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The Role of Geographic Information Systems in Paratransit Planning: A Case Study of the Greenville Transit Authority

A Thesis
Presented for the
Master of Science in Planning
Degree
The University of Tennessee, Knoxville

Virginia E. Miller
December 1994

This thesis is dedicated to the Lord Jesus Christ,
who provided me the strength, determination,
and perseverance to finish
and to my husband Bob,
whose encouragement, confidence, and love
made the task much easier.

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ABSTRACT

Transit service providers have struggled to keep up with federal regulations and variable funding cycles. New unfunded federal regulations passed in 1990 place requirements upon transit agencies that must be implemented by 1996. With this in mind, transit planners are searching for new low cost ways of planning modified transit services. Better information is needed if more efficient service planning is to be implemented.

This thesis explores the use of Geographic Information Systems (GIS) technology to meet a small transit agency's information needs. Using a case study methodology, the study examined the impact of the 1990 unfunded regulation on a small transit agency in South Carolina and undertook two GIS projects for the agency to see if GIS technology provided better information for their paratransit planning. Full documentation of the actions and resources used is included in the study, along with an overview of how GIS is being used in other transit agencies.

At the end of the research, the transit agency completed a GIS Assessment Form to report on the usefulness of the information provided. Overall, the agency's reaction was positive and spurred by the results of this study, the agency is seeking to undertake other GIS projects as part of their future transit planning.

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CHAPTER I

INTRODUCTION

Statement of Problem

Transit in the United States is plagued by cyclical funding levels dependent upon federal, state and local governments' wavering commitment to transit. Consequently, fiscal shortfalls in the transit industry leave public transportation providers searching for practical low cost methods of providing adequate levels of transit service that help those with transportation needs. As a result of changing funding levels, transit planners must continually investigate better information retrieval methods to make more efficient service decisions. New computer technologies, such as geographic information systems (GIS), may help transit planners to obtain better information about their transit service areas and transit riders. A GIS could provide information that would allow transit planners to recommend more efficient ways of route planning, service provision, and resource allocation.

Background

The Americans with Disabilities Act (ADA), passed by the federal government in 1990, places new financial responsibilities on transportation providers. ADA was passed by the federal government as civil rights legislation to protect the disabled from physical barriers to

"employment, public services, public accommodations, and services operated by private entities, and telecommunications" (Coburn, Martin, Thompson, and Norstrom, 1992). Businesses and service providers are required to modify their existing structures and equipment to be accessible to the disabled. The first two sections of ADA, Title 1 and Title 2, outline requirements for transportation providers, including public transit agencies. Two major requirements placed upon transit agencies affect transit service operations and will require many expensive modifications that must be completed by 1996. First, ADA requires that all fixed route buses operated by transit agencies be fully accessible to persons with disabilities. This means that every bus must be upgraded to provide access to the disabled. Second, "section 223 of the Americans with Disabilities Act requires that public entities which operate non-commuter fixed route transportation services also provide complementary paratransit service for individuals unable to use the fixed route system" (EG&G Dynatrend, 1993). Transit providers have to modify current services to accommodate both fixed route and paratransit ADA requirements. ADA is a powerful civil rights law that gives millions of Americans the chance to enjoy activities that were once unreachable; however, to transit providers, ADA requires expensive modifications, yet provides no funding for them. Currently, transit providers are modifying

service areas and looking for ways to use scarce resources more efficiently. Some agencies may get increased funding from state and local governments to complete the required service modifications. Others may be forced to decrease fixed route service coverage areas so that they can provide the equivalent paratransit services.

Soon after ADA was passed, the Department of Transportation required public transportation providers to prepare Compliance Plans outlining how they were going to satisfy ADA regulations and their timetable for total regulation fulfillment. In their first reports, transit agencies included goals for bus fleet modification, equivalent paratransit options, and yearly budgetary allocations. ADA has made transit providers search for new ways of financing and making services more effective. Capital subsidies can be used to upgrade the fleets, while operating subsidies will need to be stretched in order to provide increased or modified paratransit services. Consequently, public transit planners have begun searching for ways to do more with what they have and to do it before 1996.

Paratransit

As stated previously, if a rider is not able to use the fixed route system, ADA requires that transit agencies provide equivalent paratransit services for them. In many

areas, paratransit services have been operating for many years, serving the elderly and those not able to ride fixed route services. Transit agencies either provided this service or clients purchased it from another transportation provider. This form of Demand Response transit service operates on a reservation basis. Some advanced operations have real-time dispatching; while others require previous day reservations. These services use small vehicles to pick clients up at their homes and take them to their desired destinations. In some Demand Response systems, vans are used to pick up and drop off clients. In the morning, van drivers receive client reservation lists and spend the day picking and dropping off clients accordingly.

In smaller agencies, Demand Response operations may depend upon manual scheduling, dispatching, and reporting rather than sophisticated computer software. However, agencies may need better information about their paratransit service areas and about the clients than what they can obtain manually in order to provide modified levels of service for ADA. New technologies, such as paratransit scheduling software and geographic information systems (GIS), may have capabilities to help solve these service and information problems. Paratransit scheduling software would enable Demand Response services to automate the often inefficient manual techniques used for scheduling and dispatching. Geographic Information Systems would allow

transit planners to better represent data for use in more efficient service and operations planning.

Purpose of this Study

The purpose of this study is to assess how geographic information systems could be used by public paratransit providers to provide information for their paratransit planning activities. Paratransit operations, as a result of the Americans with Disabilities Act of 1990, are required to modify their service levels to reasonably accommodate the needs of the disabled. As a result, transit providers are under pressure to plan paratransit operations that provide adequate levels of service with limited resources. This thesis is an in depth case study of a small public transit operation that is faced with these service challenges. The study attempts to provide useful geographic information for the agency's Demand Response operations.

Research Questions

The following research questions were addressed in this study:

1. What information could geographic information systems provide for paratransit service planning?
2. How effective is this information for transit planners?

Methodology

The research design for this thesis is a case study of the current and potential uses of geographic information systems for the Greenville Transit Authority (GTA) located in Greenville, South Carolina. As an exploratory application thesis, the study documents current and potential uses of GIS at the GTA, particularly in their paratransit operations. As stated in the Introduction, the Americans with Disabilities Act of 1990 will play a large part in the future of paratransit operations. Consequently, the current and future impacts of ADA on the agency's paratransit operations were investigated. This thesis explores what information a GIS could provide the agency's paratransit operations as they modify services to meet ADA requirements.

Specifically, detailed research was conducted in the following areas as a foundation for potential GIS projects:

1. General background information about Greenville Transit Authority (GTA) and Greenville, SC.
2. Current and future effects of ADA upon GTA.
3. GTA's plans for ADA compliance.
4. Explanation of GTA's Demand Response operations.
5. Current use of GIS by GTA and MPO for transit.

The next phase of research identified specific GIS projects that could be undertaken for GTA's paratransit operations, and completed these as a basis for GIS

information evaluation. Investigative research looked at GTA's information needs and current applications of GIS for paratransit in other transit agencies. Information about other applications of GIS in transit was obtained from a series of informational interviews with other organizations involved in GIS transit applications. An information needs assessment of the Greenville Transit Agency was conducted by interviewing the Director of Planning of GTA and discussing potential projects. Specific projects for information evaluation were chosen by the researcher and her advisor based upon the project's time constraints, complexity, and manageability.

As a demonstration project on the computers at the University of Tennessee, a close replication of the data and geographic information system that is available to the Metropolitan Planning Organization and Greenville Transit Authority was formed. Two projects were completed in order to provide information for the paratransit operations at GTA. Research outputs were maps, coverages, analyses, and detailed documentation of the space, equipment, actions, and problems that were encountered. At the conclusion of this research, the data provided by the MPO and GTA was returned to them, as well as new coverages and documentation created in the research process.

The final phase of research synthesized the usefulness of GIS as an information provider to the Greenville Transit

Authority. Questions concerning both the usefulness and practicality of using GIS for paratransit information were given to the Planning Director at GTA and the MPO staff person assigned to transit planning. The two planners were asked to evaluate the usefulness of the provided GIS information. Evaluations were done by completing a GIS Assessment Form prepared by the researcher.

Value of the Study

As an application thesis, this study has both practical and theoretical merits. In practical terms, it explored the application of a new technology to problems faced by many paratransit providers. Many advantages exist in using the case study methodology. First, studying a small agency enabled the researcher to investigate both paratransit and GIS issues in depth and at the same time this case study was manageable project for one person to complete. Secondly, studies of new technologies, such as GIS, and how they could be applied to problems in transportation are the types of projects that are currently included on the agenda of national transportation research programs, such as the John A. Volpe National Transportation Systems Center and the Transit Cooperative Research Programs. (US Department of Transportation, 1993; Transportation Research Board, 1993). By carrying out such projects on the national research agenda, the study helps to advance the understanding of how

new ideas in transit planning are actually being put into practice.

Feasibility of Study

This study was conducted in Greenville, South Carolina and Knoxville, Tennessee. Background work on Greenville and the Greenville Transit Authority was conducted in South Carolina; while the necessary computer work was done at the University of Tennessee in Knoxville. Data was obtained from the Greenville County Planning Commission, the Greenville Transit Authority, the City of Greenville, and the Appalachian Council of Governments.

Organization of the Thesis

The thesis contains five chapters. Chapter Two outlines the computer components of a GIS, gives a basic theoretical overview of GIS concepts, summarizes areas of GIS use in local government, and places GIS for transit into a proper context. Chapter Three provides background information about Greenville, South Carolina and the Greenville Transit Authority, including a summary of economic and land use characteristics, a brief political overview, current GIS applications in the County, GTA's operations, ADA Compliance Plans overviews, and the effects of ADA upon GTA. Chapter Four contains the project documentation and research outputs that were completed for

the Greenville Transit Authority's evaluation. Chapter Five contains feedback from the GIS Assessment Form, research conclusions, and suggestions for further research.

CHAPTER II

GEOGRAPHIC INFORMATION SYSTEMS

Introduction

According to Understanding GIS: the ArcInfo Method, a geographic information system can be defined as "an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, manipulate, analyze, and display all forms of geographically referenced information" (ESRI, 1990, p.1-2). From this definition, one can see that fully developed geographic information systems are more than just complex computer software programs. Establishing and maintaining a geographic information system is a resource intensive endeavor. In this chapter, the principal computer components and theory of geographic information systems will be discussed, followed by a summary of GIS application areas in local government, including applications in transportation and transit planning.

Computer Components

Theory of Geographic Information Systems

The computer components of a GIS fall into two categories, the mapping software and hardware and the database software and hardware. These two divisions, mapping and database, set GIS apart from other types of

computer mapping applications. With a GIS, spatial data, representing geographic coordinates is linked with non-spatial data containing descriptive attributes. Data is linked based on internal database record numbers. A GIS allows users to access the graphic elements and the database information connected to those attributes. By accessing the underlying database, new relationships between graphic elements can be determined.

In a GIS, related data is kept together in layers called coverages. For example, one layer may contain information on land use, while another layer contains information on the transportation network. Having data layers allows the user to select appropriate layers needed for analysis. If done manually, this analysis technique represents layers on paper maps and overlays these paper layers in an attempt to determine the intersection or union of the layers. A GIS automates this often cumbersome process and adds the database element to it. With GIS a user can display the land use layer, overlay the transportation layer and then perform analysis without physically redrawing the maps. GIS does more than a sophisticated mapping program; rather, GIS performs analysis for determining spatial relationships between map features. GIS "gives you the ability to associate information with a feature on a map and to create new relationships" (ESRI, 1990, Understanding GIS,p 1.9).

Figure 1 shows the steps that are undertaken in a GIS project and illustrates the theory discussed above. The first step taken in a GIS project is to outline the project requirements and gather the necessary data. For example, if the GIS is to be used for a transit applications, data on bus routes, ridership statistics, land use data, and street elevations may be needed. Usually, data must be reformatted for use in a GIS, both spatial data contained on maps or in digital form and non-spatial attribute data must be converted into appropriately formatted data so that layers may be built. Consequently, much data preparation goes into a GIS project before it can be used for data analysis.

Once the GIS database is built and contains the necessary data layers, analysis can occur. Again, figure 1 illustrates this concept. Layers that have been created have be overlaid with each other to create new data relationships. Layers can also be changed, aggregated, or manipulated to form new relationships as well. As the last step in a GIS project, summary maps and reports might be composed.

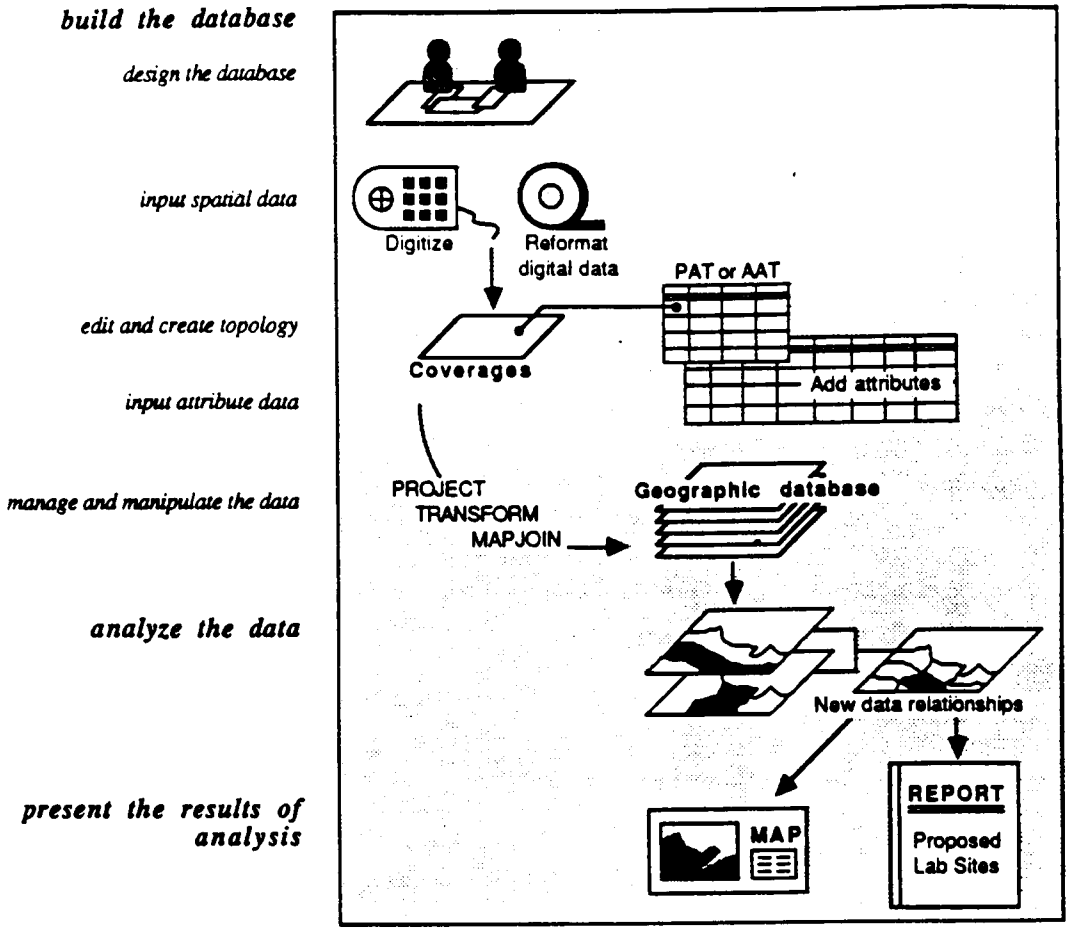


FIGURE 1

STEPS IN A GIS PROJECT

Source: ESRI. (1991). Understanding GIS--The ARC/INFO Method. Redlands: California. p. 3-2.

Applications of GIS in Local Government

In local governments, GIS has revolutionized the way information is kept and represented. In governments with strong GIS programs, many data layers are now kept and updated regularly. New applications and database additions keep GIS on the cutting edge of government applications. Currently, GIS is used in many different levels of government and in the private sector. This discussion will focus upon its use in local governments.

GIS applications exist in the following areas of local government:

1. Urban and Regional Planning Departments
2. Utility Districts
3. Emergency Ambulance Services
4. Public Health Departments
5. Environmental Control Departments
6. Political Redistricting Authorities
7. Transportation Planning and Engineering Departments
8. Police Departments

The above list is by no means exhaustive, there may be many more agencies who are GIS users as well. Once data requirements are met, GIS applications are limited only by the imagination of the user and the capabilities of the software. Specific applications make use of the buffering, intersecting, and union functions of GIS to analyze layer data in a variety of ways (Antenucci, 1991).

GIS and Transit Planning

Examples of specific applications of geographic information systems to transportation planning include "road design, highway mapping, pavement and maintenance management, capital budget planning, analysis of accident data and traffic volumes , and routing and dispatching vehicles" (Antenucci, 1991 p. 43). With the passage of the national Intelligent Vehicle Highway Systems initiative, new technologies, including GIS, are being studied for application in public transportation. The Federal Transit Administration has begun a program to "help develop, evaluate, and publicize recent technological advancements that could be applied in public transportation" (Labell et al, 1992, p.1). Although, GIS is one technology being studied; it is being coupled with other technologies to produce new applications. Carol Schweiger in the 1991 report Current Uses of Geographic Information Systems in Transit Planning identifies seven transit functions in which GIS is and could be used. To summarize these functions, transit applications of GIS and potential projects exist in the following areas:

1. Operations

    * GIS, coupled with other technologies can be applied to scheduling, runcutting, dispatching, and Automatic Vehicle Location display. These applications of GIS help transit agencies by

displaying information and improving service procedures.

2. Planning

   * GIS in connection with transportation software can be used to perform ridership forecasting.
   * GIS can help in the analysis of service planning modifications and in transit/land use development review.
   * GIS can be used for potential market analysis when combined with demographic or economic data.

3. Marketing

   * GIS applications for customer information systems in which information is displayed on routes, times, and bus locations are being developed in several places in the United States. GIS is 'the window' for information display and is coupled with other technology such as Automatic Vehicle Location.
   * GIS can be used to analyze and graphically display demographic characteristics of service areas.

4. Facilities Inventory and Management

5. Real Estate Inventory and Management

   * GIS can be used to assist in the inventory and management of facilities and real estate. GIS does this based upon the feature attributes (age, condition, or location for example) of the parcel

or facility.

6. Maintenance

   * GIS can be used to keep visual track of right of ways, bus stop locations, and vehicle locations.

7. Engineering

   * GIS can also be used to aid engineering applications.

(Schweiger, 1991, Ch 2; Labell et al, 1992, p.1).

As part of this study, three agencies that deal with transit planning were contacted to obtain lists of specific GIS transit projects: Columbia MO Planning Department, VIA Transit in Dallas, TX and the Tidewater Transportation District in Norfolk, VA. The Planning Department in Columbia Missouri has been involved with GIS for the past five years. Columbia's GIS efforts began in March 1988 in response to a proposal by the Federal Highways Administration and the Bureau of the Census to demonstrate the use of census TIGER data (Petzold, 1994). Columbia developed applications and databases for a number of areas, including transit. In an interview with John Fleck from Columbia's Planning Department, the researcher found that Columbia has used their transit database to obtain and display ridership characteristics and to plan for paratransit services. Specifically, Columbia has tied its GIS database into its paratransit scheduling software for graphic display of routes, to help prepare its ADA

Compliance Plans, and to plan efficient fixed routes (Fleck, 1994).

VIA Transit in Dallas, TX hopes to use GIS for some of the same projects as Columbia. In an interview with Jeanne Geiger from VIA's Planning Department, the researcher found that VIA does not have GIS, but hopes to in the future. Recently, VIA purchased paratransit scheduling software and hopes that GIS could interface with it for paratransit route display. Also, VIA would like graphic information on ridership characteristics and an automated system for creating maps. Currently, VIA hand colors their maps (Geiger, 1994).

The Tidewater Transportation District in Norfolk, VA uses Mapinfo software in its paratransit operations. In an interview with Randi Nimmo from TTD's paratransit department, the researcher found that TTD has used its software for a multitude of GIS applications. Projects that the agency has completed include plotting and buffering bus routes to determine ADA service areas, plotting and geocoding major generators in the transit service area, creating image files of fare zones and zone boundaries, and paratransit route planning for ADA clients, large groups, and non-ADA clients. In addition, TTD has prepared travel matrices delineating water boundaries for use with paratransit scheduling software and has created maps representing service areas based on bus availability. The

TTD paratransit reservationist has desktop access to Mapinfo to plot client destination requests and to distinguish between priority trips falling in ADA service areas from trips falling outside ADA service areas. Finally, TTD uses their GIS for draft map creation in their advertising efforts (Nimmo, 1994).

From these informational interviews and the research that has been done on transit GIS, the researcher has found a myriad of potential GIS projects that would be applicable for smaller transit agencies such as the Greenville Transit Authority. Overall, transit agencies seem to use GIS for projects that take advantage of its graphic display capabilities. In addition, route planning and ADA applications appear to be high priorities for transit and paratransit providers.

CHAPTER III

BACKGROUND OF CASE STUDY

Greenville County, South Carolina

Greenville County is nestled in the foothills of the Blue Ridge Mountains in the northwestern part of the state. According to the 1990 census, the County encompasses 797 square miles with a population of just over 300,000 (Bureau of the Census, 1990). Greenville ranks first in population within the state. Six municipalities exist in the county: Greenville, Travelers Rest, Simpsonville, Fountain City, Mauldin, and Greer. The city of Greenville is the largest, taking up 148 square miles. An orientation map showing the general outline of the county and the municipalities is shown in Figure 2.

Greenville is a prosperous city. The median household income for the County is $27,486 (Bureau of the Census, 1990). Public support within the County is strong for projects that boost its economic and social resources. Private funding for civic and cultural amenities often reaches levels that are unheard of for other cities of this size. For example, the Peace Center for the Performing Arts, open since 1990, was the product of thirty million in private donations and only twelve million in public monies.

Historically, Greenville's economy was based on textiles as was most of South Carolina. Old mills and

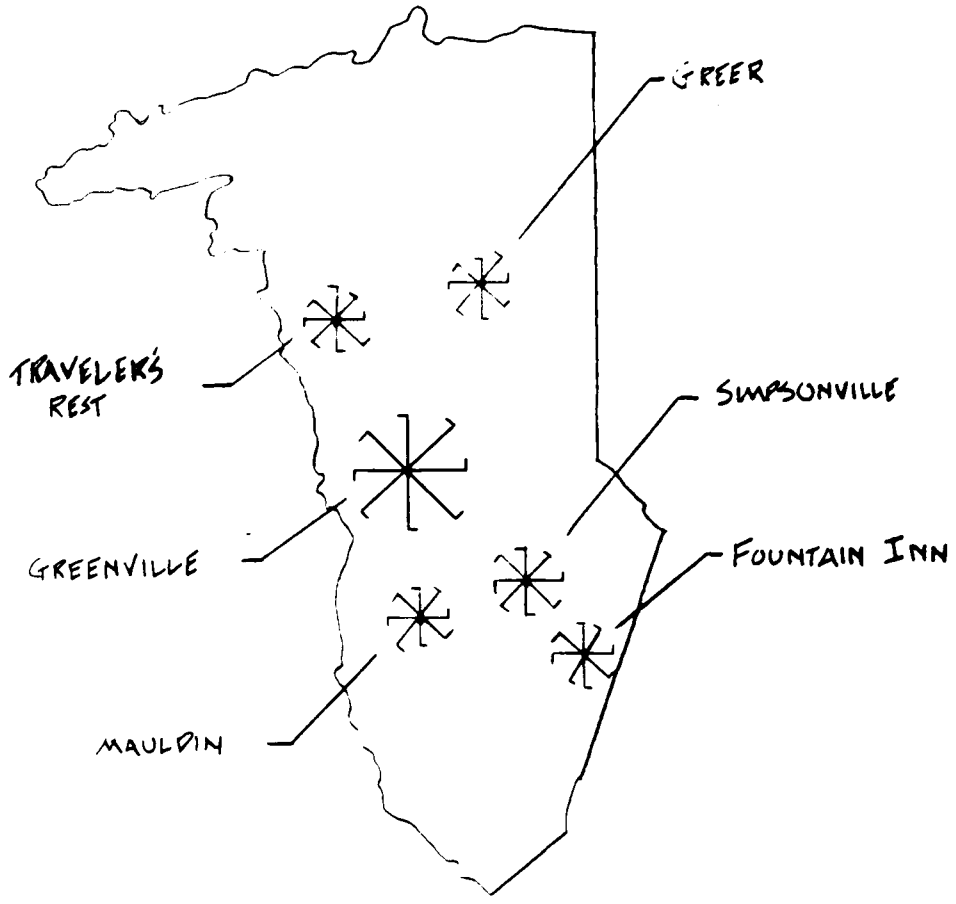


FIGURE 2

GREENVILLE COUNTY MUNICIPALITIES

abandoned buildings still exist on the west side of the city. To shift its economic base, Greenville has tried and been successful in luring international manufacturers to the area. Most of these new industries are locating in the southeast portion of the county. Recently, industries such as Hitachi and BMW have made the decision to locate in the metropolitan area. Areas near the towns of Fountain Inn and Simpsonville in the southeast have experienced much of the new economic growth - both Dow Chemicals and General Electric have plants near these towns. Major activity generators in the County include Furman University, Bob Jones University, McAlister Square, Haywood Mall, Greenville Memorial Hospital, and the new industries mentioned above. These generators tend to be located in the eastern part of the city. However, Furman and the hospital are the exceptions. Furman is located in the northwest section of the County, while the hospital is located in the southwest section. New residential construction has followed the employment base toward the east and southeast. The oldest housing stock is located north and west of the central city. Average new housing prices start around $121,000 while the median housing price is around $100,000.

Greenville County uses the Council/Manager form of government. The County Administrator is hired by the twelve member County Council. The City of Greenville has a mayor and a City Manager. The mayor is an elected official while

the City Manager is hired by a seven member City Council. City Hall is located on Main Street. Currently, the City of Greenville has 880 employees. The biggest city departments are the Police and Fire Departments. County offices are located at the west end of the Central Business District, on what once was the old Furman University campus. Both county, state, and federal offices are located there in a 300,000 square foot building. Previously, government offices were located in the Courthouse. County Square was developed after a large commercial center built on the old Furman campus failed. The County in 1986 --1987 remodeled the building. It currently houses forty eight different governmental offices. The largest departments in the building are the State Department of Social Services and the County Road and Bridge Department.

Planning in Greenville County is done by the Greenville County Planning Commission (GCPC), whose offices are located in County Square. GCPC undertakes all the traditional planning functions for Greenville County, zoning, subdivision regulation, comprehensive and current planning, and transportation planning. Urban residents of the County have a positive attitude toward the planning process and support the GCPC through the county budget and state grants. Rural county residents regard planning as intrusive; a sentiment that is common across rural areas in America (Pleasant, 1994). Politicians within the county generally

support the recommendations of the Planning Commission. The six municipalities in Greenville County use the GCPC as a coordinating body. Key municipal officials have seats on GCPC committees and in turn GCPC undertakes planning for the municipalities.

GIS in Greenville County

GIS resources within the Planning Commission include an in house PC based system, running Atlas GIS, and access to a mainframe system, running ArcInfo, located at the City of Greenville. A county-wide GIS coordinating committee, composed of the 911 EMS, Real Property Services, GCPC, Tax Assessor, Council of Governments, City of Greenville, and the Police Department, is looking into ways to develop a parcel based GIS database for the county. If this system is developed, GCPC may in the future have a Sun Workstation running ArcInfo. Currently, GCPC uses Atlas GIS to produce maps for various planning studies and is hoping to soon use the software for analytical purposes. On the City of Greenville's mainframe, GCPC has completed a demographic study of the Greenville Transit Authority's fixed route system (Pleasant, 1994).

The City of Greenville has been involved with GIS since the mid eighties. Efforts to develop a GIS database continued with mixed success until the 1989 - 1990 fiscal year. At that time, new GIS personnel completed the

database (Hammer, 1994). The City's current GIS database has many different layers that users may select to undertake GIS projects and applications. The City allows employees from other departments to be trained on the GIS system. Mark DePenning, the GIS Department Head, feels that three levels of GIS users take advantage of the department's computer resources. First are the novice users, who submit requests to the GIS department for completion rather than undertaking them personally. Second are the intermediate users, who send their personnel to be trained and who carry out projects with the supervision of the GIS Analysts. Mr. DePenning places GCPC users at this level. Third are the advanced users in Greenville, who undertake sophisticated projects that require complex GIS processing. Mr. DePenning places the Police and Fire departments at this level. These agencies use the GIS system to represent accident and crime patterns, and maintain data in the database (DePenning, 1994). Overall, the philosophy of the GIS Department in the City of Greenville allows training and access to the GIS capabilities so that Greenville County as a whole advances in its GIS efforts.

Another government agency in Greenville that has GIS capabilities is the Appalachian Council of Governments (COG). This organization is a cooperative organization of six local governments in upstate South Carolina. Its role in upstate South Carolina is to provide services, including

planning, and government coordination between its members. The agency acquired its GIS system in 1991. The system uses ArcInfo on Sun Workstations in a Local Area Network configuration. The COG also uses Atlas GIS on the PC, GRASS software, and AutoCAD (Hanning, 1994). The organization has a good working relationship with both the City of Greenville and the GCPC. It took the lead in developing an accurate road network coverage for Greenville County after processing was completed on the City's road network coverage. Examples of recent projects done by the COG include, a study of the BMW airport expansion impacts on future growth, a pollution impact study for the South Carolina Department of Heath and Environmental Control, and demographic and marketing studies for areas within the region (Hanning, 1994).

Transportation Planning in Greenville County

The current transportation network in Greenville County provides good accessibility to vehicles. The Greenville Area Transportation Study (GRATS) committee is the planning body that coordinates transportation planning improvements within the County. The GRATS team has worked hard to plan road improvements that would increase accessibility throughout the County and make it desirable place to live and work (Pleasant, 1994). Two interstates run through Greenville County. I-385 connects Greenville with I-26 which runs toward Columbia, the state capitol. I-85 runs through

the southern portion of the County. It connects Greenville with two of the fastest growing metropolitan regions in the Southeast -- Atlanta, Georgia and Charlotte, North Carolina.

Congestion along busy eastern city arterials does exist; however, movement through the county is relatively easy. Two hundred seventy five thousand automobiles are registered in the County. With a population of just over 300,000 this means that most residents do have access to automobiles. Still according to the 1990 census, approximately 8700 households do not have access to a vehicle (Bureau of the Census, 1990). Public transportation service is provided by the Greenville Transit Authority (GTA).

Public Transportation in Greenville County

GTA has 15 fixed routes that connect residential areas with major activity generators. Buses run Monday through Friday from 6AM to 7PM and Saturdays from 8AM to 6PM. Routes are structured so that service runs thirty minute or one hour timed transfers. Timed transfer means that on the hour and half hour, all buses converge at the downtown Transfer Center.

GTA also operates a Demand Response paratransit service that provides transportation to elderly, young, and disabled residents of Greenville County. Although, Demand Response operates county-wide, most of its clients reside in the

urbanized areas (GTA, 1991). In 1991, Demand Response operated weekdays from 7AM to 6PM. Since 1991, service hours have been expanded to accommodate the Americans with Disabilities regulations. GTA has a service fleet of 57 vehicles, 26 buses of various sizes ranging from 40-50 passengers to trolleys and 31 8-15 passenger vans for the Demand Response and VanPool services. Currently, 36 of these vehicles are handicapped accessible (GTA, 1994). The VanPool service, started in 1992, now operates twelve vans. These vans serve workers who commute to large industries in the area. In addition, GTA's charter services allow buses, trolleys and vans to be rented by groups for special events.

In 1991, Annual Passenger Miles for GTA were 6,049,904. To place this figure in an identifiable context, the Metropolitan Atlanta Regional Transportation Authority (MARTA) had 622,974,861 passenger miles and Knoxville Transit (K-TRANS) had 8,564,354 passenger miles (Federal Transit Administration, 1992). Average unlinked trips for GTA in 1991 were 1,066,471. According to the Glossary of Transit Terms for Section 15 annual passenger miles represent the "cumulative sum of the distances ridden by each passenger", and unlinked trips represent "the number of passengers who board public transportation revenue vehicles" (FTA, 1992, pg. 12, 18). These numbers along with a few others describe the consumption of transit services in an area. Greenville compared to the others is a relatively

small operation. Table 1 shows how GTA stacks up to other transit agencies in South Carolina.

The figures derived for Table 1 come from the Section 15 Report required each year by the federal government. The federal government collects statistics about the each transit agency in part to determine investment decisions and policy analysis. Information about expenses, income, operations and ridership, and safety characteristics are reported. Transit agencies are responsible for completing Section 15 reports each year for their transit and paratransit services. Reports are available in written and computer form. This national transit database is used by the Federal Transit Administration for distribution to other federal agencies and Congress. The data is also available to transportation providers. For this study, only statistics on South Carolina transit agencies were investigated (FTA, 1993, May).

Table 1 shows that GTA is not the biggest transit provider in the state, that honor belongs to the Charleston branch of South Carolina Electric and Gas. GTA is fourth in annual passenger miles in the state and third in operating expenses. In paratransit service, GTA ranks second only to the Pee Dee Regional Transit Authority. Overall, GTA transit services are comparable with other agencies in the state.

Table 1
Transit Systems in South Carolina

Agency*	Total Fleet	Buses	Demand Response	Annual Pass. Miles	Annual Unlinked Trips	Operating Expenses
GTA	56	26	31	$6,049,904	$1,066,471	$3,032,589
Aiken Co	8	1	3	$73,844	$6,803	$162,275
SCE&G-Chas	51	34	0	$13,510,399	$3,543,649	$4,375,448
Cola RPC	8	0	8	$108,035	$11,418	$203,415
SCE&G-Cola	58	35	0	$10,474,705	$2,961,514	$4,861,910
PDRTA	110	4	87	$7,552,002	$480,608	$2,654,601
Sptng Tran	5	5	0	$116,610	$10,998	$157,042

*
Greenville Transit Authority
Aiken County Transit system
South Carolina Electric & Gas - Charleston
Columbia/Central Midlands Regional Planning Council
South Carolina Electric & Gas - Columbia
Pee Dee Regional Transit Authority
Spartanburg County Transit System

Source: FTA. (1992). Transit Profiles. Washington, DC: US Department of Transportation.

Funding for GTA comes from local, state, and federal sources through the matching funds program. In 1991, GTA received $574,018.00 from local sources, $419,939.00 from the State, and approximately $2.5 million from the federal government (FTA, 1992). Greenville Transit has worked to secure dedicated funding from local sources for the past several years. Dedicated funding would allow GTA to have a consistent source of local matching funds available. Attempts at obtaining dedicated funding have not succeeded. Voters in Greenville County do not see the connection between expanding transit service and a better Greenville economy. Consequently local public support is inconsistent, GTA must work hard to gather local monies to provide basic service; while at the same time modify services to meet new federal regulations.

As outlined earlier in this thesis, the Americans with Disabilities Act places requirements on public transportation providers to modify or upgrade their services. Transit authorities must prepare yearly compliance plans outlining service modifications, new services provided, and future service goals. Nineteen ninety two was the first year of reporting for transit agencies, who must be in full compliance by June 30, 1996. In 1992, GTA outlined a five year plan to modify service and obtain necessary funding (GTA, 1992). Since then GTA has modified and upgraded its paratransit service hours by

adding Saturday service and longer weekday service. In addition, GTA has purchased new wheelchair lift equipped vans with larger capacities. These new vans allow GTA's Demand Response service to increase the number of riders per hour. Although, GTA seems to be progressing, the agency has been unable meet its original service goals outlined in the first Compliance Plan (GTA, 1994). ADA requires transit services to eventually increase; however federal funding for transit is declining. Transit agencies must now look to state and local levels for support. Unfortunately for GTA, in 1992 its Board of Directors voted against asking for increased local funding. Consequently, GTA must depend upon the state of South Carolina alone for funding (GTA, 1994). In the ADA Complementary Paratransit 1994 Update, GTA states that changes in state funding regulations may now allow transit agencies to use money for operating expenses that had been previously designated for capital needs. If GTA is allowed to reallocate its funding according to these new regulations, the agency will be able to meet their ADA goals (GTA, 1994).

Transit planning for GTA needs new and innovative programs to increase service efficiency. Planning for the agency is done by the GTA Planning Manager and a part time assistant. Also GCPC designates one transportation planner to work with GTA to prepare the transit portion of the yearly Transportation Improvements Program (TIP) and to help

with other projects.

GTA does not have direct access to software programs such as GIS and paratransit scheduling software that could provide information for transit planning. Instead, detailed information about demand response operations and scheduling is handled manually by four persons in the Demand Response Department. Without these key personnel, helpful planning information remains hidden in the written Demand Response records. In an interview with GTA's Planning Manager, two information areas surfaced that could be potential GIS projects suitable for research. First, GTA needs demographic information on their Demand Response clients. A similar study was done for the Greenville Transit Authority for their fixed routes by the GCPC. Second, GTA planning personnel would like to see how Demand Response vans move along their routes (Osei-Owusu, 1994). Currently, after the vans leave the lot, their location is reported only through periodic radio dispatches. With movement information on the entire route, the planning staff would be better equipped to recommend future service or operational changes.

These information needs are spatial analysis questions that could be answered using a GIS. In order to provide client characteristics information, one could represent census data spatially and overlay it with client information. Providing information for route modeling would

require more sophisticated GIS processing. Detailed movements of vans and how they interact would require a temporal GIS able to represent movements in time (Langram, 1992). This level of analysis however, is beyond the expertise and resources of the researcher. Consequently with a non-temporal GIS, GTA will get snapshots of how vans move throughout the day rather than models of real time interactions. Still, these maps would provide service and operations information for future paratransit planning. Route modeling snapshots can be done using the network capabilities of ESRI's ArcInfo program. The next chapter documents the process, products, resources, and problems that were encountered in doing these two GIS projects for the Greenville Transit Authority.

CHAPTER IV

GIS APPLICATIONS FOR GTA

Background

The geographic information system that was used for this study was the Environmental Systems Research Institute's ArcInfo program version 6.1.2. ArcInfo is considered one of the more sophisticated GIS software programs on the market today. It offers capabilities in six different areas: "geographic database generation and management, geographic analysis, geographic database manipulation, database query, geographic display and report generation and user development and customization" (Orr, 1992, pp 22-29). Spatial data in ArcInfo is represented as three different types of features: points, lines, and polygons. Points represent geographic coordinates or labels. Lines, called arcs, represent features such as streams or road networks. Polygons represent enclosed areas, such as land parcels (ESRI, 1990, Understanding GIS). The relationship between points, lines and polygons is called topology. Three important topology concepts used in ArcInfo are connectivity, contiguity, and area definition. Connectivity means that arcs connect together at nodes. Contiguity means that arcs have both direction and left and right sides. Area definition means that arcs which connect

to surround an area define a polygon (ESRI, 1990, Understanding GIS).

ArcInfo is a georelational model that connects spatial data with descriptive data (ESRI, 1991, Arc Info Data Model). The ArcInfo data structure organizes groups of related information into themes called coverages. For example, all the spatial and descriptive information for area highways may be in a coverage named HIGHWAYS. Spatial features for the coverage are connected to its database attributes based on internal record numbers. Each coverage consists of several files grouped under a coverage name. These files contain specific attributes connected to the coverage (ESRI, 1990, Understanding GIS). For example, the road network coverage that was used in both GTA projects has several files with different extensions: CL45F.aat, CL45F.add, CL45F.nat, etc. These extensions represent the different types of attribute files needed by ArcInfo. The .aat extension stands for arc attribute table and contains information about the arcs in the coverages. The .add file contains information for the address ranges along the arcs. The .nat file contains information about the nodes in the coverage.

Specific ArcInfo processes used in this study include address geocoding and the network data model. Address geocoding is a "mechanism for building a database relationship between addresses and coverage features" (ESRI,

1991, Address Geocoding, p. 2). Geocoding allows information that may be tied to addresses, to be used with coverages that have address ranges. ArcInfo uses the contiguity concepts of direction and left/right sides to assign address ranges to arcs. The process of address geocoding in ArcInfo is done with the ADDRESSMATCH command. During the course of both GTA projects, addressmatching was used. Specific processing steps are documented later in this chapter.

The network data model in ArcInfo allows the modeling of "systems of interconnected linear features through which resources are transported or communication is achieved" (ESRI, 1992, Network Analysis, p. 2-1). The elements in the network data model include: network links, network nodes, stops, centers, and turns (ESRI, 1992, Network Analysis). This data model was used extensively in the route modeling project for GTA. Essentially, ArcInfo creates routes between user specified stop nodes. At these nodes, resource movement and/or allocation can be modeled and the shortest paths between stops can be found. Specialized files are created to be used with the coverage to model series of stops or resource demand (ESRI, 1992, Network Analysis).

The rest of this chapter contains documentation on the two projects that were done for the Greenville Transit Authority. First is the Demand Response Demographic Study, followed by the Route Modeling Study. The format that is

used to document the projects lists the step taken, the command given to ArcInfo (in all caps), and then explains the command in plain English.

Demand Response Demographic Study

This study uses census information to display demographic characteristics for GTA's Demand Response operations. It follows an earlier study done by the Greenville County Planning Commission of the demographic characteristics of the GTA's fixed route services. Specifically, seven census variables were overlaid with a Demand Response client point coverage to produce thematic maps containing the census data and client locations. From these maps, summary statements were made about the characteristics of the areas where Demand Response clients live.

Outline of Project

Problem: GTA would like to have demographic characteristics information for its Demand Response operations.

Actions: Use GIS to perform overlay analysis to obtain demographic information about GTA's Demand Response clients.

a. Obtain Demand Response operations regular client list.

b. Addressmatch this list to the road

network to create a client point coverage.

c. Overlay census data and point coverage to perform analysis.

d. Prepare maps of these coverages.

e. Prepare summary of results as part of a Demand Response Project Report.

Documentation of Actions

1. Prepare the Data.

A list of clients who use the Demand Response service on a regular basis was obtained from the Demand Response Department in April 1993. GTA staff confirmed that the clients on this list use the service. After the list was received, complete address information was obtained for each client. Appendix A contains the addresses of these clients. An ASCII file containing this information was created to bring into the INFO database. The INFO file DRCLI contains the following item definitions:

CLIENT, 20, 20, C

ADDRESS, 35, 35,C

CITY, 15, 15, C

Item definitions define the item name, width, output width, and data type.

2. Prepare the Demand Response Client Cover.

a. Build the Greenville County Road Network to restore topology.

ADDRESSBUILD CL45F2.DIR LINE

This command directs ArcInfo to build addresses for the line coverage c145f2.dir.

b. Addressmatch the client info file DRCLI against the road network coverage.

ADDRESSMATCH DRCLI ADDRESS CL45F2.DIR CLIENTS 10 # REJECTS

This command directs ArcInfo to addressmatch DRCLI based on the ADDRESS item using the road cover CL45F2, to create an output file called CLIENTS with labels offset 10 units from the actual point location, and to use interactive reject processing.

The client list was addressmatched interactively using address reject processing in ArcInfo. Reject processing lets the user change an address to force a match to the road network. Since the process was done interactively no record of forces was kept; consequently, the error rate is assumed to be the same as the error rate experienced for the route modeling portion of this thesis, approximately 6.6 percent. For complete a complete explanation see the Route Modeling section of this chapter. After addressmatching was completed, the point coverage CLIENTS contained 89 client point locations.

3. Prepare Census Data Coverage.

a. The road network and the census data coverage were in two different map projections. The census data coverage was projected into the same map projection as the road network. The CLIENTS coverage did not have to be projected since it was created using the road network cover. If the census cover had not been projected into the same projection as the road network, overlay analysis would not have been possible because the coverages would not have 'matched'. Specific projection information for the road network and census coverages are in Appendix B. Map projections are the way geographers represent the earth on a flat surface. Projections have known distortions. ArcInfo is able to convert from one projection to another because it accounts for these distortions.

PROJECT COVER GTADEM2.DIR GTAPRO.PRJ GTAPRO.DIR

This command directs ArcInfo to project the coverage GTADEM2.DIR into the coverage GTAPRO.DIR using the parameters given in the projection file GTAPRO.PRJ.

b. The census coverage needed further processing in order to represent census tracts. Initially, the coverage represented census information to the block level. This level of detail was too small to provide useful information. Therefore, the data was aggregated up to the census tract level.

INFO

```
SELECT DRDEM.PAT
STATISTICS TRACT TRACTAG
>SUM POVERTY92, MALE65+, FEMALE65+, TOT65+,
>MALEWKAGE, FEMALEWKAGE, TOTWKAGE
```

This series of commands directs ArcInfo to create a file called TRACTAG based on the TRACT item values in the INFO table DRDEM.PAT and for each tract to calculate sums of the selected census variables. The TRACTAG file has the following items: TRACT, SUM_POVERTY92, SUM_MALE65+, SUM_FEMALE65+, SUM_TOT65+, SUM_MALEWKAGE, SUM_FEMALEWAGE, SUM_TOTWKAGE.

```
SELECT TRACTAG
ADDITEMS POV92, MALE65+, FEMALE65+, TOT65+,
MALEWKAGE, FEMALEWKAGE, TOTWKAGE
CALCULATE POV92 = SUM_POVERTY92 ...
CALCULATE TOTWKAGE = SUM_TOTWKAGE
DROPITEM SUM_POVERTY92 ... SUM_TOTWKAGE
```

This series of commands directs ArcInfo to add census items to the file, to calculate these new items to be equal to the sum items, and then to drop the sum items. After these commands were invoked, the census file was ready for further processing. At this stage, the census variables were in whole numbers representing people, for this project the variables needed to be in percentages. Using the totals for each variable for the county, percents were calculated for each variable.

```
SELECT TRACTAG
ADDITEMS PCTPOV,5,6,N,2 ... PCTTWKAGE, 5,6,N,2
CALCULATE PCTPOV = POVERTY92/8453
CALC PCTM65+ = MALE65+/15308
CALC PCTF65+ = FEMALE65+/24497
CALC PCTT65+ = TOTAL65+/39805
CALC PCTMWKAGE = MALEWKAGE/101711
CALC PCTFWKAGE = FEMALEWKAGE/107138
CALC PCTTWKAGE = TOTWKAGE/208849
```

These commands direct ArcInfo to calculate percentages for each variable. This completed the census data processing of this INFO file. Next, the graphic elements of the census coverage were dissolved into census tracts.

```
DISSOLVE DRDEM2 CTRACT TRACT
```

This command directs ArcInfo to group values with the same tract values into one record for the whole tract. This command collapsed 312 block records into 86 tract records for Greenville County. The two files now represent census tract information. TRACTAG and CTRACT were then joined together to create the final census cover used in the overlay analysis.

```
JOINITEM CTRACT.PAT TRACTAG CTRACT.PAT TRACT TRACT
```

This command directs ArcInfo to join the CTRACT.PAT file to the TRACTAG file to form CTRACT.PAT, to relate the two files using the TRACT item, and to start adding information after the TRACT item in the CTRACT.PAT file.

4. Prepare maps for analysis.

Maps of the demographic characteristics were prepared using the census and client coverages. An Arc Macro Language (AML) program was written to generate the maps. AMLs are programs that contain the commands needed to do specific actions in ArcInfo. Advantages of AMLs over interactive command entry are that commands do not have to be entered repeatedly, processing goes faster, and user specified changes can be made easier. The AML used to create maps for the Demand Response Demographic Study, DRMAP.AML is located in Appendix C.

The next few pages contain the maps prepared for the Greenville Transit Authority for the Demand Response Demographic Study. Overall, most Demand Response clients are concentrated in the central city areas of Greenville, with a few scattered toward the smaller cities of Travelers Rest, Greer and Simpsonville. Characteristics of the areas where the greatest client concentrations are located include: fewer working age persons, higher poverty levels, and mid range concentrations of persons over 65+. For closer analysis of specific census characteristics consult Figures 3 through 9.

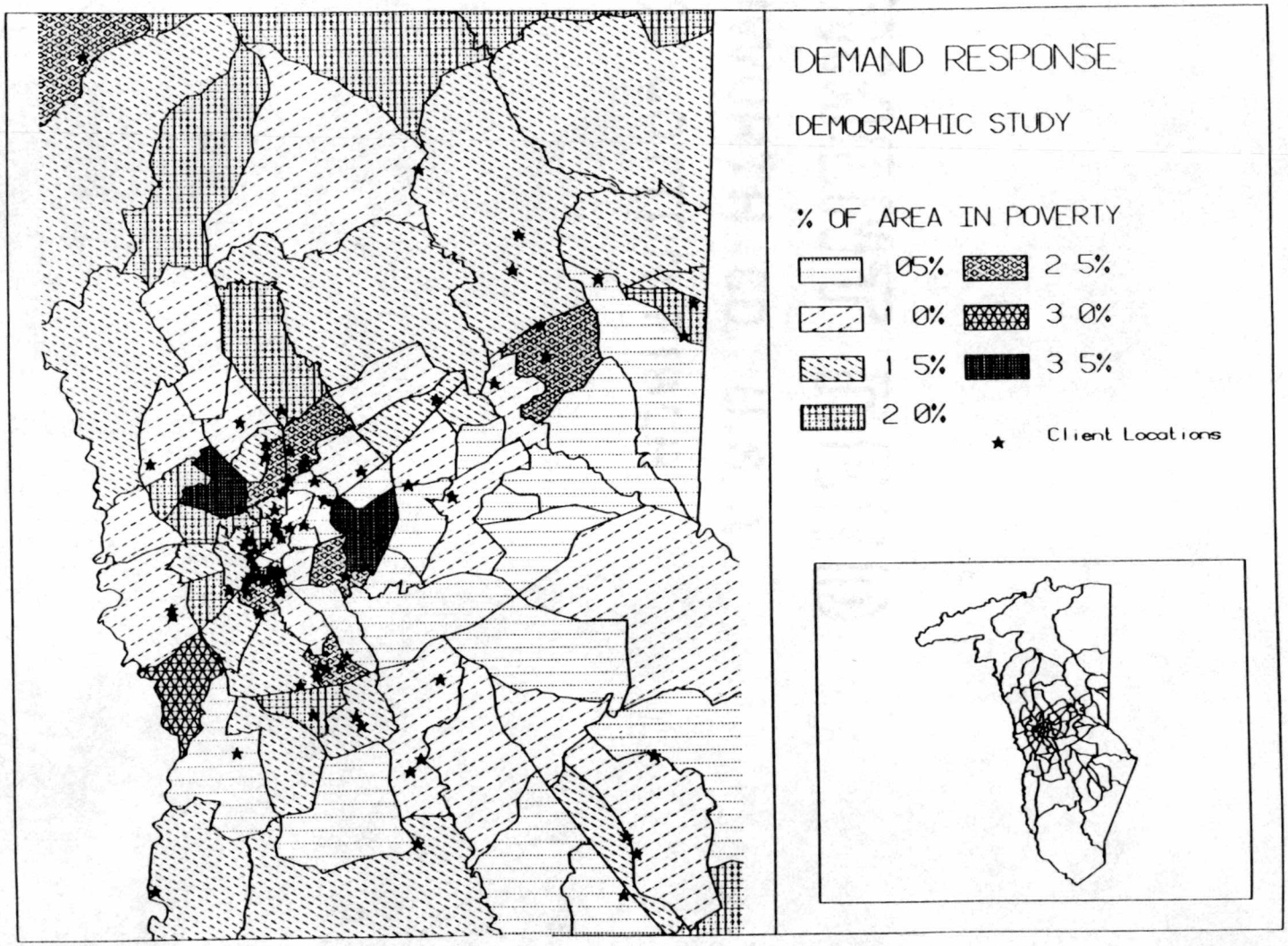


FIGURE 3

PERCENT OF AREA IN POVERTY

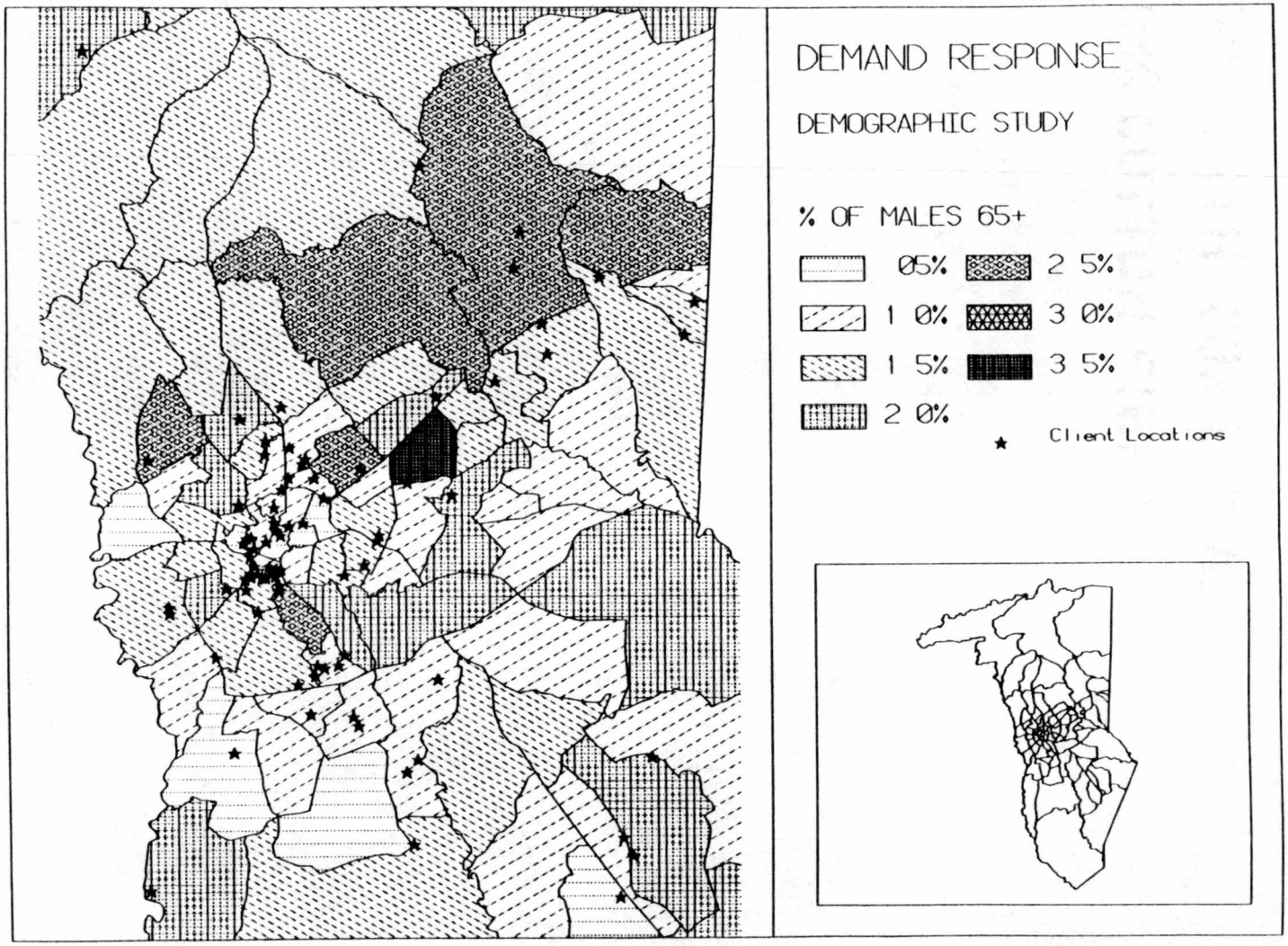


FIGURE 4

PERCENT OF MALES 65+

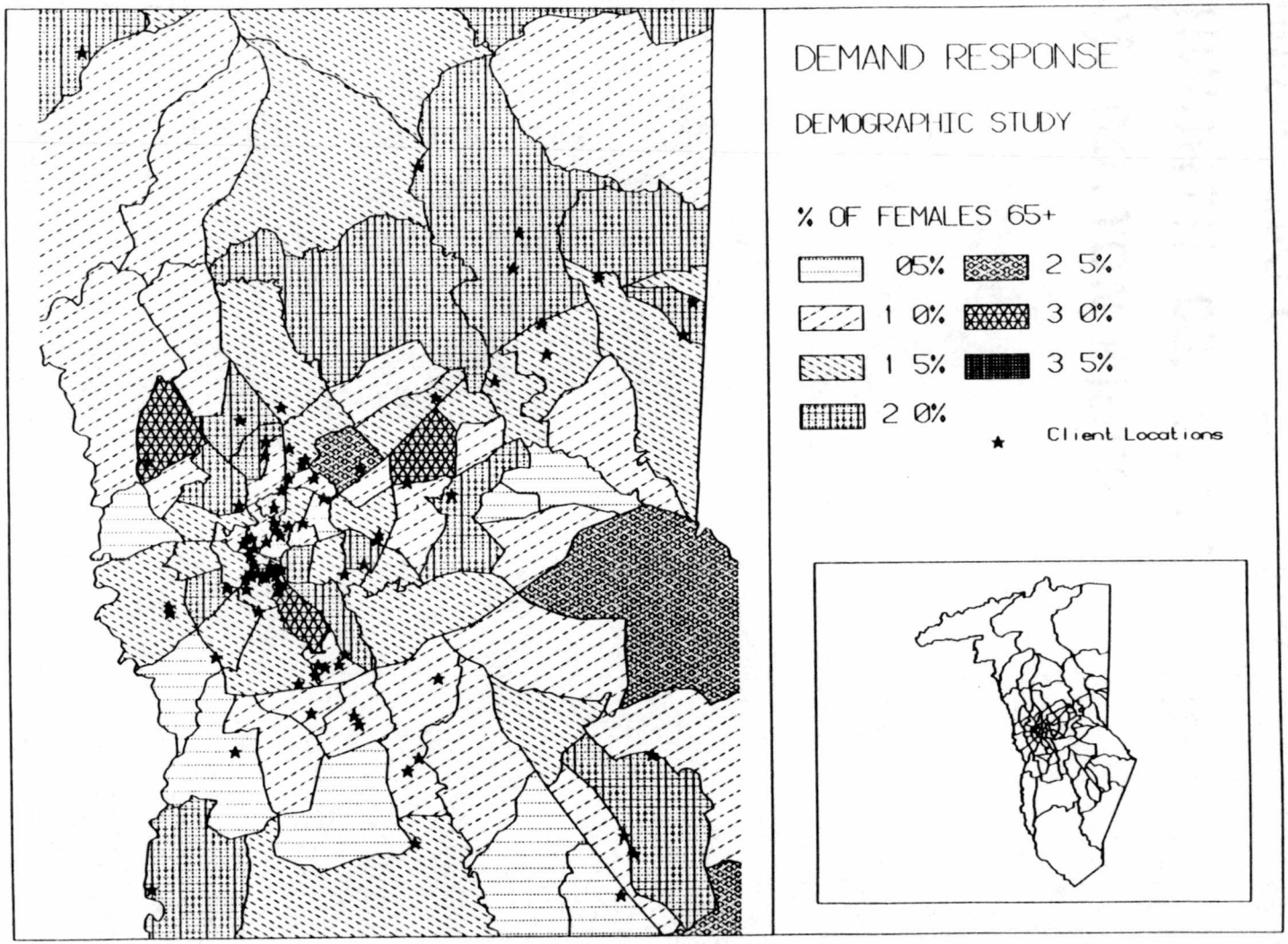


FIGURE 5

PERCENT OF FEMALES 65+

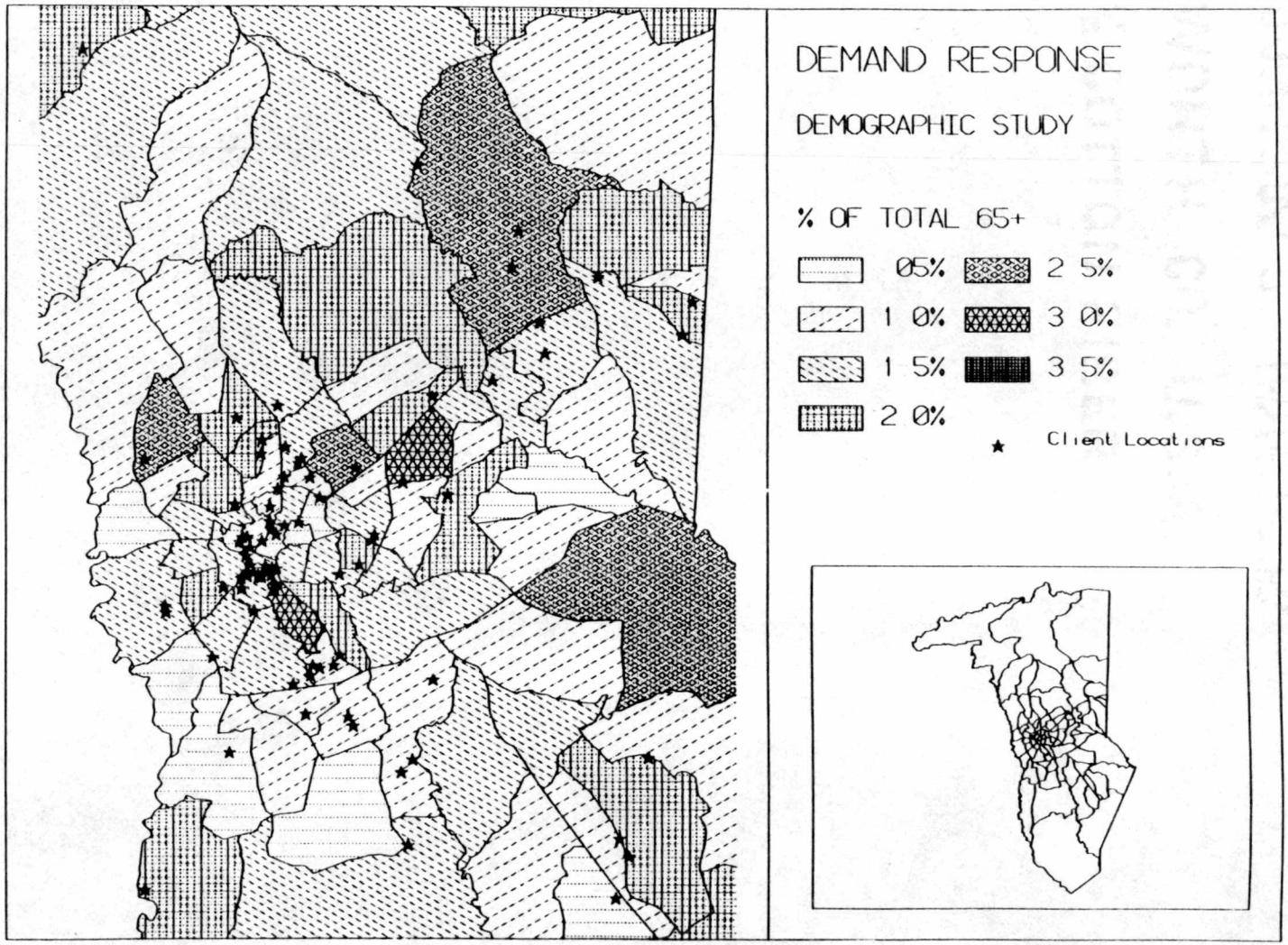


FIGURE 6

PERCENT OF TOTAL 65+

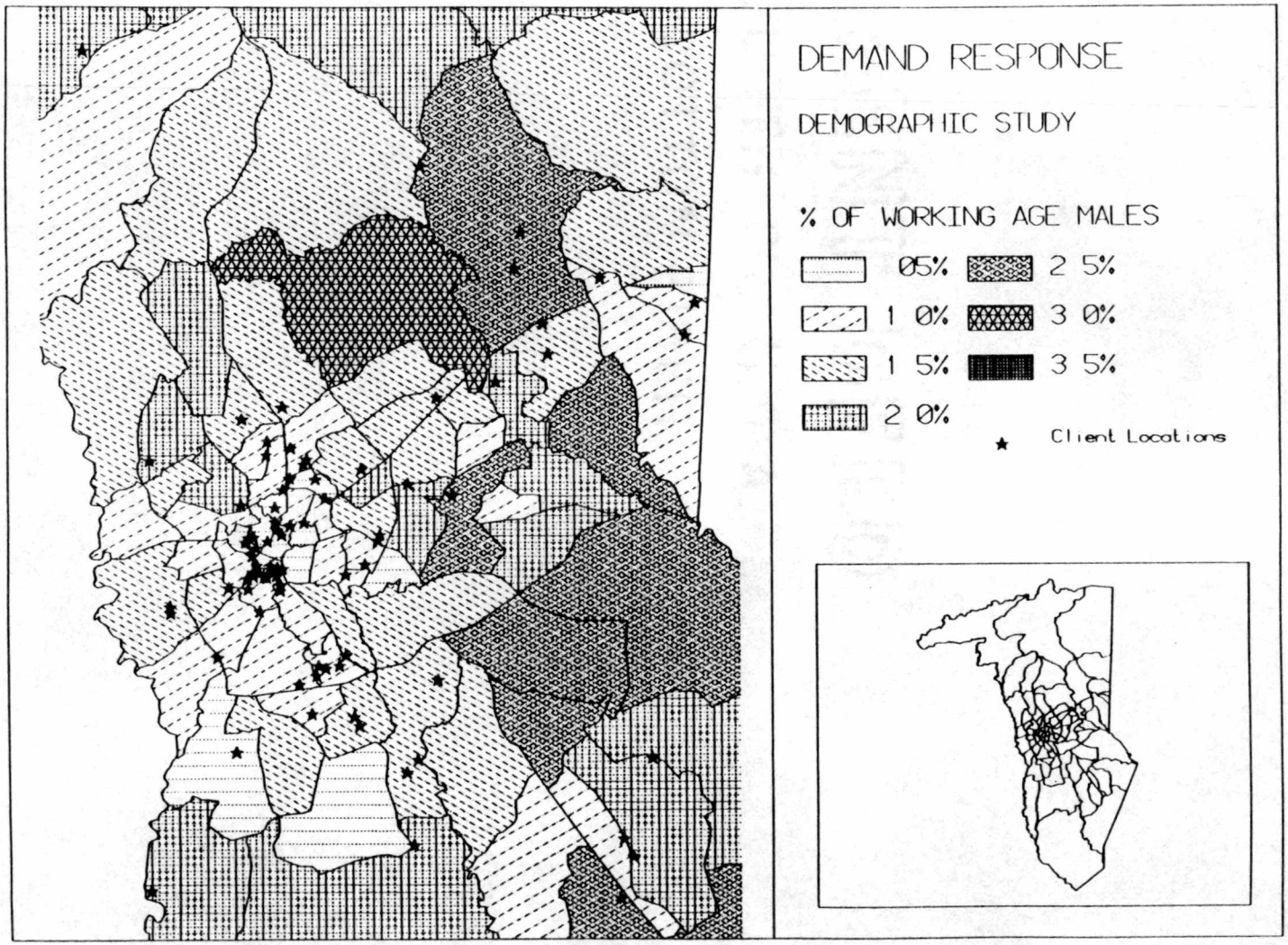


FIGURE 7

PERCENT OF WORKING AGE MALES

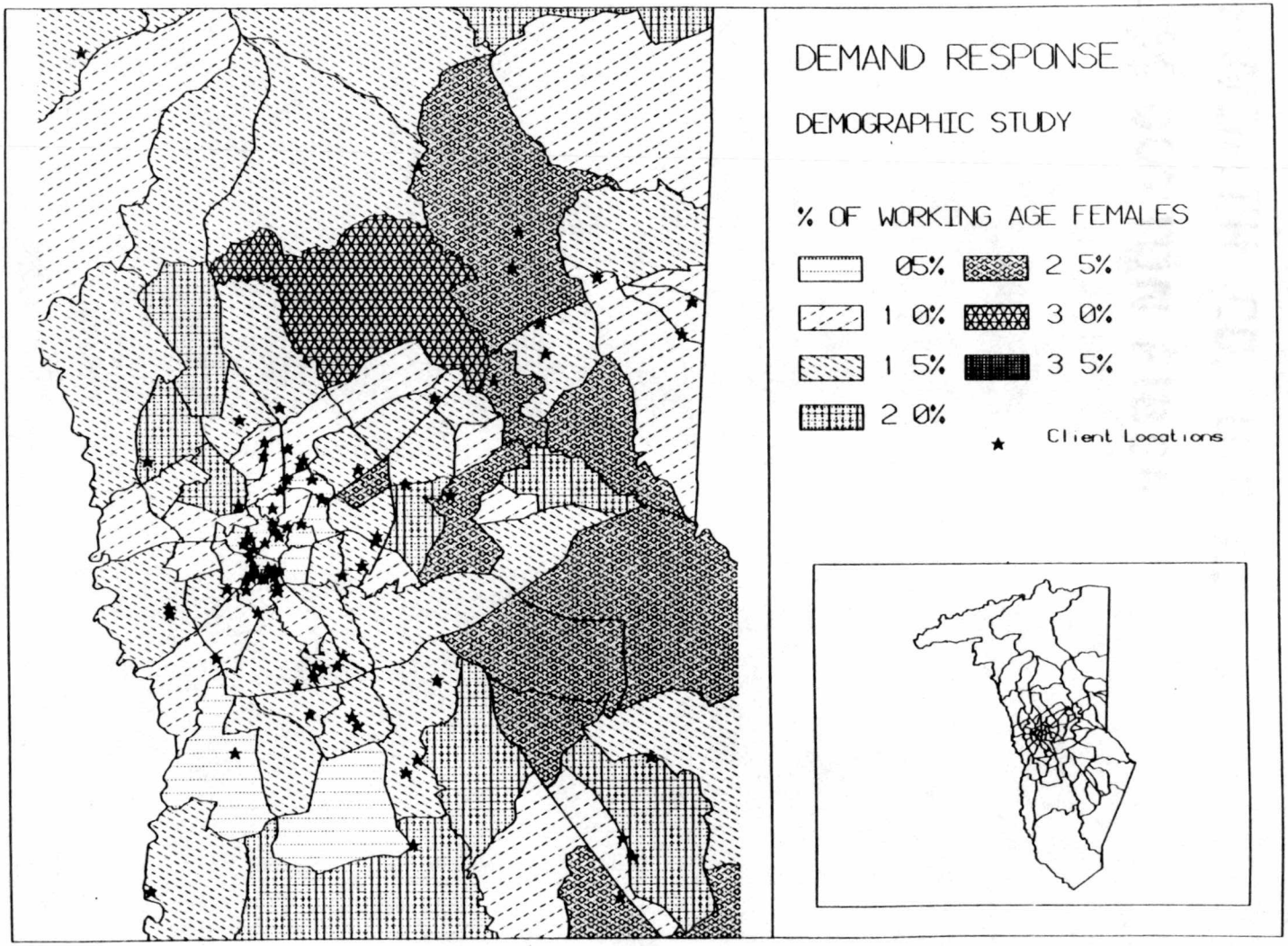


FIGURE 8

PERCENT OF WORKING AGE FEMALES

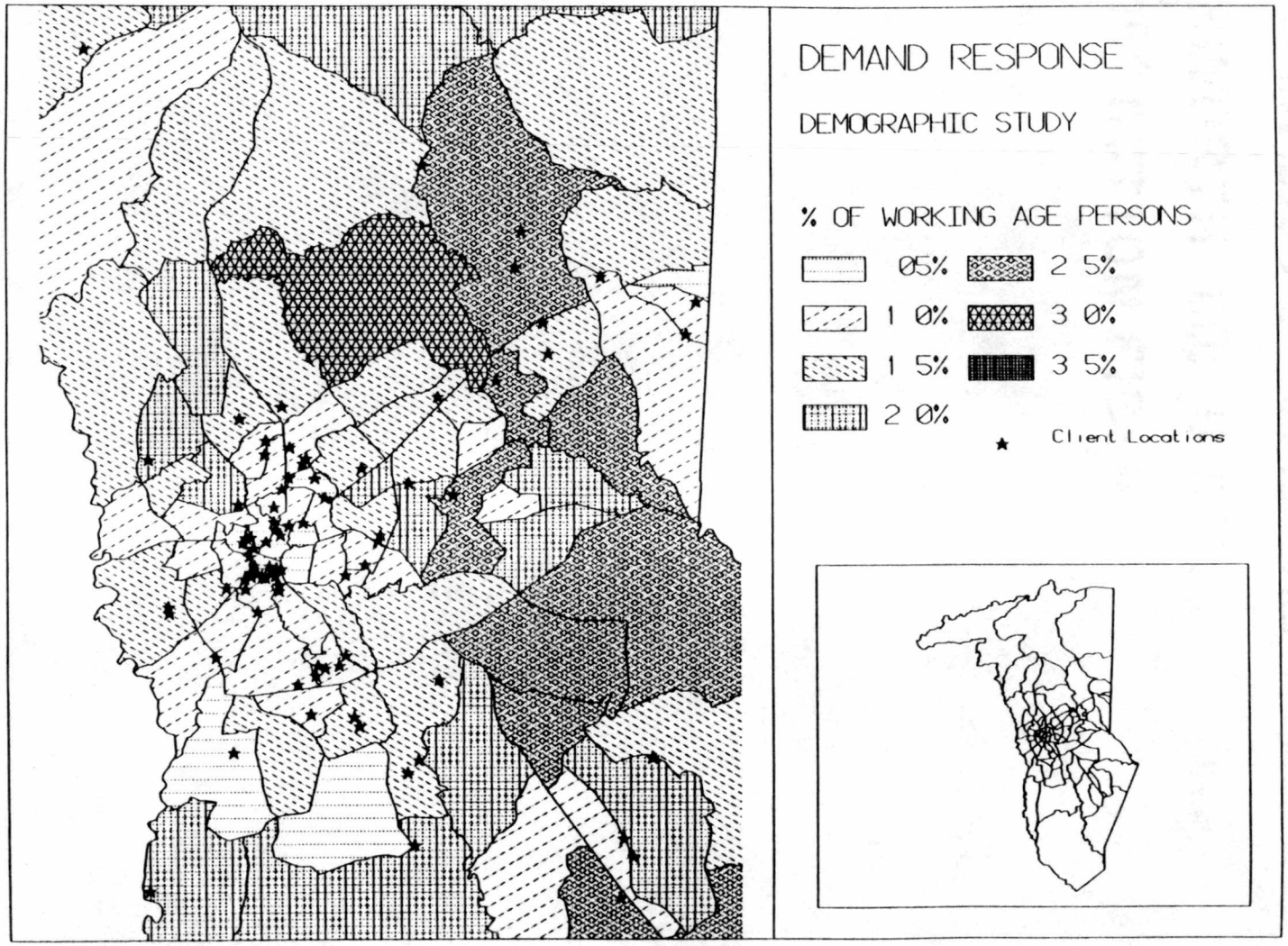


FIGURE 9

PERCENT OF WORKING AGE PERSONS

Demand Response Route Modeling Study

The route modeling project included the representation of twenty-one paths followed by the Greenville Transit Authority's Demand Response van service. Two days were modeled, August 26, 1993 and December 27, 1993. Fourteen vans ran on August 26 and 8 ran on December 27. Results given in this thesis deal with the 8 routes from December 27, 1993. After the GIS steps were preformed, August routes proved to be more difficult to represent graphically due to the number of stops made. Consequently, the fourteen August route coverages will not be included in the thesis; however, they will be returned to GTA/GCPC as ArcInfo route coverages for their use.

Outline

Problem: GTA needs pictures of how their Demand Response Vans move throughout the day to see if the vans are routing themselves in the most efficient way.

Actions: Use GIS to represent vans patterns throughout the day. Assign label points to help represent van movements.

a. Pick two random days from the period of February 1993 - February 1994.

b. Put stops in order of occurrence using information obtained from the van

drivers' logs.

c. Run the PATH command in ArcInfo to find the shortest paths between stops.

d. Create maps representing the van routes.

e. Obtain comparison statistics for each van.

f. Present findings as part of as Demand Response Report to GTA for their use in decision making.

Documentation of the Actions

Step 1: Preparing the Data

Once van routes were selected, ordered stops for each route were derived from the van service logs that were provided by GTA. The total number of stops for both days was 510. This breaks down to 371 on August 26 and 139 on December 27. Table 2 is an example of the information that was extracted.

For all 22 van routes this information was formatted into comma delimited ASCII file and each record was assigned more information to identify the route, and stop order. An INFO file was created to contain the route information. The item definitions for the file DRESPCLI are IN_ORDER,4,5,I; ROUTE_ID,4,5,I; ADDRESS,35,35,C; AND SCHED,9,10,C. The address item was parsed using the ADDRESSPARSE command so that addresses were in a format that ArcInfo could recognize.

TABLE 2
STOPS FOR AUGUST 26, 1993 VAN 204

STOP	TIME	PLACE
106 Augusta St	7:00 am	GTA
21 Lewis St	7:31 am	
120 Shaw St	7:55 am	
315 Orders St	8:00 am	
121 E Foster Ct	8:04 am	
709 Dunbar St	8:25 am	Clinic
38 Bagwell Cir	8:45 am	
100 Mallard St	9:00 am	General Daycare
900 Green Ave	9:55 am	
308 Mills Ave	10:00 am	Upstate Dialysis
100 Queen St	10:39 am	Mtn View Homes
4103 E North St	11:00 am	
709 Dunbar St	11:45 am	Clinic
121 E Foster Ct	12:00 pm	
315 Orders St	12:05 pm	
30 Perry Ave	12:15 pm	
3510 Augusta Rd	12:33 pm	VA Clinic
100 Mallard St	2:43 pm	General Daycare
38 Bagwell Cir	2:50 pm	
3510 Augusta Rd	3:05 pm	VA Clinic
30 Perry Ave	3:19 pm	
106 Augusta St	4:00 pm	GTA

Source: GTA. (1993) [Demand Response Van Driver Logs]. Unpublished Raw Data.

Step 2: Create Point Coverage of Route Stops.

ADDRESSMATCH DRESPCLI ADD2 HOPE1.DIR DRMTCH1.DIR

10 # REJECTS

This command directs ArcInfo to addressmatch the file DRESPCLI against the road network cover HOPE1.DIR, to create a point cover called DRMTCH1.DIR, and to invoke reject processing.

Five hundred and ten stops were addressmatched. Address reject processing was invoked in order to force addresses to match. Of the 510 stops processed, ArcInfo did not recognize 34. These addresses then were corrected using reject processing. Only 6.6% of the total number of stops required reject processing. After addressmatching was completed, the point coverage DRMTCH1.DIR, containing 510 stops, was created and used to build the STOP file needed by ArcInfo to determine route paths.

Step 3: Building the STOP File.

A STOP file is required to use the PATH command in Network. This file must contain the following information: Route_ID item, In_order item, Impedance item, Node_id item.

1. Route_id item: This item is the id assigned to van routes. In this project the 22 routes were given ids from 2 to 23.
2. In_order item: This item represents the ordered stops for each route, ranging from 1 to x

stops depending upon the van route.

3. Impedance item: This item represents the cost associated with each stop. In this project, the impedance value was calculated as the average time spent at a stop, that way each route had its own impedance value.

4. Node_id item: This item represents the node in the road network coverage that is nearest the stop in the stop point coverage. It is obtained from addressmatching the stops against the road network coverage.

A series of database creations and manipulations are required to create a STOP file, actions most appropriate for an AML. Unfortunately, little documentation exists in the ArcInfo manuals on the specific commands used for the database manipulation. Instead, the principal source for the next series of commands was consultations with a Geography professor at the University of Tennessee.

NEAR DRMTCH1.PAT HOPE1.DIR NODE

This command directs ArcInfo to add to the coverage DRMTCH1.DIR, the nearest node-ids from the HOPE1.DIR coverage. These node-ids are a key element in the STOP file.

ADDITEM DRMTCH1.PAT DRMTCH1.PAT HOPE1-ID 4 5 B

This command directs ArcInfo to add the item HOPE1-ID

to the DRMTCH1.PAT.

```
INFO
SELECT DRMTCH1.PAT
RELATE HOPE1.NAT 1 BY HOPE1# LINK
CALC HOPE1-ID = $1HOPE1-ID
```

This series of commands directs ArcInfo to use the HOPE1# item in HOPE1.NAT as the relate item, and to calculate HOPE1-ID in the DRMTCH1.PAT equal to the related item.

```
ARCPLOT
INFOFILE DRMTCH1.DIR POINT HOPE.STEP DRMTCH1-ID
INFOFILE DRMTCH1.DIR POINT RT.MATCH HOPE1-ID
DRMTCH1-ID
```

This series of commands directs ArcInfo to create the file HOPE.STEP containing the DRMTCH1-ID item obtained from the point coverage DRMTCH1.DIR, and to create the file RT.MATCH containing the HOPE1-ID AND DRMTCH1-ID item obtained from the point coverage DRMTCH1.DIR.

```
TABLES
UNLOAD DRESPCLI DRROUTES.STP IN_ORDER, ROUTE_ID
ADDITEM DRROUTES.STP STOP_IMP
```

This series of commands directs ArcInfo to unload the IN_ORDER and ROUTE_ID to the file DRROUTES.STP, and to add the STOP_IMP item to DRROUTES.STP from the file DRESPCLI. The item STOP_IMP was calculated as the average stop time for each van. The value was given from the equation, total

time between stops/total number of stops. Giving difference stop impedance values for each van route allowed the models to represent real impedance costs for each route.

```
JOINITEM DRROUTES.STP HOPE.STEP DRROUTES.STP
$RECNO STOP_IMP
```

This command directs ArcInfo to join the two files DRROUTES.STP and HOPE.STEP based on the $RECNO item in DRROUTES.STP, and to place joined items after the STOP_IMP item.

```
TABLES
SELECT RT.MATCH
SORT ON DRMTCH1-ID
```

This series of commands directs ArcInfo to sort the file RT.MATCH based on the values of the DRMTCH1-ID.

```
ARC
JOINITEM DRROUTES.STP RT.MATCH DRROUTES.STP
DRMTCH1-ID DRMTCH1-ID ORDERED
TABLES
DROPITEM DRROUTES.STP DRMTCH1-ID
```

This series of commands directs ArcInfo to join the two files DRROUTES.STP and RT.MATCH based upon the ordered DRMTCH1-ID item, and to drop the DRMTCH1-ID item from DRROUTES.STP after the JOINITEM step. This processed file DRROUTES.STP is now the completed STOP file needed by the PATH command.

Table 3 summarizes the database manipulations that formed the stop file DRROUTES.STP

TABLE 3

DATABASE MANIPULATIONS

Manipulation 1:

DRROUTES.STP	+	HOPE.STEP	=	DRROUTES.STP
IN_ORDER		DRMTCH1-ID		IN_ORDER
ROUTE_ID				ROUTE_ID
STOP_IMP				STOP_IMP
				DRMTCH1-ID

Manipulation 2:

DRROUTES.STP	+	RT.MATCH	=	DRROUTES.STP
IN_ORDER		DRMTCH1-ID		IN_ORDER
ROUTE_ID		HOPE1-ID		ROUTE_ID
STOP_IMP				STOP_IMP
DRMTCH1-ID				DRMTCH1-ID
				HOPE1-ID

Manipulation 3:

DRROUTES.STP - DRMTCH1-ID = DRROUTES.STP

ITEMS IN DRROUTES.STP : IN_ORDER, ROUTE_ID, STOP_IMP, HOPE1-ID.

Step 4: Using the PATH command in Network

The PATH command calculates the shortest path between stops along a route. It uses the user created STOP file as the guide to the routes and the stop order and is a command in the Arcplot module of ArcInfo. The result of this command was the creation of a route system that represents the 22 different van routes. It is attached to the road network coverage.

The ArcInfo manuals document two ways of using the PATH command, interactively and with STOP files. At the start of this project, the interactive method was chosen since little documentation on the database manipulation processes for creating a STOP file was in the manuals. When one uses the interactive path command, each stop is entered at the keyboard using the stop address. The path command then calculates routes based on the stops that are entered at the keyboard. Unfortunately, much information is lost by using the interactive method. Individual stops are buried in the route and are not retrievable. Second, commands that allow label points to be attached to stops do not work because the stops are buried. With the STOP file the integrity of the data is maintained and can be manipulated after processing. In the end, weeks of work done using the interactive path command had to be deleted and a STOP file created after consultation with persons at UT and ESRI. Documentation of the interactive PATH commands will not be reported, just

noted as a major obstacle that was encountered during the project.

The following commands were used to run the PATH command with the STOP file method.

```
ARCPLOT
NETCOVER HOPE1.DIR DEMRESP
IMPEDANCE LENGTH LENGTH
STOPS DRROUTES.STP IN_ORDER ROUTE_ID STOP_IMP # #
CUM_IMP #
PATH STOPS
```

This series of commands directs ArcInfo to use HOPE1.DIR as the road network coverage and create a route system in the coverage called DEMRESP, to use LENGTH as the from-to and to-from arc impedances, to use DRROUTES.STP as the stop file with IN_ORDER, ROUTE_ID, and STOP_IMP as relevant values, to write the CUM_IMP values to the file as it is processes, and to run the PATH command using the file specified in the STOPS command line.

Step 5: Displaying the Results of PATH

Each route was converted to an ArcInfo coverage for display and analysis.

```
ARC
RESELECT HOPE1 HOPE1 ROUTE.DEMRESP ROUTE_2 ... 23
> RESELECT DEMRESP-ID = 2 ... 23
> END
```

ROUTEARC HOPE1 ROUTE_2 .. 23 RT_2 ... 23

CLEAN RT_2 ... 23 LINE

This series of commands directs ArcInfo to select individual routes form 2 to 23 from the route system DEMRESP, to convert each route into an ArcInfo coverage called rt_2 ... to rt_23, and to clean each coverage to restore proper topology.

Next, an AML was written to produce maps of the eight routes from December 27, 1993. In addition, an AML was written to create one map that represents all eight routes at once. These AML's ROUTE.AML and BIG.AML are located in Appendix C. Maps for the eight December routes modeled are located in Appendix D along with directions for reading them and a comparison table.

Problems Encountered During the Process

Things never go exactly as they are planned. During this research effort, the researcher ran into a variety of GIS problems. Documentation of these problems is as important as documenting the GIS processes that were successful. In the developing field of transit GIS work, keeping track of mistakes helps others to learn where not to go.

Few problems were encountered in the Demand Response Demographic Study. In the data gathering portion of the study, the researcher was unaware that she did not receive

complete documentation for the coverages received from the Greenville GIS Department. Consequently, when the initial overlay analysis was tried, the census data coverage was not compatible to the clients coverage. Therefore, additional steps to project and prepare the census data were necessary.

The Demand Response Route Modeling Study was fraught with many software, documentation, data, and hardware problems. As described previously, documentation of the PATH command in the ArcInfo manuals indicated that two methods for data input were acceptable, interactive input and STOP files. After choosing the interactive method, several weeks of research and computer processing were wasted when the researcher found that the method wiped away important data -- a surprise not documented with the software. The STOP file method, chosen after the interactive method refused to work, does not have explicit creation steps in the Network Analysis User's Guide, as a result the researcher created the necessary file after consultation with three researchers at the university. A second problem dealt with the road network obtained from the Appalachian Council of Governments. The coverage has disconnected arcs that when traversed in a path process, cause the program to crash. This problem was handled by moving van stops from the disconnected arcs to a nearby connected arc; but not before many frustrating moments trying to decipher FATAL ERROR messages.

Hardware problems were encountered at the printing stages of the project. Unknown to the researcher or the University of Tennessee Computing Center consultant helping her, a bug exists in ArcInfo version 6.1.2 that prohibits Postscript files from being printed. Consequently, obtaining the necessary project maps proved to be quite a challenge. The ArcInfo manuals offered several suggestions for converting data into another print format; however, these were unworkable for the researcher given her limited resources. To overcome this problem the researcher used a Macintosh computer that could print graphics directly from the screen. Limitations to this method included map size, poor graphic quality when compared to more sophisticated printing methods, and decreased map creation flexibility.

Resources Used for Projects

Computer

The researcher used a VAX account on the Vaxcluster at UT. This account had access to ArcInfo 6.1.2 and 120,000 blocks of disk storage space. Total costs were $800.00 for the four month project. These costs include $667.44 in CPU time, $107.77 for storage, and $24.80 printing cost. The total cost that was absorbed by the Central Fund at the University of Tennessee was $667.00 for CPU time. The remaining $133.00 was covered by the School of Planning at the University of Tennessee.

Staff time

Total computer connect time for these projects came to 231.52 hours, supplemented by approximately 25 hours of consultant time from university professors, and computing center staff. The ESRI-L listserve service on the Internet was also consulted about a particular problem not documented in their ArcInfo manuals.

CHAPTER V

SUMMARY AND CONCLUSIONS

Feedback from Greenville

After the two GIS projects were completed, the Planning Director and Transportation Planner at GCPC were asked to complete a GIS Assessment Form. A copy of the form is located in Appendix E. This form asked the two questions about the research outputs and about the future of GIS in their organization. Summaries of what each said follow.

The Planning Director at GTA was pleased with the information that the GIS outputs provided. The Director felt that the information did a good job of summarizing the patterns of passenger pickups, showing areas that could be modified, and presenting clear pictures of client trends. Given prior familiarity with the Demand Response operations, he felt that the maps were easy to read and understand. When asked if another method could have been used to show the same information, the Director said no; citing previous manual attempts at route modeling and census analysis that failed.

Spurred by the usefulness of the information provided, GTA will be working with Atlas GIS to do projects through the GCPC as staff time becomes available. The Director, hoping to devote more time to GIS applications, noted that Atlas GIS appears to be simple and easy to use. Currently,

about 5% of the Director's time goes to GIS projects; however, if serious efforts to use GIS technology occur more staff time will be needed. Right now the Director feels that GTA does not have resources to commit to GIS projects. Although he feels that the two projects done by the researcher were helpful and plans to use the information to modify current Demand Response services, further projects can not be attempted by GTA until more staff time and equipment is allocated to GIS (Osei-Owusu, 1994).

The Transportation Planner at the Greenville County Planning Commission feels that the information provided by the researcher will be helpful to GTA in modifying service. However, GCPC is more interested in using the methodology and documentation as references for future projects; rather than the map output. The GCPC planner mentioned that the route modeling maps were the first that he had seen which represented the data spatially and that the maps provided a good basic representation of the van routes. Although, he did note that further map refining would be necessary if the map were to be distributed to van drivers.

Staff time for transit GIS projects at the GCPC is very limited at the present time because of demands from other transportation projects. However, the GCPC agrees with GTA that more transit GIS projects should be undertaken as time permits. In addition, the GCPC planner felt that the two projects completed by the researcher would be feasible

projects for their organization given the appropriate time and equipment.

In the future, the GCPC hopes to better utilize the analytical capabilities of their Atlas GIS software; rather than the City's ArcInfo resources. This is primarily because of in house access and user friendliness of the software. Atlas GIS software will allow demographic analysis and maps to be made for GTA; however, routing and scheduling projects will still have to use ArcInfo since Atlas does not have network capabilities. The next project that the GCPC would like to complete for GTA is to produce bus schedule maps that represent the fixed routes on County road network more accurately. Overall, both organizations were pleased with the research outputs and seem interested in pursuing GIS projects. For Greenville County, this interest means that information will be available for better transit planning overall. In addition, both organizations feel that new technological methods, in this case GIS, are far superior to the previous manual methods of planning transit service; but they recognize the commitment that must be made to develop applications.

Conclusions

This thesis has tried to answer questions concerning the viability of using GIS as an information provider for paratransit planning. Given the positive feedback from the

planning organizations in Greenville County, the researcher believes that GIS can provide useful information in other small agencies as well. For transit operators, better information obtained from the GIS provides a basis for recommending service changes. For county planning organizations, documentation of the GIS project will serve as a reference for future projects. With federal movements toward new technology, GIS has found a place in transit planning by providing new methods of representing data.

This thesis has demonstrated that GIS can be used by smaller transit agencies to obtain information for transit planning. However, whether smaller agencies can gain access to GIS software in order to complete projects is still in question. Small agencies rarely have direct access to sophisticated GIS programs like ArcInfo; although, less sophisticated software programs may have the capabilities to display transit data. As smaller agencies are exposed to the GIS output, stronger interest in applying the technology will appear; however, devoting time to GIS applications is often difficult.

Suggestions for Further Research

Further research could be done to survey the GIS resources available to small transit and paratransit providers and GIS awareness of these providers. In addition, evaluation studies of different GIS software and

its transit capabilities would be helpful to small agencies that are in a position to purchase a GIS system. Finally, more documentation needs to be completed on specific projects that have been carried out by transit agencies and the resources that were used in those projects.

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APPENDICES

APPENDIX A

DEMAND RESPONSE CLIENT LOCATIONS

CLIENT ADDRESS	CITY
110 SUMNER ST	GREENVILLE
103 LINCOLN ST	GREENVILLE
403 DUNBAR ST	GREENVILLE
409 PINCKNEY ST	GREENVILLE
130 HAMPTON AVE	GREENVILLE
18 MEADOW ST	GREENVILLE
3 MARTIN ST	GREENVILLE
411 ANSEL ST	GREENVILLE
411 ANSEL ST	GREENVILLE
4 ESTELLE ST	GREENVILLE
411 ANSEL ST	GREENVILLE
38A BAGWELL CIRCLE	GREENVILLE
18 LAWTON AVE	GREENVILLE
6 HOPKINS ST	GREENVILLE
4 ODESSA ST	GREENVILLE
111 COLLINS ST	GREENVILLE
220 MALOY ST	GREENVILLE
113 SULLIVAN ST	GREENVILLE
211 GALLIVAN ST	GREENVILLE
210 S MEMMINGER ST	GREENVILLE
136 DELLWOOD DRIVE	GREENVILLE
801 W WASHINGTON ST	GREENVILLE
415 N MAIN ST	GREENVILLE
302 S CALHOUN ST	GREENVILLE
806 GREEN AVE	GREENVILLE
106 E. PARKER RD	GREENVILLE
32 GUESS ST	GREENVILLE
52 CONWELL ST	GREENVILLE
6 CIRCLE DR	TRAVELERS REST
ST MARK ROAD	TAYLORS
11 LINDBERG ST	GREENVILLE
2 NANDINA DRIVE	GREENVILLE
WHITE HORSE ROAD	GREENVILLE
100 ELM ST	GREENVILLE
13 GURLY RD	GREENVILLE
6 TASHA DR	GREENVILLE
511 AUGUSTA ST	GREENVILLE
2 COLLINSON RD	GREENVILLE
134 BLASSIGAME RD	GREENVILLE
205 ARTILLERY ROAD	TAYLORS
20 CLOVERDALE LANE	GREENVILLE
1383 RIDGE ROAD	GREENVILLE
112 BOILING CIRCLE	GREENVILLE
100 FLEMING ST	GREENVILLE
100 CRESTWOOD FOREST DR	GREENVILLE
102 SHAY AVENUE	GREENVILLE
6 CARVER RAOD	GREENVILLE

100 QUEEN ST	GREENVILLE
15 SPENCER ST	GREENVILLE
10 GROCE AVE	GREENVILLE
37 1ST AVE	GREENVILLE
213 MILLS AVE	GREENVILLE
100 SHEMWOOD LANE	GREENVILLE
100 SHEMWOOD LANE	GREENVILLE
111 OSMOND DRIVE	TAYLORS
116 HILTON ST	GREENVILLE
50 GLENWOOD RD	GREENVILLE
114 CHURCHILL CIR	
114 W MONTCLAIR AVE	GREENVILLE
114 WOODMONT CIRCLE	GREENVILLE
359 LOOP ST	GREENVILLE
1010 S WELCOME RD	GREENVILLE
29 5TH ST	GREENVILLE
223 CHURCH ST	GREENVILLE
120 SHAW ST	GREENVILLE
116 LOCUST ST	GREENVILLE
116 LOCUST ST	GREENVILLE
4203 BOYD ST	FOUNTAIN INN
109 GILBERT ST	GREER
311 FURMAN HALL RD	GREENVILLE
529 ROCKDALE DR	GREENVILLE
100 QUEEN ST	GREENVILLE
2 UNEEDA CT	GREENVILLE
16 JULIAN AVE	GREENVILLE
12 DUKE ST	GREENVILLE
205 GOODRICH ST	GREENVILLE
10 LIONS CLUB RD	GREENVILLE
10 LIONS CLUB RD	GREENVILLE
306 BIRNIE ST	GREENVILLE
50 WOODLARK ST	GREENVILLE
11 SPRING FOREST DR	GREENVILLE
310 HILLCREST DR	GREER
121 LINCOLN RD	GREER
109 GILBERT ST	GREER
16 MCELHANEY RD	GREER
10 VICTORIA ST	GREER
816 MARUE DRIVE	TAYLORS
1275 HAYWOOD ROAD	GREENVILLE
107 MOORE ST	SIMPSONVILLE
3714 GRANDVIEW DRIVE	SIMPSONVILLE
106 S PINEY CIR	SIMPSONVILLE
107 WALKER SPRINGS RD	TAYLORS
4425 SANDY FLAT RD	TAYLORS

Adapted from: GTA. (1993). [Demand Response Van Driver Logs]. Unpublished Raw Data.

APPENDIX B

PROJECTION INFORMATION FOR CENSUS
DATA COVERAGE MANIPULATION

GTAPRO.PRJ

```
input
projection stateplane
zone 5201
datum nad83
units feet
xshift 14
yshift 33
parameters
output
projection stateplane
zone 5201
datum nad27
units feet
spheroid clarke1866
parameters
```

APPENDIX C

AML FOR DEMAND RESPONSE DEMOGRAPHIC STUDY

```
/* DRMAP.AML
/* ------------------------------------------------------
/* 6/13/94
/* ELLEN MILLER, UT SCHOOL OF PLANNING
/* ------------------------------------------------------
/*
/* NAME = NAME OF THE PLOT FILE
/* ------------------------------------------------------
ARCPLOT
display 4105
MAPE CLIENTS.DIR
PAGESIZE 11 8.5
MAPLIMITS .5 .5 6.5 8
MAPPOS CEN CEN
MAPUNITS FEET
MAPSCALE AUTOMATIC
/* ------------------------------------------------------
/* CARTOGRAPHIC ELEMENTS
LINESYMBOL 1
BOX .5 .5 10.5 8
LINE 6.5 .5 6.5 8
BOX 6.85 .75 10.25 3.5
/* ------------------------------------------------------
/* DRAWS MAP
ARCS CTRACT
SHADESET CARTO.SHD
/* POLYGONSHADES CTRACT PCTPOV CENSUS.LUT
/* POLYGONSHADES CTRACT PCTM65+ CENSUS.LUT
/* POLYGONSHADES CTRACT PCTF65+ CENSUS.LUT
/* POLYGONSHADES CTRACT PCTT65+ CENSUS.LUT
/* POLYGONSHADES CTRACT PCTMWA CENSUS.LUT
/* POLYGONSHADES CTRACT PCTFWA CENSUS.LUT
POLYGONSHADES CTRACT PCTTWA CENSUS.LUT
POINTMARKERS CLIENTS.DIR 69
/* ------------------------------------------------------
/* DRAWS REFERENCE MAP
MAPE CTRACT
MAPLIMITS 6.75 .75 10.25 3.5
MAPSCALE AUTOMATIC
ARCS CTRACT
/* ------------------------------------------------------
/* DRAWS TITLE
TEXTSIZE .20
MOVE 6.75 7.5
TEXT 'DEMAND RESPONSE
TEXTSIZE .15
MOVE 6.75 7
TEXT 'DEMOGRAPHIC STUDY'
```

```
/* ------------------------------------------------------------
/* DRAWS LEGEND
MOVE 6.75 6.25
/* TEXT '% OF AREA IN POVERTY'
/* TEXT '% OF MALES 65+'
/* TEXT '% OF FEMALES 65+'
/* TEXT '% OF TOTAL 65+'
/* TEXT '% OF WORKING AGE MALES'
/* TEXT '% OF WORKING AGE FEMALES'
TEXT '% OF WORKING AGE PERSONS'
KEYAREA 5.75 4.25 10.25 6.0
KEYPOS 6.75 6
KEYSEP .15 .20
KEYBOX .5 .20
KEYSHADE PCTSHADE.KEY
MOVE 4.75 4.00
TEXTSIZE .10
KEYMARKER CLIENTMK.KEY NOBOX
```

AML FOR BIG ROUTE MODELING MAP

```
/* BIG.AML
/* ------------------------------------------------------
/* 6/13/94
/* ELLEN MILLER, UT SCHOOL OF PLANNING
/* ------------------------------------------------------
ARCPLOT
DISPLAY 4105
MAPE DRMTCH1
PAGESIZE  14 8.5
MAPLIMITS .5 .5 8.25 7.5
MAPPOS CEN CEN
MAPUNITS FEET
MAPSCALE AUTOMATIC
/* ------------------------------------------------------
/* DRAWS CARTOGRAPHIC FEATURES
BOX .5 .5 13.5 7.5
LINE 9.50 .5 9.50 7.5
BOX 9.75 .75 13.25 3.5
/* ------------------------------------------------------
/* DRAWS MAP
LINESET CARTO.LIN
ARCLINES RT_8 101
ARCLINES RT_9 105
ARCLINES RT_10 121
ARCLINES RT_11 149
ARCLINES RT_19 125
LINESET TEMPLATE.LIN
ARCLINES RT_20 1015
ARCLINES RT_21 1033
ARCLINES RT_22 1027
MARKERSET TEMPLATE.MRK
RESELECT DRMTCH1.PAT POINT ROUTE_ID = 8
ASELECT DRMTCH1.PAT POINT ROUTE_ID = 9
ASEL DRMTCH1.PAT POINT ROUTE_ID = 10
ASEL DRMTCH1.PAT POINT ROUTE_ID = 11
ASEL DRMTCH1.PAT POINT ROUTE_ID = 19
ASEL DRMTCH1.PAT POINT ROUTE_ID = 20
ASEL DRMTCH1.PAT POINT ROUTE_ID = 21
ASEL DRMTCH1.PAT POINT ROUTE_ID = 22
POINTMARKERS DRMTCH1.DIR  69
/* ------------------------------------------------------
/* DRAWS REFERENCE MAP
MAPE HOPE1
MAPLIMITS 9.75 .75 13.25 3.5
MAPSCALE AUTOMATIC
RESELECT HOPE1 LINE RDOPER = 'C'
ASELECT HOPE1 LINE RDOPER = 'M'
ASELECT HOPE1 LINE RDOPER = 'I'
```

```
ARCS HOPE1
/* ------------------------------------------------------------
/* DRAWS TITLE
MOVE 9.75 7.0
TEXTSET CARTO.TXT
TEXTSYMBOL 121
TEXTSIZE .15
TEXT 'Demand Response\Route Modeling'
/* ------------------------------------------------------------
/* DRAWS DESCRIPTIVE INFORMATION
MOVE 9.75 6.5
TEXTSIZE .15
TEXT 'December 27, 1993  All Vans'
/* ------------------------------------------------------------
/* DRAWS LEGEND
textsize .1
KEYAREA 9.75 3.75 13.5 6.00
KEYBOX .25 .25
KEYSEP .1 .1
KEYLINE BIG.KEY NOBOX
KEYMARKER STOP.KEY NOBOX
```

AML FOR INDIVIDUAL ROUTE MAPS

```
/* ROUTES.AML
/* ------------------------------------------------------
/* 6/13/94
/* ELLEN MILLER, UT SCHOOL OF PLANNING
/* ------------------------------------------------------
/* COVER = NAME OF THE ROUTE COVERAGE
/* RT_ID = ROUTE ID
/* ------------------------------------------------------
&ARGS COVER RT_ID
/* ------------------------------------------------------
ARCPLOT
DISPLAY 4105
MAPE %COVER%
PAGESIZE 11 8.5
MAPLIMITS .5 .5 8 8
MAPPOS CEN CEN
MAPUNITS FEET
MAPSCALE AUTOMATIC
/* ------------------------------------------------------
/* DRAWS CARTOGRAPHIC ELEMEMTS
BOX .5 .5 10.5 8
LINE 8 .5 8 8
BOX 8.25 .75 10.25 3.5
/* ------------------------------------------------------
/* DRAWS MAP
LINESET CARTO.LIN
/* ARCLINES %COVER% 101
/* ARCLINES %COVER% 105
/* ARCLINES %COVER% 121
/* ARCLINES %COVER% 149
/* ARCLINES %COVER% 125
LINESET TEMPLATE.LIN
/* ARCLINES %COVER% 1015
/* ARCLINES %COVER% 1033
ARCLINES %COVER% 1027
RESELECT DRMTCH1.PAT POINTS ROUTE_ID = %RT_ID%
MARKERSET TEMPLATE.MRK
POINTMARKERS DRMTCH1 1013
TEXTSET CARTO.TXT
TEXTSYMBOL 121
TEXTSIZE .1
TEXTOFFSET .15
POINTTEXT DRMTCH1 HOPE1-ID
/* ------------------------------------------------------
/* DRAWS REFERENCE MAP
MAPE HOPE1
MAPLIMITS 8.25 .75 10.25 3.5
MAPSCALE AUTOMATIC
```

```
RESELECT HOPE1 LINE RDOPER = 'C'
ASELECT HOPE1 LINE RDOPER = 'M'
ASELECT HOPE1 LINE RDOPER = 'I'
ARCS HOPE1
/* ------------------------------------------------------
/* DRAWS TITLE
MOVE 8.25 7.5
TEXTSIZE .15
TEXT 'DEMAND RESPONSE'
MOVE 8.25 7.0
TEXT 'ROUTE MODELING'
/* ------------------------------------------------------
/* DRAWS DESCRIPTIVE INFORMATION
MOVE  8.25 6.5
TEXTSIZE .12
/* TEXT '12/27/93 VAN 133'
/* TEXT '12/27/93 VAN 130'
/* TEXT '12/27/93 VAN 134'
/* TEXT '12/27/93 VAN 132'
/* TEXT '12/27/93 VAN 203'
/* TEXT '12/27/93 VAN 131'
/* TEXT '12/27/93 VAN 135'
TEXT '12/27/93 VAN 201'
/* ------------------------------------------------------
/* DRAWS LEGEND
KEYAREA 8.25 4.25 10.25 6.0
KEYPOS 8.25 6
KEYBOX .5 .15
KEYSEP .01 .01
KEYMARKER ROUTE.KEY NOBOX
```

APPENDIX D

Interpreting the Results of the Route Modeling

Look at Figure 10 labeled 'Demand Response Route Modeling' on page 94. This map contains all eight routes for December 27, 1993. It may be hard to read since all routes converge in one area of Greenville County. The smaller reference map is the road network coverage of Greenville County that the PATH command used to create the routes. As you can see, the routes tend to stay in the City of Greenville with trails out to Travelers Rest, Greer, Simpsonville, and Fountain Inn.

Each of the eight routes have been represented individually as well. The next series of maps must be read with their accompanying text. Figure 11 is the first map on page 95. The stops are labeled with their node from the road network. The page following the map contains Table 4 and links more information to the map based on the node number. Locate node 9214 on the map and on the table: this corresponds to stop 1 at 7:00 am at 106 Augusta St (GTA), stop two is node 9495 at 7:25 am and is on the left side of the map, etc. By following along the nodes corresponding to the stop # you can trace the path of the Demand Response vans throughout the day. ArcInfo enables the user to generate directions for each path generated. Directions for each route follow their tables and includes the total calculated length of each route. To get a picture of the rest of the routes repeat the process described.

At the end of the route maps, Table 12 compares the actual mileage recorded on GTA's van logs with the calculated shortest path mileage from the PATH command. In each case except for Van 130 the calculated mileage is less than the actual. This may occur for several reasons. First, the road network of Greenville County may have been misinterpreted by the PATH command. If one way streets and closed roads were not noted in the original coverage, the PATH command would model these streets as two way streets and therefore make a shorter route than the actual van. Second, forcing addresses may have created errors in the stops location and consequently in the total mileage for the route. Finally, van routes may be longer if drivers make unscheduled stops along their routes, to get a soda or to use the restroom for example.

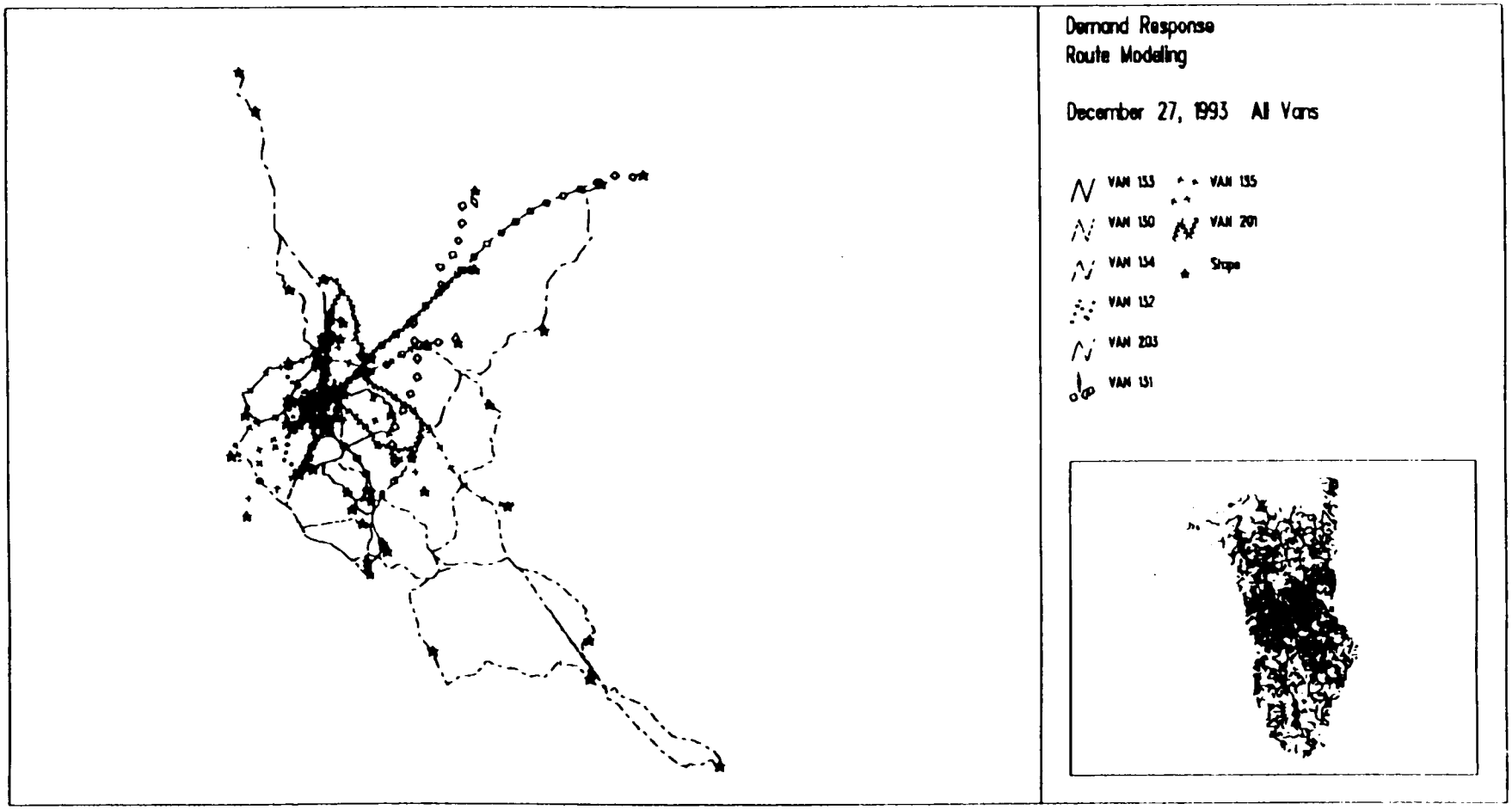


FIGURE 10

DECEMBER 27, 1993 ALL VANS

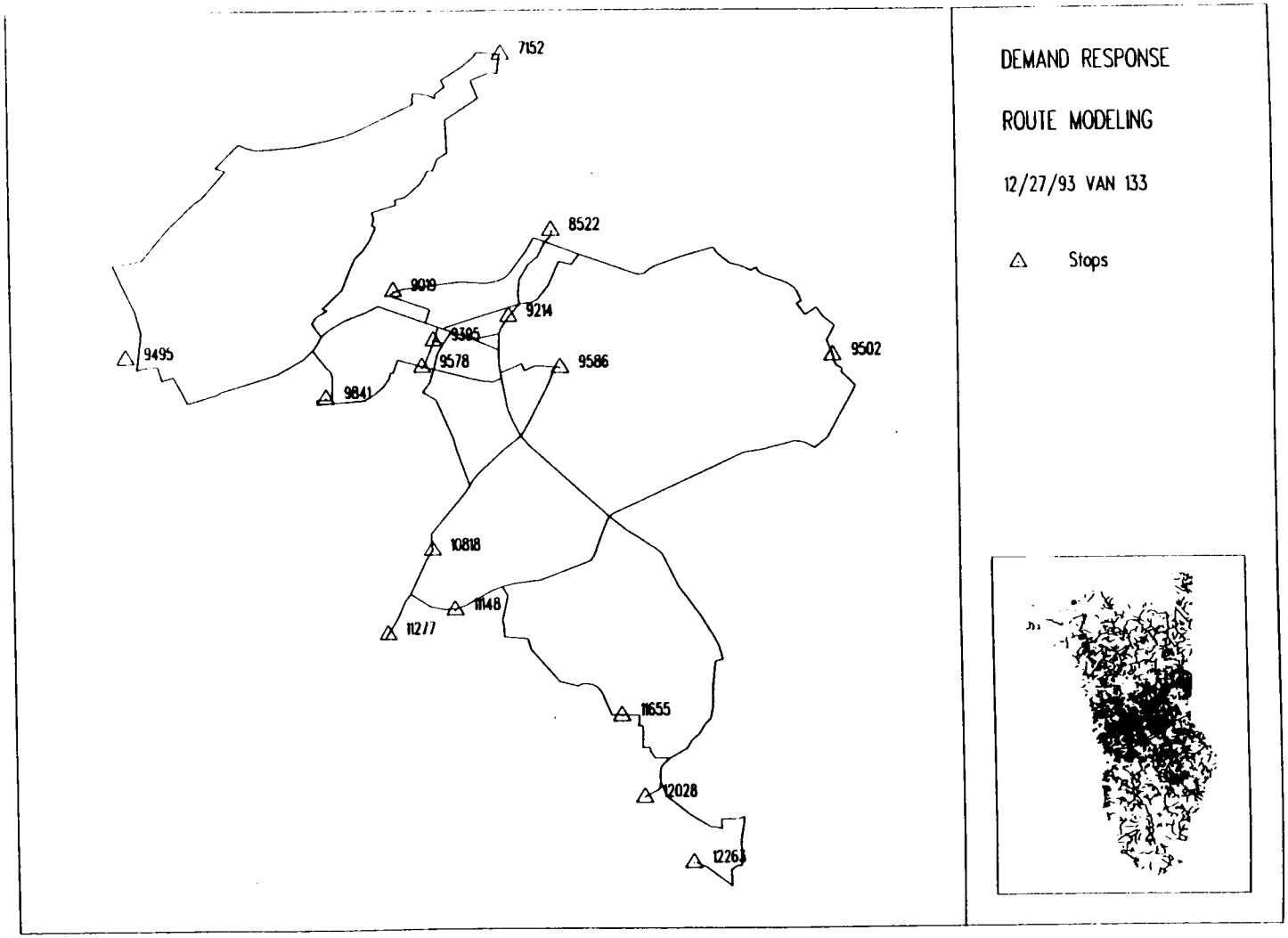


FIGURE 11

ROUTE 8 VAN 133

TABLE 4

ROUTE 8 VAN 133

DECEMBER 27, 1993

ROUTE	STOP #	NODE	TIME	STOP ADDRESS
8	1	9214	7:00 am	106 Augusta St
8	2	9495	7:25 am	21 Lewis St
8	3	7152	7:45 am	120 Shaw St
8	4	9841	7:50 am	107 Third St
8	5	9578	8:05 am	709 Dunbar St
8	6	9586	8:25 am	412 Wakefield St
8	7	9578	8:33 am	709 Dunbar St
8	8	9019	10:00 am	18 Lawton Ave
8	9	9502	10:30 am	20 Cloverdale Ln
8	10	11277	10:50 am	1009 Grove Rd
8	11	8522	11:00 am	210 W Washington St
8	12	9578	11:45 am	709 Dunbar St
8	13	9586	11:50 am	412 Wakefield St
8	14	10818	12:15 pm	701 Grove Rd
8	15	11655	12:25 pm	233 Pleasant Ridge Ave
8	16	12263	12:40 pm	607 Pine Creek Dr
8	17	11148	1:00 pm	6 Doctors Dr
8	18	9395	2:50 pm	100 Mallard St
8	19	12028	3:05 pm	2 Nandina Dr
8	20	11277	3:20 pm	1009 Grove Rd
8	21	9502	3:35 pm	20 Cloverdale Ln
8	22	9214	4:00 pm	106 Augusta St

Adapted from: GTA. (1993). [Demand Response Van Driver Logs]. Unpublished Raw Data.

DIRECTIONS

ROUTE 8 VAN 133

DECEMBER 27, 1993

Starting at AUGUSTA ST

Travel southwest for 0.136 MILES, turn right onto FIELD ST

Travel west for 0.158 MILES, turn right onto VARDRY ST

Travel west for 0.201 MILES, go straight onto PENDLETON ST

Travel west for 0.440 MILES, turn left onto EASLEY BRIDGE RD

Travel southwest for 0.229 MILES, go straight onto EASLEY BRIDGE ROAD

Travel southwest for 1.137 MILES, turn right onto TEXAS AVE

Travel northwest for 0.191 MILES, turn left onto GORDON ST

Travel west for 0.077 MILES, turn right onto NORTH WASHINGTON AVENUE

Travel north for 0.095 MILES, turn left onto GORDON STREET EXTENSION

Travel west for 0.131 MILES, turn right onto WHITE HORSE RD

Travel north for 0.701 MILES, turn right onto OIL MILL ROAD

Travel east for 0.184 MILES, turn left onto CLEMSON AVENUE

Travel northeast for 0.676 MILES, go straight onto CLEMSON

Travel northeast for 0.101 MILES, turn left onto 4TH STREET EXTENSION

Travel west for 0.065 MILES, turn right onto WOOD STREET

Travel northeast for 0.213 MILES, turn right onto WEST BRAMLETT ROAD

Travel east for 0.175 MILES, go straight onto BRAMLETT

Travel east for 0.023 MILES, go straight onto WEST BRAMLETT ROAD

Travel east for 0.190 MILES, go straight onto EAST BRAMLETT ROAD

Travel northeast for 0.833 MILES, turn right onto HAMPTON AVENUE EXTENSION

Travel east for 0.142 MILES, turn left onto MONTGOMERY AVE

Travel northeast for 0.107 MILES, turn left onto PINCKNEY ST

Travel northwest for 0.048 MILES, turn right onto ALEXANDER ST

Travel northeast for 0.157 MILES, go straight onto SHAW ST

Travel east for 0.268 MILES, turn right onto STRATHAM STREET

Travel south for 0.102 MILES, go straight onto STRATHAM

Travel south for 0.019 MILES, turn right onto STALL ST

Travel west for 0.173 MILES, turn left onto BUNCOMBE ST

Travel southeast for 0.120 MILES, turn right onto FRANK ST

Travel southwest for 0.224 MILES, go straight onto HAYGOOD ST

Travel southwest for 0.025 MILES, go straight onto PINE ST

Travel south for 0.208 MILES, turn right onto MULBERRY ST

Travel southwest for 0.064 MILES, go straight onto W WASHINGTON ST

Travel southwest for 0.109 MILES, go straight onto WILLARD ST

Travel southwest for 0.304 MILES, turn left onto CAIN ST

Travel southwest for 0.193 MILES, turn left onto QUEEN ST

Travel south for 0.085 MILES, turn left onto BIRNIE ST

Travel southeast for 0.025 MILES, turn right onto QUEEN ST

Travel southwest for 0.387 MILES, go straight onto N TEXTILE ST

Travel southwest for 0.084 MILES, go straight onto S TEXTILE ST

Travel southwest for 0.155 MILES, turn left onto TRACTION

Travel southeast for 0.031 MILES, turn right onto DORSEY BLVD

Travel southwest for 0.129 MILES, turn left onto STAR DRIVE

Travel southeast for 0.100 MILES, turn right onto EASLEY BRIDGE ROAD

Travel southwest for 0.105 MILES, turn left onto 4TH STREET - JUDSON

Travel south for 0.358 MILES, turn right onto 5TH STREET

Travel west for 0.095 MILES, turn left onto NEWBERT STREET

Travel south for 0.028 MILES, turn left onto 6TH STREET

Travel east for 0.289 MILES, go straight onto MALOY STREET

Travel northeast for 0.180 MILES, go straight onto MALLOY ST

Travel northeast for 0.074 MILES, turn right onto JENKINS ST

Travel east for 0.016 MILES, turn left onto S CALHOUN ST

Travel north for 0.090 MILES, turn right onto DUNBAR ST

Travel east for 0.669 MILES, turn left onto AUGUSTA ST

Travel north for 0.037 MILES, turn right onto THURSTON ST

Travel northeast for 0.143 MILES, turn right onto HOWE ST

Travel south for 0.048 MILES, turn left onto WAKEFIELD ST

Travel east for 0.217 MILES, turn back onto WAKEFIELD ST

Travel west for 0.217 MILES, turn right onto HOWE ST

Travel north for 0.048 MILES, turn left onto THURSTON ST

Travel southwest for 0.143 MILES, turn left onto AUGUSTA ST

Travel south for 0.037 MILES, turn right onto DUNBAR ST

Travel west for 0.500 MILES, turn right onto MALLARD ST

Travel north for 0.272 MILES, turn left onto PENDLETON ST

Travel west for 0.087 MILES, turn right onto N MEMMINGER ST

Travel north for 0.089 MILES, turn left onto PERRY AV

Travel west for 0.271 MILES, turn right onto S ACADEMY ST

Travel east for 1.057 MILES, turn right onto W MCBEE AV

Travel east for 0.194 MILES, go straight onto E MCBEE AV

Travel east for 0.594 MILES, go straight onto E WASHINGTON ST

Travel east for 0.390 MILES, turn right onto CLEVEIRVINE AV

Travel southeast for 0.286 MILES, turn left onto HAVILAND AV

Travel northeast for 0.039 MILES, turn right onto BEECHWOOD AV

Travel southeast for 0.372 MILES, turn right onto ACKLEY RD

Travel southwest for 0.035 MILES, turn left onto CELAND ST

Travel southeast for 0.094 MILES, turn left onto VIRNELLE ST

Travel northeast for 0.082 MILES, turn right onto MERLOCKE DR

Travel southeast for 0.160 MILES, turn right onto WEBSTER RD

Travel southwest for 0.105 MILES, turn left onto CLOVERDALE LA

Travel south for 0.153 MILES, turn left onto ALLENDALE LA

Travel southeast for 0.064 MILES, turn right onto GREENACRE RD

Travel south for 0.021 MILES, turn left onto MCALISTER RD

Travel south for 0.604 MILES, turn right onto E FARIS RD

Travel west for 1.386 MILES, go straight onto W FARIS RD

Travel southwest for 0.878 MILES, go straight onto WEST FARIS ROAD

Travel west for 0.636 MILES, turn left onto GROVE ROAD

Travel southwest for 0.322 MILES, turn back onto GROVE ROAD

Travel northeast for 0.322 MILES, go straight onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, turn right onto MILLS AV

Travel northeast for 0.156 MILES, go straight onto MILLS AV

Travel northeast for 0.293 MILES, turn left onto AUGUSTA ST

Travel north for 0.912 MILES, go straight onto RIVER ST

Travel north for 0.449 MILES, go straight onto S RICHARDSON ST

Travel northeast for 0.086 MILES, turn back onto S RICHARDSON ST

Travel southwest for 0.086 MILES, go straight onto RIVER ST

Travel south for 0.449 MILES, turn right onto PENDLETON ST

Travel west for 0.532 MILES, turn left onto MALLARD ST

Travel south for 0.272 MILES, turn left onto DUNBAR ST

Travel east for 0.500 MILES, turn left onto AUGUSTA ST

Travel north for 0.037 MILES, turn right onto THURSTON ST

Travel northeast for 0.143 MILES, turn right onto HOWE ST

Travel south for 0.048 MILES, turn left onto WAKEFIELD ST

Travel east for 0.217 MILES, turn back onto WAKEFIELD ST

Travel west for 0.023 MILES, turn left onto S CHURCH ST

Travel southwest for 0.493 MILES, go straight onto MILLS AV

Travel southwest for 0.293 MILES, go straight onto MILLS AV

Travel southwest for 0.156 MILES, turn left onto MILLS AV

Travel southwest for 0.398 MILES, turn left onto CHAPMAN ST

Travel south for 0.103 MILES, turn right onto GROVE RD

Travel southwest for 0.318 MILES, turn left onto WEST FARIS RD

Travel east for 0.636 MILES, turn right onto MICHAUX DRIVE

Travel south for 0.337 MILES, turn left onto CHANTICLEER DR

Travel southeast for 0.217 MILES, go straight onto EAST SEVEN OAKS DRIVE

Travel southeast for 0.379 MILES, turn left onto CHAPMAN RD

Travel east for 0.170 MILES, go straight onto CHAPMAN

Travel southeast for 0.047 MILES, go straight onto PENROSE AV

Travel south for 0.105 MILES, turn left onto PLEASANT RIDGE AV

Travel east for 0.170 MILES, turn right onto PANAMA AV

Travel south for 0.068 MILES, turn left onto POTOMAC AV

Travel east for 0.023 MILES, turn right onto PANAMA AV

Travel south for 0.137 MILES, turn left onto PACIFIC AV

Travel east for 0.046 MILES, turn right onto PASADENA AV

Travel southeast for 0.169 MILES, turn right onto PROSPERITY AV

Travel southwest for 0.160 MILES, go straight onto PROSPERITY AVE

Travel south for 0.015 MILES, go straight onto PLANTATION RD

Travel southeast for 0.464 MILES, go straight onto OLD AUGUSTA ROAD

Travel east for 0.036 MILES, turn left onto PATTON ROAD

Travel north for 0.062 MILES, turn right onto WILLIAMS DRIVE

Travel east for 0.148 MILES, turn right onto AUGUSTA ROAD

Travel south for 0.004 MILES, go straight onto AUGUSTA RD

Travel south for 0.077 MILES, go straight onto AUGUSTA ROAD UNDERPASS

Travel south for 0.012 MILES, go straight onto AUGUSTA ROAD

Travel south for 0.182 MILES, go straight onto ACCESS RAMP

Travel south for 0.004 MILES, go straight onto AUGUSTA ROAD

Travel south for 0.032 MILES, turn right onto AUGUSTA ROAD CROSSOVER

Travel west for 0.022 MILES, turn left onto AUGUSTA ROAD

Travel southwest for 0.048 MILES, turn left onto WOODMEDE WAY

Travel south for 0.105 MILES, turn right onto PINE CREEK DR

Travel northwest for 0.269 MILES, turn back onto PINE CREEK DR

Travel southeast for 0.269 MILES, turn left onto WOODMEDE

WAY

Travel north for 0.105 MILES, turn right onto

Travel northeast for 0.048 MILES, turn right onto AUGUSTA ROAD CROSSOVER

Travel east for 0.022 MILES, turn left onto AUGUSTA ROAD

Travel north for 0.032 MILES, go straight onto ACCESS RAMP

Travel north for 0.004 MILES, go straight onto AUGUSTA ROAD

Travel north for 0.182 MILES, go straight onto AUGUSTA ROAD UNDERPASS

Travel north for 0.012 MILES, go straight onto AUGUSTA RD

Travel north for 0.077 MILES, go straight onto AUGUSTA ROAD

Travel north for 0.004 MILES, turn left onto WILLIAMS DRIVE

Travel west for 0.148 MILES, turn left onto PATTON ROAD

Travel south for 0.062 MILES, turn right onto OLD AUGUSTA RD

Travel west for 0.036 MILES, go straight onto PLANTATION RD

Travel northwest for 0.464 MILES, go straight onto PROSPERITY AVENUE

Travel north for 0.015 MILES, go straight onto PROSPERITY AV

Travel northeast for 0.160 MILES, turn left onto PASADENA AV

Travel northwest for 0.169 MILES, turn left onto PACIFIC AV

Travel west for 0.046 MILES, turn right onto PANAMA AV

Travel north for 0.137 MILES, turn left onto POTOMAC AV

Travel west for 0.023 MILES, turn right onto PANAMA AV

Travel north for 0.068 MILES, turn left onto PLEASANT RIDGE AV

Travel west for 0.170 MILES, turn right onto PENROSE AV

Travel north for 0.105 MILES, go straight onto CHAPMAN

Travel northwest for 0.047 MILES, go straight onto CHAPMAN RD

Travel west for 0.170 MILES, turn right onto EAST SEVEN OAKS DRIVE

Travel northwest for 0.379 MILES, go straight onto CHANTICLEER DRIVE

Travel northwest for 0.217 MILES, turn right onto MICHAUX DR

Travel north for 0.337 MILES, turn left onto WEST FARIS ROAD

Travel west for 0.636 MILES, turn right onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, go straight onto GUESS ST

Travel north for 0.534 MILES, go straight onto GREEN AV

Travel northwest for 0.048 MILES, turn left onto NELSON ST

Travel northwest for 0.100 MILES, turn right onto ANDERSON ST

Travel northeast for 0.115 MILES, go straight onto JENKINS ST

Travel northeast for 0.001 MILES, go straight onto ANDERSON ST

Travel north for 0.232 MILES, turn left onto ARLINGTON AV

Travel west for 0.066 MILES, turn back onto ARLINGTON AV

Travel east for 0.066 MILES, turn left onto ANDERSON ST

Travel northeast for 0.090 MILES, turn right onto VARDRY ST

Travel southeast for 0.314 MILES, turn right onto AUGUSTA ST

Travel southeast for 2.496 MILES, turn right onto BLYTHE DR

Travel west for 0.047 MILES, turn left onto OLD AUGUSTA RD

Travel south for 0.369 MILES, turn right onto PROSPERITY AV

Travel southwest for 0.520 MILES, go straight onto PROSPERITY AVENUE

Travel southwest for 0.162 MILES, turn back onto PROSPERITY AVENUE

Travel northeast for 0.162 MILES, go straight onto PROSPERITY AV

Travel northeast for 0.160 MILES, turn left onto PASADENA AV

Travel northwest for 0.169 MILES, turn left onto PACIFIC AV

Travel west for 0.046 MILES, turn right onto PANAMA AV

Travel north for 0.137 MILES, turn left onto POTOMAC AV

Travel west for 0.023 MILES, turn right onto PANAMA AV

Travel north for 0.068 MILES, turn left onto PLEASANT RIDGE AV

Travel west for 0.170 MILES, turn right onto PENROSE AV

Travel north for 0.105 MILES, go straight onto Chapman

Travel northwest for 0.047 MILES, go straight onto CHAPMAN RD

Travel west for 0.170 MILES, turn right onto EAST SEVEN OAKS DR

Travel northwest for 0.379 MILES, go straight onto CHANTICLEER DRIVE

Travel northwest for 0.217 MILES, turn right onto MICHAUX DR

Travel north for 0.337 MILES, turn left onto WEST FARIS ROAD

Travel west for 0.636 MILES, turn left onto GROVE ROAD

Travel southwest for 0.322 MILES, turn back onto GROVE ROAD

Travel northeast for 0.322 MILES, turn right onto WEST FARIS RD

Travel east for 0.636 MILES, go straight onto W FARIS RD

Travel northeast for 0.878 MILES, go straight onto E FARIS RD

Travel east for 1.386 MILES, turn left onto MCALISTER RD

Travel north for 0.604 MILES, turn right onto GREENACRE RD

Travel north for 0.021 MILES, turn left onto ALLENDALE LA

Travel northwest for 0.064 MILES, turn right onto CLOVERDALE LA

Travel north for 0.153 MILES, turn right onto WEBSTER RD

Travel northeast for 0.105 MILES, turn left onto MERLOCKE DR

Travel northwest for 0.160 MILES, turn left onto VIRNELLE ST

Travel southwest for 0.082 MILES, turn right onto CELAND ST

Travel northwest for 0.094 MILES, turn right onto ACKLEY RD

Travel northeast for 0.035 MILES, turn left onto BEECHWOOD AV

Travel northwest for 0.372 MILES, turn left onto HAVILAND AV

Travel southwest for 0.039 MILES, turn right onto CLEVEIRVINE AV

Travel northwest for 0.286 MILES, turn left onto E WASHINGTON ST

Travel west for 0.390 MILES, go straight onto E MCBEE AV

Travel west for 0.492 MILES, turn left onto FALLS ST

Travel southwest for 0.080 MILES, turn right onto E COURT ST

Travel west for 0.083 MILES, turn left onto S MAIN ST

Travel southwest for 0.396 MILES, turn left onto AUGUSTA ST

Travel southwest for 0.095 MILES, End of path

Total path length is 51.992 MILES

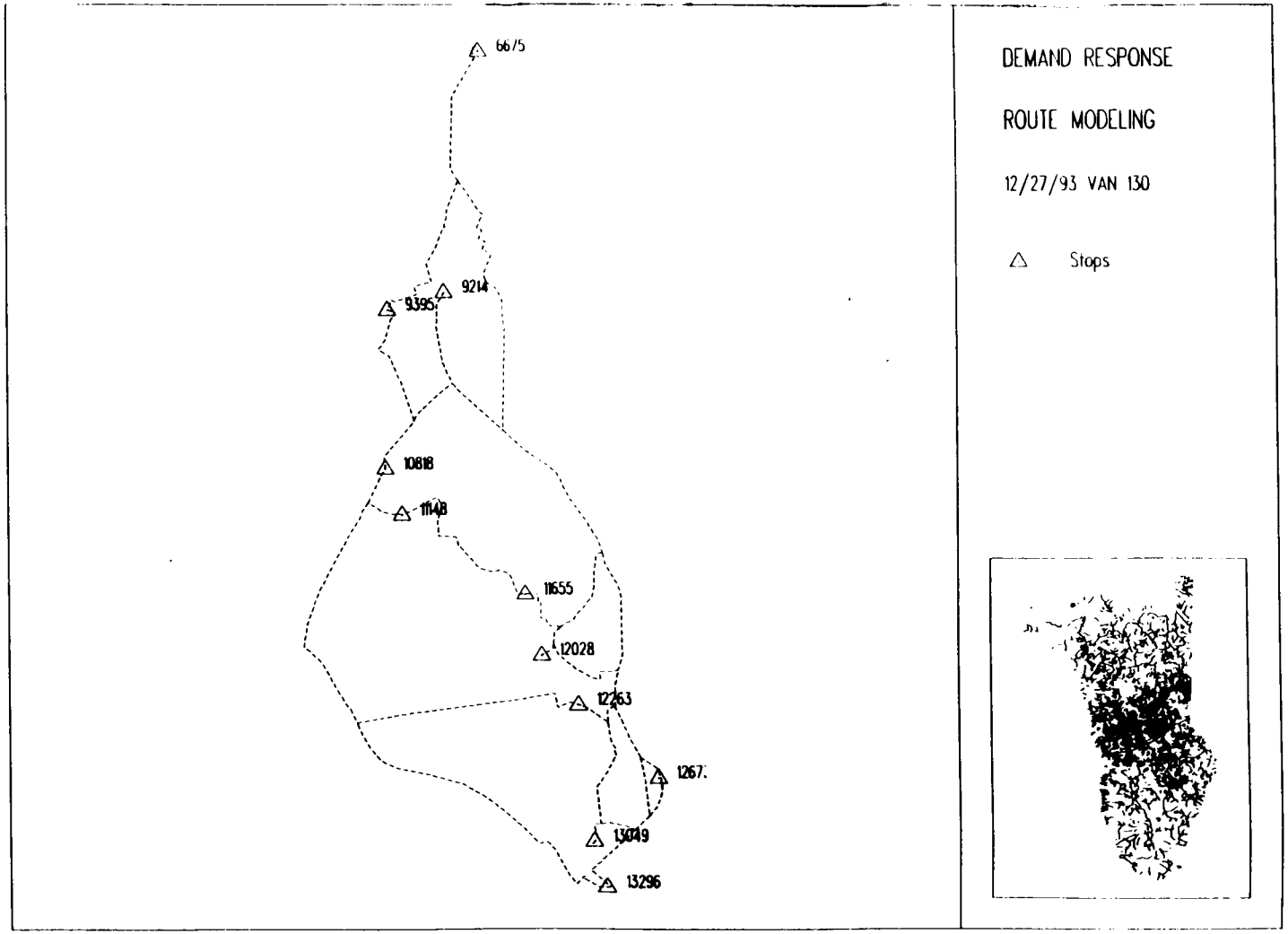


FIGURE 12

ROUTE 9 VAN 130

TABLE 5

ROUTE 9 VAN 130

DECEMBER 27, 1993

ROUTE	STOP #	NODE	TIME	STOP ADDRESS
9	1	9214	8:00 am	106 Augusta St
9	2	12028	8:34 am	2 Nandina Dr
9	3	13049	8:43 am	121 E Belvedere Rd
9	4	12673	8:48 am	114 Woodmont Cir
9	5	11655	9:00 am	233 Pleasant Ridge Ave
9	6	10818	9:11 am	701 Grove Rd
9	7	9395	9:20 am	100 Mallard St
9	8	6675	9:28 am	415 Rutherford Rd
9	9	13296	10:03 am	11 Branch St
9	10	10818	10:15 am	701 Grove Rd
9	11	12263	10:16 am	607 Pine Creek Dr
9	12	11148	10:30 am	6 Doctors Dr
9	13	9214	10:30 am	106 Augusta St

Adapted from: GTA. (1993). [Demand Response Van Driver Logs]. Unpublished Raw Data.

DIRECTIONS

VAN 130 ROUTE 9

DECEMBER 27, 1994

Starting at AUGUSTA ST

Travel southeast for 2.739 MILES, turn right onto BLYTHE DR

Travel west for 0.047 MILES, turn left onto OLD AUGUSTA RD

Travel south for 0.369 MILES, turn right onto PROSPERITY AVE

Travel southwest for 0.520 MILES, go straight onto PROSPERITY AVENUE

Travel southwest for 0.162 MILES, turn back onto PROSPERITY AVENUE

Travel northeast for 0.146 MILES, turn right onto PLANTATION RD

Travel southeast for 0.464 MILES, go straight onto OLD AUGUSTA ROAD

Travel east for 0.036 MILES, turn left onto PATTON ROAD

Travel north for 0.062 MILES, turn right onto WILLIAMS DRIVE

Travel east for 0.148 MILES, turn right onto AUGUSTA ROAD

Travel south for 0.004 MILES, go straight onto AUGUSTA RD

Travel south for 0.077 MILES, go straight onto AUGUSTA ROAD UNDERPASS

Travel south for 0.012 MILES, go straight onto AUGUSTA ROAD

Travel south for 0.182 MILES, go straight onto ACCESS RAMP

Travel south for 0.004 MILES, go straight onto AUGUSTA ROAD

Travel south for 0.032 MILES, turn right onto AUGUSTA ROAD CROSSOVER

Travel west for 0.022 MILES, turn left onto

Travel southwest for 0.048 MILES, turn left onto WOODMEDE WAY

Travel south for 0.105 MILES, go straight onto PINE CREEK DR

Travel south for 0.236 MILES, turn right onto CRESTFIELD RD

Travel southwest for 0.013 MILES, turn left onto FOXHALL RD

Travel southwest for 0.347 MILES, turn left onto MOOREMONT AVE

Travel south for 0.312 MILES, turn right onto EAST FAIRFIELD RD

Travel west for 0.057 MILES, turn left onto EAST BELVEDERE ROAD

Travel south for 0.183 MILES, turn back onto EAST BELVEDERE RD

Travel north for 0.183 MILES, turn right onto EAST FAIRFIELD RD

Travel east for 0.321 MILES, go straight onto AUGUSTA ROAD CROSSOVER

Travel southeast for 0.018 MILES, turn left onto AUGUSTA RD

Travel northeast for 0.166 MILES, go straight onto OLD AUGUSTA ROAD

Travel north for 0.597 MILES, go straight onto AUGUSTA ROAD

Travel northwest for 0.498 MILES, go straight onto ACCESS RAMP

Travel north for 0.004 MILES, go straight onto AUGUSTA ROAD

Travel north for 0.182 MILES, go straight onto AUGUSTA ROAD

UNDERPASS

Travel north for 0.012 MILES, go straight onto AUGUSTA RD

Travel north for 0.077 MILES, go straight onto AUGUSTA ROAD

Travel north for 0.004 MILES, turn left onto WILLIAMS DRIVE

Travel west for 0.148 MILES, turn left onto PATTON ROAD

Travel south for 0.062 MILES, turn right onto OLD AUGUSTA RD

Travel west for 0.036 MILES, go straight onto PLANTATION RD

Travel northwest for 0.464 MILES, go straight onto PROSPERITY AVENUE

Travel north for 0.015 MILES, go straight onto PROSPERITY AV

Travel northeast for 0.160 MILES, turn left onto PASADENA AV

Travel northwest for 0.169 MILES, turn left onto PACIFIC AV

Travel west for 0.046 MILES, turn right onto PANAMA AV

Travel north for 0.137 MILES, turn left onto POTOMAC AV

Travel west for 0.023 MILES, turn right onto PANAMA AV

Travel north for 0.068 MILES, turn left onto PLEASANT RIDGE AV

Travel west for 0.170 MILES, turn right onto PENROSE AV

Travel north for 0.105 MILES, go straight onto CHAPMAN

Travel northwest for 0.047 MILES, go straight onto CHAPMAN RD

Travel west for 0.170 MILES, turn right onto EAST SEVEN OAKS DRIVE

Travel northwest for 0.379 MILES, go straight onto CHANTICLEER DRIVE

Travel northwest for 0.217 MILES, turn right onto MICHAUX DR

Travel north for 0.337 MILES, turn left onto WEST FARIS ROAD

Travel west for 0.636 MILES, turn right onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AVE

Travel northeast for 0.398 MILES, go straight onto GUESS ST

Travel north for 0.534 MILES, go straight onto GREEN AV

Travel northwest for 0.048 MILES, turn left onto NELSON ST

Travel northwest for 0.100 MILES, turn right onto ANDERSON ST

Travel northeast for 0.115 MILES, go straight onto JENKINS ST

Travel northeast for 0.001 MILES, go straight onto ANDERSON ST

Travel north for 0.232 MILES, turn left onto ARLINGTON AV

Travel west for 0.066 MILES, turn right onto MALLARD ST

Travel north for 0.088 MILES, turn right onto PENDLETON ST

Travel east for 0.223 MILES, turn left onto N MARKLEY ST

Travel north for 0.067 MILES, turn right onto RHETT ST

Travel east for 0.151 MILES, turn left onto WARDLAW ST

Travel north for 0.155 MILES, go straight onto WESTFIELD ST

Travel northeast for 0.342 MILES, turn left onto W BROAD ST

Travel north for 0.116 MILES, go straight onto BUTLER AV

Travel north for 0.300 MILES, turn left onto BUNCOMBE ST

Travel northwest for 0.117 MILES, go straight onto RUTHERFORD ST

Travel north for 0.605 MILES, go straight onto RUTHERFORD RD

Travel northeast for 0.373 MILES, turn left onto OLD PARIS MOUNTAIN ROAD

Travel north for 0.082 MILES, turn right onto LOVE STREET

Travel east for 0.046 MILES, turn right onto MACK STREET

Travel southeast for 0.045 MILES, turn back onto MACK STREET

Travel northwest for 0.045 MILES, turn left onto LOVE STREET

Travel west for 0.046 MILES, turn left onto OLD PARIS MOUNTAIN ROAD

Travel south for 0.082 MILES, turn right onto RUTHERFORD RD

Travel southwest for 0.373 MILES, go straight onto RUTHERFORD ST

Travel south for 0.605 MILES, go straight onto BUNCOMBE ST

Travel southeast for 0.463 MILES, turn right onto RICHARDSON ST

Travel south for 0.125 MILES, turn left onto W WASHINGTON ST

Travel east for 0.045 MILES, turn right onto S LAURENS ST

Travel south for 0.083 MILES, turn left onto W MCBEE AV

Travel southeast for 0.056 MILES, turn right onto S MAIN ST

Travel south for 0.069 MILES, turn left onto E COURT ST

Travel southeast for 0.082 MILES, turn right onto FALLS ST

Travel south for 0.254 MILES, turn left onto E CAMPERDOWN WY

Travel southeast for 0.063 MILES, go straight onto CLEVELAND ST

Travel south for 0.494 MILES, go straight onto JONES AV

Travel south for 0.756 MILES, turn left onto AUGUSTA ST

Travel southeast for 1.672 MILES, go straight onto AUGUSTA ROAD

Travel south for 0.712 MILES, go straight onto AUGUSTA RD

Travel south for 0.077 MILES, go straight onto AUGUSTA ROAD UNDERPASS

Travel south for 0.012 MILES, go straight onto AUGUSTA ROAD

Travel south for 0.182 MILES, go straight onto ACCESS RAMP

Travel south for 0.004 MILES, go straight onto AUGUSTA ROAD

Travel south for 1.647 MILES, turn left onto EAST GANTT ST

Travel southeast for 0.207 MILES, turn right onto BRANCH ST

Travel west for 0.221 MILES, turn right onto DONALDSON ROAD

Travel north for 0.028 MILES, turn left onto AUGUSTA ROAD

Travel southwest for 0.093 MILES, turn right onto AUGUSTA ROAD CROSSOVER

Travel northwest for 0.022 MILES, go straight onto WHILLER DR

Travel northwest for 0.077 MILES, go straight onto TOWER DR

Travel northwest for 0.238 MILES, go straight onto WHILLER DR

Travel northwest for 0.093 MILES, turn left onto EAST FAIRFIELD ROAD

Travel west for 0.075 MILES, turn right onto WHITE HORSE RD

Travel northwest for 2.660 MILES, turn right onto GROVE ROAD

Travel northeast for 1.344 MILES, go straight onto GROVE RD

Travel northeast for 0.318 MILES, turn back onto GROVE RD

Travel southwest for 0.318 MILES, go straight onto GROVE RD

Travel southwest for 1.344 MILES, turn left onto WHITE HORSE RD

Travel southeast for 0.782 MILES, turn left onto SC FRONTAGE ROAD 1107

Travel east for 0.047 MILES, go straight onto BRUCE ROAD

Travel east for 1.602 MILES, turn right onto EAST DORCHESTER

Travel south for 0.122 MILES, turn left onto PINE CREEK DR

Travel east for 0.462 MILES, turn left onto WOODMEDE WAY

Travel north for 0.105 MILES, turn right onto

Travel northeast for 0.048 MILES, turn right onto AUGUSTA ROAD CROSSOVER

Travel east for 0.022 MILES, turn left onto AUGUSTA ROAD

Travel north for 0.032 MILES, go straight onto ACCESS RAMP

Travel north for 0.004 MILES, go straight onto AUGUSTA ROAD

Travel north for 0.182 MILES, go straight onto AUGUSTA ROAD UNDERPASS

Travel north for 0.012 MILES, go straight onto AUGUSTA RD

Travel north for 0.077 MILES, go straight onto AUGUSTA ROAD

Travel north for 0.004 MILES, turn left onto WILLIAMS DRIVE

Travel west for 0.148 MILES, turn left onto PATTON ROAD

Travel south for 0.062 MILES, turn right onto OLD AUGUSTA ROAD

Travel west for 0.036 MILES, go straight onto PLANTATION RD

Travel northwest for 0.464 MILES, go straight onto PROSPERITY AVENUE

Travel north for 0.015 MILES, go straight onto PROSPERITY AV

Travel northeast for 0.160 MILES, turn left onto PASADENA AV

Travel northwest for 0.169 MILES, turn left onto PACIFIC AV

Travel west for 0.046 MILES, turn right onto PANAMA AV

Travel north for 0.137 MILES, turn left onto POTOMAC AV

Travel west for 0.023 MILES, turn right onto PANAMA AV

Travel north for 0.068 MILES, turn left onto PLEASANT RIDGE AV

Travel west for 0.170 MILES, turn right onto PENROSE AV

Travel north for 0.105 MILES, go straight onto CHAPMAN

Travel northwest for 0.047 MILES, go straight onto CHAPMAN RD

Travel west for 0.170 MILES, turn right onto EAST SEVEN OAKS DRIVE

Travel northwest for 0.379 MILES, go straight onto CHANTICLEER DRIVE

Travel northwest for 0.217 MILES, turn right onto MICHAUX DR

Travel north for 0.337 MILES, turn left onto WEST FARIS ROAD

Travel west for 0.636 MILES, turn right onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, turn right onto MILLS AV

Travel northeast for 0.156 MILES, go straight onto MILLS AV

Travel northeast for 0.293 MILES, turn left onto AUGUSTA ST

Travel north for 0.817 MILES, End of path

Total path length is 40.357 MILES

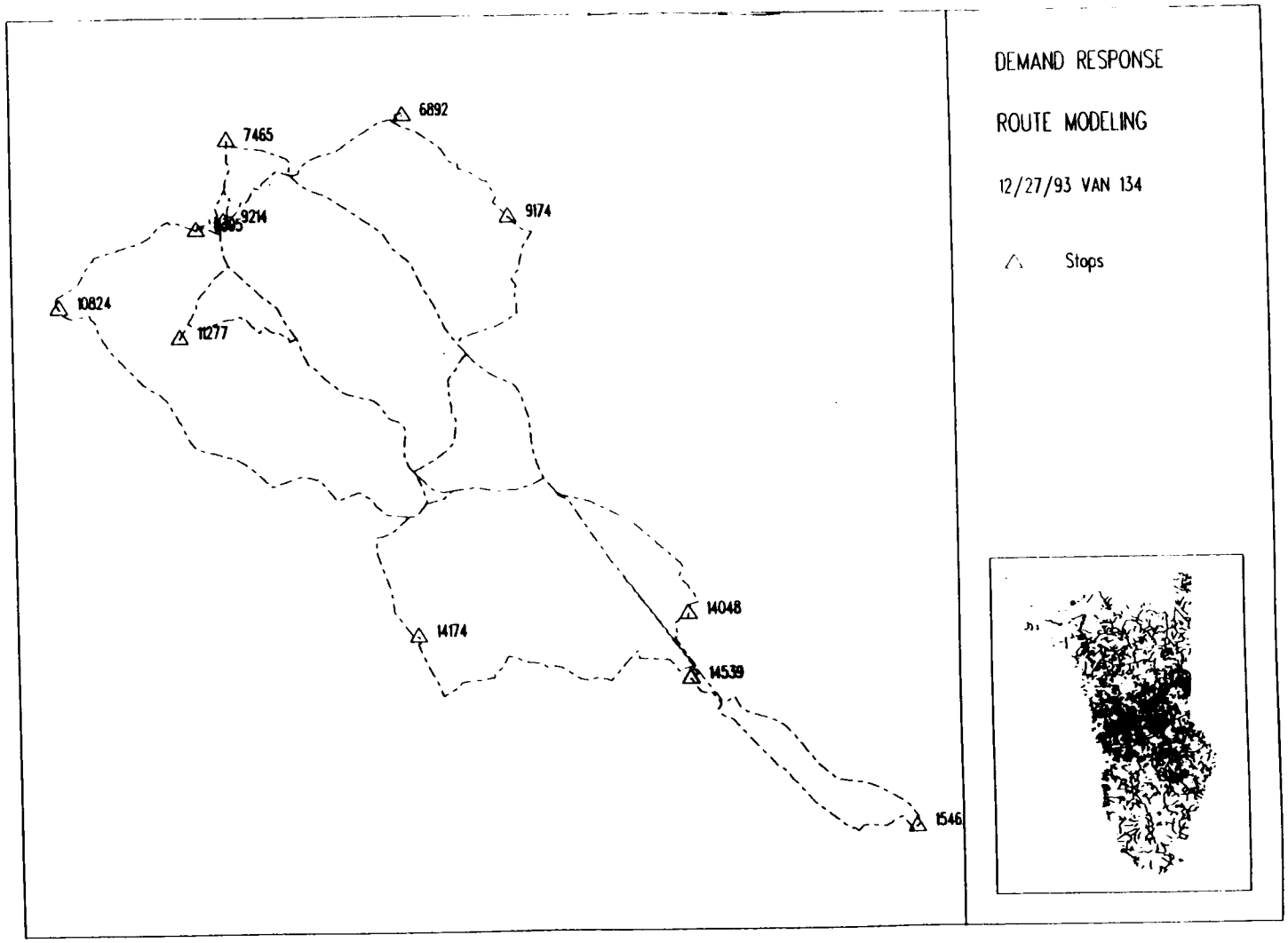


FIGURE 13

ROUTE 10 VAN 134

TABLE 6

ROUTE 10 VAN 134

DECEMBER 27, 1993

ROUTE	STOP #	NODE	TIME	STOP ADDRESS
10	1	9214	7:30 am	106 Augusta St
10	2	6892	8:00 am	50 Glenwood Rd
10	3	9174	8:17 am	1 Marcus Blvd
10	4	14174	8:40 am	102 Shay Ave
10	5	14539	8:59 am	206 Brentwood Way
10	6	14048	9:15 am	203 Boyd St
10	7	9395	9:47 am	100 Mallard St
10	8	7465	10:00 am	415 Rutherford St
10	9	14539	11:04 am	308 Brentwood Way
10	10	15462	11:17 am	206 Case St
10	11	11277	11:50 am	1009 Grove Rd
10	12	9214	12:00 pm	106 Augusta St
10	13	7465	2:30 pm	415 Rutherford St
10	14	9395	2:40 pm	100 Mallard St
10	15	10824	2:55 pm	1010 S Welcome Rd
10	16	14539	3:25 pm	206 Brentwood Way
10	17	14048	3:39 pm	203 Boyd St
10	18	11277	4:15 pm	1009 Grove Rd
10	19	14539	5:08 pm	308 Brentwood Way
10	20	15462	5:20 pm	206 Case St
10	21	9214	6:00 pm	106 Augusta St

Adapted from: GTA. (1993). [Demand Response Van Driver Logs]. Unpublished Raw Data.

DIRECTIONS

VAN 134 ROUTE 10

DECEMBER 27, 1993

Starting at AUGUSTA ST

Travel northeast for 0.095 MILES, turn right onto S MAIN ST

Travel northeast for 0.396 MILES, turn right onto E COURT ST

Travel east for 0.083 MILES, turn left onto FALLS ST

Travel northeast for 0.080 MILES, go straight onto S SPRING ST

Travel north for 0.081 MILES, go straight onto N SPRING ST

Travel northeast for 0.133 MILES, turn right onto E NORTH ST

Travel east for 0.095 MILES, turn left onto N CHURCH ST

Travel northeast for 0.326 MILES, go straight onto ACCESS RAMP

Travel northeast for 0.135 MILES, turn right onto E PARK AV

Travel east for 0.242 MILES, go straight onto E NORTH ST

Travel northeast for 1.856 MILES, go straight onto E NORTH EXT ST

Travel east for 0.272 MILES, turn left onto TRENHOLM ROAD

Travel northwest for 0.074 MILES, turn right onto ELMIRA ST

Travel north for 0.121 MILES, turn back onto ELMIRA STREET

Travel west for 0.121 MILES, turn left onto TRENHOLM ROAD

Travel southeast for 0.074 MILES, turn right onto E NORTH EXT ST

Travel west for 0.088 MILES, turn left onto PELHAM RD

Travel southeast for 1.418 MILES, turn right onto HAYWOOD RD

Travel south for 0.107 MILES, turn left onto ORCHARD PARK DR

Travel southeast for 0.547 MILES, turn right onto PATEWOOD DR

Travel southeast for 1.282 MILES, turn right onto ROPER MOUNTAIN RD

Travel southwest for 0.380 MILES, go straight onto VERDAE BLVD

Travel south for 0.543 MILES, turn left onto OLD SULPHUR SPRINGS RD

Travel south for 0.552 MILES, go straight onto SALTERS RD

Travel south for 0.084 MILES, turn right onto I 85

Travel southwest for 1.055 MILES, go straight onto ACCESS RAMP

Travel south for 0.148 MILES, go straight onto LAURENS RD

Travel southeast for 0.199 MILES, turn right onto FAIRFOREST WAY

Travel southwest for 0.556 MILES, turn left onto RIDGE RD

Travel south for 2.019 MILES, turn left onto MAULDIN RD

Travel southeast for 0.081 MILES, go straight onto CONESTEE LAKE ROAD

Travel south for 0.550 MILES, go straight onto CONESTEE ROAD

Travel southwest for 0.394 MILES, turn left onto MAIN STREET

Travel southwest for 0.674 MILES, turn left onto FORK SHOALS ROAD

Travel south for 1.938 MILES, turn left onto SHAY AVENUE

Travel northeast for 0.074 MILES, turn right onto TRAY DRIVE

Travel south for 0.184 MILES, turn left onto FORK SHOALS RD

Travel southeast for 1.011 MILES, turn left onto LOG SHOALS ROAD

Travel northeast for 1.419 MILES, turn right onto MCCALL RD

Travel east for 1.899 MILES, turn left onto WEST GEORGIA RD

Travel northeast for 0.701 MILES, turn right onto NEELY FERRY ROAD

Travel south for 0.149 MILES, turn left onto SEMINOLE DRIVE

Travel east for 0.774 MILES, turn left onto CAPEWOOD ROAD

Travel northeast for 0.103 MILES, go straight onto RICHARDSON STREET

Travel east for 0.141 MILES, turn right onto GRANDVIEW DRIVE

Travel southeast for 0.156 MILES, turn right onto BRENTWOOD WAY

Travel southwest for 0.136 MILES, turn back onto BRENTWOOD WAY

Travel northeast for 0.136 MILES, turn left onto GRANDVIEW DR

Travel northwest for 0.156 MILES, turn right onto RICHARDSON STREET

Travel east for 0.058 MILES, turn left onto INDUSTRIAL DRIVE

Travel northwest for 0.622 MILES, turn right onto WEST GEORGIA ROAD

Travel east for 0.046 MILES, turn left onto BOYD AVENUE

Travel north for 0.779 MILES, turn right onto BENSON STREET

Travel east for 0.147 MILES, turn left onto NORTH MAPLE ST

Travel northwest for 0.564 MILES, turn right onto PELHAM RD

Travel north for 0.193 MILES, turn left onto NORTHEAST MAIN STREET

Travel northwest for 1.498 MILES, go straight onto SOUTH MAIN STREET

Travel northwest for 1.397 MILES, turn left onto WEST BUTLER ROAD

Travel west for 1.613 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.721 MILES, go straight onto MAULDIN RD

Travel northwest for 1.570 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.768 MILES, go straight onto MAULDIN RD

Travel northwest for 0.005 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.592 MILES, turn right onto AUGUSTA ST

Travel northwest for 2.820 MILES, turn left onto VARDRY ST

Travel northwest for 0.314 MILES, turn left onto ANDERSON ST

Travel southwest for 0.090 MILES, turn right onto ARLINGTON AV

Travel west for 0.066 MILES, turn right onto MALLARD ST

Travel north for 0.088 MILES, turn right onto PENDLETON ST

Travel east for 0.223 MILES, turn left onto N MARKLEY ST

Travel north for 0.067 MILES, turn right onto RHETT ST

Travel east for 0.151 MILES, turn left onto WARDLAW ST

Travel north for 0.155 MILES, go straight onto WESTFIELD ST

Travel northeast for 0.342 MILES, turn left onto W BROAD ST

Travel north for 0.116 MILES, go straight onto BUTLER AV

Travel north for 0.300 MILES, turn left onto BUNCOMBE ST

Travel northwest for 0.117 MILES, go straight onto RUTHERFORD ST

Travel north for 0.360 MILES, turn back onto RUTHERFORD ST

Travel south for 0.080 MILES, turn left onto W STONE AV

Travel east for 0.585 MILES, go straight onto E STONE AV

Travel southeast for 0.881 MILES, go straight onto LAURENS RD

Travel southeast for 4.363 MILES, go straight onto LAURENS ROAD

Travel southeast for 1.196 MILES, go straight onto USHWY 276

Travel south for 0.523 MILES, go straight onto NORTH MAIN STREET

Travel south for 1.004 MILES, go straight onto SOUTH MAIN STREET

Travel southeast for 0.316 MILES, go straight onto USHWY 276

Travel southeast for 1.736 MILES, go straight onto US HIGHWAY 276

Travel southeast for 0.137 MILES, turn right onto INTERSTATE 385

Travel southeast for 2.010 MILES, turn right onto RICHARDSON STREET

Travel west for 0.023 MILES, turn left onto GRANDVIEW DRIVE

Travel southeast for 0.156 MILES, turn right onto BRENTWOOD WAY

Travel southwest for 0.136 MILES, turn left onto ASHLEY OAKS DRIVE

Travel southeast for 0.285 MILES, turn left onto BRENTWOOD WAY

Travel east for 0.199 MILES, turn right onto GRANDVIEW DRIVE

Travel southeast for 1.850 MILES, turn left onto HARRISON BRIDGE ROAD

Travel east for 0.049 MILES, turn right onto NORTH WOODS DR

Travel southeast for 1.699 MILES, turn left onto FAIRVIEW STREET

Travel east for 0.844 MILES, turn right onto WOODSIDE AVENUE

Travel southeast for 0.294 MILES, turn left onto CASE STREET

Travel northeast for 0.178 MILES, turn left onto WALL STREET

Travel northwest for 0.119 MILES, turn right onto JONES STREET

Travel northeast for 0.053 MILES, turn left onto NORTH MAIN STREET

Travel northwest for 2.296 MILES, go straight onto SOUTHEAST MAIN STREET

Travel northwest for 1.614 MILES, turn left onto PLAIN ST

Travel southwest for 0.152 MILES, go straight onto INTERSTATE 385 RAMP

Travel west for 0.088 MILES, turn right onto INTERSTATE 385

Travel northwest for 1.561 MILES, go straight onto

Travel west for 1.193 MILES, go straight onto US HIGHWAY 276

Travel northwest for 0.149 MILES, go straight onto USHwy 276

Travel northwest for 1.736 MILES, go straight onto SOUTH MAIN STREET

Travel northwest for 0.316 MILES, turn left onto WEST BUTLER ROAD

Travel west for 1.613 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.721 MILES, go straight onto MAULDIN RD

Travel northwest for 1.570 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.768 MILES, go straight onto MAULDIN RD

Travel northwest for 0.005 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.592 MILES, turn right onto AUGUSTA ST

Travel north for 0.492 MILES, turn left onto AMHERST AV

Travel southwest for 0.121 MILES, turn right onto TYLER ST

Travel northwest for 0.082 MILES, turn left onto RICE ST

Travel southwest for 0.014 MILES, turn right onto MEYERS DR

Travel northwest for 0.872 MILES, go straight onto BALENTINE DR

Travel west for 0.123 MILES, turn right onto OSCEOLA DR

Travel northwest for 0.078 MILES, turn left onto W FARIS RD

Travel west for 0.340 MILES, go straight onto WEST FARIS

ROAD

Travel west for 0.636 MILES, turn left onto GROVE ROAD

Travel southwest for 0.322 MILES, turn back onto GROVE ROAD

Travel northeast for 0.322 MILES, go straight onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, turn right onto MILLS AV

Travel northeast for 0.156 MILES, go straight onto MILLS AV

Travel northeast for 0.293 MILES, turn left onto AUGUSTA ST

Travel north for 0.912 MILES, go straight onto RIVER ST

Travel north for 0.268 MILES, turn left onto REEDY VIEW DR

Travel northwest for 0.069 MILES, turn right onto S ACADEMY ST

Travel northeast for 0.046 MILES, turn left onto W BROAD ST

Travel north for 0.282 MILES, go straight onto BUTLER AV

Travel north for 0.300 MILES, turn left onto BUNCOMBE ST

Travel northwest for 0.117 MILES, go straight onto RUTHERFORD ST

Travel north for 0.360 MILES, turn back onto RUTHERFORD ST

Travel south for 0.360 MILES, go straight onto BUNCOMBE ST

Travel southeast for 0.117 MILES, turn right onto BUTLER AV

Travel south for 0.300 MILES, go straight onto W BROAD ST

Travel south for 0.116 MILES, turn right onto WESTFIELD ST

Travel southwest for 0.342 MILES, go straight onto WARDLAW ST

Travel south for 0.155 MILES, turn right onto RHETT ST

Travel west for 0.151 MILES, turn left onto N MARKLEY ST

Travel south for 0.067 MILES, turn right onto PENDLETON ST

Travel west for 0.223 MILES, turn left onto MALLARD ST

Travel south for 0.088 MILES, turn right onto ARLINGTON AV

Travel west for 0.485 MILES, turn right onto ST FRANCIS BLVD

Travel northwest for 0.059 MILES, turn left onto EASLEY BRIDGE RD

Travel west for 0.077 MILES, go straight onto EASLEY BRIDGE ROAD

Travel southwest for 1.376 MILES, turn left onto OLD EASLEY BRIDGE ROAD

Travel southwest for 0.966 MILES, turn left onto NEW DUNHAM BRIDGE ROAD

Travel south for 0.093 MILES, turn left onto SOUTH WELCOME ROAD

Travel east for 0.724 MILES, turn right onto WHITE HORSE ROAD

Travel southeast for 4.515 MILES, turn left onto EAST FAIRFIELD ROAD

Travel east for 0.798 MILES, go straight onto AUGUSTA ROAD CROSSOVER

Travel southeast for 0.018 MILES, turn left onto AUGUSTA RD

Travel northeast for 0.033 MILES, turn right onto HICKS ROAD

Travel southeast for 0.501 MILES, turn left onto WHITE HORSE ROAD EXTENSION

Travel east for 0.389 MILES, turn right onto FORK SHOALS RD

Travel southeast for 0.363 MILES, go straight onto CONESTEE ROAD

Travel east for 1.551 MILES, turn right onto WEST BUTLER RD

Travel east for 1.613 MILES, turn right onto SOUTH MAIN ST

Travel southeast for 0.316 MILES, go straight onto USHWY 276

Travel southeast for 1.736 MILES, go straight onto US HIGHWAY 276

Travel southeast for 0.137 MILES, turn right onto INTERSTATE 385

Travel southeast for 2.010 MILES, turn right onto RICHARDSON STREET

Travel west for 0.023 MILES, turn left onto GRANDVIEW DRIVE

Travel southeast for 0.156 MILES, turn right onto BRENTWOOD WAY

Travel southwest for 0.136 MILES, turn back onto BRENTWOOD WAY

Travel northeast for 0.136 MILES, turn left onto GRANDVIEW DRIVE

Travel northwest for 0.156 MILES, turn right onto RICHARDSON STREET

Travel east for 0.058 MILES, turn left onto INDUSTRIAL DRIVE

Travel northwest for 0.622 MILES, turn right onto WEST GEORGIA ROAD

Travel east for 0.046 MILES, turn left onto BOYD AVENUE

Travel north for 0.779 MILES, turn right onto BENSON STREET

Travel east for 0.147 MILES, turn left onto NORTH MAPLE ST

Travel northwest for 0.564 MILES, turn right onto PELHAM RD

Travel north for 0.193 MILES, turn left onto NORTHEAST MAIN STREET

Travel northwest for 1.498 MILES, go straight onto SOUTH MAIN STREET

Travel northwest for 1.397 MILES, turn left onto WEST BUTLER ROAD

Travel west for 1.613 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.721 MILES, go straight onto MAULDIN RD

Travel northwest for 1.570 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.768 MILES, go straight onto MAULDIN RD

Travel northwest for 0.005 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.592 MILES, turn right onto AUGUSTA ST

Travel north for 0.492 MILES, turn left onto AMHERST AV

Travel southwest for 0.121 MILES, turn right onto TYLER ST

Travel northwest for 0.082 MILES, turn left onto RICE ST

Travel southwest for 0.014 MILES, turn right onto MEYERS DR

Travel northwest for 0.872 MILES, go straight onto BALENTINE DR

Travel west for 0.123 MILES, turn right onto OSCEOLA DR

Travel northwest for 0.078 MILES, turn left onto W FARIS RD

Travel west for 0.340 MILES, go straight onto WEST FARIS RD

Travel west for 0.636 MILES, turn left onto GROVE ROAD

Travel southwest for 0.322 MILES, turn back onto GROVE ROAD

Travel northeast for 0.322 MILES, turn right onto WEST FARIS ROAD

Travel east for 0.636 MILES, go straight onto W FARIS RD

Travel east for 0.340 MILES, turn right onto OSCEOLA DR

Travel southeast for 0.078 MILES, turn left onto BALENTINE DR

Travel east for 0.123 MILES, go straight onto MEYERS DR

Travel southeast for 0.872 MILES, turn left onto RICE ST

Travel northeast for 0.014 MILES, turn right onto TYLER ST

Travel southeast for 0.082 MILES, turn left onto AMHERST AV

Travel northeast for 0.121 MILES, turn right onto AUGUSTA ST

Travel south for 0.492 MILES, turn left onto MAULDIN ROAD

Travel southeast for 0.592 MILES, go straight onto MAULDIN RD

Travel southeast for 0.005 MILES, go straight onto MAULDIN ROAD

Travel southeast for 0.768 MILES, go straight onto MAULDIN RD

Travel southeast for 1.570 MILES, go straight onto MAULDIN ROAD

Travel southeast for 0.721 MILES, go straight onto WEST BUTLER ROAD

Travel east for 1.613 MILES, turn right onto SOUTH MAIN ST

Travel southeast for 0.316 MILES, go straight onto USHwy 276

Travel southeast for 1.736 MILES, go straight onto US HIGHWAY 276

Travel southeast for 0.137 MILES, turn right onto INTERSTATE 385

Travel southeast for 2.010 MILES, turn right onto RICHARDSON STREET

Travel west for 0.023 MILES, turn left onto GRANDVIEW DRIVE

Travel southeast for 0.156 MILES, turn right onto BRENTWOOD WAY

Travel southwest for 0.136 MILES, turn left onto ASHLEY OAKS DRIVE

Travel southeast for 0.285 MILES, turn left onto BRENTWOOD WAY

Travel east for 0.199 MILES, turn right onto GRANDVIEW DRIVE

Travel southeast for 1.850 MILES, turn left onto HARRISON BRIDGE ROAD

Travel east for 0.049 MILES, turn right onto NORTH WOODS DR

Travel southeast for 1.699 MILES, turn left onto FAIRVIEW ST

Travel east for 0.844 MILES, turn right onto WOODSIDE AVENUE

Travel southeast for 0.294 MILES, turn left onto CASE STREET

Travel northeast for 0.178 MILES, turn left onto WALL STREET

Travel northwest for 0.119 MILES, turn right onto JONES ST

Travel northeast for 0.053 MILES, turn left onto NORTH MAIN STREET

Travel northwest for 2.296 MILES, go straight onto SOUTHEAST MAIN STREET

Travel northwest for 1.614 MILES, turn left onto PLAIN ST

Travel southwest for 0.152 MILES, go straight onto INTERSTATE 385 RAMP

Travel west for 0.088 MILES, turn right onto INTERSTATE 385

Travel northwest for 1.561 MILES, go straight onto

Travel northwest for 1.193 MILES, go straight onto US HIGHWAY 276

Travel northwest for 0.149 MILES, go straight onto US HWY 276

Travel northwest for 1.736 MILES, go straight onto SOUTH MAIN STREET

Travel northwest for 0.316 MILES, turn left onto WEST BUTLER ROAD

Travel west for 1.613 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.721 MILES, go straight onto MAULDIN RD

Travel northwest for 1.570 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.768 MILES, go straight onto MAULDIN RD

Travel northwest for 0.005 MILES, go straight onto MAULDIN ROAD

Travel northwest for 0.592 MILES, turn right onto AUGUSTA ST

Travel northwest for 3.062 MILES, End of path

Total path length is 149.536 MILES

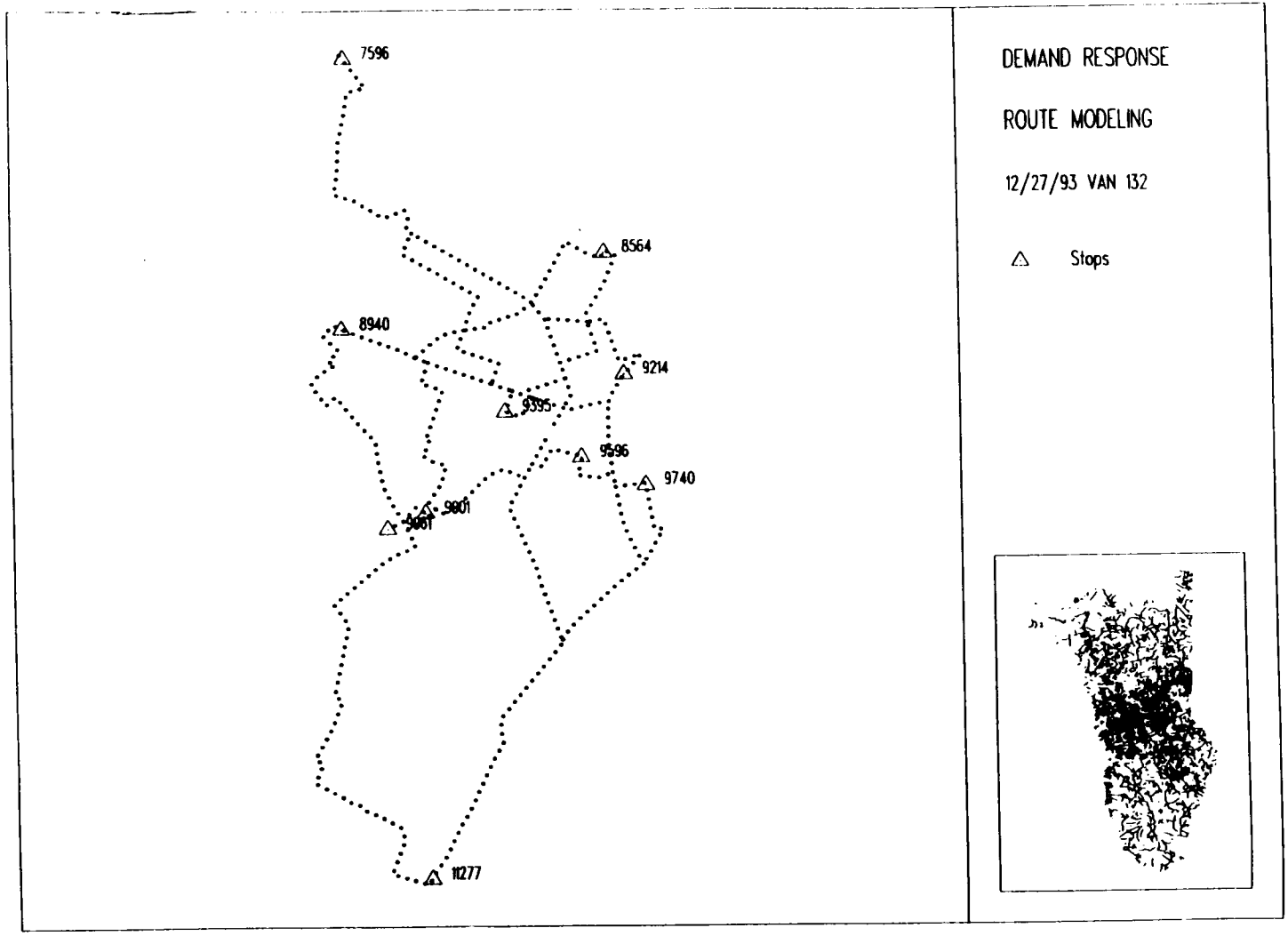


FIGURE 14

ROUTE 11 VAN 132

TABLE 7

ROUTE 11 VAN 132

DECEMBER 27, 1993

ROUTE	STOP #	NODE	TIME	STOP ADDRESS
11	1	9214	7:00 am	106 Augusta St
11	2	7596	9:20 am	106 E Parker Rd
11	3	9395	9:30 am	100 Mallard St
11	4	8564	10:15 am	3 Martin St
11	5	8940	10:30 am	1167 Pendleton St
11	6	9901	10:40 am	4 Estelle St
11	7	9961	10:41 am	4 Odessa St
11	8	9596	10:55 am	6 Hopkins St
11	9	9740	10:58 am	7 Chicora Ave
11	10	11277	11:06 am	1009 Grove Rd
11	11	9214	11:30 am	106 Augusta St
11	12	9395	2:04 pm	100 Mallard St
11	13	7596	2:14 pm	106 E Parker Rd
11	14	11277	3:47 pm	1009 Grove Rd
11	15	9901	3:55 pm	4 Estelle St
11	16	9596	4:00 pm	6 Hopkins St
11	17	9740	4:03 pm	7 Chicora Ave
11	18	11277	4:27 pm	1009 Grove Rd
11	19	9961	4:39 pm	4 Odessa St
11	20	8940	4:46 pm	1167 Pendleton St
11	21	9214	5:30 pm	106 Augusta St

Adapted from: GTA. (1993). [Demand Response Van Driver Logs]. Unpublished Raw Data.

DIRECTIONS

ROUTE 11 VAN 132

DECEMBER 27, 1993

Starting at AUGUSTA ST

Travel northeast for 0.095 MILES, turn left onto PENDLETON ST

Travel west for 0.090 MILES, turn right onto ONEAL ST

Travel north for 0.180 MILES, turn left onto S ACADEMY ST

Travel west for 0.230 MILES, turn right onto N MARKLEY ST

Travel northwest for 0.077 MILES, go straight onto BIRNIE ST

Travel northwest for 0.580 MILES, turn right onto QUEEN ST

Travel north for 0.085 MILES, turn left onto CAIN ST

Travel west for 0.090 MILES, turn right onto BIRNIE EXT ST

Travel northwest for 0.217 MILES, turn right onto NORTH VANCE STREET

Travel north for 0.414 MILES, turn right onto EAST BRAMLETT RD

Travel east for 0.075 MILES, turn left onto EAST PARKER ROAD

Travel northwest for 0.177 MILES, turn back onto EAST PARKER ROAD

Travel southeast for 0.177 MILES, turn right onto EAST BRAMLETT ROAD

Travel west for 0.075 MILES, turn left onto NORTH VANCE ST

Travel south for 0.414 MILES, turn left onto BIRNIE EXT ST

Travel southeast for 0.217 MILES, turn left onto CAIN ST

Travel east for 0.090 MILES, turn right onto QUEEN ST

Travel south for 0.085 MILES, turn left onto BIRNIE ST

Travel southeast for 0.025 MILES, turn right onto QUEEN ST

Travel southwest for 0.092 MILES, turn left onto GOWER ST

Travel southeast for 0.341 MILES, turn right onto N LEACH ST

Travel south for 0.229 MILES, turn left onto PERRY AV

Travel east for 0.175 MILES, turn right onto N MEMMINGER ST

Travel south for 0.089 MILES, turn left onto PENDLETON ST

Travel east for 0.087 MILES, turn right onto MALLARD ST

Travel north for 0.088 MILES, turn back onto MALLARD ST

Travel north for 0.088 MILES, turn right onto PENDLETON ST

Travel east for 0.223 MILES, turn left onto N MARKLEY ST

Travel north for 0.067 MILES, turn right onto RHETT ST

Travel east for 0.151 MILES, turn left onto WARDLAW ST

Travel north for 0.155 MILES, go straight onto WESTFIELD ST

Travel northeast for 0.267 MILES, turn left onto GIBBS ST

Travel west for 0.047 MILES, turn left onto MARTIN ST

Travel south for 0.033 MILES, turn right onto SYCAMORE ST

Travel northwest for 0.153 MILES, turn left onto S HUDSON ST

Travel southwest for 0.280 MILES, go straight onto N CALHOUN ST

Travel southwest for 0.207 MILES, turn right onto S ACADEMY ST

Travel southwest for 0.324 MILES, turn right onto PENDLETON ST

Travel west for 0.346 MILES, turn back onto PENDLETON ST

Travel east for 0.399 MILES, turn right onto SUMNER ST

Travel south for 0.089 MILES, turn left onto ARLINGTON AV

Travel east for 0.088 MILES, turn right onto S LEACH ST

Travel south for 0.203 MILES, turn left onto DUNBAR ST

Travel east for 0.013 MILES, turn right onto MINUS ST

Travel southwest for 0.077 MILES, turn left onto JENKINS ST

Travel southeast for 0.102 MILES, turn right onto HORTON ST

Travel south for 0.085 MILES, turn right onto TAYLOR ST

Travel southwest for 0.085 MILES, turn left onto STERLING ST

Travel southeast for 0.038 MILES, turn right onto AVERILL ST

Travel southwest for 0.036 MILES, turn right onto ESTELLE ST

Travel northwest for 0.062 MILES, turn left onto ODESSA ST

Travel southwest for 0.145 MILES, turn back onto ODESSA ST

Travel northeast for 0.145 MILES, turn right onto ESTELLE ST

Travel southeast for 0.062 MILES, turn left onto AVERILL ST

Travel northeast for 0.036 MILES, go straight onto AVERILL ST

Travel northeast for 0.006 MILES, turn right onto STERLING ST

Travel southeast for 0.032 MILES, turn left onto CONWELL ST

Travel northeast for 0.239 MILES, turn right onto JENKINS ST

Travel east for 0.059 MILES, turn left onto JENKINS ST

Travel northeast for 0.001 MILES, turn right onto JENKINS ST

Travel east for 0.096 MILES, turn left onto GREEN AV

Travel northeast for 0.063 MILES, turn right onto DUNBAR ST

Travel east for 0.041 MILES, turn left onto CALVARY ST

Travel northeast for 0.081 MILES, turn right onto ANSEL ST

Travel east for 0.121 MILES, turn right onto HOPKINS ST

Travel south for 0.079 MILES, turn left onto DUNBAR ST

Travel east for 0.141 MILES, turn right onto AUGUSTA ST

Travel south for 0.061 MILES, turn left onto HAYNIE ST

Travel east for 0.116 MILES, turn right onto CHICORA AV

Travel south for 0.189 MILES, turn left onto MCKAY ST

Travel east for 0.035 MILES, turn right onto S CHURCH ST

Travel southwest for 0.162 MILES, go straight onto MILLS AV

Travel southwest for 0.293 MILES, go straight onto MILLS AV

Travel southwest for 0.156 MILES, turn left onto MILLS AV

Travel southwest for 0.398 MILES, turn left onto CHAPMAN ST

Travel south for 0.103 MILES, turn right onto GROVE RD

Travel southwest for 0.318 MILES, go straight onto GROVE RD

Travel southwest for 0.322 MILES, turn back onto GROVE ROAD

Travel northeast for 0.322 MILES, go straight onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, turn right onto MILLS AV

Travel northeast for 0.156 MILES, go straight onto MILLS AV

Travel northeast for 0.293 MILES, turn left onto AUGUSTA ST

Travel north for 0.817 MILES, turn back onto AUGUSTA ST

Travel southwest for 0.136 MILES, turn right onto FIELD ST

Travel west for 0.158 MILES, turn right onto VARDRY ST

Travel west for 0.148 MILES, turn left onto ANDERSON ST

Travel southwest for 0.090 MILES, turn right onto ARLINGTON AV

Travel west for 0.066 MILES, turn right onto MALLARD ST

Travel north for 0.088 MILES, turn left onto PENDLETON ST

Travel west for 0.087 MILES, turn right onto N MEMMINGER ST

Travel north for 0.089 MILES, turn left onto PERRY AV

Travel west for 0.175 MILES, turn right onto N LEACH ST

Travel north for 0.229 MILES, turn left onto GOWER ST

Travel northwest for 0.341 MILES, turn right onto QUEEN ST

Travel northeast for 0.092 MILES, turn left onto BIRNIE ST

Travel northwest for 0.025 MILES, turn right onto QUEEN ST

Travel north for 0.085 MILES, turn left onto CAIN ST

Travel west for 0.090 MILES, turn right onto BIRNIE EXT ST

Travel northwest for 0.217 MILES, turn right onto NORTH VANCE STREET

Travel north for 0.414 MILES, turn right onto EAST BRAMLETT ROAD

Travel east for 0.075 MILES, turn left onto EAST PARKER ROAD

Travel northwest for 0.177 MILES, turn back onto EAST PARKER ROAD

Travel southeast for 0.177 MILES, turn right onto EAST BRAMLETT ROAD

Travel west for 0.075 MILES, turn left onto NORTH VANCE ST

Travel south for 0.414 MILES, turn left onto BIRNIE EXT ST

Travel southeast for 0.217 MILES, turn left onto CAIN ST

Travel east for 0.090 MILES, turn right onto QUEEN ST

Travel south for 0.085 MILES, turn left onto BIRNIE ST

Travel southeast for 0.580 MILES, go straight onto N MARKLEY

ST

Travel south for 0.329 MILES, go straight onto S MARKLEY ST

Travel south for 0.069 MILES, turn right onto GREEN AV

Travel southwest for 0.567 MILES, go straight onto GUESS ST

Travel south for 0.534 MILES, go straight onto MILLS AV

Travel southwest for 0.398 MILES, turn left onto CHAPMAN ST

Travel south for 0.103 MILES, turn right onto GROVE RD

Travel southwest for 0.318 MILES, go straight onto GROVE RD

Travel southwest for 0.322 MILES, turn right onto BUTTERNUT DR

Travel west for 0.151 MILES, turn right onto BEAR DRIVE

Travel north for 0.200 MILES, go straight onto SIMPSON ST

Travel northwest for 0.080 MILES, go straight onto WEST FARIS ROAD

Travel northwest for 0.239 MILES, go straight onto WEST SIMPSON ST

Travel northwest for 0.060 MILES, turn right onto SMYTHE

Travel northeast for 0.031 MILES, go straight onto SMYTHE AVE

Travel north for 0.052 MILES, turn left onto ADGER STREET

Travel northwest for 0.036 MILES, turn right onto SEYLE ST

Travel northeast for 0.258 MILES, turn left onto WHITTEN-WALLACE STREET

Travel northwest for 0.036 MILES, turn right onto HUTCHENS

Travel north for 0.112 MILES, go straight onto HUTCHINS ST

Travel north for 0.179 MILES, turn left onto DUNEAN STREET

Travel northwest for 0.101 MILES, turn right onto ANDERSON RD

Travel northeast for 0.405 MILES, turn left onto VALENTINE ST

Travel northwest for 0.070 MILES, turn right onto AVERILL ST

Travel northeast for 0.139 MILES, go straight onto AVERILL ST

Travel northeast for 0.006 MILES, turn right onto STERLING ST

Travel southeast for 0.032 MILES, turn left onto CONWELL ST

Travel northeast for 0.239 MILES, turn right onto JENKINS ST

Travel east for 0.059 MILES, turn left onto JENKINS ST

Travel northeast for 0.001 MILES, turn right onto JENKINS ST

Travel east for 0.096 MILES, turn left onto GREEN AV

Travel northeast for 0.063 MILES, turn right onto DUNBAR ST

Travel east for 0.041 MILES, turn left onto CALVARY ST

Travel northeast for 0.081 MILES, turn right onto ANSEL ST

Travel east for 0.121 MILES, turn right onto HOPKINS ST

Travel south for 0.079 MILES, turn left onto DUNBAR ST

Travel east for 0.141 MILES, turn right onto AUGUSTA ST

Travel south for 0.061 MILES, turn left onto HAYNIE ST

Travel east for 0.116 MILES, turn right onto CHICORA AV

Travel south for 0.189 MILES, turn left onto MCKAY ST

Travel east for 0.035 MILES, turn right onto S CHURCH ST

Travel southwest for 0.162 MILES, go straight onto MILLS AV

Travel southwest for 0.293 MILES, go straight onto MILLS AV

Travel southwest for 0.156 MILES, turn left onto MILLS AV

Travel southwest for 0.398 MILES, turn left onto CHAPMAN ST

Travel south for 0.103 MILES, turn right onto GROVE RD

Travel southwest for 0.318 MILES, go straight onto GROVE RD

Travel southwest for 0.322 MILES, turn right onto BUTTERNUT DR

Travel west for 0.151 MILES, turn right onto BEAR DRIVE

Travel north for 0.200 MILES, go straight onto SIMPSON ST

Travel northwest for 0.080 MILES, go straight onto WEST FARIS ROAD

Travel northwest for 0.239 MILES, go straight onto WEST SIMPSON STREET

Travel northwest for 0.060 MILES, turn right onto SMYTHE

Travel northeast for 0.031 MILES, go straight onto SMYTHE AVE

Travel north for 0.052 MILES, turn left onto ADGER STREET

Travel northwest for 0.036 MILES, turn right onto SEYLE ST

Travel northeast for 0.258 MILES, turn left onto WHITTEN-WALLACE STREET

Travel northwest for 0.036 MILES, turn right onto HUTCHENS

Travel north for 0.112 MILES, go straight onto HUTCHINS ST

Travel north for 0.179 MILES, turn left onto DUNEAN STREET

Travel northwest for 0.101 MILES, turn right onto ANDERSON RD

Travel northeast for 0.405 MILES, turn left onto VALENTINE ST

Travel northwest for 0.070 MILES, go straight onto VALENTINE

Travel northwest for 0.039 MILES, turn left onto ODESSA ST

Travel southwest for 0.068 MILES, turn back onto ODESSA ST

Travel northeast for 0.068 MILES, turn left onto VALENTINE ST

Travel north for 0.253 MILES, go straight onto ANDREWS ST

Travel northwest for 0.328 MILES, turn left onto EASLEY BRIDGE ROAD

Travel southwest for 0.052 MILES, turn right onto STAR DRIVE

Travel northwest for 0.100 MILES, turn right onto DORSEY BLVD

Travel northeast for 0.129 MILES, turn left onto TRACTION

Travel northwest for 0.031 MILES, turn right onto S TEXTILE ST

Travel northeast for 0.058 MILES, turn left onto BURDETTE ST

Travel northwest for 0.086 MILES, turn right onto AIKEN ST

Travel northeast for 0.058 MILES, turn right onto PENDLETON ST

Travel east for 0.785 MILES, go straight onto VARDRY ST

Travel east for 0.201 MILES, turn left onto FIELD ST

Travel east for 0.158 MILES, turn left onto AUGUSTA ST

Travel north for 0.136 MILES, End of path

Total path length is 30.903 MILES

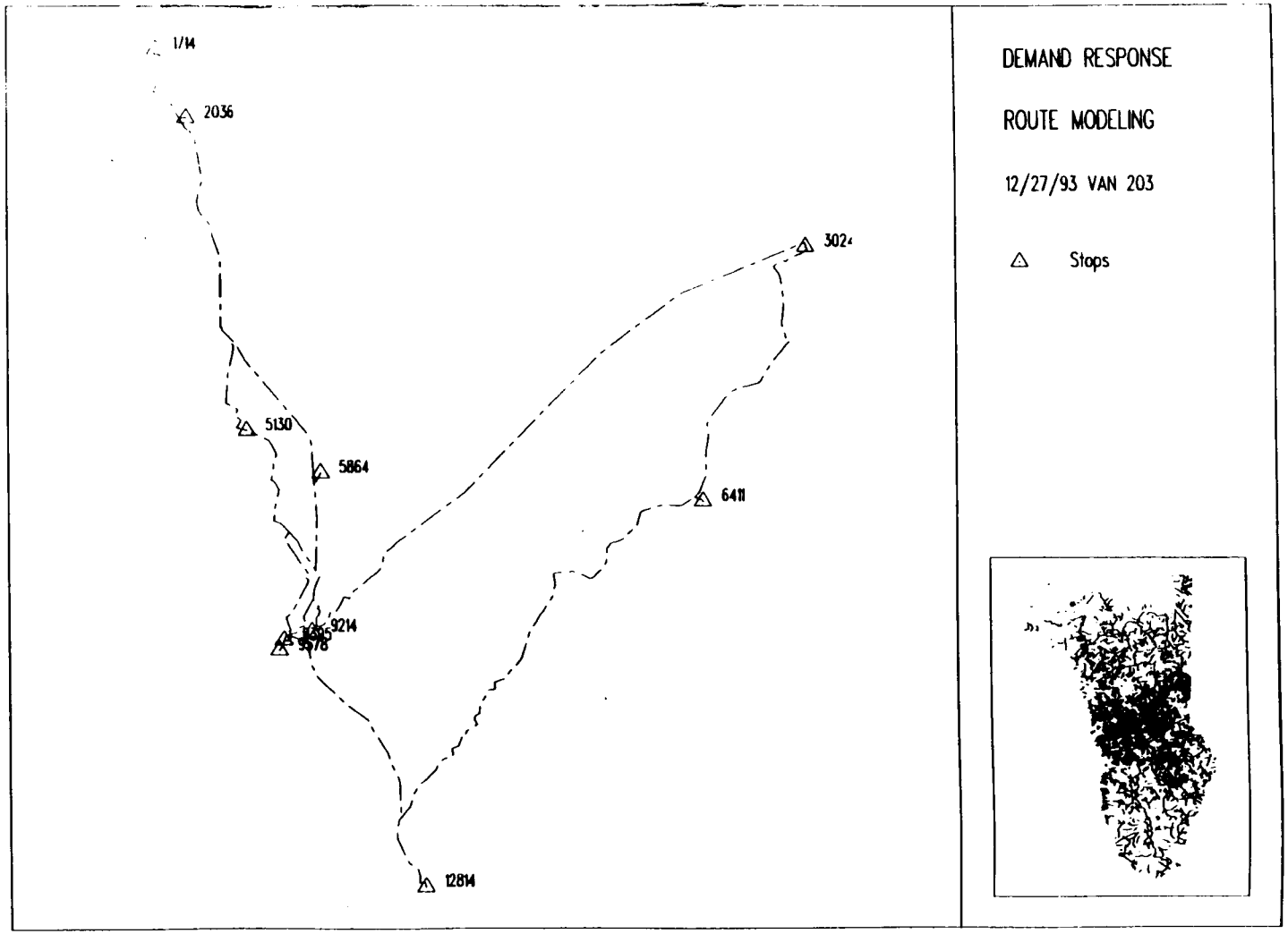


FIGURE 15

ROUTE 19 VAN 203

TABLE 8

ROUTE 19 VAN 203

DECEMBER 27, 1993

ROUTE	STOP #	NODE	TIME	STOP ADDRESS
19	1	9214	7:00 am	106 Augusta St
19	2	5864	7:33 am	311 Furman Hall Rd
19	3	2036	7:52 am	2 Henderson Ct
19	4	5130	8:05 am	6 Circle Dr
19	5	1714	8:15 am	315 Fernleaf Dr
19	6	9578	8:47 am	709 Dunbar St
19	7	9395	9:00 am	100 Mallard St
19	8	12814	10:16 am	114 Churchill Cir
19	9	6411	10:39 am	276 Phillips Rd
19	10	3024	11:09 am	106 Dill Ave
19	11	9214	12:00 pm	106 Augusta St
19	12	9395	2:50 pm	100 Mallard St
19	13	5130	3:25 pm	6 Circle Dr
19	14	9214	4:00 pm	106 Augusta St

Adapted from: GTA. (1993). [Demand Response Van Driver Logs]. Unpublished Raw Data.

DIRECTIONS

ROUTE 19 VAN 203

DECEMBER 27, 1993

Starting at AUGUSTA ST

Travel northeast for 0.095 MILES, go straight onto RIVER ST

Travel north for 0.268 MILES, turn left onto REEDY VIEW DR

Travel northwest for 0.069 MILES, turn right onto S ACADEMY ST

Travel northeast for 0.046 MILES, turn left onto W BROAD ST

Travel north for 0.282 MILES, go straight onto BUTLER AV

Travel north for 0.300 MILES, turn left onto BUNCOMBE ST

Travel northwest for 0.117 MILES, go straight onto RUTHERFORD ST

Travel north for 0.605 MILES, go straight onto POINSETT HWY

Travel north for 0.148 MILES, go straight onto POINSETT HIGHWAY

Travel north for 0.764 MILES, go straight onto

Travel northeast for 0.057 MILES, turn left onto GOLDSMITH AVENUE

Travel north for 0.025 MILES, turn right onto FURMAN HILL RD

Travel northeast for 0.040 MILES, go straight onto FURMAN HALL ROAD

Travel north for 0.077 MILES, turn back onto FURMAN HALL ROAD

Travel southwest for 0.077 MILES, go straight onto FURMAN

HILL ROAD

Travel southwest for 0.040 MILES, turn right onto GOLDSMITH AVE

Travel northwest for 0.087 MILES, turn right onto POINSETT HIGHWAY

Travel northwest for 1.417 MILES, go straight onto POINTSETT HIGHWAY

Travel north for 2.988 MILES, go straight onto POINSETT HIGHWAY

Travel northwest for 0.702 MILES, go straight onto HIGHWAY 276

Travel north for 0.547 MILES, go straight onto SOUTH MAIN ST

Travel north for 0.971 MILES, go straight onto NORTH MAIN ST

Travel northwest for 0.192 MILES, turn right onto HENDERSON DR

Travel east for 0.112 MILES, turn back onto HENDERSON DRIVE

Travel west for 0.112 MILES, turn left onto NORTH MAIN ST

Travel southeast for 0.192 MILES, go straight onto SOUTH MAIN STREET

Travel south for 0.971 MILES, go straight onto HIGHWAY 276

Travel south for 0.547 MILES, go straight onto POINSETT HIGHWAY

Travel southeast for 0.702 MILES, go straight onto POINTSETT HIGHWAY

Travel south for 1.578 MILES, turn right onto RAMP

Travel southeast for 0.172 MILES, turn right onto OLD

BUNCOMBE ROAD

Travel south for 1.003 MILES, turn left onto OVERTON AVENUE

Travel southeast for 0.236 MILES, turn right onto STRADLEY TERRACE

Travel south for 0.129 MILES, turn left onto VERNER DRIVE

Travel southeast for 0.131 MILES, turn right onto MONTIS DRIVE

Travel southwest for 0.156 MILES, turn left onto NORTH FRANKLIN ROAD

Travel east for 0.181 MILES, turn back onto NORTH FRANKLIN ROAD

Travel west for 0.181 MILES, turn right onto MONTIS DRIVE

Travel northeast for 0.156 MILES, turn left onto VERNER DR

Travel northwest for 0.131 MILES, turn right onto STRADLEY TER

Travel north for 0.129 MILES, turn left onto OVERTON AVENUE

Travel northwest for 0.236 MILES, turn right onto OLD BUNCOMBE ROAD

Travel north for 1.003 MILES, turn left onto RAMP

Travel northwest for 0.172 MILES, turn left onto POINTSETT HIGHWAY

Travel north for 1.578 MILES, go straight onto POINSETT HIGHWAY

Travel northwest for 0.702 MILES, go straight onto HIGHWAY 276

Travel north for 0.547 MILES, go straight onto SOUTH MAIN ST

Travel north for 0.971 MILES, go straight onto NORTH MAIN ST

Travel northwest for 0.570 MILES, turn right onto

Travel north for 0.047 MILES, turn left onto MAIN

Travel northwest for 0.176 MILES, go straight onto DUNCAN RD

Travel north for 0.597 MILES, turn left onto WENDFIELD DRIVE

Travel northwest for 0.285 MILES, turn right onto FERNLEAF DRIVE

Travel north for 0.107 MILES, turn back onto FERNLEAF DRIVE

Travel south for 0.107 MILES, turn left onto WENDFIELD DRIVE

Travel southeast for 0.285 MILES, turn right onto DUNCAN RD

Travel south for 0.597 MILES, go straight onto MAIN

Travel southeast for 0.176 MILES, turn right onto

Travel south for 0.047 MILES, turn left onto NORTH MAIN ST

Travel southeast for 0.570 MILES, go straight onto SOUTH MAIN STREET

Travel south for 0.971 MILES, go straight onto HIGHWAY 276

Travel south for 0.547 MILES, go straight onto POINSETT HIGHWAY

Travel southeast for 0.702 MILES, go straight onto POINSETT HIGHWAY

Travel south for 2.988 MILES, go straight onto POINSETT HIGHWAY

Travel south for 2.299 MILES, go straight onto POINSETT HWY

Travel south for 0.148 MILES, go straight onto RUTHERFORD ST

Travel south for 0.605 MILES, go straight onto BUNCOMBE ST

Travel southeast for 0.117 MILES, turn right onto BUTLER AV

Travel south for 0.300 MILES, go straight onto W BROAD ST

Travel south for 0.116 MILES, turn right onto WESTFIELD ST

Travel southwest for 0.342 MILES, go straight onto WARDLAW ST

Travel south for 0.155 MILES, turn right onto RHETT ST

Travel west for 0.151 MILES, turn left onto N MARKLEY ST

Travel south for 0.067 MILES, turn right onto PENDLETON ST

Travel west for 0.223 MILES, turn left onto MALLARD ST

Travel south for 0.272 MILES, turn back onto MALLARD ST

Travel north for 0.183 MILES, turn right onto ARLINGTON AV

Travel east for 0.066 MILES, turn left onto ANDERSON ST

Travel northeast for 0.090 MILES, turn right onto VARDRY ST

Travel southeast for 0.314 MILES, turn right onto AUGUSTA ST

Travel southeast for 2.820 MILES, go straight onto AUGUSTA RD

Travel south for 0.712 MILES, go straight onto AUGUSTA RD

Travel south for 0.077 MILES, go straight onto AUGUSTA ROAD UNDERPASS

Travel south for 0.012 MILES, go straight onto AUGUSTA ROAD

Travel south for 0.182 MILES, go straight onto ACCESS RAMP

Travel south for 0.004 MILES, go straight onto AUGUSTA ROAD

Travel southeast for 0.498 MILES, go straight onto OLD AUGUSTA ROAD

Travel southeast for 0.407 MILES, turn left onto CLEARVIEW AVENUE

Travel east for 0.083 MILES, turn right onto HIGH STREET

Travel north for 0.087 MILES, turn back onto HIGH STREET

Travel north for 0.087 MILES, turn left onto CLEARVIEW AVE

Travel west for 0.083 MILES, turn right onto OLD AUGUSTA RD

Travel northwest for 0.407 MILES, go straight onto AUGUSTA RD

Travel northwest for 0.498 MILES, go straight onto ACCESS RAMP

Travel north for 0.004 MILES, go straight onto AUGUSTA ROAD

Travel north for 0.182 MILES, go straight onto AUGUSTA ROAD UNDERPASS

Travel north for 0.012 MILES, go straight onto AUGUSTA RD

Travel north for 0.077 MILES, go straight onto AUGUSTA ROAD

Travel north for 0.004 MILES, turn right onto S PLEASANTBURG DR

Travel northeast for 0.083 MILES, go straight onto S PLEASANTBURG DR

Travel northeast for 0.248 MILES, go straight onto S PLEASANTBURG DRIVE

Travel north for 0.217 MILES, go straight onto S PLEASANTBURG DR

Travel northeast for 0.686 MILES, turn right onto WINDMONT RD

Travel northeast for 0.253 MILES, turn left onto PARKINS MILL RD

Travel north for 0.097 MILES, turn right onto PONDEROSA RD

Travel northeast for 0.282 MILES, turn right onto CLEVELAND EXT ST

Travel southeast for 0.047 MILES, turn left onto HENDERSON RD

Travel northeast for 0.343 MILES, turn left onto WEMBLEY RD

Travel north for 0.159 MILES, turn right onto HIALEAH RD

Travel northeast for 0.505 MILES, turn right onto CAROLINA AV

Travel northeast for 0.255 MILES, turn right onto LAUREL CREEK LA

Travel east for 0.205 MILES, turn left onto LAURENS RD

Travel northwest for 0.028 MILES, turn right onto HAYWOOD RD

Travel northeast for 2.010 MILES, turn right onto PELHAM RD

Travel east for 0.625 MILES, turn left onto HUDSON RD

Travel northeast for 0.077 MILES, go straight onto HUDSON

Travel northeast for 1.187 MILES, go straight onto ST HWY S-23-347

Travel northeast for 0.034 MILES, go straight onto HUDSON

Travel north for 0.218 MILES, turn right onto ST HWY S-23-347

Travel east for 0.234 MILES, go straight onto HUDSON

Travel east for 0.753 MILES, turn right onto PHILLIPS ROAD

Travel east for 0.130 MILES, turn back onto PHILLIPS ROADT

Travel west for 0.130 MILES, turn right onto ST HWY S-23-347

Travel northeast for 0.103 MILES, go straight onto HUDSON

Travel northeast for 0.087 MILES, go straight onto ST HWY S-23-347

Travel north for 0.268 MILES, go straight onto HUDSON

Travel north for 0.083 MILES, go straight onto ST HWY S-23-347

Travel north for 0.052 MILES, go straight onto HUDSON

Travel north for 0.496 MILES, go straight onto ST HWY S-23-347

Travel north for 0.223 MILES, turn right onto BRUSHY CREEK ROAD

Travel northeast for 1.700 MILES, go straight onto BRUSHY CREEK ROAED

Travel northeast for 0.360 MILES, turn left onto SOUTH SUBER ROAD

Travel north for 1.364 MILES, turn right onto CHICK SPRINGS ROAD

Travel northeast for 0.657 MILES, turn left onto DILL AVENUE

Travel northwest for 0.127 MILES, turn left onto WEST WADE HAMPTON BOULEVARD

Travel southwest for 0.650 MILES, go straight onto WADE HAMPTON BOULEVARD

Travel southwest for 6.359 MILES, go straight onto WADE HAMPTON BLVD

Travel southwest for 0.208 MILES, go straight onto WADE HAMPTON BLVD

Travel southwest for 1.693 MILES, go straight onto N CHURCH

ST

Travel southwest for 0.994 MILES, turn right onto E NORTH ST

Travel west for 0.095 MILES, turn left onto N SPRING ST

Travel southwest for 0.133 MILES, go straight onto S SPRING ST

Travel south for 0.081 MILES, go straight onto FALLS ST

Travel southwest for 0.080 MILES, turn right onto E COURT ST

Travel west for 0.083 MILES, turn left onto S MAIN ST

Travel southwest for 0.396 MILES, turn left onto AUGUSTA ST

Travel southwest for 0.231 MILES, turn right onto FIELD ST

Travel west for 0.158 MILES, turn right onto VARDRY ST

Travel west for 0.148 MILES, turn left onto ANDERSON ST

Travel southwest for 0.090 MILES, turn right onto ARLINGTON AV

Travel west for 0.066 MILES, turn right onto MALLARD ST

Travel north for 0.088 MILES, turn right onto PENDLETON ST

Travel east for 0.076 MILES, turn left onto PERRY AV

Travel north for 0.065 MILES, turn right onto RHETT ST

Travel east for 0.028 MILES, turn left onto MCCALL ST

Travel north for 0.241 MILES, turn right onto N CALHOUN ST

Travel northeast for 0.099 MILES, go straight onto S HUDSON ST

Travel northeast for 0.500 MILES, go straight onto N HUDSON ST

Travel northeast for 0.151 MILES, turn left onto HAMPTON AV

Travel northwest for 0.094 MILES, turn right onto LLOYD ST

Travel northeast for 0.078 MILES, turn left onto PINCKNEY ST

Travel northwest for 0.401 MILES, turn right onto FRANK ST

Travel northeast for 0.003 MILES, turn left onto PINCKNEY ST

Travel northwest for 0.125 MILES, go straight onto PINCKNEY STREET

Travel north for 0.335 MILES, turn left onto OLD BUNCOMBE RD

Travel northwest for 0.187 MILES, go straight onto ST HWY 183

Travel west for 0.124 MILES, turn right onto OLD BUNCOMBE RD

Travel north for 0.757 MILES, turn right onto BROCKMAN AVE

Travel north for 0.333 MILES, turn right onto NORTH FRANKLIN ROAD

Travel northwest for 0.794 MILES, turn back onto NORTH FRANKLIN ROAD

Travel southeast for 0.794 MILES, turn left onto BROCKMAN AVENUE

Travel south for 0.333 MILES, turn left onto OLD BUNCOMBE ROAD

Travel south for 0.757 MILES, turn left onto ST HWY 183

Travel east for 0.124 MILES, go straight onto OLD BUNCOMBE

Travel southeast for 0.402 MILES, go straight onto BUNCOMBE

Travel southeast for 0.051 MILES, go straight onto BUNCOMBE ST

Travel southeast for 0.654 MILES, turn right onto BUTLER AV

Travel south for 0.300 MILES, go straight onto W BROAD ST

Travel south for 0.282 MILES, turn right onto S ACADEMY ST

Travel southwest for 0.046 MILES, turn left onto REEDY VIEW DRIVE

Travel southeast for 0.069 MILES, turn right onto RIVER ST

Travel south for 0.268 MILES, go straight onto AUGUSTA ST

Travel southwest for 0.095 MILES, End of path

Total path length is 76.843 MILES

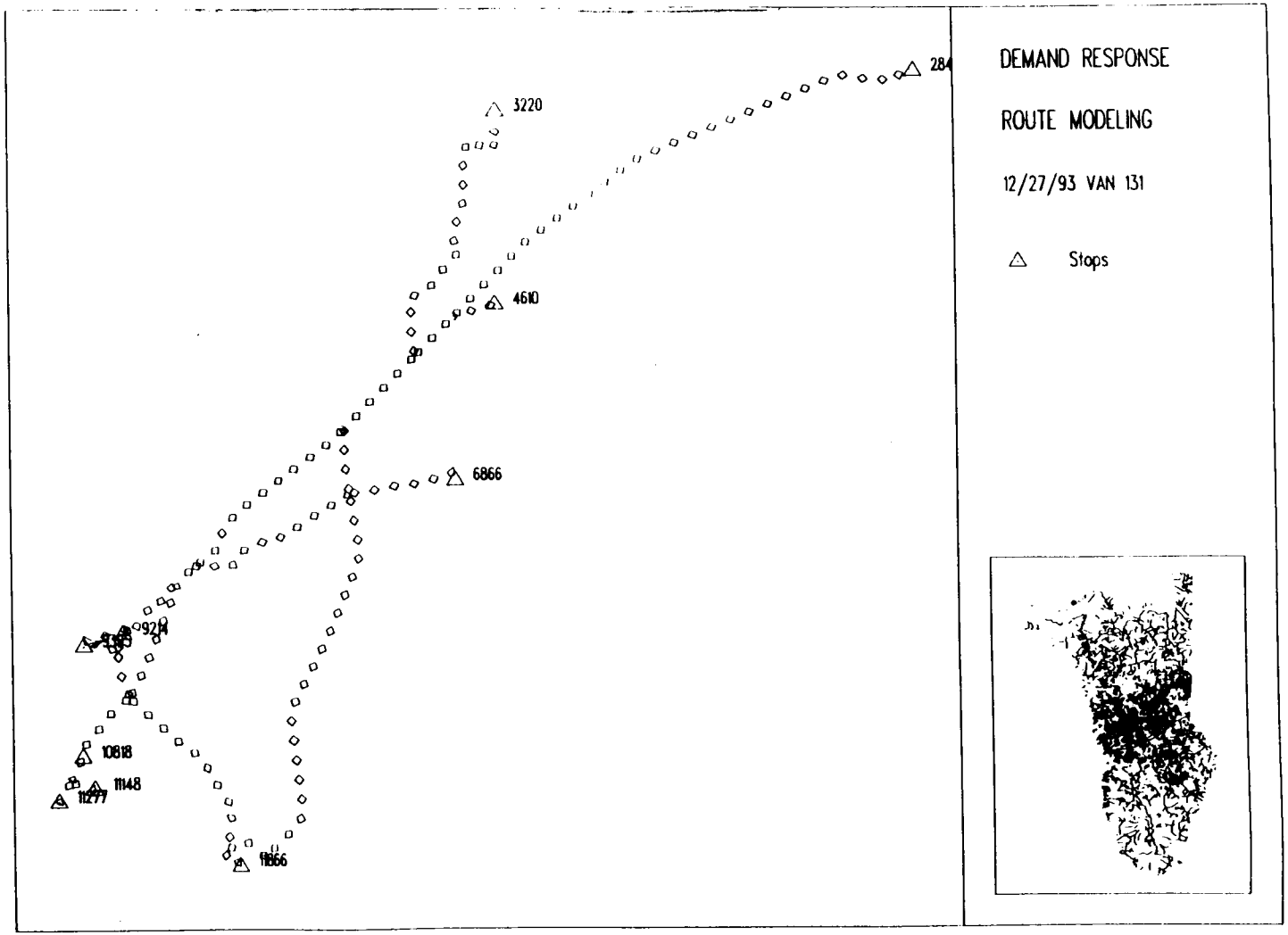


FIGURE 16

ROUTE 20 VAN 131

TABLE 9

ROUTE 20 VAN 131

DECEMBER 27, 1993

ROUTE	STOP #	NODE	TIME	STOP ADDRESS
20	1	9214	9:00 am	106 Augusta St
20	2	6866	9:12 am	11 Springforest Dr
20	3	9395	9:35 am	100 Mallard St
20	4	11866	10:00 am	2 Collinson Rd
20	5	4610	10:19 am	101 Sutton Dr
20	6	11277	10:44 am	1009 Grove Rd
20	7	2843	11:21 am	212 Oakland Ave
20	8	10818	11:40 am	701 Grove Rd
20	9	11277	12:00 pm	1009 Grove Rd
20	10	3220	12:26 pm	105 Goodwin Dr
20	11	9214	12:45 pm	106 Augusta St
20	12	11148	3:56 pm	6 Doctors Dr
20	13	9214	4:30 pm	106 Augusta St

Adapted from: GTA. (1993). [Demand Response Van Driver Logs]. Unpublished Raw Data.

DIRECTIONS

ROUTE 20 VAN 131

DECEMBER 27, 1993

Starting at AUGUSTA ST

Travel northeast for 0.095 MILES, turn right onto S MAIN ST

Travel northeast for 0.396 MILES, turn right onto E COURT ST

Travel east for 0.083 MILES, turn left onto FALLS ST

Travel northeast for 0.080 MILES, go straight onto S SPRING ST

Travel north for 0.081 MILES, go straight onto N SPRING ST

Travel northeast for 0.133 MILES, turn right onto E NORTH ST

Travel east for 0.095 MILES, turn left onto N CHURCH ST

Travel northeast for 0.326 MILES, go straight onto ACCESS RAMP

Travel northeast for 0.135 MILES, turn right onto E PARK AV

Travel east for 0.242 MILES, go straight onto E NORTH ST

Travel northeast for 1.856 MILES, go straight onto E NORTH EXT ST

Travel east for 0.473 MILES, go straight onto EAST NORTH ST

Travel east for 0.796 MILES, turn right onto BEAUFORT STREET

Travel north for 0.103 MILES, turn back onto BEAUFORT STREET

Travel north for 0.103 MILES, turn left onto EAST NORTH ST

Travel west for 0.796 MILES, go straight onto E NORTH EXT ST

Travel west for 0.473 MILES, go straight onto E NORTH ST

Travel southwest for 1.856 MILES, go straight onto E PARK AV

Travel west for 0.242 MILES, turn left onto ACCESS RAMP

Travel southwest for 0.135 MILES, go straight onto N CHURCH ST

Travel southwest for 0.326 MILES, turn right onto E NORTH ST

Travel west for 0.095 MILES, turn left onto N SPRING ST

Travel southwest for 0.133 MILES, go straight onto S SPRING ST

Travel south for 0.081 MILES, go straight onto FALLS ST

Travel southwest for 0.080 MILES, turn right onto E COURT ST

Travel west for 0.083 MILES, turn left onto S MAIN ST

Travel southwest for 0.396 MILES, go straight onto PENDLETON ST

Travel west for 0.532 MILES, turn left onto MALLARD ST

Travel south for 0.088 MILES, turn left onto ARLINGTON AV

Travel east for 0.066 MILES, turn left onto ANDERSON ST

Travel northeast for 0.090 MILES, turn right onto VARDRY ST

Travel southeast for 0.314 MILES, turn right onto AUGUSTA ST

Travel southeast for 2.496 MILES, turn right onto BLYTHE DR

Travel west for 0.047 MILES, turn left onto OLD AUGUSTA RD

Travel south for 0.405 MILES, go straight onto OLD AUGUSTA RD

Travel south for 0.131 MILES, turn left onto COLLINSON ROAD

Travel east for 0.014 MILES, go straight onto COLLINSON DRIVE

Travel east for 0.201 MILES, go straight onto COLLINSON ROAD

Travel southeast for 0.029 MILES, turn back onto COLLINSON ROAD

Travel northwest for 0.029 MILES, go straight onto COLLINSON DR

Travel west for 0.201 MILES, go straight onto COLLINSON ROAD

Travel west for 0.014 MILES, turn right onto OLD AUGUSTA RD

Travel north for 0.131 MILES, turn right onto POTOMAC AV

Travel northeast for 0.251 MILES, go straight onto MAULDIN ROAD

Travel southeast for 0.354 MILES, turn left onto S PLEASANTBURG DR

Travel north for 2.975 MILES, go straight onto N PLEASANTBURG DR

Travel north for 2.622 MILES, turn right onto WADE HAMPTON BOULEVARD

Travel northeast for 1.888 MILES, go straight onto EAST LEE ROAD

Travel east for 0.525 MILES, turn back onto EAST LEE RD

Travel west for 0.525 MILES, go straight onto WADE HAMPTON BOULEVARD

Travel southwest for 1.888 MILES, go straight onto WADE HAMPTON BLVD

Travel southwest for 0.208 MILES, go straight onto WADE HAMPTON BLVD

Travel southwest for 1.693 MILES, go straight onto N CHURCH ST

Travel southwest for 1.122 MILES, go straight onto S CHURCH ST

Travel southwest for 1.301 MILES, go straight onto MILLS AV

Travel southwest for 0.293 MILES, go straight onto MILLS AV

Travel southwest for 0.156 MILES, turn left onto MILLS AV

Travel southwest for 0.398 MILES, turn left onto CHAPMAN ST

Travel south for 0.103 MILES, turn right onto GROVE RD

Travel southwest for 0.318 MILES, go straight onto GROVE ROAD

Travel southwest for 0.322 MILES, turn back onto GROVE ROAD

Travel northeast for 0.322 MILES, go straight onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, turn right onto MILLS AV

Travel northeast for 0.156 MILES, go straight onto MILLS AV

Travel northeast for 0.293 MILES, go straight onto S CHURCH ST

Travel northeast for 1.301 MILES, go straight onto N CHURCH ST

Travel northeast for 1.122 MILES, go straight onto WADE HAMPTON BLVD

Travel northeast for 1.693 MILES, go straight onto WADE HAMPTON BLVD

Travel northeast for 0.208 MILES, go straight onto WADE HAMPTON BOULEVARD

Travel northeast for 6.359 MILES, go straight onto WEST WADE HAMPTON BOULEVARD

Travel northeast for 1.031 MILES, turn right onto WEST

POINSETT STREET

Travel east for 0.668 MILES, turn left onto CHESTERFIELD STREET

Travel north for 0.040 MILES, turn right onto OAKLAND AVENUE

Travel east for 0.201 MILES, turn back onto OAKLAND AVENUE

Travel west for 0.201 MILES, turn left onto CHESTERFIELD ST

Travel south for 0.040 MILES, turn right onto WEST POINSETT ST

Travel west for 0.668 MILES, turn left onto WEST WADE HAMPTON BOULEVARD

Travel southwest for 1.031 MILES, go straight onto WADE HAMPTON BOULEVARD

Travel southwest for 6.359 MILES, go straight onto WADE HAMPTON BLVD

Travel southwest for 0.208 MILES, go straight onto WADE HAMPTON BLVD

Travel southwest for 1.693 MILES, go straight onto N CHURCH ST

Travel southwest for 1.122 MILES, go straight onto S CHURCH ST

Travel southwest for 1.301 MILES, go straight onto MILLS AV

Travel southwest for 0.293 MILES, go straight onto MILLS AV

Travel southwest for 0.156 MILES, turn left onto MILLS AV

Travel southwest for 0.398 MILES, turn left onto CHAPMAN ST

Travel south for 0.103 MILES, turn right onto GROVE RD

Travel southwest for 0.318 MILES, go straight onto GROVE

ROAD

Travel southwest for 0.322 MILES, turn back onto GROVE ROAD

Travel northeast for 0.322 MILES, go straight onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, turn right onto MILLS AV

Travel northeast for 0.156 MILES, go straight onto MILLS AV

Travel northeast for 0.293 MILES, go straight onto S CHURCH ST

Travel northeast for 1.301 MILES, go straight onto N CHURCH ST

Travel northeast for 1.122 MILES, go straight onto WADE HAMPTON BLVD

Travel northeast for 1.693 MILES, go straight onto WADE HAMPTON BLVD

Travel northeast for 0.208 MILES, go straight onto WADE HAMPTON BOULEVARD

Travel northeast for 1.222 MILES, turn left onto DONNAN ROAD

Travel north for 0.713 MILES, turn right onto RUTHERFORD ROAD

Travel northeast for 0.269 MILES, go straight onto RUTHERFORD ROAD

Travel northeast for 0.283 MILES, go straight onto RUTHERFORD ROAD

Travel northeast for 0.284 MILES, turn left onto CHURCH

Travel northwest for 0.125 MILES, turn right onto TANNER RD

Travel north for 1.323 MILES, go straight onto OLD TANNER

Travel northeast for 0.008 MILES, turn right onto FOREST HILL DRIVE

Travel southeast for 0.090 MILES, turn left onto BRIDGEWOOD LANE

Travel east for 0.263 MILES, turn left onto CANNON LANE

Travel northeast for 0.151 MILES, turn left onto REID SCHOOL ROAD

Travel northwest for 0.159 MILES, turn right onto WINDING WAY

Travel northeast for 0.050 MILES, turn left onto SUNDOWN CIRCLE

Travel north for 0.099 MILES, turn back onto SUNDOWN CIRCLE

Travel southeast for 0.099 MILES, turn right onto WINDING WAY

Travel southwest for 0.050 MILES, turn left onto REID SCHOOL RD

Travel southeast for 0.159 MILES, turn right onto CANNON LN

Travel southwest for 0.151 MILES, turn right onto BRIDGEWOOD LANE

Travel west for 0.263 MILES, turn right onto FOREST HILL DR

Travel northwest for 0.090 MILES, turn left onto OLD TANNER

Travel southwest for 0.008 MILES, go straight onto TANNER ROAD

Travel south for 1.323 MILES, turn left onto CHURCH

Travel southeast for 0.125 MILES, turn right onto RUTHERFORD

ROAD

Travel southwest for 0.284 MILES, go straight onto RUTHERFORD ROAD

Travel southwest for 0.283 MILES, go straight onto RUTHERFORD ROAD

Travel southwest for 0.269 MILES, turn left onto DONNAN ROAD

Travel south for 0.713 MILES, turn right onto WADE HAMPTON BOULEVARD

Travel southwest for 1.222 MILES, go straight onto WADE HAMPTON BLVD

Travel southwest for 0.208 MILES, go straight onto WADE HAMPTON BLVD

Travel southwest for 1.693 MILES, go straight onto N CHURCH ST

Travel southwest for 0.994 MILES, turn right onto E NORTH ST

Travel west for 0.095 MILES, turn left onto N SPRING ST

Travel southwest for 0.133 MILES, go straight onto S SPRING ST

Travel south for 0.081 MILES, go straight onto FALLS ST

Travel southwest for 0.080 MILES, turn right onto E COURT ST

Travel west for 0.083 MILES, turn left onto S MAIN ST

Travel southwest for 0.396 MILES, turn left onto AUGUSTA ST

Travel south for 0.912 MILES, turn right onto MILLS AV

Travel southwest for 0.293 MILES, go straight onto MILLS AV

Travel southwest for 0.156 MILES, turn left onto MILLS AV

Travel southwest for 0.398 MILES, turn left onto CHAPMAN ST

Travel south for 0.103 MILES, turn right onto GROVE RD

Travel southwest for 0.318 MILES, turn left onto WEST FARIS ROAD

Travel southeast for 0.312 MILES, turn back onto WEST FARIS RD

Travel west for 0.312 MILES, turn right onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, turn right onto MILLS AV

Travel northeast for 0.156 MILES, go straight onto MILLS AV

Travel northeast for 0.293 MILES, turn left onto AUGUSTA ST

Travel north for 0.817 MILES, End of path

Total path length is 84.484 MILES

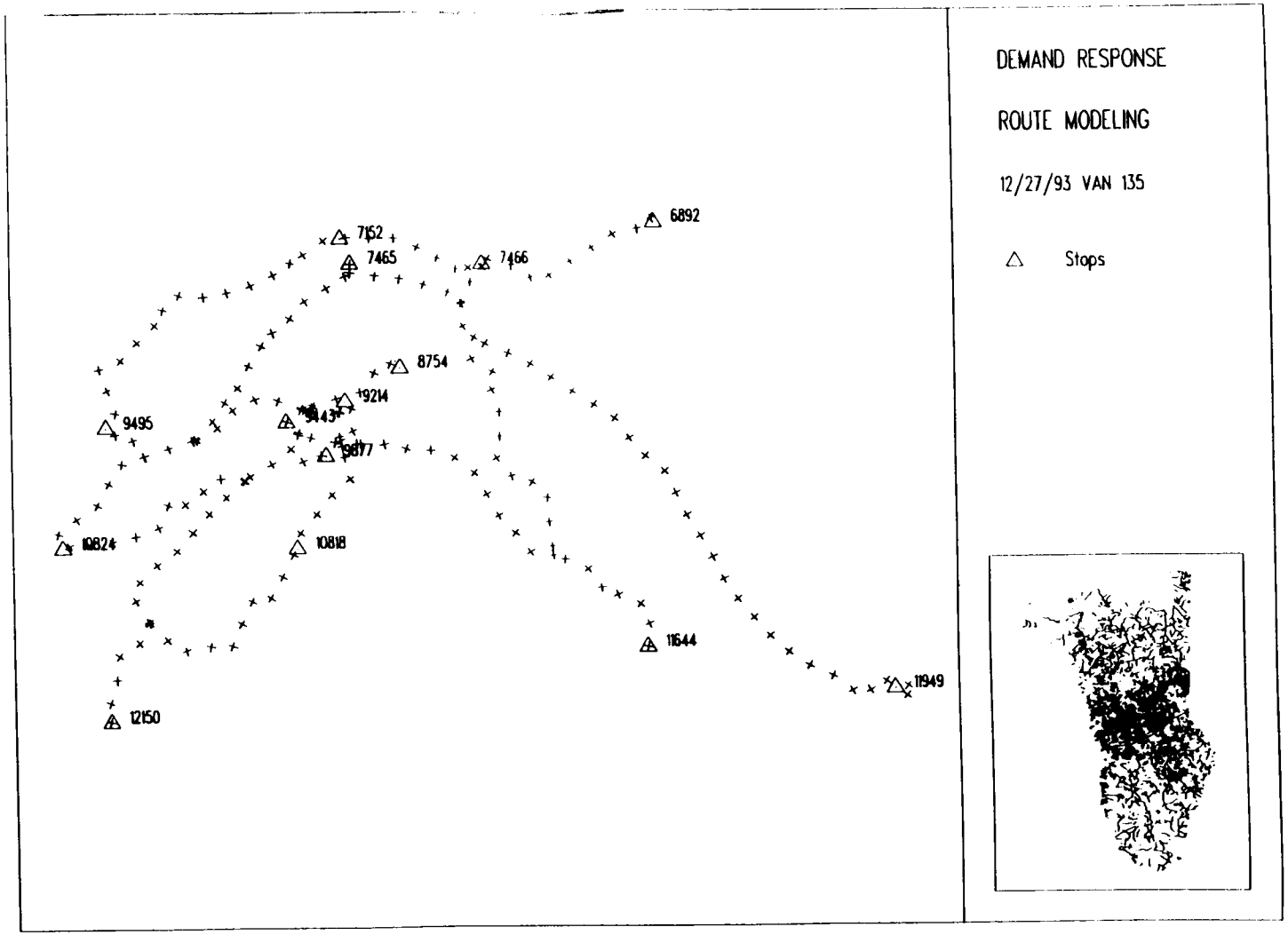


FIGURE 17

ROUTE 21 VAN 135

TABLE 10

ROUTE 21 VAN 135

DECEMBER 27, 1993

ROUTE	STOP #	NODE	TIME	STOP ADDRESS
21	1	9214	7:00 am	106 Augusta St
21	2	9877	7:50 am	113 Sullivan St
21	3	10824	8:12 am	1010 S Welcome Rd
21	4	7465	8:26 am	415 Rutherford St
21	5	11949	8:40 am	100 Industrial Blvd
21	6	7466	9:00 am	2 Gay St
21	7	11644	9:15 am	101 Parkins Lake Rd
21	8	9443	9:40 am	210 S Memminger St
21	9	8754	9:45 am	402 E McBee Ave
21	10	12150	10:05 am	104 Satterfield Dr
21	11	10818	10:10 am	701 Grove Rd
21	12	9214	10:30 am	106 Augusta St
21	13	11644	2:30 pm	101 Parkins Lake Rd
21	14	7466	2:54 pm	2 Gay St
21	15	6892	3:50 pm	50 Glenwood Rd
21	16	7152	4:30 pm	120 Shaw St
21	17	9495	4:50 pm	21 Lewis St
21	18	9214	5:00 pm	106 Augusta St

Adapted from: GTA. (1993). [Demand Response Van Driver Logs]. Unpublished Raw Data.

DIRECTIONS

ROUTE 21 VAN 135

DECEMBER 27, 1993

Starting at AUGUSTA ST

Travel south for 0.426 MILES, turn right onto DUNBAR ST

Travel west for 0.060 MILES, turn left onto BURNS ST

Travel south for 0.140 MILES, turn right onto SULLIVAN ST

Travel west for 0.352 MILES, turn right onto GUESS ST

Travel northwest for 0.042 MILES, go straight onto GREENAV

Travel northwest for 0.048 MILES, turn left onto NELSON ST

Travel northwest for 0.100 MILES, turn left onto ANDERSON ST

Travel southwest for 0.171 MILES, go straight onto ST HWY 81

Travel southwest for 0.184 MILES, go straight onto ANDERSON ROAD

Travel southwest for 0.216 MILES, turn right onto HONOUR ST

Travel northwest for 0.068 MILES, turn left onto 11TH STREET

Travel west for 0.277 MILES, turn left onto HAWKINS STREET

Travel southwest for 0.075 MILES, go straight onto VALLEY ST

Travel southwest for 0.272 MILES, turn right onto CRESTONE AVE

Travel northwest for 0.044 MILES, turn left onto HILL STREET

Travel southwest for 0.118 MILES, turn right onto SOUTH WASHINGTON AVENUE

Travel northwest for 0.121 MILES, turn left onto SOUTH FLORIDA AVENUE

Travel southwest for 0.832 MILES, turn right onto COLE ROAD

Travel west for 0.157 MILES, go straight onto ALOHA DRIVE

Travel west for 0.151 MILES, turn right onto BRANIFF LANE

Travel northwest for 0.067 MILES, turn left onto BEST DRIVE

Travel southwest for 0.126 MILES, turn right onto SOUTH WELCOME ROAD

Travel northwest for 0.131 MILES, turn right onto NEW DUNHAM BRIDGE ROAD

Travel north for 0.093 MILES, turn right onto OLD EASLEY BRIDGE ROAD

Travel northeast for 0.966 MILES, turn right onto EASLEY BRIDGE ROAD

Travel east for 0.772 MILES, turn left onto DORSEY AVENUE

Travel northeast for 0.214 MILES, go straight onto DORSEY BOULEVARD

Travel northeast for 0.370 MILES, turn left onto TRACTION

Travel northwest for 0.031 MILES, turn right onto S TEXTILE ST

Travel northeast for 0.155 MILES, go straight onto N TEXTILE ST

Travel northeast for 0.084 MILES, go straight onto QUEEN ST

Travel northeast for 0.387 MILES, turn left onto BIRNIE ST

Travel northwest for 0.025 MILES, turn right onto QUEEN ST

Travel north for 0.085 MILES, turn right onto CAIN ST

Travel northeast for 0.193 MILES, turn right onto WILLARD ST

Travel northeast for 0.304 MILES, go straight onto W WASHINGTON ST

Travel northeast for 0.109 MILES, go straight onto MULBERRY ST

Travel northeast for 0.420 MILES, turn left onto BUNCOMBE ST

Travel northwest for 0.023 MILES, turn right onto GOODWIN ST

Travel east for 0.151 MILES, turn left onto RUTHERFORD ST

Travel north for 0.099 MILES, turn back onto RUTHERFORD ST

Travel south for 0.080 MILES, turn left onto W STONE AV

Travel east for 0.585 MILES, go straight onto E STONE AV

Travel southeast for 0.881 MILES, go straight onto LAURENS RD

Travel southeast for 4.363 MILES, go straight onto LAURENS RD

Travel southeast for 1.196 MILES, turn left onto FORRESTER DR

Travel northeast for 0.334 MILES, turn right onto INDUSTRIAL BOULEVARD

Travel southeast for 0.376 MILES, turn left onto SOUTH PARK DRIVE

Travel northeast for 0.091 MILES, turn left onto MOURNING DOVE LANE

Travel north for 0.104 MILES, turn back onto MOURNING DOVE LN

Travel southeast for 0.104 MILES, turn right onto SOUTH PARK DRIVE

Travel southwest for 0.091 MILES, turn right onto INDUSTRIAL BOULEVARD

Travel northwest for 0.376 MILES, turn left onto FORRESTER DRIVE

Travel southwest for 0.334 MILES, turn right onto LAURENS ROAD

Travel northwest for 1.196 MILES, go straight onto LAURENS RD

Travel northwest for 4.363 MILES, go straight onto E STONE AV

Travel north for 0.283 MILES, turn right onto ASHMORE ST

Travel northeast for 0.058 MILES, turn right onto SPARTANBURG ST

Travel northeast for 0.154 MILES, turn left onto MT ZION ST

Travel northeast for 0.171 MILES, turn left onto MT EUSTIS ST

Travel northwest for 0.004 MILES, turn right onto MT ZION ST

Travel northeast for 0.083 MILES, turn left onto MT EUSTIS ST

Travel northwest for 0.058 MILES, turn right onto STAG ST

Travel northeast for 0.018 MILES, turn back onto STAG ST

Travel southwest for 0.018 MILES, turn left onto MT EUSTIS ST

Travel southeast for 0.058 MILES, turn right onto MT ZION ST

Travel southwest for 0.083 MILES, turn left onto MT EUSTIS ST

Travel southeast for 0.004 MILES, turn right onto MT ZION ST

Travel southwest for 0.171 MILES, turn right onto

SPARTANBURG ST

Travel southwest for 0.154 MILES, turn left onto ASHMORE ST

Travel southwest for 0.058 MILES, turn left onto E STONE AV

Travel south for 0.283 MILES, go straight onto LAURENS RD

Travel southeast for 0.126 MILES, turn right onto RICHLAND WY

Travel south for 0.234 MILES, turn left onto E WASHINGTON ST

Travel east for 0.012 MILES, turn right onto CLEVEIRVINE AV

Travel southeast for 0.286 MILES, turn right onto HAVILAND AV

Travel southwest for 0.106 MILES, go straight onto NICHOLTOWN RD

Travel southeast for 0.283 MILES, turn right onto REBECCA ST

Travel south for 0.377 MILES, go straight onto ALAMEDA ST

Travel south for 0.382 MILES, turn right onto GLENN RD

Travel southeast for 0.108 MILES, turn right onto CATLIN CIR

Travel south for 0.045 MILES, turn left onto E FARIS RD

Travel east for 0.346 MILES, turn right onto S PLEASANTBURG DR

Travel south for 0.661 MILES, turn left onto CLEVELAND EXT ST

Travel southeast for 1.188 MILES, turn right onto E PARKINS MILL RD

Travel southwest for 0.025 MILES, turn left onto PARKINS

LAKE RD

Travel south for 0.407 MILES, turn back onto PARKINS LAKE RD

Travel north for 0.407 MILES, turn right onto E PARKINS MILL RD

Travel northeast for 0.025 MILES, turn left onto CLEVELAND EXT ST

Travel northwest for 1.188 MILES, go straight onto CLEVELAND ST

Travel northwest for 2.118 MILES, turn right onto JONES AV

Travel north for 0.023 MILES, turn left onto PEARL AV

Travel west for 0.260 MILES, go straight onto HAYNIE ST

Travel west for 0.280 MILES, turn right onto AUGUSTA ST

Travel north for 0.061 MILES, turn left onto DUNBAR ST

Travel west for 0.581 MILES, turn right onto S MEMMINGER ST

Travel north for 0.190 MILES, turn right onto ARLINGTON AV

Travel east for 0.087 MILES, turn left onto MALLARD ST

Travel north for 0.088 MILES, turn right onto PENDLETON ST

Travel east for 0.532 MILES, go straight onto S MAIN ST

Travel northeast for 0.396 MILES, turn right onto E COURT ST

Travel east for 0.083 MILES, turn left onto FALLS ST

Travel northeast for 0.080 MILES, turn right onto E MCBEE AV

Travel east for 0.131 MILES, turn back onto E MCBEE AV

Travel west for 0.131 MILES, turn left onto FALLS ST

Travel southwest for 0.080 MILES, turn right onto E COURT ST

Travel west for 0.083 MILES, turn left onto S MAIN ST

Travel southwest for 0.396 MILES, go straight onto PENDLETON

ST

Travel west for 0.415 MILES, turn left onto ANDERSON ST

Travel southwest for 0.376 MILES, go straight onto JENKINS ST

Travel southwest for 0.001 MILES, go straight onto ANDERSON ST

Travel southwest for 0.286 MILES, go straight onto ST HWY 81

Travel southwest for 0.184 MILES, go straight onto ANDERSON ROAD

Travel southwest for 1.850 MILES, turn left onto WHITE HORSE ROAD

Travel southeast for 0.363 MILES, go straight onto STAUNTON BRIDGE ROAD

Travel southwest for 1.181 MILES, turn left onto SATTERFIELD DRIVE

Travel north for 0.067 MILES, turn back onto SATTERFIELD DRIVE

Travel west for 0.067 MILES, turn right onto STAUNTON BRIDGE ROAD

Travel northeast for 1.181 MILES, turn right onto WHITE HORSE ROAD

Travel southeast for 0.425 MILES, turn left onto TWO NOTCH ROAD

Travel east for 0.541 MILES, turn left onto BEAR DRIVE

Travel northeast for 0.561 MILES, turn right onto BUTTERNUT DRIVE

Travel east for 0.151 MILES, turn left onto GROVE ROAD

Travel northeast for 0.322 MILES, go straight onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, turn right onto MILLS AV

Travel northeast for 0.156 MILES, go straight onto MILLS AV

Travel northeast for 0.293 MILES, turn left onto AUGUSTA ST

Travel north for 0.817 MILES, turn right onto UNIVERSITY ST

Travel southeast for 0.084 MILES, turn right onto HOWE ST

Travel south for 0.415 MILES, turn left onto HAYNIE ST

Travel east for 0.124 MILES, go straight onto PEARL AV

Travel east for 0.260 MILES, turn right onto JONES AV

Travel south for 0.023 MILES, turn left onto CLEVELAND ST

Travel southeast for 2.118 MILES, go straight onto CLEVELAND EXT ST

Travel southeast for 1.188 MILES, turn right onto E PARKINS MILL RD

Travel southwest for 0.025 MILES, turn left onto PARKINS LAKE RD

Travel south for 0.407 MILES, turn back onto PARKINS LAKE RD

Travel north for 0.407 MILES, turn right onto E PARKINS MILL RD Travel northeast for 0.025 MILES, turn left onto CLEVELAND EXT ST

Travel northwest for 1.188 MILES, turn right onto S PLEASANTBURG DR

Travel north for 0.661 MILES, turn left onto E FARIS RD

Travel west for 0.346 MILES, turn right onto CATLIN CIR

Travel north for 0.045 MILES, turn left onto GLENN RD

Travel northwest for 0.108 MILES, turn left onto ALAMEDA ST

Travel north for 0.382 MILES, go straight onto REBECCA ST

Travel north for 0.377 MILES, turn left onto NICHOLTOWN RD

Travel northwest for 0.283 MILES, go straight onto HAVILAND AV

Travel northeast for 0.106 MILES, turn left onto CLEVEIRVINE AV

Travel northwest for 0.286 MILES, turn left onto E WASHINGTON ST

Travel west for 0.012 MILES, turn right onto RICHLAND WY

Travel north for 0.234 MILES, turn left onto LAURENS RD

Travel northwest for 0.126 MILES, go straight onto E STONE AV

Travel north for 0.283 MILES, turn right onto ASHMORE ST

Travel northeast for 0.058 MILES, turn right onto SPARTANBURG ST

Travel northeast for 0.154 MILES, turn left onto MT ZION ST

Travel northeast for 0.171 MILES, turn left onto MT EUSTIS ST

Travel northwest for 0.004 MILES, turn right onto MT ZION ST

Travel northeast for 0.083 MILES, turn left onto MT EUSTIS ST

Travel northwest for 0.058 MILES, turn right onto STAG ST

Travel northeast for 0.091 MILES, turn right onto DUPONT DR

Travel southeast for 0.465 MILES, turn left onto PRESCOTT ST

Travel northeast for 0.155 MILES, turn right onto BLACKBURN ST

Travel southeast for 0.092 MILES, turn left onto E NORTH ST

Travel northeast for 0.830 MILES, go straight onto E NORTH EXT ST

Travel east for 0.272 MILES, turn left onto TRENHOLM ROAD

Travel northwest for 0.074 MILES, turn right onto ELMIRA ST

Travel north for 0.121 MILES, turn back onto ELMIRA STREET

Travel west for 0.121 MILES, turn left onto TRENHOLM ROAD

Travel southeast for 0.074 MILES, turn right onto E NORTH EXT ST

Travel west for 0.272 MILES, go straight onto E NORTH ST

Travel southwest for 0.830 MILES, turn right onto BLACKBURN ST

Travel northwest for 0.092 MILES, turn left onto PRESCOTT ST

Travel southwest for 0.155 MILES, turn right onto DUPONT DR

Travel northwest for 0.539 MILES, turn left onto WADE HAMPTON BLVD

Travel southwest for 0.310 MILES, turn right onto CARY ST

Travel west for 0.040 MILES, turn right onto MOHAWK DR

Travel north for 0.123 MILES, turn left onto GALLIVAN ST

Travel west for 0.393 MILES, turn right onto N MAIN ST

Travel north for 0.026 MILES, turn left onto ASHLEY AV

Travel west for 0.688 MILES, turn left onto RUTHERFORD RD

Travel southwest for 0.043 MILES, go straight onto SHAW ST

Travel west for 0.384 MILES, go straight onto ALEXANDER ST

Travel southwest for 0.157 MILES, turn left onto PINCKNEY ST

Travel southeast for 0.048 MILES, turn right onto MONTGOMERY AVENUE

Travel southwest for 0.107 MILES, turn right onto HAMPTON AVENUE EXTENSION

Travel west for 0.142 MILES, turn left onto EAST BRAMLETT RD

Travel southwest for 0.833 MILES, go straight onto WEST BRAMLETT ROAD

Travel west for 0.190 MILES, go straight onto BRAMLETT

Travel west for 0.023 MILES, go straight onto WEST BRAMLETT ROAD

Travel west for 0.175 MILES, turn left onto WOOD STREET

Travel southwest for 0.213 MILES, turn left onto 4TH STREET EXTENSION

Travel east for 0.065 MILES, turn right onto CLEMSON

Travel southwest for 0.101 MILES, go straight onto CLEMSON AVENUE

Travel southwest for 0.676 MILES, turn right onto OIL MILL RD

Travel west for 0.184 MILES, turn left onto WHITE HORSE ROAD

Travel south for 0.701 MILES, turn left onto GORDON STREET EXTENSION

Travel east for 0.131 MILES, turn right onto NORTH WASHINGTON AVENUE

Travel south for 0.095 MILES, turn left onto GORDON STREET

Travel east for 0.077 MILES, turn right onto TEXAS AVENUE

Travel southeast for 0.191 MILES, turn left onto EASLEY BRIDGE ROAD

Travel northeast for 1.137 MILES, go straight onto EASLEY BRIDGE RD

Travel northeast for 0.229 MILES, turn right onto PENDLETON ST

Travel east for 0.440 MILES, go straight onto VARDRY ST

Travel east for 0.201 MILES, turn left onto FIELD ST

Travel east for 0.158 MILES, turn left onto AUGUSTA ST

Travel north for 0.136 MILES, End of path

Total path length is 69.294 MILES

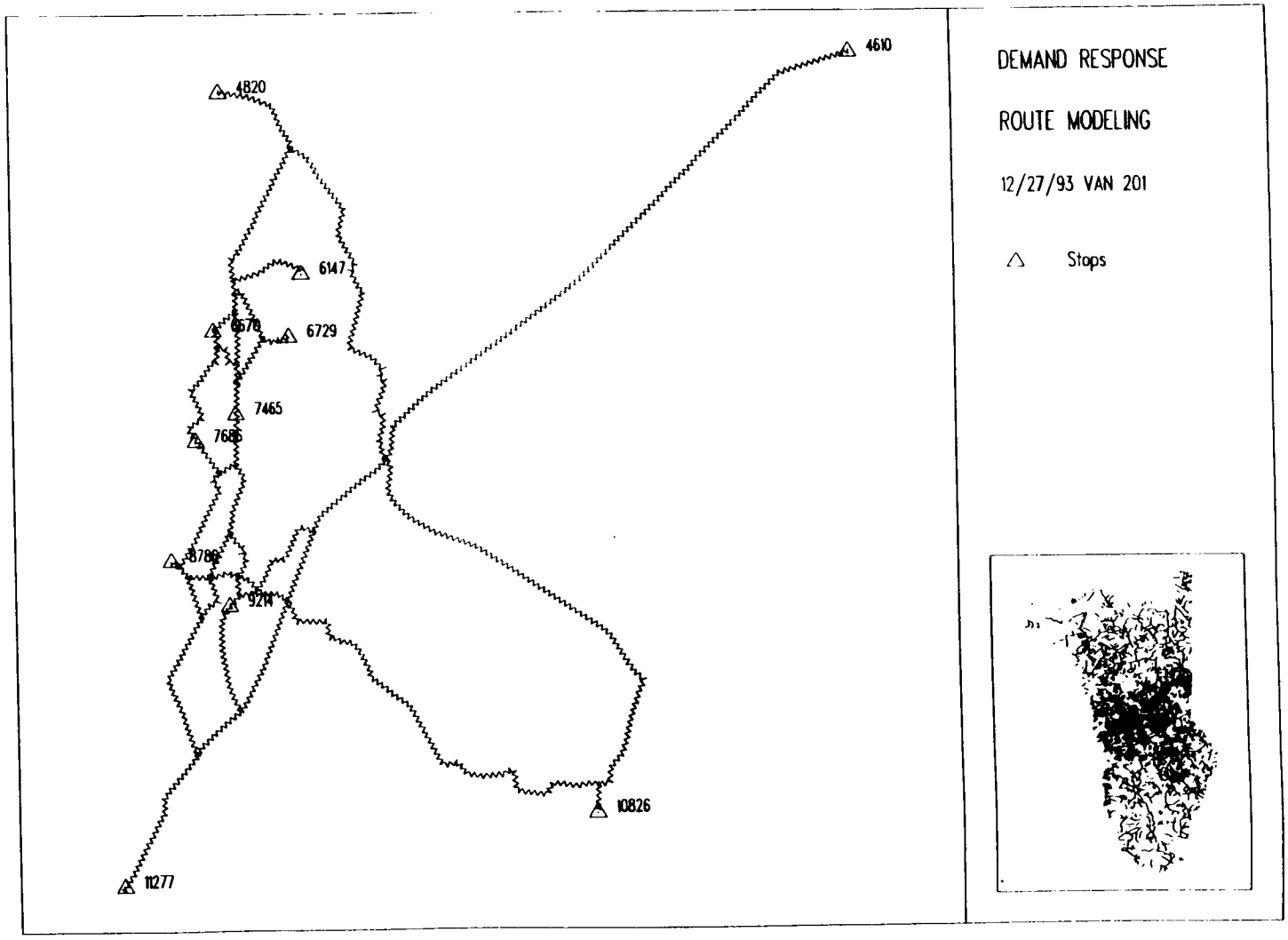


FIGURE 18

ROUTE 22 VAN 201

TABLE 11

ROUTE 22 VAN 201

DECEMBER 27, 1993

ROUTE	STOP #	NODE	TIME	STOP ADDRESS
22	1	9214	8:00 am	106 Augusta St
22	2	6729	8:20 am	12 Foster Ct
22	3	6147	8:30 am	359 Loop St
22	4	6670	8:35 am	106 Hammett St Ext
22	5	7465	8:40 am	415 Rutherford St
22	6	8786	8:55 am	306 Birnie St
22	7	10826	9:15 am	Sagamore Ln
22	8	4820	9:40 am	100 Crestwood Forest Dr
22	9	7686	10:00 am	409 Pinckney St
22	10	11277	10:15 am	1009 Grove Rd
22	11	9214	10:30 am	106 Augusta St
22	12	11277	3:30 pm	1009 Grove Rd
22	13	4820	3:55 pm	100 Crestwood Forest Dr
22	14	7686	4:10 pm	409 Pinckney St
22	15	11277	4:35 pm	1009 Grove Rd
22	16	4610	5:10 pm	101 Sutton Dr
22	17	9214	5:30 pm	106 Augusta St

Adapted from: GTA. (1993). [Demand Response Van Driver Logs]. Unpublished Raw Data.

DIRECTIONS

ROUTE 22 VAN 201

DECEMBER 27, 1993

Starting at AUGUSTA ST

Travel northeast for 0.095 MILES, go straight onto RIVER ST

Travel north for 0.268 MILES, turn left onto REEDY VIEW DR

Travel northwest for 0.069 MILES, turn right onto S ACADEMY ST

Travel northeast for 0.046 MILES, turn left onto W BROAD ST

Travel north for 0.282 MILES, go straight onto BUTLER AV

Travel north for 0.300 MILES, turn left onto BUNCOMBE ST

Travel northwest for 0.117 MILES, go straight onto RUTHERFORD ST

Travel north for 0.605 MILES, go straight onto RUTHERFORD RD

Travel northeast for 0.373 MILES, turn right onto COTTON ST

Travel east for 0.132 MILES, turn right onto FOSTER ST

Travel east for 0.100 MILES, turn back onto FOSTER ST

Travel west for 0.100 MILES, turn left onto COTTON ST

Travel west for 0.132 MILES, turn right onto OLD PARIS MOUNTAIN ROAD

Travel northwest for 0.274 MILES, go straight onto OLD PARIS MOUNTAIN ROAD

Travel northwest for 0.022 MILES, go straight onto OLD PARIS MOUNTAIN ROAD

Travel northwest for 0.147 MILES, turn right onto POINSETT HIGHWAY

Travel north for 0.103 MILES, turn right onto LOOP STREET

Travel northeast for 0.557 MILES, turn back onto LOOP STREET

Travel west for 0.557 MILES, turn left onto POINSETT HIGHWAY

Travel south for 0.227 MILES, turn right onto HAMMETT STREET EXTENSION

Travel southwest for 0.213 MILES, turn back onto HAMMETT STREET EXTENSION

Travel northeast for 0.026 MILES, turn right onto CONYERS ST

Travel south for 0.134 MILES, turn left onto 3RD

Travel east for 0.073 MILES, turn right onto ORDERS STREET

Travel south for 0.108 MILES, turn left onto CATHEY STREET

Travel east for 0.065 MILES, turn right onto POINSETT HWY

Travel south for 0.148 MILES, go straight onto RUTHERFORD ST

Travel south for 0.605 MILES, turn right onto BUNCOMBE ST

Travel northwest for 0.016 MILES, turn left onto LLOYD ST

Travel southwest for 0.129 MILES, turn right onto LLOYD ST

Travel southwest for 0.079 MILES, turn left onto HAMPTON AV

Travel southeast for 0.094 MILES, turn right onto N HUDSON ST

Travel southwest for 0.151 MILES, go straight onto S HUDSON ST

Travel southwest for 0.500 MILES, turn right onto BIRNIE ST

Travel northwest for 0.063 MILES, turn back onto BIRNIE ST

Travel southeast for 0.073 MILES, go straight onto N MARKLEY ST

Travel southeast for 0.077 MILES, turn left onto S ACADEMY

ST

Travel east for 0.303 MILES, turn right onto W CAMPERDOWN WY

Travel southeast for 0.170 MILES, turn right onto HAMMOND ST

Travel southeast for 0.002 MILES, go straight onto W CAMPERDOWN WY

Travel southeast for 0.084 MILES, go straight onto E CAMPERDOWN WY

Travel east for 0.223 MILES, go straight onto CLEVELAND ST

Travel southeast for 0.199 MILES, turn left onto RIDGELAND DR

Travel east for 0.243 MILES, turn right onto MCDANIEL AV

Travel south for 0.113 MILES, turn left onto WOODLAND WY

Travel east for 0.189 MILES, turn right onto SOUTHLAND AV

Travel southeast for 0.257 MILES, turn right onto BOXWOOD LA

Travel south for 0.037 MILES, turn left onto CLEVELAND ST

Travel southeast for 0.847 MILES, turn left onto UNNAMED ST

Travel east for 0.570 MILES, turn right onto S PLEASANTBURG DR

Travel south for 0.154 MILES, turn left onto SKYVIEW DR

Travel east for 0.224 MILES, turn left onto PARKINS MILL RD

Travel north for 0.095 MILES, turn right onto SHELBURNE RD

Travel east for 0.326 MILES, turn right onto SAGAMORE LA

Travel south for 0.191 MILES, turn back onto SAGAMORE LA

Travel north for 0.191 MILES, turn right onto SHELBURNE RD

Travel east for 0.076 MILES, turn left onto WEMBLEY RD

Travel north for 0.812 MILES, turn left onto LAURENS RD

Travel northwest for 2.208 MILES, go straight onto E STONE AV

Travel north for 0.400 MILES, turn right onto COLUMN STT

Travel north for 0.118 MILES, turn right onto MOHAWK DR

Travel north for 0.200 MILES, turn left onto GALLIVAN ST

Travel west for 0.064 MILES, turn right onto PARKWOOD DR

Travel north for 0.242 MILES, turn left onto E HILLCREST DR

Travel northwest for 0.061 MILES, turn right onto BENNETT ST

Travel northeast for 0.080 MILES, turn left onto E MONTCLAIR AV

Travel northwest for 0.300 MILES, turn right onto N MAIN ST

Travel north for 0.433 MILES, turn left onto W AVONDALE DR

Travel west for 0.017 MILES, turn right onto ARCADIA DR

Travel northwest for 0.167 MILES, turn right onto RUTHERFORD RD

Travel northeast for 0.057 MILES, turn left onto WORLEY RD

Travel north for 0.450 MILES, turn left onto WORLEY ROAD

Travel northwest for 0.766 MILES, go straight onto CRESTWOOD DRIVE

Travel northwest for 0.175 MILES, turn left onto CRESTWOOD FOREST DRIVE

Travel west for 0.397 MILES, turn back onto CRESTWOOD FOREST DRIVE

Travel east for 0.397 MILES, turn right onto CRESTWOOD DRIVE

Travel southeast for 0.175 MILES, go straight onto WORLEY ROAD

Travel southeast for 0.171 MILES, go straight onto FURMAN HALL ROAD

Travel southwest for 0.815 MILES, go straight onto FURMAN HALL ROAD

Travel southwest for 0.040 MILES, turn left onto GOLDSMITH AVENUE

Travel south for 0.025 MILES, turn right onto

Travel southwest for 0.057 MILES, go straight onto POINSETT HIGHWAY

Travel south for 0.387 MILES, turn right onto HAMMETT STREET EXTENSION

Travel southwest for 0.187 MILES, turn left onto CONYERS ST

Travel south for 0.242 MILES, turn right onto D STREET - A

Travel southwest for 0.173 MILES, go straight onto SHAW ST

Travel southwest for 0.131 MILES, turn left onto OLD BUNCOMBE

Travel southeast for 0.052 MILES, go straight onto BUNCOMBE

Travel southeast for 0.051 MILES, go straight onto BUNCOMBE ST

Travel southeast for 0.120 MILES, turn right onto FRANK ST

Travel southwest for 0.141 MILES, turn left onto PINCKNEY ST

Travel southeast for 0.401 MILES, turn right onto LLOYD ST

Travel southwest for 0.078 MILES, turn left onto HAMPTON AV

Travel southeast for 0.094 MILES, turn right onto N HUDSON ST

Travel southwest for 0.151 MILES, go straight onto S HUDSON

ST

Travel southwest for 0.500 MILES, turn left onto BIRNIE ST

Travel southeast for 0.010 MILES, go straight onto N MARKLEY ST

Travel south for 0.329 MILES, go straight onto S MARKLEY ST

Travel south for 0.069 MILES, turn right onto GREEN AV

Travel southwest for 0.567 MILES, go straight onto GUESS ST

Travel south for 0.534 MILES, go straight onto MILLS AV

Travel southwest for 0.398 MILES, turn left onto CHAPMAN ST

Travel south for 0.103 MILES, turn right onto GROVE RD

Travel southwest for 0.318 MILES, go straight onto GROVE RD

Travel southwest for 0.322 MILES, turn back onto GROVE ROAD

Travel northeast for 0.322 MILES, go straight onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, turn right onto MILLS AV

Travel northeast for 0.156 MILES, go straight onto MILLS AV

Travel northeast for 0.293 MILES, turn left onto AUGUSTA ST

Travel north for 0.817 MILES, turn back onto AUGUSTA ST

Travel south for 0.817 MILES, turn right onto MILLS AV

Travel southwest for 0.293 MILES, go straight onto MILLS AV

Travel southwest for 0.156 MILES, turn left onto MILLS AV

Travel southwest for 0.398 MILES, turn left onto CHAPMAN ST

Travel south for 0.103 MILES, turn right onto GROVE RDT

Travel southwest for 0.318 MILES, go straight onto GROVE ROAD Travel southwest for 0.322 MILES, turn back onto GROVE

ROAD Travel northeast for 0.322 MILES, go straight onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, go straight onto GUESS ST

Travel north for 0.534 MILES, go straight onto GREEN AV

Travel northeast for 0.672 MILES, turn right onto PENDLETON ST

Travel east for 0.075 MILES, turn left onto WARDLAW ST

Travel north for 0.221 MILES, go straight onto WESTFIELD ST

Travel northeast for 0.342 MILES, turn left onto W BROAD ST

Travel north for 0.116 MILES, go straight onto BUTLER AV

Travel north for 0.300 MILES, turn left onto BUNCOMBE ST

Travel northwest for 0.117 MILES, go straight onto RUTHERFORD ST

Travel north for 0.605 MILES, go straight onto POINSETT HWY

Travel north for 0.148 MILES, go straight onto POINSETT HIGHWAY

Travel north for 0.764 MILES, go straight onto

Travel northeast for 0.057 MILES, turn left onto GOLDSMITH AVENUE

Travel north for 0.025 MILES, turn right onto FURMAN HILL ROAD

Travel northeast for 0.040 MILES, go straight onto FURMAN HALL ROAD

Travel northeast for 0.815 MILES, go straight onto WORLEY RD

Travel northwest for 0.171 MILES, go straight onto CRESTWOOD DRIVE

Travel northwest for 0.175 MILES, turn left onto CRESTWOOD FOREST DRIVE

Travel west for 0.397 MILES, turn back onto CRESTWOOD FOREST DRIVE

Travel east for 0.397 MILES, turn right onto CRESTWOOD DRIVE

Travel southeast for 0.175 MILES, go straight onto WORLEY RD

Travel southeast for 0.171 MILES, go straight onto FURMAN HALL ROAD

Travel southwest for 0.815 MILES, go straight onto FURMAN HALL ROAD

Travel southwest for 0.040 MILES, turn left onto GOLDSMITH AVENUE

Travel south for 0.025 MILES, turn right onto

Travel southwest for 0.057 MILES, go straight onto POINSETT HIGHWAY

Travel south for 0.387 MILES, turn right onto HAMMETT STREET EXTENSION

Travel southwest for 0.187 MILES, turn left onto CONYERS ST

Travel south for 0.242 MILES, turn right onto D STREET

Travel southwest for 0.173 MILES, go straight onto SHAW ST

Travel southwest for 0.131 MILES, turn left onto OLD BUNCOMBE

Travel southeast for 0.052 MILES, go straight onto BUNCOMBE

Travel southeast for 0.051 MILES, go straight onto BUNCOMBE

ST

Travel southeast for 0.120 MILES, turn right onto FRANK ST

Travel southwest for 0.141 MILES, turn left onto PINCKNEY ST

Travel southeast for 0.401 MILES, turn right onto LLOYD ST

Travel southwest for 0.078 MILES, turn left onto HAMPTON AV

Travel southeast for 0.094 MILES, turn right onto N HUDSON ST

Travel southwest for 0.151 MILES, go straight onto S HUDSON ST

Travel southwest for 0.500 MILES, turn left onto BIRNIE ST

Travel southeast for 0.010 MILES, go straight onto N MARKLEY ST

Travel south for 0.329 MILES, go straight onto S MARKLEY ST

Travel south for 0.069 MILES, turn right onto GREEN AV

Travel southwest for 0.567 MILES, go straight onto GUESS ST

Travel south for 0.534 MILES, go straight onto MILLS AV

Travel southwest for 0.398 MILES, turn left onto CHAPMAN ST

Travel south for 0.103 MILES, turn right onto GROVE RD

Travel southwest for 0.318 MILES, go straight onto GROVE ROAD

Travel southwest for 0.322 MILES, turn back onto GROVE ROAD

Travel northeast for 0.322 MILES, go straight onto GROVE RD

Travel northeast for 0.318 MILES, turn left onto CHAPMAN ST

Travel north for 0.103 MILES, turn right onto MILLS AV

Travel northeast for 0.398 MILES, turn right onto MILLS AV

Travel northeast for 0.156 MILES, go straight onto MILLS AV

Travel northeast for 0.293 MILES, go straight onto S CHURCH ST

Travel northeast for 1.301 MILES, go straight onto N CHURCH ST

Travel northeast for 1.122 MILES, go straight onto WADE HAMPTON BLVD

Travel northeast for 1.693 MILES, go straight onto WADE HAMPTON BLVD

Travel northeast for 0.208 MILES, go straight onto WADE HAMPTON BOULEVARD

Travel northeast for 1.888 MILES, go straight onto EAST LEE ROAD

Travel east for 0.525 MILES, turn back onto EAST LEE ROAD

Travel west for 0.525 MILES, go straight onto WADE HAMPTON BOULEVARD

Travel southwest for 1.888 MILES, go straight onto WADE HAMPTON BLVD

Travel southwest for 0.208 MILES, go straight onto WADE HAMPTON BLVD

Travel southwest for 1.693 MILES, go straight onto N CHURCH ST

Travel southwest for 0.994 MILES, turn right onto E NORTH ST

Travel west for 0.095 MILES, turn left onto N SPRING ST

Travel southwest for 0.133 MILES, go straight onto S SPRING ST

Travel south for 0.081 MILES, go straight onto FALLS ST

Travel southwest for 0.080 MILES, turn right onto E COURT ST

Travel west for 0.083 MILES, turn left onto S MAIN ST

Travel southwest for 0.396 MILES, turn left onto AUGUSTA ST

Travel southwest for 0.095 MILES, End of path

Total path length is 58.701 MILES

TABLE 12

ACTUAL VERSUS ARCINFO MILEAGE

VAN	VAN LOG MILEAGE (includes deadhead)	NETWORK CALCULATED MILEAGE	+/-
133	93	51.992	41.00
130	38	40.357	-2.35
134	187	149.536	37.44
132	47	30.903	16.09
203	108	76.843	31.15
131	106	84.484	21.51
135	84	69.294	14.70
201	60	58.701	1.299

Adapted from: GTA. (1993). [Demand Response Van Driver Logs]. Unpublished Raw Data.

APPENDIX E

GIS ASSESSMENT FORM

After examining the results from the demographic and route modeling applications please answer the following questions.

Informational

1. How will you use the information provided?

2. Evaluate the strengths and weaknesses of each project's resulting information; include detailed comments on clarity, usefulness, practicality, presentation, and organization, etc.

3. Do you feel that the amount of resources expended justify the information obtained?

4. Do you feel that the information provided could have been obtained another way; if so, how?

Technical

1. What access does your organization have to GIS?

2. Do you have personnel that use GIS for transit applications? How much of their job is dedicated to transit GIS applications?

3. How feasible do you think the two projects would be for your personnel to complete?

4. Does your organization plan on using GIS for future transit applications? what kinds of applications?

5. What GIS software do you use for transit applications? why?

VITA

Virginia E. Miller was born in Lancaster, South Carolina on December 1, 1969. She attended Indian Land Senior High School in Fort Mill, South Carolina where she graduated at Valedictorian in 1988. She enrolled in Furman University in the Fall of 1988 where she received a Furman Scholar Scholarship. She was graduated with a Bachelor of Arts degree in Economics and Urban Studies in 1992.

In the Fall of 1992, she accepted a graduate assistantship at the School of Planning at the University of Tennessee, where she received the Outstanding First Year Student Award and Academic Achievement Award. She was graduated with a Master of Science in Planning in December 1994. She is a member of the American Planning Association, the Information Technology Division of APA, and Phi Kappa Phi. The author plans to pursue a career in transportation and transit planning and use GIS skills in her work.