	57	55,276
Somerset	1,108	0	1,108
Takoma Park	7,297	14	7,311
Washington Grove	500	5	505
Total	119,991	162	120,143
Montgomery County	576,475	1,291	577,768
Grand Total	696,466	1,455	697,911

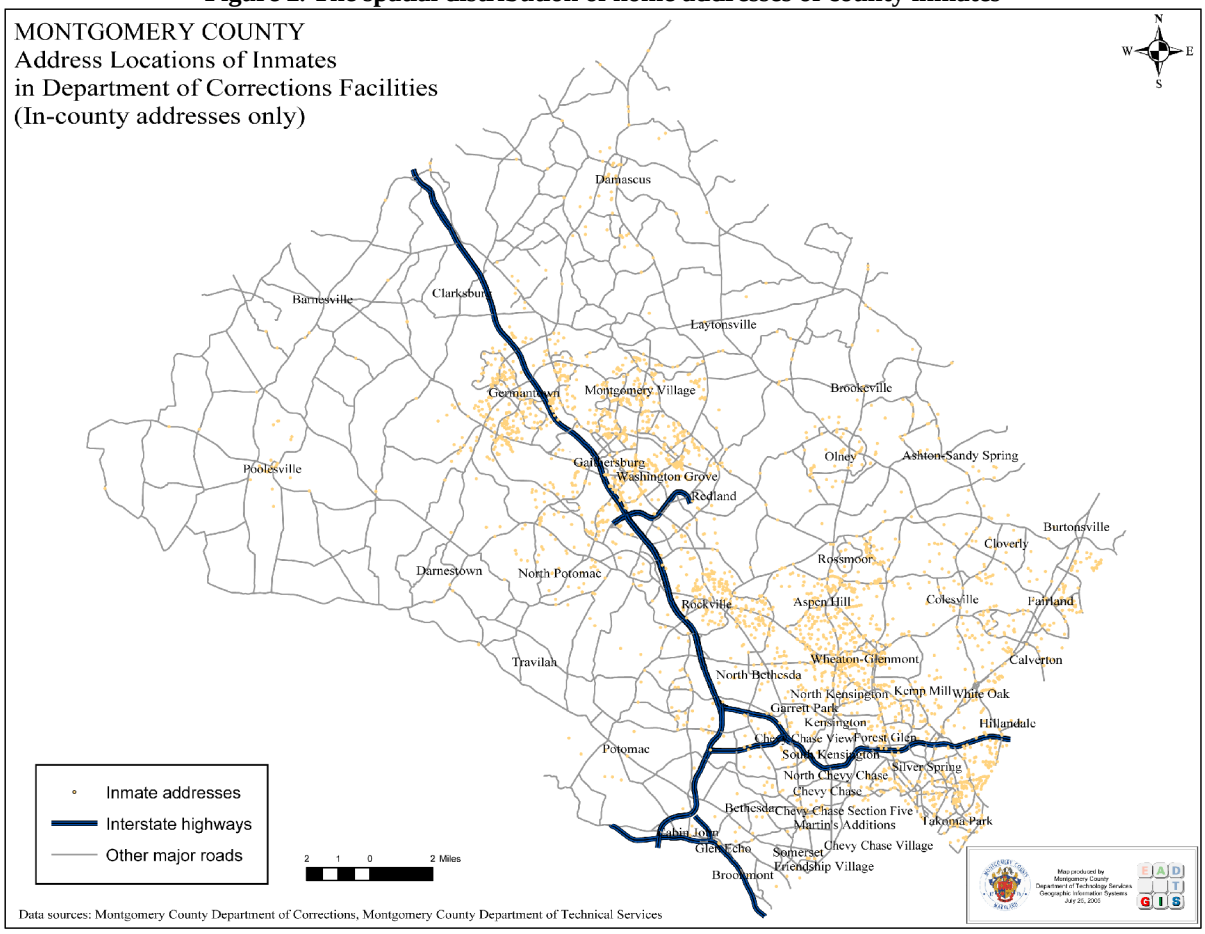
This map shows a strong pattern of motor vehicle registration growth in the developing cities and towns in the northern part of the county relative to county as a whole, especially the established urban core to the south. While the overall number for the 22 political subdivisions (which account for 18% of the grand total) within the county increases annually at about 2%, the rate of increase for the rest of county (82% of the grand total) is also significant, at close to 1%. The county has successfully fended off the towns and villages for larger (than actual) shares of the SHA revenues, and has thus enhanced its revenue position in this particular area. The November 30, 2004 number of vehicle registrations for the county is 583,003; this translates to about $15 million in State revenue to the county. As for the 1-2 person-years saved in the Finance Department, county tax payers can be assured that resources are being used efficiently.

Geocoding the Inmate Home Addresses

The DTS-GIS analyst processed the inmate home address file (7,490 records, without inmate names or any other personal data aside from addresses) provided by DOCR. Pre-processing entailed separating out out-of-county addresses, deleting duplicates, and eliminating incomplete addresses. 4,410 records were left to be geo-coded, of which 4,160 were successfully geocoded (Figure 2 - The spatial distribution of home

addresses of county inmates). The reference file used was again the very up-to-date street centerline file. GIS geo-processing techniques helped to provide a succinct and clear picture of the spatial distribution of inmate home addresses. The pre-processing involved also alerted the DOCR IT folks of the need for better structure and quality control in the inmate file.

Figure 2: The spatial distribution of home addresses of county inmates

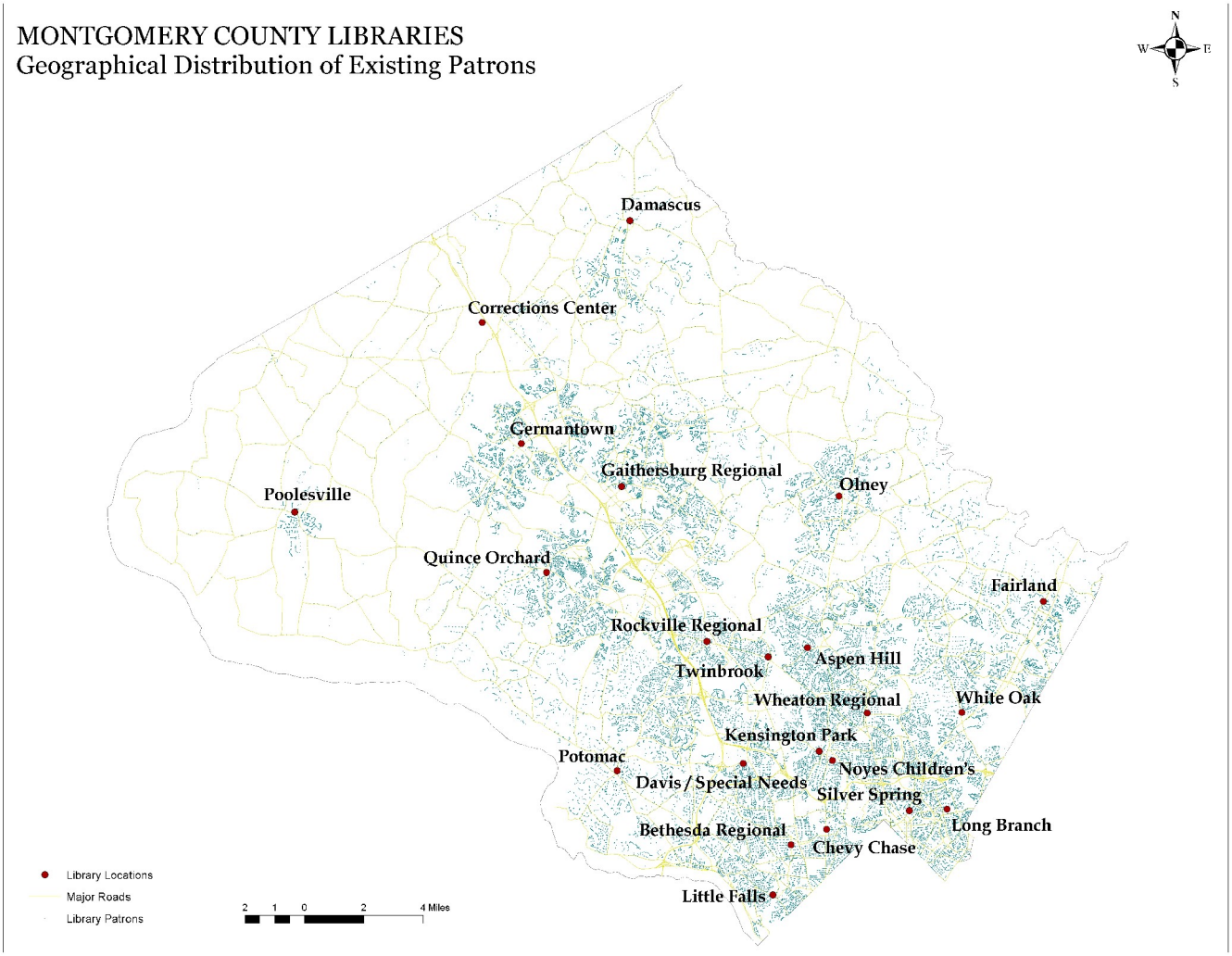


With the help of this map, the spatial distribution of the inmate home addresses can be ascertained much more easily than by reading a text file (a picture is worth a thousand words). These dots can be aggregated into summary statistics based on Police Reporting Areas, Community Analysis Zones, or Census Tracts. This data (crime type, inmate demographics, etc.) can be further analyzed along with the Police or Census data. Crime prevention programs (such as gang violence prevention) will be more effective if they are formulated with these data as part of the input.

<u>Geocoding Public Libraries Card Holder Home Addresses</u>

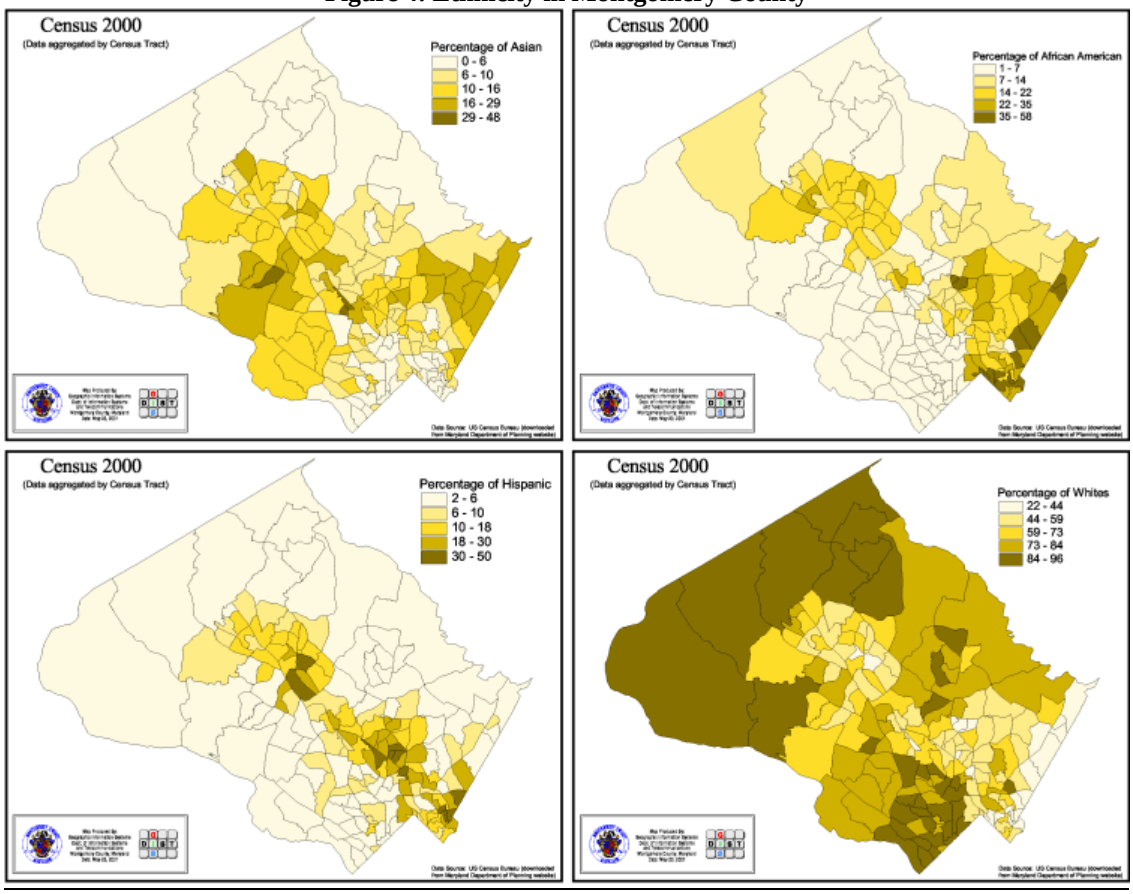
The DTS-GIS analyst pre-processed the 500,000 card holder home addresses file (again, with no names) provided by MCPL. In this step, she corrected spelling errors, standardized street types and weeded out the out-of-County addresses. The geocoded dots (home addresses) were mapped along with the 22 regional and branch libraries. (Figure 3 – Geographical Distribution of Existing Patrons.)

Figure 3: Geographical Distribution of Existing Patrons



Should the card holder database contain information such as ethnicity, age, education level, or language spoken at home, this spatial distribution map (along with the attributes) can be further analyzed to provide input to library collection acquisition programs, special community book clubs, seminars, and branch library staffing plans (especially for the check-out counters and reference desks). As an alternative, the US Census data (Figure 4 – Ethnicity in Montgomery County) can be used along with card holder locations (or summary statistics) for planning purposes.

Figure 4: Ethnicity in Montgomery County



4.0 Use of Technology

The street centerline database is maintained by the DTS-GIS team using ESRI's ArcGIS software. The geoprocessing module of ArcGIS is used to geocode the MVA motor vehicle registrations, the DOCR inmate home addresses and MCPL card holder addresses. The ArcMap component is used to compose maps.

These are basic technologies in any local government GIS shop.

5.0 The Cost of the Program

Existing GIS hardware and software components were utilized for these geocoding programs. The investment being made on the maintenance of an up-to-date and highly accurate street centerline file was also leveraged for these applications. DTS-GIS staff time spent on these three innovative geocoding projects was about two weeks ($4,000) for each of them.

6.0 The Results/Success of the Program

The annual geo-coding of the 700,000 MVA motor vehicle registrations for the Finance Department safeguards the county's proper share of the SHA rebates ($15M). The savings of one (or more) person-year of staff time is worth approximately $80,000.

The geoprocessing of the 8,000 inmate home address data revealed the need to revamp the database structure and implement rigorous quality control procedures. The resulting spatial distribution map of the inmate home addresses is an invaluable data layer for the corrections, public safety, and human services departments in their efforts to devise crime prevention and inmate rehabilitation programs.

The geo-processing of the 500,000 MCPL library-card holder home addresses presented the library planning staff with a clear picture of patron distribution around the county. Coupled with other demographic information, it allows the county to target its spending in order to provide more relevant and effective library services in different parts of the county.

7.0 Worthiness of an Award

The projects described in this submission represent innovative ways of using geocoding techniques to allow agencies at the county and state level to visualize the data they have on hand in a new way so that they may spend resources more effectively and enhance revenues. These applications allow the county to derive greater benefits from its existing investment in GIS data, hardware and software, and .in the case of MVA motor vehicle registration processing, to realize very significant labor savings.