

**Development and Implementation
of an Automatic Passenger Counter System
at a Small Transit Company**

by

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(ABSTRACT)

Automatic Passenger Counter (APC) systems can be very powerful tools for helping transit managers make important decisions about transit operations. Compared to the traditional method of manual data collection, they are a definite improvement. Not only can they collect data tirelessly for days at a time for far less cost, but they also provide very accurate information about the time and distance at which passenger activities occur. This information can be quickly processed into meaningful reports using specially developed software, reducing data turn-around time from months to minutes.

This thesis describes the development and installation of an APC system for Valley Metro of Roanoke, Virginia. The research was carried out by the Departments of Civil and Electrical Engineering at Virginia Tech with funding provided by the Virginia Department of Highways and Transportation. The result is an integrated system of equipment, software, and operating techniques which will greatly improve the flow of information

at Valley Metro, allowing management the time and resources to do more planning and less paperwork. The work is significant for the following reasons:

The software is easy to learn and use and can be run on inexpensive personal computers.

The project demonstrates that APC systems are feasible for small transit companies, and that accurate location referencing can be achieved without signposts.

The system could be applied at other small transit companies with very little modification required.

The following chapters describe the project, including the experiences (both good and bad) and insights gained along the way.

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1.0 INTRODUCTION

1.1 BACKGROUND

Transit companies across America are facing a serious problem. The federal government, as part of its effort to reduce budget deficits, is planning major cutbacks in the operating subsidies it grants to mass transit. The resulting funding gap will have to be bridged by a combination of increased state and local funding, service reductions, and fare increases. In addition, these cuts mean that transit agencies will need to become more efficient in order to remain viable. In order to improve efficiency, transit managers will need to make intelligent, informed decisions, but such decisions require data which is generally very expensive. Thus the transit planner faces a paradox: To save money he or she needs to make wise decisions based on accurate data, but to get the data he will probably have to spend all of the money that would have been saved. Automatic Passenger Counter Systems (or APC's) can solve this dilemma.

1.2 DESCRIPTION

An automatic passenger counter system is basically what its name implies. One of its major functions is to count the number of passengers boarding or alighting a vehicle (generally a bus). In most transit systems, the number of passengers boarded is available from tallies the driver keeps

for fare collection records. The main difference is that APC's can tell when and where the passengers board or deboard. This accomplished by recording time and distance data along with the passenger count. The data is stored in an onboard microprocessor (computer), and later transferred and processed. There are a number of advantages to knowing the location and time of passenger activities rather than just the magnitude. For instance, such information may show that certain parts of a route have very little activity. Route revision in such an instance may result in improved service at no additional cost. Similarly, the data might indicate a very sharp increase in demand at certain times of day. This may point out the need for more or larger buses, or perhaps reduced headways. Such trends would never become apparent without the time and location data which APC's provide. Finally, the APC system can be used to evaluate the transit system's schedule adherence. The data might show that certain stops are consistently being reached well before or after the scheduled arrival time. Adjusting the schedule would not only benefit the riders, but would also relieve the extra pressure which an unrealistic schedule places on the drivers.

1.3 APC'S VS. MANUAL COLLECTION

Clearly, APC's can be very valuable to transit management. However, as was mentioned earlier, efficiency is the objective, and cost is a major element of efficiency. If the data is so expensive to collect and process that it absorbs all of the savings that are generated, then very little has been accomplished. Fortunately, low cost is one of the key features

of automatic passenger counter systems. This claim is based on relative cost of APC's to the alternative - manual data collection. Certain types of data are required of all transit companies by the federal government as a condition for any subsidies:

Under Section 15 of the Urban Mass Transportation Act of 1964, as amended, the Secretary of Transportation may not make any grant under Section 5 or 9 of the act unless the applicant for the grant and any beneficiaries are each subject to a reporting system and a uniform system of accounts and records as prescribed by the Secretary [1].

Since part of this data deals with the amount of service provided and consumed (i.e. operational data), most transit services are forced to either hire full-time personnel to handle data collection or to contract out to private firms. This manual data collection is very labor intensive, and therefore quite expensive (the actual costs are discussed in greater detail in "Costs of APC Systems" on page 21). In addition, the drudgery of riding a bus for hours on end makes it very difficult to attract reliable, competent people to perform the on board surveys. Finally, due to the high costs, counts are often concentrated within a span of a couple of weeks. Therefore, the actual seasonal fluctuations in service and ridership go largely undetected. A combination of many of the above factors led the Valley-Metro transit company in Roanoke, Virginia to investigate the possibility of acquiring and installing an automatic passenger counter system.

1.4 THE PROJECT

In late 1984, the Virginia Department of Highways and Transportation agreed to fund an experimental application of an automatic passenger counter system at Valley-Metro. The research was to be conducted through a joint effort of two departments within the College of Civil Engineering at Virginia Polytechnic Institute and State University (Virginia Tech) in Blacksburg, Virginia. In general, the Electrical Engineering Department, under the guidance of Dr. Charles Nunnally, would handle the hardware side of the project. The Transportation Division of the Department of Civil Engineering, under the direction of Dr. Antoine Hobeika, was in charge of developing the main software, testing the system, and instructing the Valley-Metro officials in its implementation and use.

1.4.1 The Early Stages

Much of the early work dealt with the basic hardware of the system. One major problem encountered was that the whole area of automatic passenger counters is relatively new and highly specialized. Thus, there has not been enough time to completely work all of the "bugs" out of the equipment. In addition, the lack of information from real world applications makes certain aspects of the system implementation a trial and error process. Finally, since the field is highly specialized, there are very few suppliers of APC equipment. The equipment which is supplied is still produced in fairly small quantities, and though efforts have been made

to standardize the major components [2], there is considerable variation in equipment among the suppliers.

Several key decisions were made at this phase of the project. Red Pine Instruments (formerly Issacs Associates) was chosen as the chief supplier for the project. Red Pine had a great deal of experience in the APC field, having installed equipment for several systems, including those in Portland, Calgary, and Ottawa. They supplied both the front and rear sensors and the onboard storage equipment (the equipment is described in detail in "Equipment at Valley Metro" on page 23). Soon after the equipment arrived, the research group began to deal with the problems of system access, sensor location, and data retrieval. Sanjeev Shankar and Edgar de Leon Izeppi performed a great deal of work in this phase, and laid the groundwork for the final stages.

1.4.2 The Final Stages

After the basic hardware was placed and tested, major attention was focused on developing the software that would turn the raw data into reports that the management could quickly and easily interpret. The process faced many obstacles. One major stumbling block was collecting reliable distance data. Since accurate distance measurement is essential to the location of passenger activities, the problems encountered in this area created a considerable logjam for the rest of the software development. Umesh Avadhani worked out many of these problems, and created reports which served as the authors model in creating the final system. The au-

thor continued the work from that point, making several changes in the software system in order to make the system user friendly and to allow a much simpler means of creating graphical output. He also reworked the basic activity location technique in order to eliminate the need for signposts. Finally, he devised techniques for creating the required external and reference files which were simple and inexpensive, and which made the the APC package a complete, integrated system. However, the final delivery of that system was delayed when a major bridge rehabilitation project forced a major detour on the project test route. This detour required additional data collection before final testing of the software under actual operating conditions could be completed. These problems were soon solved, however, and the completed system, both hardware and software, was presented to Valley-Metro officials. The remainder of this thesis gives the details of the equipment and programs installed and developed in this final stage of research, along with a summary of the experience gained along the way.

2.0 LITERATURE REVIEW

2.1 OVERVIEW

All automatic passenger counter systems have basically the same purpose: to collect reliable data on passenger activities and transit service (i.e. travel times, etc.). These data provide information which is very valuable for planning, evaluating, and monitoring system performance. This common purpose has led many different transit properties to implement APC systems. This chapter will attempt to summarize their experiences, with added focus on the experience at Valley Metro.

2.2 CHARACTERISTICS

It is important to distinguish at the outset the difference between APC systems and Automatic Vehicle Monitoring (AVM) systems. Typically, AVM systems provide continuous, instantaneous information about vehicle location, emergency status, and schedule adherence [5]. This information is transmitted by radio to a central facility, where it is used to make decisions on a "real-time" basis and studied off line for operational analysis. On the other hand, APC systems generally store the information on board the bus. The information is retrieved periodically (usually between 1 day and 2 weeks), and is processed to generate reports for operational analysis. Though APC's had their start as components of AVM

systems, most transit systems have opted to use APC's alone as their surveillance tool.

There are four major steps in the automatic passenger counting process (see Figure 1 on page 9). They are as follows:

1. Data Acquisition

This phase of the process involves sensing the type of activity which occurs (passenger on or off, door opening, etc.) as well as the relative time and distance at which it occurs.

2. Data Recording

At this step the signals from the various sensors are recieved and sent through a logic algorithm which screens the data and records it in a specified format on some type of storage media. The time and distance are "stamped" to each data log as it is recorded.

3. Data Transfer

This is a crucial and often troublesome step in the APC process. All of the information stored on the bus must be transferred to a central facility and be processed before it can be of any use. There are a variety of methods of accomplishing this task, and they are detailed in "Equipment" on page 10.

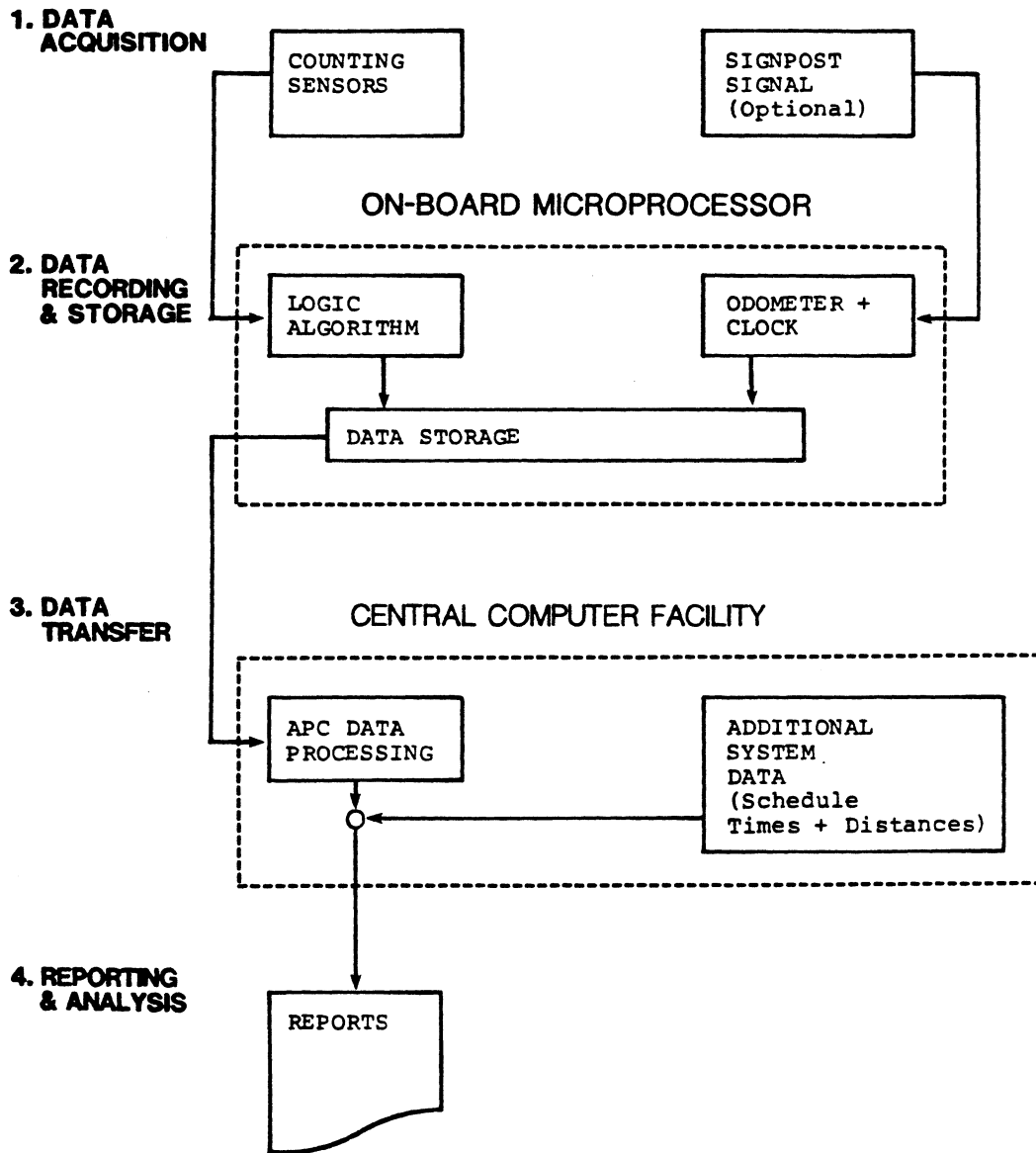


Figure 1. Basic Steps and Components of the APC Technique: (from [5])

4. Reporting and Analysis

Once the data is brought to the central processing facility, it must be processed and converted into a database. From this database, a variety of useful reports can be developed. These reports range in detail from the individual bus stop level to monthly or annual summaries. The level used by a particular transit company depends on their objectives. For example detailed information is required if the data is to be used for making schedule or route modifications, but more general reports are useful for determining fleet requirements or for determining gross ridership.

2.3 EQUIPMENT

Though all APC systems have a similar function, they may be very different in the equipment they use to accomplish their tasks. In general, equipment reliability has been a concern for most systems, and the experience at Valley Metro has been no different. One problem is the lack of industry standards. Every company supplying the equipment seems to use a different approach to solve the same problems. Several conferences have been held to address this key point [2], but since each supplier has a vested interest in making sure that the standard approach is his approach, progress has been slow. Reliability will no doubt improve as more systems are put to work and more experience is gained. Despite the differences, the major components of APC systems fall into a few general categories.

2.3.1 Counters

The most fundamental function of an APC is to sense passenger activities (i.e. boardings and alightings). There are three main types of sensors which perform this function:

1. Infrared Beam Sensors

This type of sensor transmits two or more beams of infrared light across the doorway of the bus. When one or more of the beams is broken the signal is sent to a logic unit in the on board computer. Depending upon the order in which the beams are restored, the signal is registered as an "off" or an "on". Generally, the more beams there are, the more reliable the count [5]. This is the type of sensor used at Valley Metro.

2. Reflective Infrared Beam Sensors

These sensors are very similar to the regular infrared sensors except that they use transmitters that also act as receivers of the beam. Thus, only one side of the doorway has a sensor unit; the other side has a reflector mounted opposite the light source.

3. Treadle Sensor Mats

APC SYSTEMS IN NORTH AMERICA

	Number of Units	Type of Counter	Implementation Date
<u>AVM SYSTEMS</u>			
Windsor (formerly Cincinnati)	27 Counters 37 Signposts	Pro-Data Dual Beam	1981 (1977-1981)
Los Angeles	200 Counters 500 Signposts	Dynamic Control Treadle Mats	1980
Toronto	100 Counters 16 Signposts	Dual Beam (self-designed)	1976
<u>OPERATIONAL APC SYSTEMS</u>			
Ottawa	49 Counters (16 new units anticipated)	Pro-Data Dual Beam (Paul Isaacs Infrared Beam)	1978-79 1982 (new systems)
Seattle	56 Counters (acquiring 250 signposts)	Dynamic Control Treadle Mats	1978
<u>NEW APC SYSTEMS</u>			
Calgary	5 Counters (demonstration)	Paul Isaacs Infrared Beam	1982
CALTRANS	25 Counters (obtaining 65 units from LA)	Dynamain Multiple Beam	1979 (purchase) 1982 (implementa- tion)
Columbus	6 Counters 8 Signposts	Pro-Data Dual Beam	1982
Kalamazoo	20 Counters 30 Signposts	Honeywell Dual Beam	1982
Minneapolis/ St. Paul	44 Counters	Pro-Data Dual Beam	1979 (purchase)
Portland	50 Counters	Paul Isaacs Infrared Beam	1982
Quebec City	3 Counters (10 new units)	Pro-Data Dual Beam (Paul Isaacs Infrared Beam)	1980 1982 (new systems)

Figure 2. Counters in North American APC Systems: (from [5])

Another way to sense the presence of a passenger is through the use of pressure sensitive mats. These mats are placed on the stairways at the front and rear of the bus and send a signal to the onboard computer when a force exceeding some predetermined threshold amount is applied. Depending on the sequence in which the signal is triggered the logic unit records the activity as either an on or an off. A fourth type of sensor is being developed, but has not been used in actual service. This sensor would be similar to infrared sensors but would use ultrasonic sound waves rather than beams of light. 2. Figure 2 on page 12 lists several actual APC installations and the types of counters they use.

2.3.2 Signposts

Signposts are optional equipment employed by many APC systems to increase the accuracy of the location determination. Signposts are transmitters located at specified points along a fixed route which periodically emit a coded signal. When a properly equipped bus enters the range of the signpost, it receives the signal and records the time and location at which the event occurred. Later, this information provides a very convenient reference point for determining the location of a particular event (e. g. passenger boarded).

On systems without signposts, data location referencing is performed by special software which compares the events with detailed schedule and/or reference files. This method eliminates the problems and costs associated

with signposts (e.g. equipment costs, vandalism, battery replacement). This was the technique used at Valley Metro, and although it requires a more complicated data processing program, it was felt that the savings in costs more than offset the slight increase in processing time. The referencing algorithm is discussed in greater detail in "Location of "Good" Loops" on page 56.

2.3.3 On-Board Microprocessor

All APC systems utilize some type of on-board computer to interpret the signals from the sensors and create data records. This computer has a built in clock which determines either the actual time or the time elapsed since the unit was "reset". This unit also receives impulses from the bus odometer which it uses to determine relative distances. This computer is the "brains" of the APC system.

2.3.4 Data Storage and Transfer Equipment

All the data which is collected must be stored. Most systems use solid state memory modules onboard the bus [5]. This helps eliminate data errors caused by physical mishandling (a potential problem with magnetic media), but is generally limits the total amount of data that can be stored before it must be retrieved. Retrieval is usually carried out using some type of portable computer. Kalamazoo Metro Transit combines data storage and transfer by utilizing magnetic cassettes which can be simply removed and replaced when full [4]. A few systems use electronic

METHODS OF APC STORAGE, TRANSFER AND REFERENCING*

	Method of Data Storage	Method of Data Transfer	Method of Stop Referencing
<u>OPERATIONAL APC SYSTEMS</u>			
Ottawa	Solid State	Portable Unit	Extensive schedule files matched with counts
Seattle	Solid State	Portable Unit	Match schedule time and APC recorded times (acquiring signposts)
<u>NEW APC SYSTEMS</u>			
Calgary	Solid State	Portable Unit	No stop-referencing capability at this time
CALTRANS	Solid State	Transmission at Garage	Extensive schedule files matched with counts
Columbus	Magnetic Tape	Portable Unit	Match distance files, aided by signposts
Kalamazoo	Magnetic Tape	Portable Unit	Match distance files; aided by signposts
Minneapolis/ St. Paul	No Storage Capability	No Transfer	Drivers manually record stop and APC count from display
Portland	Solid State	Transmission at Garage	Extensive schedule files matched with counts
Quebec City	Solid State	Portable Unit	No stop-referencing capability at this time

* AVM systems not included in table since storage, transfer and referencing capabilities are not required for AVM technologies.

Figure 3. Data Storage, Transfer, and Referencing in North American APC Systems : (from [5])

transfer systems which automatically dump the data when the bus returns to the garage. No physical handling is required and the process is very fast. However, it is also expensive compared to other methods. Figure 3 on page 15 summarizes the methods of data storage, data transfer, and stop referencing for several other North American APC systems.

2.3.5 Data Processing Equipment

The equipment used to process the data may vary from personal computers to large mainframe systems. The choice is generally a function of the amount of system size and level of reporting desired. Faster, more powerful units are required to handle large amounts of data or to produce very detailed reports. Availability of skilled personnel to process the data is a crucial factor. Some systems actually have contracts with private firms which handle all of the data processing and report generation [4]. Such an arrangement may be very convenient; however, it tends to increase data turnaround time and costs to the transit company.

2.4 ACCURACY OF APC'S

Any discussion of automatic passenger counter systems eventually leads to the issue of accuracy. How good are the counts, and how do they compare to the counts obtained by manual ride checkers? A major study sponsored by the Urban Mass Transit Administration (UMTA) Office of Bus and Paratransit Systems was conducted to determine just that. The study was conducted by the Transportation Systems Center of Cambridge, Mass. and

involved the following transit agencies: Minneapolis/ St. Paul, (MTC); Columbus, (COTA); Seattle, (METRO); and Kalamazoo, (METRO TRANSIT) [6]. The study focused on the accuracy of APC systems compared to manual systems and does not compare one APC system with another. The statistics given are of two types: Total passenger counts and stop by stop analysis.

2.4.1 Total Passenger Counts Summary

This is a measure of the difference in the total counted ons or offs by the APC and by ride checkers compared to a "truth team". The truth team was made up of two counters, each of whom was responsible for recording all passenger activities at one door only. (Normally, one ride checker is responsible for both doors, and at peak periods, he or she may have trouble keeping track of all activities). The two "truth" team members were not to compare notes in order to maintain the integrity of the test. The results of the test are presented in Table 1 on page 18 from [6].

The results show that the "truth" standard was unreliable, and that the manual checkers were slightly more accurate than the APC's (2.6% error vs. 5.8%). However, since the ride checkers knew they were being monitored, their performance was probably better than usual. This statistic is somewhat useful if the system is being used mainly to determine the gross number of passenger activities. But since it aggregates the counts and the errors can cancel each other out, it says very little about the actual accuracy of the system. The second set of statistics does a much better job.

Table 1. Total Passenger Counts Summary

					<u>"Truth"</u> <u>TEAM</u>			<u>RIDE-CHECKER</u>			<u>APCS</u>		
<u>Day</u>	<u>Coach</u>	<u>Start Load</u>	<u>End Load</u>	<u>Expect Diff. (Off-On)</u>	<u>On</u>	<u>Off</u>	<u>Diff</u>	<u>On</u>	<u>Off</u>	<u>Diff</u>	<u>On</u>	<u>Off</u>	<u>Diff</u>
1	A	20	2	18	380	392	12	419	400	-19	413	414	1
	B	22	1	21	434	445	11	405	358	-47	394	407	13
2	A	32	0	32	378	426	48	411	422	11	377	424	47
	B	17	0	17	423	441	18	418	422	4	374	402	28
3	A	31	3	28	400	426	26	376	379	3	398	437	39
	B	16	0	16	383	492	109	384	496	112	439	458	19
TOTAL	A	83	5	78	1158	1244	86	1206	1201	-5	1188	1275	87
TOTAL	B	55	1	54	1240	1378	138	1207	1276	69	1207	1267	60
TOTAL		138	6	132	2398	2622	224	2413	2477	64	2395	2542	147
% Difference Between On and Off					8.5%			2.6%			5.8%		

2.4.2 Stop-by-Stop Analysis

This test tracked both the magnitude and frequency of errors at any given stop. The results indicate that the accuracy of the passenger counts, both manual and APC, are inversely proportional to the number of passengers boarding or alighting. This was also the experience at Valley Metro. The reason for this is that for manual checkers, the view is often blocked by other passengers, and also that it is impossible for one person to constantly monitor both doors simultaneously. With APC's, on the other hand, passengers tend to stand in the beams, or a passenger boarding blocks the beams so that they cannot detect another passenger alighting. Therefore, the best way to evaluate the accuracy is by grouping it according to the number of passengers per activity. Table 2 on page 20 from [6] summarizes the study results.

Again, it shows that manual checkers are slightly more accurate, but their results are probably biased on the high side for the reason stated earlier. The conclusion is that automatic passenger counters are very competitive with manual collection methods as far as accuracy is concerned. In addition, once the system is in place, it can collect continuously collect data for days at a time.

2.5 COSTS OF APC SYSTEMS

As mentioned earlier, one of the main justifications for APC systems is to save money. If the data collection program is not cost effective,

Table 2. Stop-by-Stop Accuracy Comparison

NUMBER OF PASSENGERS BOARDING/ALIGHTING	Number Of Observations	% of Time No count Errors		% of Time Count was Within ± 1		% of time Count was Within ± 2		% of time Count Error was Equal to or Greater than 3	
		APCS	R/C	APCS	R/C	APCS	R/C	APCS	R/C
1	4100	87.4	91.8	99.4	99.4	99.9	99.8	0.1	0.2
2	1900	80.8	88.3	97.0	95.8	99.9	99.7	0.1	0.3
3	970	73.8	83.4	94.9	95.3	98.3	97.7	1.7	2.3
4	515	62.7	79.9	89.5	93.6	95.7	97.5	4.3	2.5
5	285	61.4	75.1	87.7	90.2	95.1	95.1	4.9	4.7
6	208	60.6	82.2	87.5	96.1	94.7	99.9	5.3	0.1
7	140	48.6	70.6	80.3	89.5	90.1	91.6	9.9	8.4
8	120	41.2	68.0	75.6	90.1	89.0	95.8	11.0	4.2
9	80	42.7	66.7	75.6	89.3	90.2	95.3	9.8	4.7
10	70	45.7	57.7	72.8	78.8	85.6	91.5	14.4	8.5
11	45	53.2	73.5	78.7	89.8	95.7	93.9	14.3	6.1
12	32	53.1	65.6	84.3	78.1	96.8	87.5	13.2	12.5

*Note that ride checker performance is probably biased high, since the ride checkers were aware that their results were being compared to two other count sources.

TABLE 4
COMPARISON OF
APCS AND RIDE-CHECKER*
ACCURACY
(Composite Data)

there is no great advantage in having the system. In light of this fact, cost comparisons have been made between manual and automated collection methods. They reveal that APC systems have a higher initial cost due to the expense of equipment and installation. However, the annual costs for the installed system tend to be significantly lower than manual methods, and the payback period is usually less than five years. The cost per additional unit is much less for APC system, since most of that cost is software development and data processing. A comparison of the marginal cost of adding a full time checker (about \$23,00) to that of an additional APC unit (about \$6000 per equipped bus) clearly illustrates this fact [5]. The larger the bus system, the larger the potential for savings with an APC system, as illustrated in Table 3 on page 22 (from [5]). Note, however that on small systems (i. e. less than 50 peak hour buses) the projected costs for APC systems are higher than those for manual data collection. One major objective of this research is to determine the feasibility of APC systems for such transit companies.

Table 3. Cost Comparison for Different Size Transit Companies

Peak Buses	Number of Traffic Checkers Required*	Number of APC Equipped Buses*	Annual Costs**		Annual Costs per Unit**	
			Manual Program	APC Program	Manual Program	APC Program
25	1	1	59,000	82,000	59,000	82,000
50	2	2	86,000	84,000	43,000	42,000
100	4	4	142,000	121,000	36,000	30,000
200	6	6	201,000	142,000	33,000	24,000
300	7	7	227,000	149,000	32,000	21,000
500	13	13	385,000	196,000	30,000	15,000
750	15	15	436,000	223,000	29,000	15,000
1000	19	19	532,000	245,000	28,000	13,000
2000	38	38	\$1,027,000	\$398,000	\$27,000	\$10,000

*Assumes the maximum number of units (checkers or APC buses) required as stated in the Bus Transit Monitoring Study.

**Assumes the costs accrued over a five-year period (discount rates were not applied to annualized costs).

3.0 EQUIPMENT AT VALLEY METRO

The experience at Valley Metro has been that installation of a new APC system is not without its problems. Equipment problems caused numerous delays and a great deal of frustration for everyone involved. Some of these problems were actual equipment breakdowns; others were due to errors in the installation. This chapter describes some of these problems, their solutions, and ways in which they may be prevented. It also gives a detailed description of the particular equipment used at Valley Metro, so that the system can be compared to other APC installations.

3.1 ON-BOARD EQUIPMENT

3.1.1 Counters

The counters selected for the project are infrared, dual-beam types supplied by Red Pine Instruments. There are a total of eight (8) counters which function as two sets, one at the front door and one at the rear. Two sensors are mounted on each side of the doorway, directly opposite the other two for that door. Thus there is a series of four horizontal light beams at each door. When all four of these beams are broken simultaneously, a count is pending: if the innermost beam is restored first, then the signal is interpreted as a passenger off. If the outermost beam is restored first, then an on is recorded. Figure 4 on page

25 and Figure 5 on page 26 show the sensors and their locations at the front and rear doors.

As the figures show, the sensors are skewed both horizontally and vertically by about six (6) inches and are an average of 48 inches above the steps. It was found that this configuration was effective at counting the passengers without creating false records due to swinging arms, handbags, etc. The problem arises when several passengers board at once. Often one passenger crowds the one boarding just ahead of them, and there is not a sufficient gap for the sensors to distinguish one from another. Another problem observed is that passengers deboarding from the front can be missed when a boarding passenger stops waits in the stairwell and blocking the beams. This would not occur at systems which have a policy of boarding only at the front door, exit only at the rear door. Finally, some passenger offs were missed at the rear door when the passengers stood in the stairway before the bus was stopped. If they were already breaking the beams when the door was opened and the beams were activated, then no off was recorded. Since undercounting was far more common than overcounting, there may be some advantage to reducing the sensors horizontal spacing, thus making it easier for all four beams to be broken at once. Of course any new configuration needs to be carefully checked under actual conditions to verify accuracy.

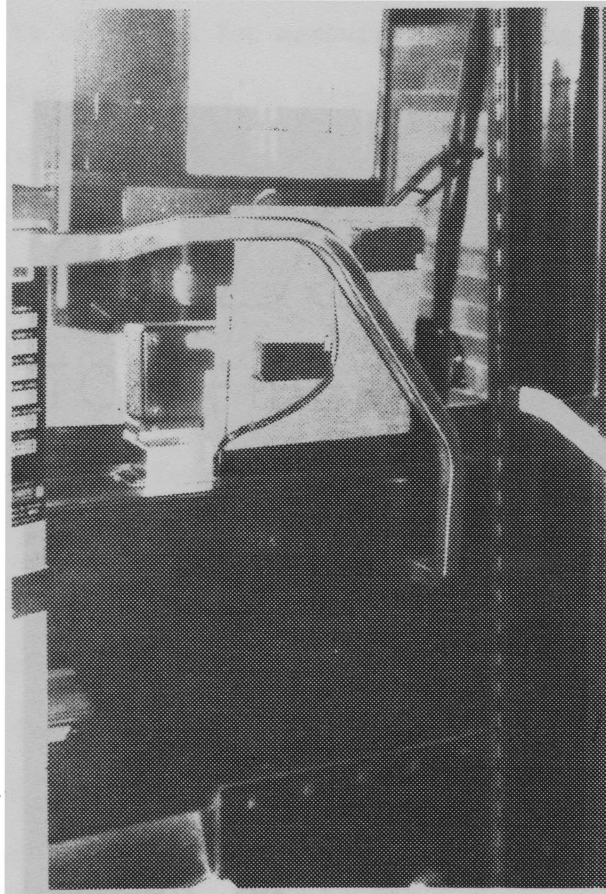


Figure 4. Front Door Counters: The sensors and their location



Figure 5. Rear Door Counters: The sensor and their location

3.1.2 Distance Measuring Equipment

The accurate determination of distance is extremely important for APC systems. It is essential for measuring operating speed, passenger miles, and for matching activities to stops. Other APC applications have experienced problems with distance measurement, and this problem plagued the Valley Metro project in the early days. Variations in the impulses from the odometer caused delays in the development and testing of the software for the project.

Transmission Pickup: Investigation revealed that electrical noise within the odometer itself was causing false signals to be sent to the onboard microprocessor. The decision was made to bypass the odometer altogether and to pick up the signal directly from the transmission drive coupling. The research team was able to track down Stemco Instruments of Dallas, Texas a company which made a coupling which fit the Allison V-730 transmission and produced a very clean signal.

Impulse Converter: The new transmission pickup eliminated the false records, but the value of the odometer impulse appeared to fluctuate. Calculations revealed that at speeds over 20 m.p.h. the signal was being sent to the microprocessor faster than it could be handled. Thus, some of the distance was "lost". A simple converter was built to divide the number of impulses coming from the odometer pickup so that only every eighth one actually went to the microprocessor. The distance travelled

per odometer impulse is now 8.58 feet, and calibration runs and actual data have shown that distance measurement is now remarkably consistent.

3.1.3 Signboard Signal

Originally, the project called for the installation of signposts on the routes to ease the data location process. However, manufacturer's delays arose and threatened to cause serious delays to the project completion. The decision was made to try a new approach. At the beginning of each trip, the driver is supposed to change the destination signs on the bus. Since the location of these points on the route were the same as the proposed signpost locations, it was felt that the signboard change could serve the same function as the signpost. The signboard is scrolled by an electric motor, so it was easy to splice into the wires and send the signal to the microprocessor. Thus when the driver changed the sign, a special data log was created that would mark the beginning of each trip. Experience quickly proved that this method would not work as planned. The problem is that occasionally the driver would forget to change the sign until a few stops into the trip. Others would change the sign before the designated stop. There was not enough consistency to be confident in this method of stop referencing, but the signboard record is very helpful when used in combination with others to locate the beginning of a trip.

3.1.4 System Modules

All of the previously discussed equipment serve to detect and transmit signals whenever certain events occur. The system modules receive those signals, interpret them, and create and store the information. Together the modules form the "heart and brain" of the APC system. Figure 6 on page 30 shows their location behind the right front passenger seat, and the following discussion details the function of each module.

Front and Rear Modules: These modules interpret the signals from the counter sensors. They house the logic circuitry which determines whether an activity is an on or an off, and they also keep a count of the cumulative totals of each since the system was turned on or reset. The only difference is that the rear module has an extra chip which converts any valid signal to an off. This was added when it was noticed that the rear door occasionally interpreted an off as an on. Since the front door is the only one which can be used for boarding, the ons from the rear were errors. The problem was that by counting an off as an on, the counter was in effect raising the number of passengers on board by two, so that by the end of the day when the bus returned to the garage, the data still indicated that quite a few passengers were still on board. The new configuration should remedy this problem.

Count Storage Module: The count storage module (CSM) is the core of system. It receives the counts from the front and rear module, the signal from the signboard, and which include the type of activity, the distance

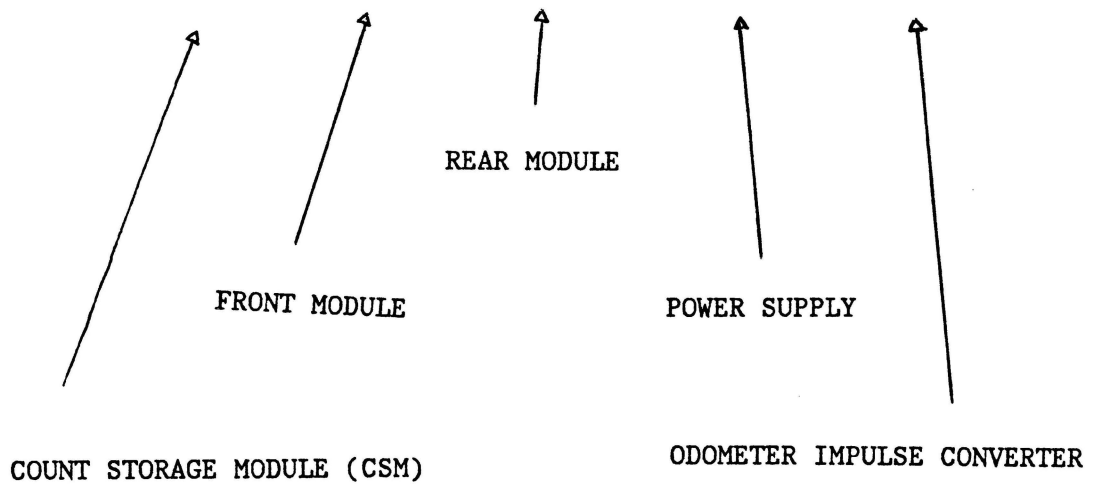
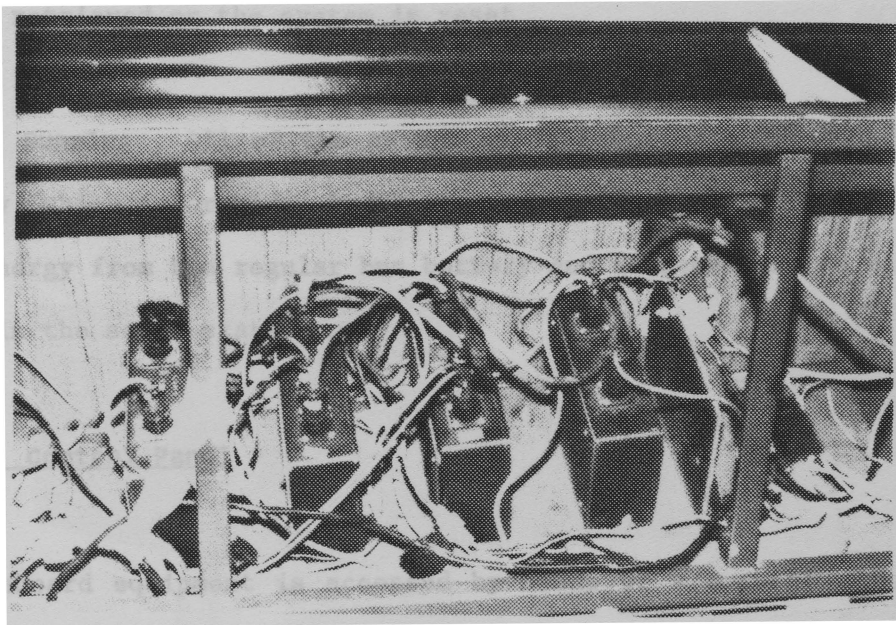


Figure 6. System Modules: The units and their location

from the last activity, and the relative time (determined by its internal clock). In addition it stores this data in its solid state memory until it is retrieved or the system is reset.

Power Supply: All of the equipment is requires a 12 Volt D.C. power supply, which is provided by the power supply module. This module draws its energy from the regular bus battery and is necessary to maintain the data in the solid state memory.

3.1.5 Control Panel

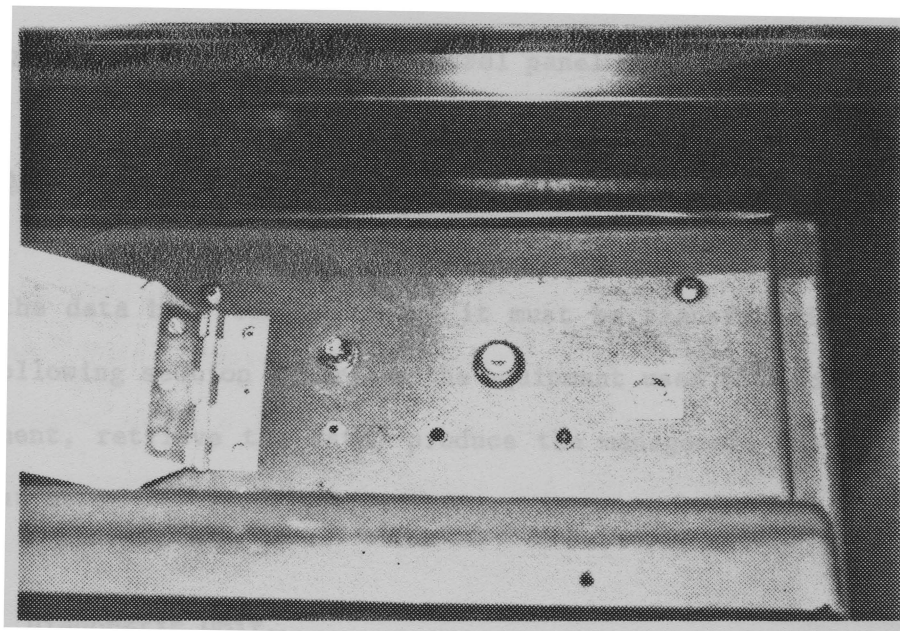
The onboard equipment is accessed by means of a control panel located behind the right front passenger seat just above the system modules. It contains several components, each of which is identified below and in Figure 7 on page 32

1. Power On/Off Switch - keyed switch used to turn the system on or off and to reset the memory
2. Power On/Off Indicator - LED indicates when power is on
3. Data Transfer Jack - Phono type jack which connects to the data retrieval computer

COVER

DIAGNOSTIC UNIT PORT

POWER ON/OFF SWITCH



DATA TRANSFER JACK

TRANSMISSION SIGNAL PORT

POWER ON/OFF INDICATOR

Figure 7. Elements of the Control Panel

4. Diagnostic Unit Connection - Connects the diagnostic unit to the CSM so that the system status can be monitored. (see "Diagnostic Unit." on page 33 for more about the diagnostic unit).
5. Transmission Signal Port- bypasses the transmission converter to allow direct monitoring of the signal from the transmission.
6. Cover and Lock - Protects control panel from tampering

3.2 DATA RETRIEVAL/PROCESSING EQUIPMENT

Once the data has been collected it must be transferred and processed. The following section describes the equipment used to monitor the onboard equipment, retrieve the data, produce the management reports, and print the output.

3.2.1 Diagnostic Unit.

This unit, as the name implies, is mainly used to diagnose problems with the onboard equipment. By entering numerical codes via the keypad, the status of the onboard components can be checked. The three valid codes are as follows:

- 1 - Gives the status of the front and rear doors (open or closed) and indicates whether or not the individual beams for both the front and rear sensors are broken (B) or unbroken (U).

2 - Gives the amount of CSM memory used, along with the time (in hours, minutes, and seconds) and the distance (in odometer impulses) since power was turned on or reset.

10 - Gives the number of offs and ons for both the front and rear since the system was turned on or reset.

Figure 8 on page 35 shows the diagnostic unit.

3.2.2 Data General Portable Computer

The data retrieval is carried out using the Data General One portable computer. This computer is truly portable, weighing less than 20 pounds and accompanied by a handy carrying case. It is nonetheless a quite powerful computer, with 256K memory and two 3-1/2", 720K disk drives. The computer has been slightly modified so that it uses a phono type jack in place of the usual printer style connector. It is very easy to use to for data retrieval, which is explained in detail in "Data Retrieval" on page 78. Its only drawback is that its screen is somewhat difficult to read in very dim light, but the newer version has supposedly corrected this problem.

3.2.3 Auxiliary Disk Drive

In order to transfer the data from the 3-1/2" microdisks of the Data General to the 5-1/4" diskettes used by most personal computers, an aux-

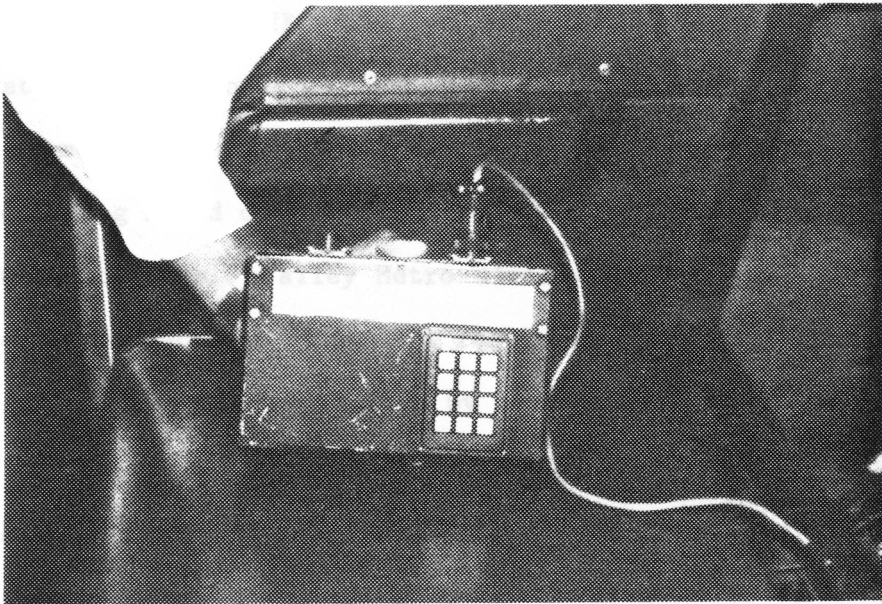


Figure 8. The Diagnostic Unit

iliary disk drive by Manzana Corp. is used. This drive works just like it was an extra drive built into the system, and is designated as either drive C or D, depending on the computer to which it is connected.

3.2.4 IBM PC-XT

The processing of data and generation of reports is carried out in house using an ordinary IBM PC-XT. Virtually any computer using the Disk Operating System could be used, but the XT is very handy due to its hard disk memory. The number and length of files resulting from the data processing would quickly make regular floppy disk storage cumbersome and a waste of time. Valley Metro already had the computer on hand before the APC project, so it was not really an additional equipment acquisition, bringing the system cost down by several thousand dollars.

3.2.5 Printer

All reports are designed for the standard 80 column printer. It is recommended that an inexpensive (less than \$500) dot matrix printer would be the most suitable choice, since it could print reports quickly, including the plots which a daisy wheel printer cannot.

3.3 SUMMARY

Without the proper equipment, an APC system simply cannot function. careful installation is also crucial. A two dollar connector that breaks

can bring down the system just as fast as a major malfunction in the CSM. Location of counter sesors is very important, as is a clean distance signal (the use of the direct transmission pickup is highly recommended). Once the equipment is in place and working, the tremendous benefits of the APC system make the effort worthwhile.

4.0 DATA AT VALLEY METRO

As the previous chapters indicate, an APC system generates useful data for a transit company. The purpose of this chapter is to describe the types of data, its organization, and the amount produced under typical operating conditions.

4.1 DATA LOGS

The data stored in the CSM is in the form of fixed length records called "logs". Each logs contains 5 bytes, and each byte has a specific meaning. Logs are created for the following reasons:

- The bus is idle for more than one minute.
- The bus begins moving after an idle of more than one minute.
- The counter sensors detect a passenger boarding or alighting.
- The destination signboard is changed.
- The time or distance registers overflow and are reset.

The last reason requires explanation. In order to efficiently utilize the the onboard memory, the distance register was designed to handle a maximum of 256 odometer impulse units. If the bus travels more than that distance between logs, then a special log is created indicating that fact, and the register is cleared and again begins accumulating data. A similar arrangement causes a log to be created if an hour passes between consec-

utive logs. Figure 9 on page 40 lists the various types of logs and the explains their meaning.

Each byte of the log has a unique meaning which is explained below:

1. Type - The first byte gives a code indicating the reason for the log's creation. Figure 10 on page 41 lists these codes and their meanings.
2. Time - The second byte is reserved for recording the elapsed time (in units of 15 seconds) since the previous log.
3. Dist - The third byte gives the distance (in converted odometer impulses; 1 impulse = 8.58 feet) from the previous log
4. Ons - The fourth byte tells how many passengers boarded the bus.
5. Offs - The fifth byte tells how many passengers deboarded the bus. This list is for the general case; for certain types of logs, some of the bytes have no meaning. Figure 10 on page 41 lists the logs and the information contained in each byte (inactive bytes contain zeros, X's indicate active bytes).

4.2 MANUALLY INPUT "HEADER" LOGS

As Figure 10 on page 41 shows, the type 12 logs are different from the other logs. These logs are known as header logs, and they are created

- 1 POWER ON/RESET
- 2 HOUR OVERFLOW
- 3 BUS IS IDLE FOR ONE MINUTE
- 4 DISTANCE OVERFLOW
- 5 PASSENGERS ACTIVITY (ONS OR OFFS)
- 6 END IDLE OF MORE THAN 2 MINUTES
- 7 ELAPSED TIME SINCE POWER ON/RESET
- 8 DISTANCE (IN ODOMETER IMPULSES) SINCE
POWER ON/RESET
- 11 SIGNBOARD CHANGED BY DRIVER (INDICATES
BEGINNING OR END OF A TRIP
- 12 MANUALLY INPUT MONTH-DAY-YEAR-ROUTE
- 12 MANUALLY INPUT DAY OF WK-BLOCK-HOURS-MINUTES
- 12 MANUALLY INPUT BUS ID-0-0-0

Figure 9. Types of Logs and Their Meaning.

REASON	TYPE	TIME	DIST	ONS	OFFS
POWER ON	1	0	0	0	0
HOUR OVERFLOW	2	0	0	0	0
ONE MIN. IDLE	3	X	X	0	0
DIST OVERFLOW	4	X	X	0	0
PASSENGER LOG	5	X	X	X	X
END LONG IDLE	6	X	X	X	X
ELAPSED TIME	7	X	X	X	X
TOTAL DISTANCE	8	0	X	X	X
SIGN BOARD LOG	11	X	X	0	1
HEADER RECORD	12	MONTH	DAY	YEAR	ROUTE
HEADER RECORD	12	DAY OF WK.	BLOCK	HOUR	MINUTE
HEADER RECORD	12	BUS ID	0	0	0

Figure 10. Types of Logs and the Information Contained in Each Byte

at the time of data retrieval. They always appear as a series of three (3) consecutive records at the end of the file. They contain important information concerning the rest of the data in the file, including the bus number, route, schedule block, and date on which the data was collected. They also include the "real time" at data dumping from which the time of day of all the activities can be determined. The actual process of data retrieval is explained in detail in "Data Transfer" on page 81.

4.3 TYPICAL DATA

Although there are ten regular service routes at Valley Metro, all tests were conducted on the Cove Road/Prospect Hills Route. This route comprises 207 different stops and is approximately 20.7 miles long for a complete round trip. Scheduled service on this route runs from around 6:00 a.m. to about 7:00 p.m. Data collected on this route for a full day produced a file averaging 12K in length and containing around 700 separate data logs. Appendix C contains actual raw data files collected using the APC on the test route.

5.0 DATA PROCESSING SOFTWARE

5.1 OVERVIEW

The pages of raw data are of little use to anyone until they can be processed and transformed into meaningful information. This process is very challenging, and at many APC installations the costs of software development exceed the cost of the hardware. This chapter will discuss the information which is required for data processing and describe the software which was developed to accomplish this task.

The programs for processing the data are written in BASIC and then compiled to form executable files. This means that the programs can be run by simply typing the name of the file at the DOS prompt. BASIC was chosen as the type of language for the software for several reasons:

- BASIC is very convenient for providing interaction between the user and the program.
- BASIC programs are easy to create and modify, since with an interpreter, the program can be run immediately after changes; Many other languages must be compiled after every change before they can be run.

- The data retrieval program was written in BASIC; By using BASIC for the rest of the software, the software package has more unity.
- The author was experienced at creating interactive programs in BASIC.
- Finally, and most importantly, BASIC has excellent graphics capability, allowing plots to be simply and quickly created. FORTRAN does not support graphics. Therefore, to create a plot for data from a FORTRAN program, the information must be transferred to another program (such as SYMPHONY) before any plots can be generated. This adds several hundred dollars to the system cost, makes the system much more complicated, and increases the time required for processing.

Another important feature of the software is that the process of matching the data to particular stops is accomplished through the use of a logic algorithm which eliminates the need for signposts. This means a savings of several hundred dollars per route in equipment costs and elimination of the maintenance and installation worries. The matching algorithm is described in detail in "Location of "Good" Loops" on page 56.

5.2 REFERENCE FILES

In order to reference the data to individual stops, several external reference files are required. They are the following:

1. Stop Distances File - a file containing a number for every stop on a particular route along with the distance between these stops
2. Stop Names File - a file containing a description or "name" for each of the stops on a particular route.
3. Schedule (Block) File - a file containing the scheduled arrival time at each timepoint throughout the day for each block. A block is the schedule for each particular bus on a given day. If a route normally has 4 buses operating at the same time then it has 4 blocks. The combination of these blocks is the route schedule. A timepoint is a stop for which the arrival times are listed in the official schedule. Normally there are several timepoints on each route.

The data required for these files and the techniques for obtaining it are detailed in "Reference Files - MAKEFILE PROGRAM" on page 82.

5.3 EXTERNAL FILES

The other type of files required is the external files. These files contain important information about the transit company, the equipped vehicles, etc. They also contain information which governs the naming and assignment of files. For instance, the external file might indicate that all reference files for the schedules will have the base of "BLOCK" and will be stored and retrieved from drive C. In addition the external files contain important parameters which affect the matching process. The reason they are not a part of the program is that they can be changed very easily without requiring the program to be recompiled. Thus the

external files are software modules which can be easily modified or replaced, allowing the main program to remain generic. There are two external files, SYSTINFO.EXT and SECT15.EXT. The variables contained in each are explained in "Appendix A. External Files" on page 103.

5.4 APCDATA

The main data processing is carried out by using the APCDATA program. This is an interactive BASIC program which converts the raw data into activity records, matches the activities to stops, and stores the results in an output file. Since the output files serve as the input for all of the reports, listings, and plots, it can be thought of as the "heart" of the software package. For this reason, the major steps of this program will be described in the following section (see Figure 11 on page 47 for a flowchart of the program).

5.4.1 Program Description

The program begins by retrieving the relevant information from the SYSTINFO.EXT external file.

A menu is displayed. For data processing the user selects option "1".

The program asks the user which raw data file is to be processed. When the file name is entered, the program goes to the appropriate drive and retrieves the data.

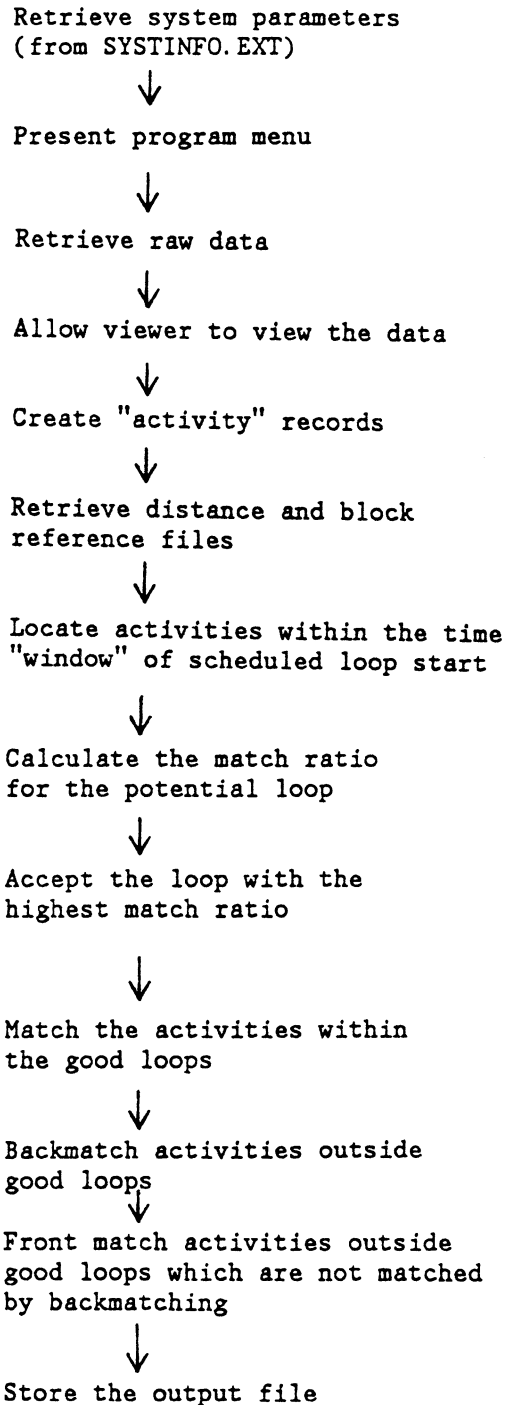


Figure 11. Data Processing - General Flowchart

From the information contained in the three manually input logs at the end of the data file, the program determines the time at which the data was dumped, the route, block, date, day of the week, and vehicle on which the data was collected. In addition, the length of odometer impulses and the seated and standing capacity of the bus retrieved.

The program gives the user a chance to view the raw data. At any point the user can continue viewing or else quit and continue with the data processing.

Next the program creates activity records from the raw data. An activity is considered any long idle, signboard change, or passenger on or off. This part of the program determines the cumulative distance at which each activity occurred, along with the distance from the previous activity. In addition, it uses the time of data dumping to determine the time of day (in 15 second time units) of each activity. Finally, it determines the passenger load at each activity, which is simply the passenger load at the previous activity plus the number of passengers boarded and minus the number deboarded. When all activity records have been completed, the raw data is cleared to conserve memory.

Using the block and route numbers for the data, the program automatically retrieves the appropriate reference files. The user is given

a chance to specify other files if the data was collected under unusual circumstances (e.g. holiday schedule).

The program then begins the process of locating the data with respect to the stops on the route. The first step is to locate the "good" loops in the data. To accomplish this, the program searches for the activities which begin and end a loop. Any activity which occurs within a time specific time range of the scheduled time for the beginning of a loop is assumed to have taken place at stop number 1. The program then checks how well the rest of the activities within that potential loop match the reference files. Only those activities which begin and end each loop and produce the best fit are recorded for use in the actual matching of activities to stops. The process is discussed in detail in "Location of "Good" Loops" on page 56.

The program then matches the activities within the good loops, based on how the actual distances compare to the distances contained in the stop distance reference file. If the the difference between the actual distance and the reference distance is within a certain range ($\text{deltas1} = + \text{ or } - 3$ odometer impulses) then the activity is given a match value of "4" and the stop number of the reference stop is assigned to the activity. A match value of "2" indicates the difference was less than deltas2 ($+ \text{ or } - 6$ odometer impulses). If the difference is greater than 6 impulses, the program assigns the stop number of the reference stop which gives the least difference and gives a match value of zero.

DELTA1 = 4

DELTA2 = 2

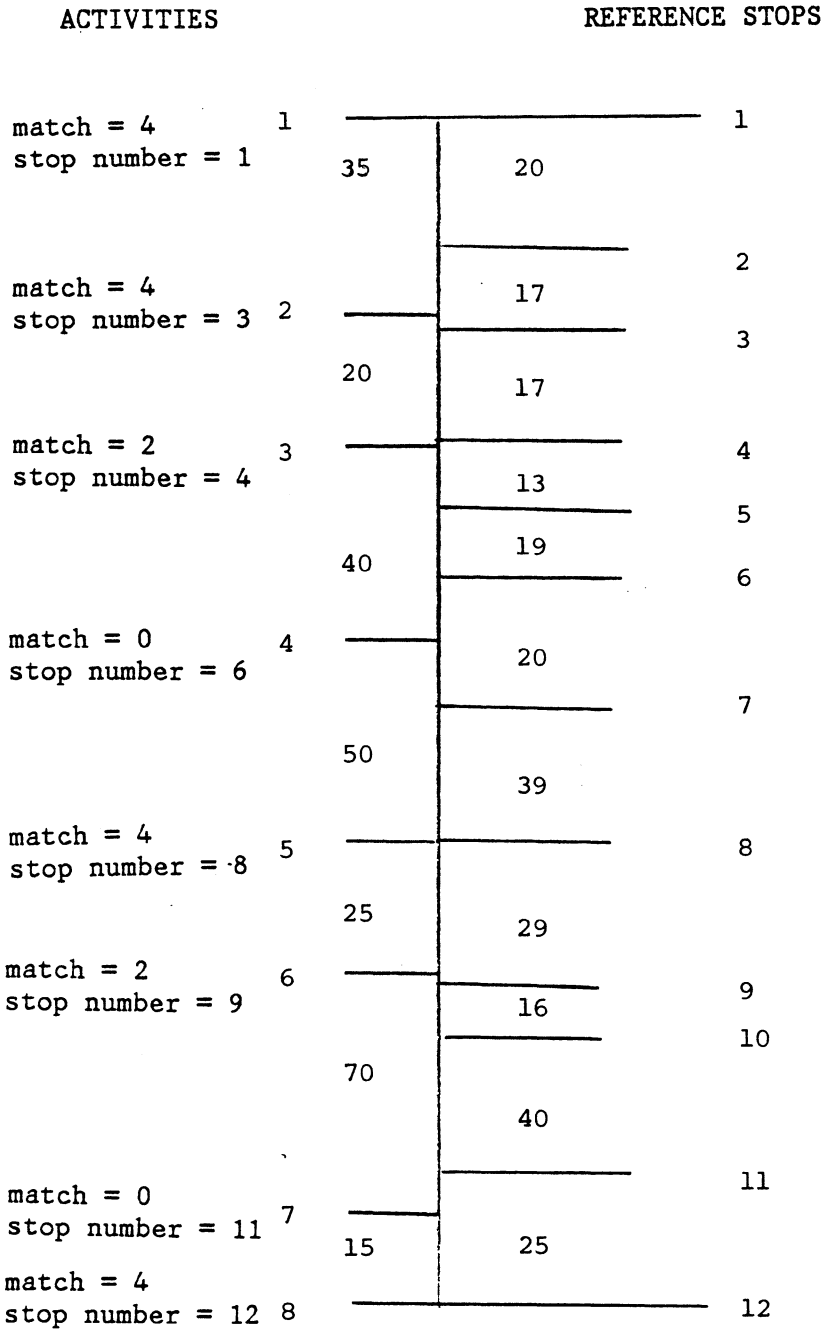


Figure 12. Example of the Basic Matching Process

Figure 12 on page 50 shows a hypothetical set of 8 activities and the corresponding reference file containing 12 stops. Assume the values of deltas1 and deltas2 are 4 and 2, respectively. The numbers between the horizontal lines indicate the distances between the individual activities and reference stops, respectively. To begin the matching process, activity 1 is assigned stop number 1 and a match score of 4 (since it lines up perfectly with the reference stop).

The next step is to try to match activity number 2. If activity 2 is compared to reference stop 2, the difference is $35 - 20 = 15$. Since 15 is greater than deltas1 (4), there is no match. Since the reference distance is less than the activity distance, the program adds the distance between stop 2 and 3 to get a "reference sum" of $20 + 17 = 37$. The difference between the activity distance (35) and the reference sum (37) is 2, which is within the range of deltas2 . Therefore, activity 2 is assigned a stop number 3 and a match score of 4. The reference sum is reset to zero.

Similarly, activity 3 is matched to stop number 4, and since the difference is $20 - 17 = 3$, the match score is 2 (difference < deltas1).

For activity 4, no positive match can be made. If it is compared to stop 6 the difference is 8 ($= 40 - (13 + 19)$). Compared to stop 7, the difference is -12 ($= 40 - (13 + 19 + 20)$). Neither of these differences has a magnitude less than deltas1 , so the match score is

zero. Since stop number 6 is the closest, activity 4 is assigned to stop number 6, but the reference distance is not reset.

Since activity 4 was not a good match, the distance is added to the distance to activity 5, so that the "activity sum" is $40 + 50 = 90$. When this number is compared to the reference sum from stops 4 through 8 ($= 13 + 19 + 20 + 39 = 91$), the difference is only 1. Therefore, activity 5 is assigned to stop number 8 and given a match score of 4 (since the difference is less than $\text{deltas}2$). Since the match was good, both the activity sum and the reference sum are reset to zero.

The process would continue in like manner until all of the activities had been assigned a stop number and a match score. These values are shown in the example.

If the stop number assigned to the activity is the stop number of a timepoint, the program retrieves the scheduled time for that loop and timepoint. This value is saved as the "schedtime" for the activity. Activities which are not at timepoints have a schedtime of zero.

The process continues until all activities between the beginning and end of the loop have been matched for every loop.

Next the program goes to the beginning of the first loop. Since there are usually some activities occurring before the first full loop, a different matching technique is required. This is known as "back-

matching". Since the stop number of the activity beginning the first loop is known (1), the backmatching process uses this point as the starting point. Matching is carried out in a similar fashion as the matching within good loops with a very important exception: The program proceeds backwards through the activities and reference files. If the difference between the actual and reference distances is less than deltas2 (= 6 odometer impulses), then the match value assigned is "1" ; otherwise, it is zero. The process continues until the time of an activity is earlier than the first scheduled stop.

If there are any gaps between the good loops (if for instance the bus is forced to take a significant detour which causes the loop to be considered "bad"), then the program backmatches from the beginning of the next good loop to the end of the last good loop.

At the end of the day there are often activities which occur after the last full loop. These activities are matched by "frontmatching". This is exactly like the matching within the good loops, except that a match value of "3" is assigned when the difference between actual and reference distances is less than + or - 6 odometer impulses. Frontmatching ceases when an activity occurs after the last scheduled stop for the day.

Again, if a gap exists between the good loops, frontmatching is performed from the end of the last good loop to the first activity which has been positively located by backmatching (i. e. match = 1).

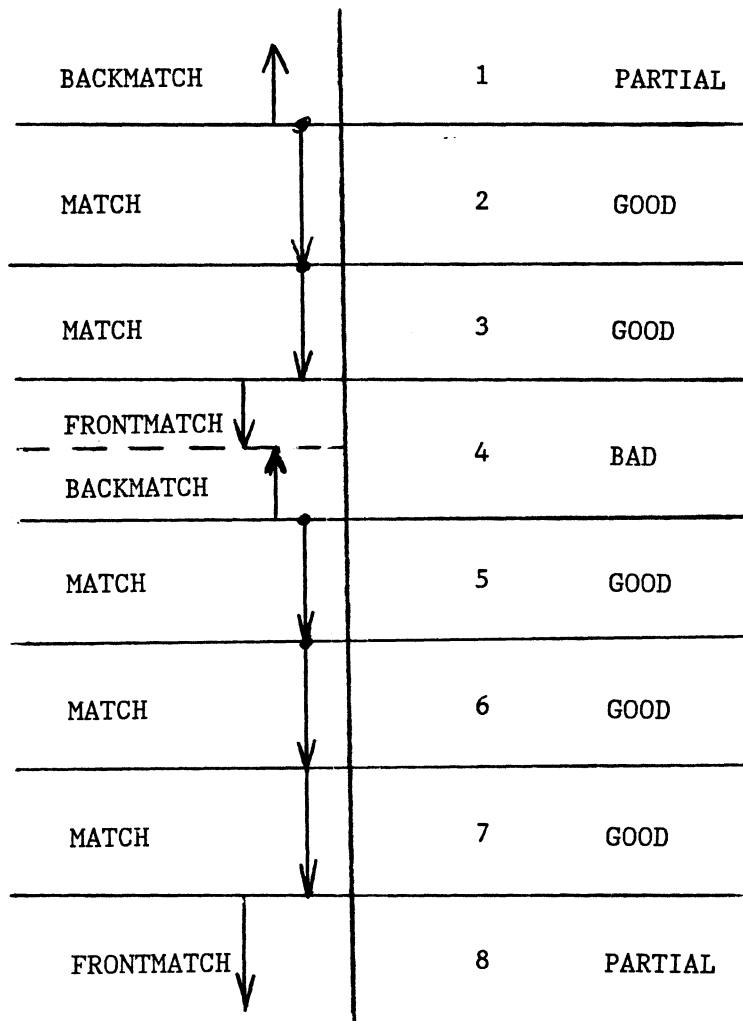


Figure 13. Example of the Three Types of Matching

Figure 13 on page 54 gives a schematic example of the data for one day and the way in which matching would proceed. The example assumes that the activities which begin and ending all of the good loops have been located (they are represented by the horizontal lines in the example). Loops 2, 3, 5, 6, and 7 have been identified as "good" so the regular matching process takes place from the beginning to the end of each of these loops.

When all good loops have been matched, the next step is backmatching. Since loop number 1 is only a partial loop, backmatching takes place from the beginning of loop 2 until an activity occurring before the scheduled time for the start of the days service is located. Backmatching would also take place from the beginning of loop 5 to the end of loop 3, since loop 4 did not meet the criteria for a good loop.

The final step is frontmatching. Since loop 4 is "bad" the program calls for frontmatching from the end of loop 3 up to the last activity positively matched through backmatching (indicated by the dotted line in the example). Thus, through backmatching and frontmatching the "bad" loops, the program should close in on the point at which the deviation from the typical route occurred. The last step in the example would be frontmatching the partial loop 8 from the end of loop 7 until an activity occurring after the last scheduled stop occurred.

Finally, the matched activity records are stored as the output file. For each activity the following information is included - activity

type; stop number assigned during matching; cumulative distance from start of the day (in odometer impulses); time of day (in 15 second time units); scheduled arrival time (0 unless the activity occurs at a timepoint); passenger ons; passenger offs; passenger load. This file is given the same base name as the raw data from which it is processed, but is assigned an extension of ".OUT" to distinguish it as a processed data file.

5.4.2 Location of "Good" Loops

As the program description indicates, the correct location of good loops is critical to the correct matching of activities to stops. This section details the process of defining the good loops.

Locating a good loop means identifying the activities which occur at the beginning and end of that loop. In making this identification, the program considers every activity to be a potential beginning of a loop. It then determines the true loop beginning by applying a two step test.

The first step of the test is that the time the activity occurs must be within a specific time range of the scheduled beginning of the loop. This time range is known as "deltat" and is currently set at 8 minutes. If the activity occurs more than deltat before the scheduled time, then the activity is rejected and the next activity is tested. If the activity occurs more than "deltat" after the scheduled time then the program sets

the reference time as the scheduled time for the next loop, and the process continues with the next activity.

Those activities which fall within "deltat" of the scheduled beginning of a loop go on to the second test. In this test, the program assigns the activity to stop number 1, and begins matching the subsequent activities just as in the example in Figure 12 on page 50. The only difference is that no stop number is actually assigned to the activity, and the program just keeps track of the number of positive matches (i.e. difference < deltas1) which occur. The matching continues until either the last reference stop is reached or the total accumulated distance from the first activity exceeds that of a full loop. When either of these conditions is met, matching stops.

Next, the "match ratio" is calculated. This ratio reflects the percentage of activities which produced a good match out of all of the activities which were matched. Referring to the example of Figure 12 on page 50, the match ratio would be the number of activities which recieved a match score of greater than zero (6) divided by the total number of activities (8). Thus, the match ratio for the hypothetical loop would be $6 / 8 = .75$.

If the match ratio is greater than .5, then the temporary beginning and ending of that loop would be the first and last activities matched.

The process would be repeated starting at the activity following the activity which was last checked as the potential beginning of a loop. Those activities which are associated with the highest match ratio for each loop are finally accepted as the actual beginning and end of that loop. If none of the activities produce a match ratio greater than .5, then the loop is considered bad.

By locating loops in this way, the program is able to quickly make the referencing. Only those activities within Δt are examined, so that the data processing is much faster than if every activity were examined. By separating the "good" loops from the "bad" ones in this way, the program is able to find starting points from which it can close in from in from the front (frontmatching) and from behind (through backmatching). Thus, the program is trying to recognize the pattern of the data, and notifies the user when there are abnormalities in that data.

Another important feature of the loop locating algorithm is that it locates the loops independently of one another. This means that if for some reason a "bad" loop is accepted as "good", then only the activities within that loop will be mismatched. The rest of the days loops should be unaffected. This means that very little data will be wasted due to problems with locating the activities.

5.5 COMMENTS ON DATA PROCESSING

5.5.1 Limitations

This system of data processing has a few limitations. It can only be used for fixed route service. If the route changes during the day, the reference files are not valid for that portion, and mismatching might occur. In addition, the program assumes the bus is assigned to the same block for the entire day. If the block changes the data after the change will be useless. However, with a little care in scheduling, this should not be a problem. Finally, the program processes data for a single day at a time.

5.5.2 Accuracy of the Matching

The question of how good is the matching process is an important one. To answer it, several loops were compared between the locations of activities from an onboard observer. In each of these cases the location of loops was correct for all of the data sampled. However, on a few of the stops, particularly the very closely spaced ones, the program occasionally matched an activity to the stop before or after the actual one. But for the vast majority of stops, the process works very well. It appears that the confidence of location is a function of the number of stops the bus makes. Since variation in distance can occur due to changes in tire pressure, lane changes, and even drivers, the less distance between the activities, the higher the probability of a positive match.

5.5.3 Operations

The number of files involved in the APC data processing quickly adds up. For this reason, it is recommended that a computer with a hard disk drive be used for data processing. This eliminates the need for shifting disks required for reference files, data files, storage, and the program itself. It is recommended that data be processed at least once a week. Not only will that give the management information sooner, but it will keep the data from "piling up". Also, by processing the data weekly, any serious problems with the equipment will be discovered more quickly, and steps can be taken to correct the problems before a large number of useless data files are collected.

6.0 GENERATING LISTINGS, REPORTS, AND PLOTS

After the data has been processed, the ultimate goal of the APC system can be realized - meaningful information can be delivered into the hands of the transit management. Important decisions about fleet requirements, route design, schedules, and quality and types of service can be made with more confidence than ever before. And finally, valuable human resources can be freed from the monotonous, time consuming task of making on board surveys and manually processing field data. They can devote themselves to more rewarding and productive pursuits - and not only the transit company, but also the general public, will benefit. This chapter is devoted to describing these listings, plots, and reports, along with software which produces them.

6.1 BUS STOP LISTING

The Bus Stop Listing is the most detailed of the reports obtained from the processed data. It is a sort of "daily diary" of a the APC equipped vehicle, listing every passenger on or off, along with the stop number and name, the time of day, and the distance since the beginning of the day's operation at which the activity occurred. In addition, the listing gives the schedule time and schedule deviation at any timepoints at which the bus stopped during the day. Finally it gives the passenger load at each stop throughout the day.

The bus stop listing is generated by selecting option "2" of the APCDATA program. It is included in this program because it serves as the most complete check of the processed data, and it would normally be the first report generated upon completion of the data processing. The steps of the program are very simple:

The program asks the user which output file to retrieve for creating the listing and acts according to the users command.

Next the user is given the choice of viewing the report on the screen or printing a hardcopy of the report.

Using the information about which route the output file represents, the program suggests the appropriate stop names file.

The program begins preparing and processing the report. The only real calculations required are those to convert the time from 15 second increments into hours, minutes, and seconds and to convert the distance from odometer impulses to miles. The rest is simply a matter of printing the information in the proper format.

Figure 14 on page 63 shows a sample page from a bus stop listing.

One very important feature of the bus stop listing, as well as all other reports and plots, is that it can be printed on standard 8-1/2 inch by 11 inch computer paper. This means that no special printers or paper are

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
41	JEFFERSON & MAPLE	0	0.07	5:37:30			1	1	0
102	ROUTT & BLACK OAK	0	6.55	5:49:15			1	0	1
105	PERNCLIFF APTS. S.	0	6.67	5:53:30			1	0	2
113	COVE ROAD & FRESNO	0	7.51	5:56:30			1	0	3
129	STAUNTON & 21 st	0	8.95	5:59:15			1	0	4
132	STAUNTON & 18 th	0	9.20	6: 0:15			1	0	5
139	STAUNTON & 12 th	0	9.76	6: 2:30			5	0	10
154	JEFFERSON & WELLS	0	11.26	6: 6:45			1	0	11
160	SALEM & 1 st	0	11.87	6: 9:30			0	1	10
161	JEFFERSON & CAMPBEL	0	12.00	6:10:15			0	3	7
164	JEFFERSON & FRANKLI	0	12.09	6:16:30			3	3	7
165	JEFFERSON & BULLIT	0	12.18	6:17: 0			1	0	8
179	JEFFERSON & MC CLAN	0	13.47	6:20: 0			0	5	3
180	JEFFERSON & 22 nd	0	13.56	6:20:45			0	1	2
190	26 th & AVENHAM	0	14.32	6:23:15			1	0	3
204	FRANKLIN & PENARTH	0	15.61	6:26: 0			0	1	2
1	BRENDLES	4	16.25	6:35:45	6:30: 0	- 5:45	3	3	2
9	FRANKLIN (COLONY HO	4	17.39	6:39:15			1	0	3
32	JEFFERSON & YELLOW	4	19.33	6:43:15			1	0	4
41	JEFFERSON & MAPLE	0	21.48	6:49:45			0	2	2
42	JEFFERSON & ALBEMAR	2	21.68	6:50:45			1	0	3
50	CAMPBELL & MARKET S	0	22.16	6:57: 0			1	3	1
51	WILLIAMSON (YELLOW	0	22.37	6:58: 0			1	0	2
74	STAUNTON & 16 th	2	24.72	7: 7:30			1	0	3
103	ROUTT & FERNCLIFF	2	27.57	7:14:30			0	1	2
106	FERNCLIFF (RUFFNER	2	27.95	7:17:30			1	0	3
113	COVE ROAD & FRESNO	0	28.72	7:20: 0			2	0	5
117	COVE ROAD & FAIRLAN	0	29.03	7:21: 0			1	0	6
122	LAFAYETTE & DELAWAR	0	29.55	7:22:15			1	0	7
123	LAFAYETTE & CLIFTON	0	29.61	7:22:45			3	0	10
125	LAFAYETTE & STAUNTO	0	29.76	7:23:45			1	1	10
126	STAUNTON & 24 th	2	29.88	7:24:15			1	0	11
127	STAUNTON & 23 rd	4	29.96	7:24:45			1	0	12
131	STAUNTON & 19 th	4	30.30	7:26: 0			0	1	11
144	ORANGE & 8 th	0	31.48	7:29:30			0	1	10
145	ORANGE & 5 th	4	31.61	7:30: 0			2	0	12
161	JEFFERSON & CAMPBEL	0	33.01	7:36: 0			3	4	11
162	JEFFERSON & CHURCH	4	33.10	7:38: 0	7:35: 0	- 3: 0	6	1	16
169	JEFFERSON & ALBEMAR	4	33.60	7:41:15			1	1	16
178	JEFFERSON & WELLER	2	34.49	7:44:15	7:42: 0	- 2:15	0	1	15
179	JEFFERSON & MC CLAN	2	34.57	7:44:45			1	0	16
181	JEFFERSON & 23 rd	4	34.76	7:45:30			0	1	15
184	JEFFERSON & 26 th	2	35.01	7:46:30			1	0	16
189	26 th & WYCLIFF	2	35.37	7:47:30			0	1	15
192	AVENHAM & 28 th	4	35.62	7:48:45			0	1	14
195	AVENHAM & CASSELL	4	35.90	7:50: 0			2	0	16
198	AVENHAM & WHITE OAK	4	36.21	7:50:45			0	1	15
204	FRANKLIN & PENARTH	4	36.78	7:52:30			0	2	13
205	FRANKLIN (TANGLEWOO	0	37.13	7:53:45			0	1	12
1	BRENDLES	3	37.40	8: 0: 0	7:55: 0	- 5: 0	1	2	11
7	FRANKLIN (SHELL)	3	38.41	8: 5:45			2	1	12

Figure 14. Bus Stop Listing: (sample page)

required, and most transit companies would not even need to purchase a printer just for the APC system, and the overall equipment costs are reduced accordingly. Another helpful aspect is that the user need only remember the base name of the original data file for any of the reports. The program automatically supplies the appropriate drive designation and extensions.

6.2 TIMEPOINT PROFILE REPORT

The timepoint profile report is a very useful report for monitoring schedule performance. This report aggregates some of the data from the bus stop listing while providing additional information which the listing does not. At every timepoint at which the bus stops, a statistics are reported, including the stop name and number, the load at that point, and the scheduled time, the actual time at which the bus left the stop, and the difference between the two (schedule deviation). The program also accumulates statistics between the timepoints, including the number of passenger "ons" and "offs", the maximum load and the stop at which it occurred, the number of stops the bus made, and the distance, time, and operating speed. See Figure 15 on page 65 for an example.

The main steps required to obtain the report are as follows.

The user selects option "1" of the REPORTS program.

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	
	ONS	OPFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		SPEED
104	FERNCLIFF APTS. N.				1	5:53:30	5:50: 0	- 3:30	
	10	4	11	154	9	5.41	18:15		17.80
162	JEFFERSON & CHURCH				7	6:11:45	6:10: 0	- 1:45	
	8	13	8	165	11	4.16	24: 0		10.40
1	BRENDLES				2	6:35:45	6:30: 0	- 5:45	

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	
	ONS	OPFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		SPEED
1	BRENDLES				2	6:35:45	6:30: 0	- 5:45	
	3	2	4	32	5	5.91	17:30		20.27
48	JEFFERSON & CHURCH				3	6:53:15	6:50: 0	- 3:15	
	3	4	3	48	7	5.52	22:45		14.55
104	FERNCLIFF APTS. N.				2	7:16: 0	7:10: 0	- 6: 0	
	22	8	16	162	14	5.42	22: 0		14.78
162	JEFFERSON & CHURCH				16	7:38: 0	7:35: 0	- 3: 0	
	1	2	16	162	2	1.39	6:15		13.34
178	JEFFERSON & WELLES				15	7:44:15	7:42: 0	- 2:15	
	5	9	16	179	13	2.92	15:45		11.11
1	BRENDLES				11	8: 0: 0	7:55: 0	- 5: 0	

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	
	ONS	OPFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		SPEED
1	BRENDLES				11	8: 0: 0	7:55: 0	- 5: 0	
	2	2	12	7	5	5.92	21: 0		16.91
48	JEFFERSON & CHURCH				11	8:21: 0	8:19: 0	- 2: 0	
	0	3	11	48	6	5.34	24: 0		13.35
104	FERNCLIFF APTS. N.				8	8:45: 0	8:40: 0	- 5: 0	
	4	4	10	121	8	5.57	23: 0		14.53
162	JEFFERSON & CHURCH				8	9: 8: 0	9: 5: 0	- 3: 0	
	12	6	15	167	5	1.41	6:30		12.98
178	JEFFERSON & WELLES				14	9:14:30	9:12: 0	- 2:30	
	6	15	14	178	11	3.15	17:15		10.95
1	BRENDLES				5	9:31:45	9:25: 0	- 6:45	

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	
	ONS	OPFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		SPEED
1	BRENDLES				5	9:31:45	9:25: 0	- 6:45	
	7	2	12	33	6	5.92	21:30		16.53
48	JEFFERSON & CHURCH				10	9:53:15	9:50: 0	- 3:15	
	8	6	14	59	9	5.52	21:30		15.40
104	FERNCLIFF APTS. N.				12	10:14:45	10:10: 0	- 4:45	
	22	13	21	151	15	5.42	23:15		13.99
162	JEFFERSON & CHURCH				21	10:38: 0	10:35: 0	- 3: 0	
	2	6	23	163	3	1.38	7:30		11.06

Figure 13. Timepoint Profile Report: (sample page)

Figure 15. Timepoint Profile Report: (sample page)

The program asks the user which output file to retrieve and acts accordingly.

Next the user is given the choice of a screen output or a hardcopy print.

The program automatically retrieves the stop names reference file which is appropriate for this data. The user can accept it or specify another if the data is for a temporary route or is otherwise unusual.

The program prints the report heading and begins scanning the file for the activities which occur at the timepoints. When a timepoint is encountered, the information for that activity is printed. The program then begins accumulating data until it reaches the next activity occurring at a timepoint.

The information concerning activities is printed, followed by the information for the current timepoint. The inter-timepoint data is cleared and the process is repeated until the last activity is reached.

6.3 SECTION 15 DAILY REPORT

The earlier chapters mentioned the ability of APC systems to collect and process the information required for the Section 15 Annual Report to UMTA. That report is a compilation of many data samples obtained from many

different trips throughout the year. The daily report contains that data broken down by time periods. The steps of the program which produce the report are as follows:

Important parameters are retrieved from the SECT15.EXT external file which indicate the time of day at which the a.m. peak, midday, the p.m. peak, and night periods occur. These times may vary from one transit company to another since they are based on the times at which extra buses begin and end service.

The program then asks the user to indicate which output file to retrieve for processing. Once again, the name is the same as it was for the raw data, only the extension ".OUT" is added.

Next the program sets the limits of the time periods based on the information retrieved in the first step.

The program searches for trips, which according to UMTA are one-way trips in regular revenue service from terminal point on the route to the other [8]. Therefore, the program searches for activities whose stop number is either 1 or the number of the "turnpoint". When such an activity is located the program checks ahead to see if the bus stopped at the other end of the route. In order to comply with the UMTA definition of a trip, only those trips which begin and end at terminal points are included. This means that the drivers should

attempt to make there layovers and/or signboard changes at these two points in order to increase the number of "acceptable" trips per day.

When a trip is located it is classified according to the time period in which it begins.

The following data is accumulated for each trip:

- passengers boarded
- passengers on board
- distance travelled
- trip time
- passenger miles
- passenger minutes
- capacity miles
- seat miles
- number of trips

These total are accumulated for each time period (Saturday and Sunday are considered single periods).

The totals for each period are stored in a matrix known as the section 15 daily report file. Its name is the same as that of the output file from which it was created and it is given an extension of ".15".

Since the file fits easily on the screen it is printed to the screen and the user is instructed to use the Shift-PrtSc combination to obtain a hardcopy.

In addition to the variables mentioned above, three others are included for each time period under the heading "Sample Averages". These are the number of unlinked passengers per trip (= passengers boarded / no. of trips), the passenger miles per trip, and the unlinked passenger trip time (passenger minutes / no. of trips).

See Figure 16 on page 70 for a sample section 15 daily report.

6.4 SECTION 15 ANNUAL REPORT TO UMTA

To create the annual report to UMTA is simply a matter of combining daily report files until enough trips are included to satisfy the requirements for confidence and precision levels specified by UMTA. The sample sizes required depend on the frequency of sampling, and are contained in Figure 17 on page 71.

In addition to meeting the sample size requirement, the samples should be selected at random. The individual trips cannot be randomly selected since they are grouped by days in the daily report. Still, the block numbers to which the equipped buses are assigned could be selected at random, thus ensuring a good representation of overall operations of the transit company.

ROANOKE VALLEY METRO
 ROUTE # 1
 BUS # 194

SECTION 15 DAILY REPORT
 COVE RD./PROSPECT HILLS
 SEATED CAPACITY 42

PREPARED 08-25-1986
 THURSDAY 7-17-86
 TOTAL CAPACITY 66

TIME PERIOD	WEEKDAY			NIGHT	WEEKEND	
	AM PEAK	MIDDAY	PM PEAK		SATURDAY	SUNDAY
Passengers Boarded	9	126	66	0	0	0
Passengers On Board	32	1664	950	0	0	0
Bus Trip Distance	11	64	43	0	0	0
Passenger Miles	32	872	509	0	0	0
Bus Trip Time	47	283	178	0	0	0
Passenger Minutes	31	948	527	0	0	0
Capacity Miles	755	4236	2823	0	0	0
Seat Miles	480	2696	1796	0	0	0
Trips in Sample	1	6	4	0	0	0
SAMPLE AVERAGES						
Unlinked Pass/Trip	9	21	17	0	0	0
Pass. Miles/Trip	32	145	127	0	0	0
Unl. Pass. Trip Time	31	158	132	0	0	0

Figure 16. Section 15 Daily Report

ALTERNATIVE SAMPLING PLANS THAT WILL YIELD
REQUIRED ACCURACY*

Plan Number	Frequency of Sampling	Bus Trips in Sample	Total Sample Size for Year
1	Every Day	2	730
2	Every Second Day	3	549
3	Every Third Day	5	610
4	Every Fourth Day	7	644
5	Every Fifth Day	10	730
6	Every Sixth Day	15	915

*95% probability that true value of total passenger miles lies within 10% of sample estimate

Figure 17. Required Sample Sizes For Section 15 Annual Report

The steps of this part of the REPORTS program are extremely simple:

The program asks which daily report file to add to the cumulative file.

The cumulative file is retrieved, the values from the daily report are added for each variable and each time period. The sums are stored as the new cumulative file.

The program asks whether the user would like a print of the new cumulative file. If the reply is yes, then the user is given the choice of including the annual totals or leaving them out. Until the final report is to be printed there is no need to include them. If it is decided to include them the program asks for the total number of trips (including trippers and shuttles) for each time period for the entire year.

A hardcopy of the report is printed. If the annual totals are included the report will contain the total annual unlinked passenger trips (= no. of trips x unlinked passengers per trip) and the annual total passenger miles (= no. of trips x passenger miles per trip). This report is in the same form as the the required final report. Figure 18 on page 73 shows a sample annual report (includes data from only two daily report files).

ROANOKE VALLEY METRO	SECTION 15 ANNUAL REPORT	PREPARED 08-25-1986
TRANSIT ID 3007	NON-RAIL MODES	MODE MB
FISCAL YEAR END 6/30/86	FORM 406A	LEVEL R

TIME PERIOD	AM PEAK	MIDDAY	PM PEAK	NIGHT	SATDAY	SUNDAY	TOTAL
Passengers Boarded	9	126	66	0	0	0	201
Pass. On Board	32	1664	950	0	0	0	2646
Bus Trip Distance	11	64	43	0	0	0	118
Passenger Miles	32	872	509	0	0	0	1414
Bus Trip Time	47	283	178	0	0	0	509
Passenger Minutes	31	948	527	0	0	0	1506
Capacity Miles	755	4236	2823	0	0	0	7814
Seat Miles	480	2696	1796	0	0	0	4972
Trips in Sample	1	6	4	0	0	0	11
Total Trips	500	900	200	0	800	0	2400
SAMPLE AVERAGES							
Unl. Pass./Trip	9	21	17	0	0	0	47
Pass. Miles/Trip	32	145	127	0	0	0	305
Unl Pass Trip Time	31	158	132	0	0	0	321
ANNUAL TOTALS							
Unl. Pass. Trips	4500	18900	3300	0	0	0	26700
Passenger Miles	16122	130832	25454	0	0	0	172409

Figure 18. Section 15 Annual Report to UMTA

In order to provide documentation of the origin of the numbers contained in the final report, it is recommended that a hardcopy be made of every daily report file included in the annual report file. In fact since the daily report takes less than half a page, the resulting cumulative file can be included at the bottom of the same sheet to show the "year to date" values of the data included in the cumulative file.

6.5 PASSENGER LOAD PLOT

The old adage that a "picture is worth a thousand words" may be overworked but it is often very true. Certain types of information are much easier to interpret if they are in graphical form as opposed to tabular form. It is for this reason that the PLOTS program was developed. This program allows the user to create two different types of plots from the output file, the first of which is the passenger load plot.

The steps of this program are again very simple:

The passenger load plot option ("1") is selected from the menu. The program then asks which output file to retrieve in order to create the plot, and responds to the user's input.

The program displays a message indicating that a large plot can be obtained by pressing the left Shift - PrtSc combination once the plot is completed on the screen. (This capability is provided by the

program GRAFTRAX.EXE, which is entered from the AUTOEXEC.BAT file executed automatically during the original "booting" of the APC Program Disk)

The axes, headings, and labels are printed.

The passenger load vs. the time of day is plotted to the screen

Figure 19 on page 76 shows a sample passenger load plot.

This plot can be very valuable in determining optimal headways and adequacy of vehicles at providing seating which matches the demand.

6.6 ROUTE DEMAND PLOT

This plot gives a graphical representation of the number of passengers boarded throughout each hour of the day. The steps are identical to those for the passenger load plot except that a bar chart indicating passengers boarded per hour is created instead of a line graph. Figure 20 on page 77 shows a route demand plot.

This plot can be very helpful in determining "peaking" effects and for indentifying the required amount of service at various times throughout the day.

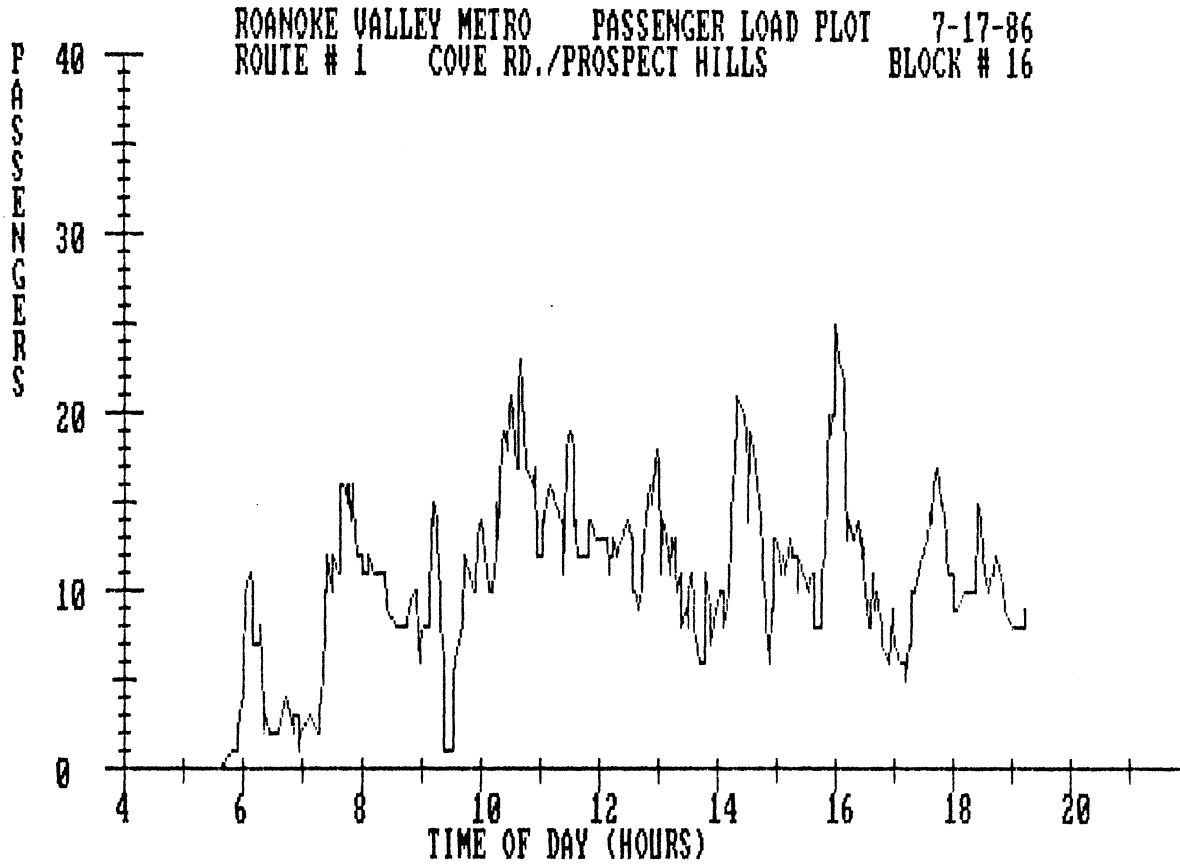


Figure 19. Passenger Load Plot

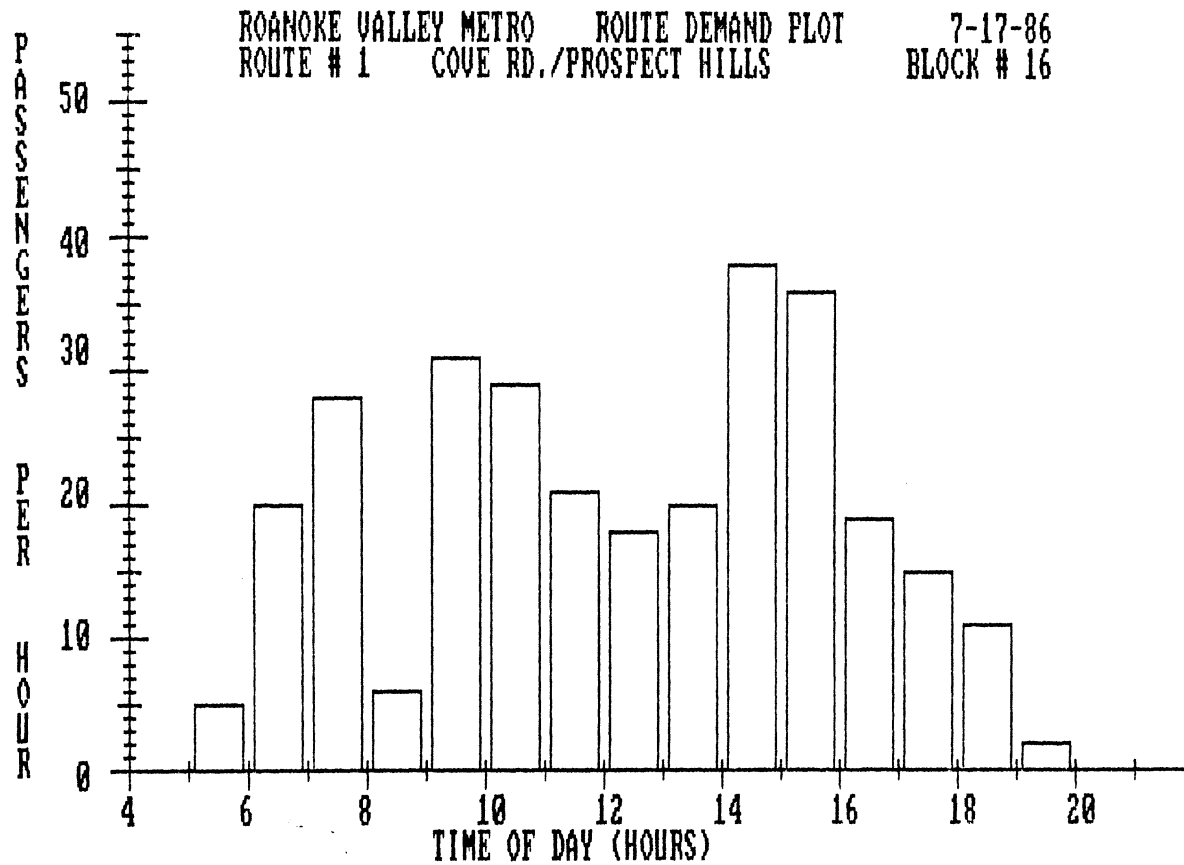


Figure 20. Route Demand Plot

7.0 USERS GUIDE

7.1 INTRODUCTION

This guide describes the methods for retrieving and processing data collected using the Automatic Passenger Counter System. It explains how to create the necessary reference files, and how to generate the reports and plots which help the management monitor the system and make decisions to help improve it.

The software has been designed with the user in mind; It is interactive, and leads the user through the programs by asking simple questions (in English - not "Computerese") and acting according to the users instructions. In fact, it is hoped that after the programs have been used a few times, this guide will be unnecessary. Nonetheless, like anything new, the software is bound to raise some questions at first. This guide, along with the accompanying demonstrations, should answer them.

7.2 DATA RETRIEVAL

The following section explains in detail the steps required in order to retrieve the data stored in the CSM.

1. Plug the "bus" end of the communications cord into the large round phono jack behind the first seat on the right side of the bus. Plug

the "computer" end into a similar jack on the left side of the Data General Computer. Check to make sure that the APC-DATADUMP.BAS PROGRAM diskette is in the front drive and the data storage diskette is in the rear drive.

2. Turn on the computer. There will be several messages displayed while the computer loads its operating system. When the message "Ok" appears (after about 20 seconds) , the computer is ready.
3. Press the key marked "F3". The word "LOAD" will appear followed by a quotation mark and a blinking cursor. Type "DUMP " and press the return key. The "Ok" message will again appear on the screen.
4. Press the key marked "F2". A menu will be displayed. Press "T" to transfer data from the bus to the computer disk. Press the return key.
5. A message reading : "S-Screen only, D-Disk only, B-Both. Enter choice... " will appear on the screen. Press "D" and strike return.
6. The computer will ask for the "OUTPUT FILE NAME". Name the file in the following way: Press "B", followed by the number of the block on which the bus was operating that day. Next, type the first 3 letters of the name of the month, followed by the day of the month. For example if the bus was on block #14 on July 23rd, then the output file name would be "B14JUL23".

7. The computer will then ask for the "24 HOUR REAL TIME HOUR". Enter the current hour and press return. (If the hour is past noon, add 12 to the current hour. For example, 6 p.m. would be entered as 18.) Next the computer will ask for the "24 HOUR REAL TIME MINUTES". Enter the number and press return. The computer will dump the data to the storage disk, displaying a flashing code indicating the amount of data stored. The process may take a couple of minutes.
8. When the data has been dumped, the computer will ask for the month. Enter the number of the month and press return. Do the same for the day. For the year, enter only the last two digits and press return.
9. Next , the computer will ask for the "ROUTE ID". Enter the number of the route on which the bus was operating that day and press return.
10. The computer will ask for the day of the week. Enter the appropriate number and press return.
11. Finally, the computer will ask for the block number for the bus for that day. Enter the number and press return.
12. The computer will display two sets of numbers that echo the information which just been entered. The numbers will be in the following form:

12 MONTH DAY YEAR ROUTE ID

12	DAYOFWK	BLOCK	HOUR	MINUTE
12	BUS ID	0	0	0

13. Check to make sure these numbers are correct. If any are incorrect, make a note of which ones they are and submit it with the data diskette.
14. The data dumping process is complete. Turn off the computer and disconnect the communications cord. Insert the key into the power on/off switch. Turn it to the left until the power on indicator light goes off. Then turn it back to the right until the light comes back on and remove the key. The computer is reset and ready to collect the next day's data.

7.3 DATA TRANSFER

Since the data is retrieved on 3-1/2 " diskettes but processing requires 5-1/4 " diskettes, a transfer step is required. This transfer is accomplished by following these simple steps:

1. Be sure that the the auxilliary disk drive is plugged in and connected to the drive slot in the back of the computer. Insert the data disk (containing raw data retrieved using the Data General) into the auxilliary drive and turn it on using the red switch on the back.

2. Insert the "APC TRANSFER DISK" into the A: drive of the main data processing computer and turn on the computer.
3. When the A> prompt appears, strike D: and return. The auxilliary drive, designated as the "D:" drive is now the current drive. It operates just like the other drives. Data can be transferred using the DOS "copy" command (for example, "D>copy B14JUL23.DAT C:" copies the file to the hard disk C: drive.

The data transfer is then complete, and the data disk can be cleared and used again.

7.4 REFERENCE FILES - MAKEFILE PROGRAM

In order to identify the stops at which the various activities occur it is necessary to reference the activities to files which contain the names of all of the stops on the routes and the distances between them. A reference file is also necessary in order to determine schedule deviations at the timepoints. This section describes the data required for these files, along with some techniques for obtaining them. Then it describes MAKEFILE ,the program which enables the user to easily create the necessary reference files.

7.4.1 Data for the Stop Distances and Names Reference Files

Collecting the data for the distance file requires two people: a bus driver and a recorder who is familiar with the route to record the data. They should take the equipped bus, the diagnostic unit, and the stop distance and names data forms (see Figure 21 on page 84) and perform the following steps:

1. Drive the bus to the beginning of the route (one of the terminal points, preferably the stop at which the drivers change the destination sign at the beginning of a one-way trip).
2. When the bus reaches that point, the recorder should reset the distance registers of the on board computer by turning the APC power on/off switch to the left until the red light goes out. Then he should turn the power back on and connect the diagnostic unit and press the "2" key.
3. Next, he should record the stop number (in this case 1), a description or name which identifies the stop, and the distance reading from the diagnostic unit (which is equal to or close to zero at this point).
4. The driver should then drive to the next stop, where the recorder again writes the number, name, and distance. The process is repeated until the bus returns to the starting point, where the final record is made.

5. If a stop is a "timepoint" (a stop for which a scheduled time is listed in the route schedule), the recorder should mark a "T" to the left of the stop number.
6. Finally, the recorder notes the total number of stops, along with the stop number of the turn around point at the far end of the route, where the bus begins the return trip to the starting point. This stop is the "turnpoint".

7.4.2 Data for the Schedule (Block) Reference File

The data for the schedule reference file is very easy to obtain. In fact, most of it is contained in the schedule sheets which the dispatcher keeps for each route. There will be a reference file for each block. This file will identify the numbers and names of the timepoints, and will record the scheduled time for each of these timepoints for every loop the bus makes during the day. In order to simplify the creation of the file, the following steps should be taken:

1. Make a copy of the schedule sheet for each route.
2. Read across the top of the columns until the name of the beginning of the loop (as determined in the collection of the stop information) is located. Mark the number "1" next to the name. This will be the first timepoint.

3. Move to the next column to the right ; if it is identical to the column just numbered, then mark out the whole column; if it is different, then give it number "2".
4. Continue numbering the timepoints as above. When the last column is reached, continue with the first column on the left until all columns are either numbered or marked out.
5. Next determine the number of loops. This is done by locating the column for the last timepoint, and then counting the number of times the number of the block for this file is encountered while reading down the column. If there are any scheduled stops beyond the last one in that column, then add one to the count. This final number is the number of loops. The sample shows a schedule sheet which has been prepared.
6. To make it easier to keep track of the loops, it is a good idea to use a highlighting marker to note which lines of the schedule sheet should be included for this particular block (see Figure 22 on page 87.)
7. Finally, determine the stop number of each timepoint from the stop names and distance data sheets for that route.

Once this information is obtained, the file can be created using the Schedule (Block) option of the MAKEFILE program.

PREPARED SCHED. SHEET FOR BLOCK 16
NO. OF TIMEPOINTS = 8 NO. OF LOOPS = 10

SCHEDULE SHEET

ROUTE COVE ROAD / PROSPECT HILLS MEN THRU FRI SCHEDULE

IN EFFECT 7/6/82

BLK	OUT CHANGE	5 FERRELL APTS	6 11th CHANGE	7 JETERSON CHURCH	8 KANSAS MEMORIAL HOSPITAL	TANGELWOOD PARK	1 TANGELWOOD PARK	2 KANSAS MEMORIAL HOSPITAL	3 JETERSON CHURCH	4 11th CHANGE	FERRELL APTS
17	545								550	558	
15	535			540	547		600	612	620	628	
16	535	602	610	617	625		700	712	720	728	
17	610	622	635	642							
18	610	625	637	650	657			657	705	713	
15	640	652	705	712			725	740	750	758	
16	710	722	735	742			825	840	850	858	
18	725	737	750	757				757	805	813	
17	740	752	805	812			825	840	850	858	
15	810	822	835	842			855	910	920	928	
18	825	837	850	857				857	905		
16	840	852	905	912			925	940	950	958	
	910	922	935	942			955	1010	1020	1028	
	940	952	1005	1012			1025	1040	1050	1058	
16	1040	1052	1105	1112			1125	1140	1150	1158	
17	1040	1052	1105	1112			1125	1140	1150	1158	
15	1110	1122	1135	1142			1155	1210	1220	1228	
16	1165	1177	1210	1217			1230	1245	1255	1263	
17	1215	1227	1240	1247			130	115	125	137	
15	1245	1257	110	117			130	145	155	203	
16	1245	1257	140	147			230	245	255	263	
17	145	157	210	217			300	315	325	333	
15	215	227	240	247				336	345	353	
18	325										
16	320	302	315	322			400	415	425	433	
17	315	327	340	347			430	446	455	503	
15	345	357	410	417			480	505	515	525	
16	345	357	430	437			540	555	605	613	
17	445	457	510	517			605	618	625	633	
15	520	532	545	552							
16	605	607	620	627							
17	605	617	645								

LOOP 10

Figure 22. Sample Prepared Schedule Form: (for block 16)

To run MAKEFILE, place the APC program disk in the A: drive and turn on the computer. If the computer is already on, press Ctrl-Alt-Del together to reset. When the A> prompt appears, type MAKEFILE. A menu will appear on the screen asking the user to choose one of four options. These options are discussed individually.

7.4.3 Create or Edit Stop Distance File

The user chooses to either edit or create a new file by typing either an "e" or a "c". If the create option is chosen, the program will ask a series of questions which the user should answer using the information from the stop distance forms. Then the program asks for the cumulative distance to each stop. The user should simply type in the corresponding number from the distance column of the forms. When the last stop is completed, the user is given a chance to view and the file and edit any incorrect entries. Finally, the program will what the file name will be. This name will include the drive to which the file will be sent, followed by "DIST", the route number, and the extension ".REF". The user should accept this name unless the file is for a temporary route, i.e. one with a detour or other irregularity. In that case, another name may be desired to distinguish the file from the regular one. If the edit option is chosen, the user is asked which file to retrieve. Then it displays the contents and from that point on it functions just like the create option.

7.4.4 Create or Edit Stop Names File

This option is very similar to the Stop Distance Option, except that it asks for the stop names rather than the cumulative distance. The other difference is that the file name includes the drive, "NAMES", the route number, and the extension ".REF". All other functions are practically identical, and the discussion above applies to this option as well.

7.4.5 Create or Edit Schedule (Block) Reference File

This option follows the same pattern as the previous two. After the information about the number of stops, the block number, and the number of timepoints are entered, the program will prompt the user for the stop number of each timepoint. Next it prompts the user for the scheduled time at each timepoint by loops. If there is no entry (often the first or last loop is incomplete), then enter 0,0 . Otherwise, enter the hour, followed by a comma, and then the minute. Again, use 24 hour time for the hour (e.g. 6:00 p.m. = 18 hours). When all the loops and timepoints are entered, the program allows the user to view and or edit the values. Finally, it displays the file name, consisting of the drive, "BLOCK" , the block number, and the extension ".REF". Unless the schedule is for a holiday or Saturday, then accept the name given by the computer. For Saturday blocks, include the number "6" between "BLOCK" and the block number. Holiday or temporary schedules can be given any other name.

7.4.6 Quit (Exit to DOS)

This option terminates the program and returns the system to DOS.

7.5 DATA PROCESSING - APCDATA PROGRAM

Once the reference files are created and the data is transferred to the main computer, the raw data can be processed. This is carried out by using the program APCDATA.

This program is started by typing "APCDATA" when the DOS prompt appears. A menu offering three options is displayed. These options are:

7.5.1 Process Raw Data File

This option takes the raw data file, processes it, and creates the output file which will serve as the basis for all other reports, lists, and plots. The program first asks which raw data file is to be processed. The user needs to type in only the file name (the drive and extension are added by the program). For example, entering "B14JUL25" will cause the data collected on block #14 on July 23rd to be processed. Once the raw data is retrieved, the user is given the chance to view it. Then the program will create activity records which include the type of activity (ons, offs, long idle, etc) and the time of day and distance from the day's starting point. Then the program automatically determines which reference files to retrieve in order to match the activities to the stops.

The user is given a chance to change these files if the data was collected on a special route or a modified schedule, but in the majority of cases these files will be the appropriate ones. Once the reference files are specified, the program will continue until the data is processed, and will then return to the menu. This program requires a great number of steps and calculations, and takes a couple of minutes to complete.

7.5.2 Generate Bus Stop Listing

The next option allows the user to have a detailed look at all of the major activities which occurred during the day's operation. In addition, it gives the location, time, and distance at which the ons or offs occurred. When option 2 is chosen, the program asks which output file to retrieve. Again the user needs only to enter the file name (exactly the same as for option 1); the program automatically retrieves the processed data to use as input. The user can select either screen (S) or printed output (P). Finally, the user is given a chance to select which stop names file to be used in describing the file. When the user has finished viewing or printing the file the program returns to the menu.

7.5.3 Quit (Exit to DOS)

Terminates the program and returns to DOS

7.6 GENERATION OF REPORTS - REPORTS PROGRAM

From the processed data file (output file), there are several useful reports which can be created. These are obtained using the program REPORTS.

To enter the reports program, type REPORTS at the DOS prompt. The program presents the user with a menu containing four options:

7.6.1 Generate Time Point Profile Report

This report summarizes the days operation by accumulating important information at and between the timepoints. The user is asked which output file to process (follow the same procedure as for the bus stop listing). Then he can choose a screen display or printed copy, and is given the choice of which stop names file to use for referencing. The report will then be printed or displayed, and upon completion, the program returns to the menu.

7.6.2 Create Section 15 Daily Report File

The collection of data for the UMTA Section 15 Report is a very important function of the APC system. To gather and store the relevant information from the output file, option 2 should be selected. The filename should be specified the same as for the other reports. The report is then displayed on the screen. For a printed copy, the user should press either Shift key together with the PrtsC key. When the print is complete or the

user has finished viewing the data, he can strike any key to return to the menu.

7.6.3 Update Section 15 Annual Report File

The daily report files can be accumulated by adding them to the Section 15 cumulative report file. The third option performs this important function. The program asks which daily report file should be added. Only the original file name (ex. B14JUL23) is necessary, since the program automatically selects the drive and includes the extension ".15". The daily file values will be added to the cumulative file, and the user is given a chance to print a copy of the updated cumulative file. If the print option is taken, then the program asks whether or not to include annual totals. Unless the report is about to be completed for the current fiscal year, the annual totals are unnecessary. If they are included, the report asks for the total annual number of trips for each time period - a.m. peak (6 to 9); midday (9 to 3:30); p.m. peak (3:30 to 7); night (after 7 p.m.); Saturday (all day); and Sunday (all day). The report will then be printed, and upon completion, the program returns to the menu.

7.6.4 Quit (Exit to DOS)

This option terminates the program and returns the system to DOS. :h

7.7 GENERATION OF PLOTS - PLOTS PROGRAM

Many types of information are better presented in graphical form. Accordingly, there are two different types of plots which can be created from the APC output files using the PLOTS program.

To enter this program, enter "PLOTS" at the DOS prompt. A menu offering three options will be presented:

7.7.1 Passenger Load Plot

The passenger load plot is a simple graph of the number of passengers on board vs. the time of day. The program asks which output file to retrieve, and again only the filename (ex. "B14JUL23) is required. When the file has been retrieved, several instructions will appear on the screen. These instructions tell the user that the plot will be displayed to the screen. Once the plot is complete the user can make a large hardcopy print by pressing the left Shift key together with the PrtSc key. A small copy is obtained by pressing the right Shift key together with the PrtSc key. Any other key returns the program to the PLOTS menu.

7.7.2 Route Demand Plot

The route demand plot is a bar chart showing the number of passengers boarded during each hour of the day. Again, the only input required is

the output filename. The rest of the steps are identical to the passenger load plot.

7.7.3 Quit (Exit to DOS)

Terminates execution and returns the system to DOS.

8.0 CONCLUSIONS AND RECOMMENDATIONS

For several years, automatic passenger counters have been put to work at several large transit properties. While there have been certain problems associated with the systems, the general consensus is that they offer a wealth of information to transit managers, and that they will eventually replace manual collection techniques. The Valley Metro Project has helped demonstrate that APC'S are feasible for small transit companies as well.

8.1 COSTS

Throughout the project, efforts have been made to keep the system costs as low as possible. The problems and costs associated with signposts are eliminated by utilizing the loop location software the match the activities to the stops. This results in a savings of about \$600 per route [5]. In addition, the software can be run on personal computers (which most transit companies already have), so that major expenditures for data processing are reduced. Finally, all reports are designed to be printed on standard 80 column printers, which most companies also already own or can purchase for less than \$500 dollars.

Just as important as the equipment cost savings are the reductions of management time required for manually processing the field data collected by the manual checkers. The months of tedious work required to prepare the Section 15 Annual Report can be reduced to a few minutes per week

using the APC's. The money saved by eliminating the need for manual checkers (about \$17,000 was the estimate for 1986 [9]) can be put to far better use. In addition, since APC's qualify for capital grants from UMTA, the actual cost to individual transit companies is minimized. This is in contrast to manual collection methods, which normally come out of the operating budget of the transit company, the area which faces the most severe cuts under current administration policy. It is difficult to set an actual figure on the costs since the amount of time required for the creation of files, processing and retrieving data, and performing maintenance on the equipment will not become apparent until after the system is in fully in place. Nonetheless, it is clear that the costs will be competitive to those for manual data collection, and that the results will be superior.

8.2 IMPLEMENTATION

The system was designed to be very easy for the transit system to use. Great emphasis has been placed on making the software interactive and easy to learn. Techniques for easily collecting the data required for the external files were developed so that the transit company would be self sufficient in operating and maintaining the system after it was fully installed and demonstrated. Software was created to make it easy to create the files after the data was retrieved. Finally a user guide giving step-by-step instructions on the operations of the software and equipment were provided to help the users become familiar with the system.

8.3 RECOMMENDATIONS

There are a few areas in which further work needs to be done in order to fully test the software in order to gain more insight into the matching process:

The threshold or cutoff value of the match ratio should be experimented with in order that the optimum value may be determined. The current value of .5 seems to work fairly well, but other values may prove to be better at identifying the good loops while screening out the bad ones.

Data should be processed for a different values of deltas1 (the maximum acceptable variance allowed for a "good" match) in order to determine the sensitivity of the match ratio to the size of deltas1 . On those stops where there is not a good match, the actual difference between the reference distance and the actual distance should be determined in order to find out why the distances did not match.

The reference file data should be collected for several loops on the same route in order to determine the variance in data collected using the bus. Also, the data should be processed using the average reference file to see if there is an improvement in the match ratio.

There should be an investigation of the idea of possibly "overriding" the matches set on a good loop with a fairly match ratio if a later

loop is located with an extremely high match ratio. Backmatching over the earlier loop from the excellent loop could possibly provide a better quality match.

The reliability of matching using the loopmatch algorithm should be compared to that achieved by other systems using software to locate stops without using signposts. Also, a comparison with those using signposts would be valuable in determining if signposts actually provide a significantly more reliable referencing technique.

Another area for improvement is in the Section 15 Cumulative File. The program should be modified to allow the user to delete a daily file if he or she so desires. The change would be very easy to make, and would greatly improve the flexibility of the software.

Finally, it appears that the chief limitation of the APC technology is in the area of passenger sensors. While they generally work well for isolated loadings and unloadings, they need to be improved in order to better detect the correct passenger counts during multiple loading and unloading situations. Research in this area would be of value to any APC application.

8.4 COMMENTS

The potential of the Valley Metro Automatic Passenger Counter System has barely been tapped. There is almost no limit to the types of relevant

information which can be obtained from the reports. Further programs could show schedule deviation vs. time of day, the effects of weather or seasonal variations on ridership, or any number of other important relationships. In fact, the APC's give so much information that there may be some temptation for abuse. The management should avoid using information from the APC to discipline drivers. The quality of the data obtained from the routes depends a great deal on the drivers, and if they see the system as a threat, they may attempt to foil the data collection efforts. On the other hand, if the management uses the information in a positive way, such as adjusting the schedules so that drivers are not pressured to reach certain stops in an unreasonably short amount of time, then the drivers may view it as their ally. And if the APC can help the drivers and the management communicate and work together, it will be worth far more than data it collects.

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APPENDIX A. EXTERNAL FILES

A.1 SYSTINFO.EXT

The variables contained in the external file are listed below, along with an explanation of the meaning of each one.

SYST\$

DISTBASE\$, NAMEBASE\$, BLOCKBASE\$, SECT15BASE\$

DATADRV\$, DISTDRV\$, NAMEDRV\$, BLOCKDRV\$, OUTDRV\$, SECT15DRV\$

DELTAL, DELTAT, DELTAS1, DELTAS2

CLICK, AF, SEATS, CAP

SYST\$ - The name of the transit company

DISTBASE\$ - The base name of the distance reference files

(Used to automatically name and retrieve these files)

NAMEBASE\$ - The base name of the names reference files

BLOCKBASE\$ - The base name of the block (schedule) reference files

SECT15BASE\$ - The base name for the section 15 cumulative report

DATADRV\$ - The disk drive from which the raw data will be retrieved

DISTDRV\$ - The disk drive for storage and retrieval of the distance
reference files

NAMESDRV\$ - The disk drive for storage and retrieval of the stop names reference files

BLOCKDRV\$ - The disk drive for storage and retrieval of the block (schedule) reference files

OUTDRV\$ - The disk drive for storage and retrieval of the output files

SECTDRV\$ - The disk drive for storage and retrieval of the section 15 daily and annual (cumulative) files

DELTAL - The number of odometer impulses in the range for determining when the match ratio routine should end

DELTAT - The number of time units (15 seconds each) which form the time range for the loop location process

DELTAS1 - The number of odometer impulses which set the outer limit of a positive match (match = 2 if the difference between actual and reference distances within a good loop is < deltas1)

DELTAS2 - The number of odometer impulses which form the inner limit of a positive match (match = 4 if the difference between actual and reference distances within a good loop is < deltas2)

CLICK - The number of feet per odometer impulse

AF - An adjustment factor which reduces the reference distance so that the effect of the increased distance measured between stops due to pulling into and away from the curb is minimized

SEATS - The average number of seats per bus for the transit company

CAP - The average maximum standing capacity per bus for the transit company

The actual values of these variables at Valley Metro are shown at the end of Appendix A.

A.2 SECT15.EXT

This external file contains information about the transit system which is required for creating the section 15 reports. The variables are listed below, along with an explanation of their meaning.

TRANSITID\$,MODE\$,LEVEL\$,FISCALYR\$
WKDYBEGIN,AMPEAK,MIDDAY,PMPEAK,NIGHT,WKDYEND
SATBEGIN,SATEND,SUNBEGIN,SUNEND

TRANSITID\$ - an identification number assigned to the transit company

MODE\$ - An identification of the type of transit service (bus, etc.)

LEVEL\$ - The reporting level for the section 15 reports

FISCALYR\$ - The date of the end of the fiscal year for the company

WKDYBEGIN - The time (in 15 second units) at which the first service begins on a typical weekday

AMPEAK - The time at which the morning peak period begins (in 15 second units)

MIDDAY - The time at which the midday period begins (15 sec. units)

PMPEAK - The time at which the evening peak period begins (in 15 sec. units)

NIGHT - The time at which the night service begins (in 15 sec. units)

WKDYEND - The time at which the last service ends on a typical week-day.

SATBEGIN - The time at which service begins on a typical Saturday (in 15 sec. units)

SATEND - The time at which service ends on a typical Saturday (in 15 sec. units)

SUNBEGIN - The time at which service begins on a typical Sunday (in 15 sec. units) d

SUNEND - The time at which service ends on a typical Sunday (in 15 sec. units)

See the end of Appendix A for the actual values used at Valley Metro.

SYSTINFO.EXT

ROANOKE VALLEY METRO
DIST,BLOCK,NAMES,SECTION
C:,C:,C:,C:,C:,C:
25,32,6,3
8.58,.26,42,66

SECT15.EXT

3007,MB,R,6/30/86
1360,1440,2160,3600,4560,4700
2160,4080,0,0

APPENDIX B. REFERENCE FILES

B.1 DIST1.REF

1, "COVE RD. /PROSPECT HILLS", 208, 104
1, 1
2, 178
3, 44
4, 53
5, 56
6, 253
7, 33
8, 43
9, 47
10, 39
11, 46
12, 53
13, 62
14, 76
15, 77
16, 47
17, 57
18, 63
19, 53
20, 54
21, 52
22, 44
23, 44
24, 46
25, 46
26, 36
27, 46
28, 53
29, 53
30, 54
31, 54
32, 42
33, 87
34, 53
35, 87
36, 97
37, 50
38, 36
39, 83
40, 354
41, 565

42,42
43,54
44,52
45,41
46,68
47,37
48,53
49,52
50,74
51,118
52,83
53,52
54,40
55,41
56,18
57,48
58,26
59,83
60,58
61,81
62,70
63,105
64,125
65,103
66,77
67,24
68,39
69,48
70,53
71,32
72,40
73,34
74,53
75,53
76,53
77,54
78,53
79,52
80,53
81,52
82,66
83,67
84,54
85,26
86,44
87,47
88,99
89,50
90,51
91,72
92,56

93,44
94,40
95,55
96,84
97,36
98,65
99,165
100,88
101,101
102,44
103,32
104,71
105,99
106,66
107,47
108,91
109,36
110,119
111,65
112,37
113,81
114,61
115,37
116,32
117,67
118,79
119,45
120,48
121,94
122,51
123,39
124,41
125,50
126,71
127,52
128,52
129,25
130,81
131,53
132,53
133,54
134,52
135,52
136,47
137,36
138,25
139,53
140,47
141,51
142,66
143,35

144,87
145,148
146,86
147,109
148,33
149,57
150,88
151,36
152,35
153,34
154,31
155,65
156,22
157,37
158,46
159,66
160,37
161,74
162,61
163,25
164,33
165,78
166,40
167,29
168,55
169,52
170,57
171,40
172,61
173,40
174,50
175,30
176,30
177,80
178,163
179,47
180,63
181,54
182,54
183,51
184,54
185,42
186,37
187,46
188,45
189,46
190,46
191,55
192,54
193,58
194,55

195,62
196,42
197,79
198,73
199,55
200,53
201,55
202,42
203,53
204,94
205,198
206,125
207,57
208,145

B.2 NAMES1.REF

1,"COVE ROAD - PROSPECT HILLS",208
"BRENDLES "
"OGDEN & FRANKLIN "
"FRANKLIN & ELM VIEW RD. "
"FRANKLIN & AVENHAM MANOR"
"FRANKLIN & TANGLEWOOD"
"FRANKLIN (TEXACO)"
"FRANKLIN (SHELL)"
"FRANKLIN (WAFFLE HOUSE)"
"FRANKLIN (COLONY HOUSE)"
"FRANKLIN (BERGLUND MAZDA)"
"FRANKLIN & WILLOW OAK"
"AVENHAM & DILLARD"
"AVENHAM & SOMERSET"
"AVENHAM (MIDBLOCK)"
"AVENHAM & CLYDESDALE"
"AVENHAM & CASSELL"
"AVENHAM & AUDUBON"
"AVENHAM & 29 th"
"AVENHAM & 28th"
"AVENHAM & 27 th"
"AVENHAM & 26 th"
"26 th & WYCLIFFE"
"26 th & CAROLINA"
"26 th & ROSALIND"
"26 th & CRYSTAL SPRING"
"26 th & RICHELIEU"
"26 th & JEFFERSON"
"JEFFERSON & 25 th"
"JEFFERSON & 24 th"
"JEFFERSON & 23 rd"
"JEFFERSON & 22 nd"
"JEFFERSON & YELLOW MT. "
"JEFFERSON & WELLER"
"ROANOKE MEMORIAL (1)"
"RMH PARKING GARAGE"
"BELLEVIEW & LINDEN"
"BELLVIEW (MIDBLOCK)"
"BELLEVIEW & LAUREL"
"BELLEVIEW & WALNUT"
"DETOUR STOP 1"
"JEFFERSON & MAPLE"
"JEFFERSON & ALBEMARLE"
"JEFFERSON & HIGHLAND"
"JEFFERSON & MOUNTAIN"
"JEFFERSON & ELM AVE. "
"JEFFERSON (LIBRARY)"
"JEFFERSON & FRANKLIN RD. "

"JEFFERSON & CHURCH"
"JEFFERSON & CAMPBELL"
"CAMPBELL & MARKET ST. "
"WILLIAMSON (YELLOW CAB)"
"WELLS & COMMONWEALTH"
"WELLS & HOTEL ROANOKE 1"
"WELLS & JEFFERSON"
"JEFFERSON & GILMER"
"GILMER & GAINSBORO"
"GAINSBORO & PATTON"
"GAINSBORO & HARRISON"
"GAINSBORO & MADISON"
"GAINSBORO & McDOWELL"
"GAINSBORO & ORANGE"
"ORANGE & QUARRY"
"ORANGE & 5 th"
"ORANGE & 8 th"
"ORANGE & 10 th"
"ORANGE & 11 th"
"11 th & HANNOVER"
"11 th & STAUNTON"
"STAUNTON & 12 th"
"STAUNTON & 13 th"
"STAUNTON & 14 th"
"STAUNTON & EUREKA CIRCLE 1"
"STAUNTON & 15 th"
"STAUNTON & 16 th"
"STAUNTON & 17 th"
"STAUNTON & 18 th"
"STAUNTON & 19 th"
"STAUNTON & 20 th"
"STAUNTON & 21 st"
"STAUNTON & 22 nd"
"STAUNTON & 23 rd"
"STAUNTON & 24 th"
"STAUNTON & LAFAYETTE"
"LAFAYETTE (B&G GROC.)"
"LAFAYETTE & CLIFTON"
"LAFAYETTE & DELAWARE"
"LAFAYETTE & MASSACHUSSETS"
"LAFAYETTE & FLORIDA"
"LAFAYETTE (MIDBLOCK)"
"LAFAYETTE & COVE ROAD"
"COVE ROAD & FAIRLAND"
"COVE ROAD & ASPEN"
"COVE ROAD & WELLSLEY"
"COVE ROAD & ABBOTT"
"COVE ROAD & COVELAND"
"COVE ROAD & GOLFSIDE"
"COVE ROAD & GUILDHALL"
"COVE ROAD & HERSHBERGER"

"COVE ROAD & (Midblock 1)"
 "COVE ROAD & (Midblock 2)"
 "COVE ROAD & ROUTT"
 "ROUTT & BLACK OAK"
 "ROUTT & FERNCLIFF"
 "FERNCLIFF APTS. N. "
 "FERNCLIFF APTS. S. "
 "FERNCLIFF (RUFFNER JR.)"
 "FERNCLIFF (HILLS)"
 "FERNCLIFF & HERSHBERGER"
 "HERSHBERGER & SWARTHMORE"
 "HERSHBERGER & COVE ROAD"
 "COVE ROAD & GUILDHALL"
 "COVE ROAD & GOLFSIDE"
 "COVE ROAD & FRESNO"
 "COVE ROAD & ABBOTT"
 "COVE ROAD & WELLSLEY"
 "COVE ROAD & ASPEN"
 "COVE ROAD & FAIRLAND"
 "COVE ROAD & LAFAYETTE"
 "LAFAYETTE MIDBLOCK"
 "LAFAYETTE & FLORIDA"
 "LAFAYETTE & MASSACHUSSETS"
 "LAFAYETTE & DELAWARE"
 "LAFAYETTE & CLIFTON"
 "LAFAYETTE & NEW YORK"
 "LAFAYETTE & STAUNTON"
 "STAUNTON & 24 th"
 "STAUNTON & 23 rd"
 "STAUNTON & 22 nd"
 "STAUNTON & 21 st"
 "STAUNTON & 20 th"
 "STAUNTON & 19 th"
 "STAUNTON & 18 th"
 "STAUNTON & 17 th"
 "STAUNTON & 16 th"
 "STAUNTON & 15 th"
 "STAUNTON & EUREKA CIRCLE 1"
 "STAUNTON & 14 th"
 "STAUNTON & 13 th"
 "STAUNTON & 12 th"
 "STAUNTON & 11 th"
 "11 th & HANOVER"
 "ORANGE & 10 th"
 "ORANGE (FAR SIDE STOP)"
 "ORANGE & 8 th"
 "ORANGE & 5 th"
 "ORANGE & QUARRY"
 "ORANGE & GAINSBORO"
 "GAINSBORO & McDOWELL"
 "GAINSBORO & MADISON"

"GAINSBORO & HARRISON"
 "GAINSBORO & PATTON"
 "1st & GILMER"
 "GILMER & JEFFERSON"
 "JEFFERSON & WELLS"
 "WELLS & HOTEL ROANOKE 1"
 "WELLS & HOTEL ROANOKE 2"
 "WELLS & WILLIAMSON "
 "WILLIAMSON & SHENANDOAH"
 "WILLIAMSON & SALEM"
 "SALEM & 1 st"
 "JEFFERSON & CAMPBELL"
 "JEFFERSON & CHURCH"
 "JEFFERSON (HEIRONIMUS)"
 "JEFFERSON & FRANKLIN RD. "
 "JEFFERSON & BULLIT"
 "JEFFERSON & ELM AVE. "
 "JEFFERSON & MOUNTAIN"
 "JEFFERSON & HIGHLAND"
 "JEFFERSON & ALBEMARLE"
 "JEFFERSON & MAPLE"
 "DETOUR STOP 2"
 "DETOUR STOP 3"
 "DETOUR STOP 4"
 "DETOUR STOP 5"
 "DETOUR STOP 6"
 "DETOUR STOP 7"
 "DETOUR STOP 8"
 "JEFFERSON & WELLER"
 "JEFFERSON & MC CLANAHAN"
 "JEFFERSON & 22 nd"
 "JEFFERSON & 23 rd"
 "JEFFERSON & 24 th"
 "JEFFERSON & 25 th"
 "JEFFERSON & 26 th"
 "26 th & RICHELIEU"
 "26 th & CRYSTAL SPRING"
 "26 th & ROSALIND"
 "26 th & CAROLINA"
 "26 th & WYCLIFF"
 "26 th & AVENHAM"
 "AVENHAM & 27 th"
 "AVENHAM & 28 th"
 "AVENHAM & 29 th"
 "AVENHAM & WILDWOOD"
 "AVENHAM & CASSELL"
 "AVENHAM & WHITE OAK (1)"
 "AVENHAM MIDBLOCK"
 "AVENHAM & WHITE OAK (2)"
 "AVENHAM & FRANKLIN ROAD"
 "AVENHAM (WOODCRAFT KITCHENS)"

"FRANKLIN & DUKE OF GLOUC"
"FRANKLIN (K-MART)"
"FRANKLIN & TOWNSIDE"
"FRANKLIN & PENARTH"
"FRANKLIN (TANGLEWOOD)"
"SUPER X"
"PENNEY'S"
"BRENDES "

B.3 BLOCK16.REF

16,10,8,1400,4540

1

34

48

68

104

142

162

178

0

0

0

0

1400

1448

1480

1508

1560

1608

1640

1672

1720

1768

1820

1848

1900

1960

1996

2031

2080

2128

2180

2208

2260

2320

2360

2392

2440

2488

2540

2568

2620

2680

2720

2752

2800

2868

2920

2948
3000
3060
3100
3132
3180
3228
3280
3308
3360
3420
3460
3492
3540
3608
3660
3688
3760
3820
3860
3892
3939
3988
4040
4068
4120
4180
4220
4252
4300
4348
4400
4428
4480
4520
4540
0
0
0
0
0

E.4 BLOCK17.REF

17,9,8,1400,4500
1
34
48
68
104
142
162
178
0
0
1400
1432
1480
1528
1580
1608
1680
1728
1760
1792
1840
1888
1936
1968
2020
2080
2120
2152
2200
2248
2300
2328
2380
2440
2480
2512
2560
2608
2660
2688
2740
2800
2840
2872
2920
2988
3040

3068
3120
3180
3220
3252
3300
3348
3400
3428
3480
3540
3580
3612
3660
3708
3760
3788
3840
3900
3939
3971
4020
4068
4120
4148
4240
4300
4340
4372
4420
4460
4500
0

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640 LOCATE 16,15,1
650 INPUT "What is the stop number at the end of the outbound trip ? ",
        TURNPOINT
660 DIM STOPNO(NOSTOPS),DPLS(NOSTOPS)
670 FOR I = 1 TO NOSTOPS
680   CLS : LOCATE 13,10,1
690   PRINT "What is the cumulative distance to stop number";I ;;
        INPUT THISONE
700   DPLS(I) = THISONE - LASTONE
710   LASTONE = THISONE
720 NEXT I
730 F$ = DISTDRV$ + DISTBASE$ + RIGHT$(STR$(ROUTENO),LEN(STR$(ROUTENO)) - 1) +
        ".REF"

740 '
750 '-----view or edit the file-----
760 '
770 CLS
780 LOCATE 9,15,0
790 PRINT "1 - The number of this route is";ROUTENO
800 LOCATE 11,15,1
810 PRINT "2 - The name of this route is ";ROUTENAMES$
820 LOCATE 13,15,1
830 PRINT "3 - There are";NOSTOPS ;;PRINT "stops on this route. "
840 LOCATE 15,15,1
850 PRINT "4 - The stop number at the end of the outbound trip is";TURNPOINT
860 LOCATE 20,10,1
870 INPUT "Do you want to change any of the above values (Y or N) ? ",CHANGES$
880 IF CHANGES$ = "y" OR CHANGES$ = "Y" THEN 910
890 IF CHANGES$ = "n" OR CHANGES$ = "N" THEN 1090
900 LOCATE 22,10,1 : PRINT "INVALID INPUT - ENTER EITHER Y OR N - TRY AGAIN" :
        GOTO 860
910 LOCATE 22,10,1 :INPUT "Enter the line number (above) of the variable you wis
h to change. ",WHICHONE
920 CLS
930 ON WHICHONE GOTO 940,970,1000,1060
940 LOCATE 13,15,0
950 INPUT "What is the number of this route ? ",ROUTENO
960 GOTO 770
970 LOCATE 13,15,0
980 INPUT "What is the name of the route ? ",ROUTENAMES$
990 GOTO 770
1000 LOCATE 13,5,0
1010 PRINT "If you change the number of stops, you will have to create a new fil
e."
1020 LOCATE 15,5,1 :PRINT "Enter Y to change the number of stops and create a ne
w file"
1030 LOCATE 16,5,1 :INPUT "Enter N to leave the number of stops unchanged ",
        CHANGES$
1040 IF CHANGES$ = "y" OR CHANGES$ = "Y" THEN 520
1050 GOTO 770
1060 LOCATE 13,15,0
1070 INPUT "What is the stop number at the end of the outbound trip ? ",
        TURNPOINT
1080 GOTO 770
1090 '
1100 IF CHANGES$ = "Y" OR CHANGES$ = "y" THEN CUM = LASTCUM ELSE LASTCUM = CUM
1110 CLS
1120 PAGE = PAGE + 1
1130 LOCATE 2,20,0 :PRINT "STOP DISTANCES FILE FOR ROUTE NUMBER";ROUTENO
1140 LOCATE 4,18,0 : PRINT "STOP #";: PRINT TAB(30) "DIST FROM LAST STOP";: PRIN
T TAB(55) "CUMULATIVE DIST"
1150 LOCATE 5,20,0
1160 IF PAGE > 1 THEN 1170 ELSE 1180
1170 LNUM = 0 :GOTO 1420
1180 FOR I = 1 TO NOSTOPS
1190   STOPNO(I) = I

```



```

1790 FOR I = 1 TO NOSTOPS
1800     INPUT #1,STOPNAME$(I)
1810 NEXT I
1820 CLOSE #1
1830 GOTO 2020
1840 ERASE STOPNAME$
1850 '
1860 '-----create a new file-----
1870 '
1880 CLS
1890 LOCATE 11,15,0
1900 INPUT "What is the number of this route ? ",ROUTENO
1910 LOCATE 14,15,0 : PRINT "(Enter the name in all capital letters.)"
1920 LOCATE 13,15,1
1930 INPUT "What is the name of the route ? ",ROUTENAME$
1940 LOCATE 16,15,1
1950 INPUT "How many stops are there on this route ? ",NOSTOPS
1960 DIM STOPNAME$(NOSTOPS)
1970 FOR I = 1 TO NOSTOPS
1980     CLS : LOCATE 13,10,1
1990     PRINT "What is the name of stop number";I ;: INPUT STOPNAME$(I)
2000 NEXT I
2010 F$ = NAMEDRV$ + NAMEBASE$ + RIGHT$(STR$(ROUTENO),LEN(STR$(ROUTENO)) - 1) +
      ".REF"
2020 '
2030 '-----view or edit the file-----
2040 '
2050 CLS
2060 LOCATE 11,15,0
2070 PRINT "1 - The number of this route is";ROUTENO
2080 LOCATE 13,15,1
2090 PRINT "2 - The name of this route is ";ROUTENAME$
2100 LOCATE 15,15,1
2110 PRINT "3 - There are";NOSTOPS ;:PRINT "stops on this route. "
2120 LOCATE 20,10,1 :
2130 INPUT "Do you want to change any of the above values (Y or N) ? ",CHANGES
2140 IF CHANGES = "y" OR CHANGES = "Y" THEN 2170
2150 IF CHANGES = "n" OR CHANGES = "N" THEN 2320
2160 LOCATE 22,10,1 : PRINT "INVALID INPUT - ENTER EITHER Y OR N - TRY AGAIN" :
      GOTO 2120
2170 LOCATE 22,10,1 :INPUT "Enter the line number (above) of the variable you wi
sh to change. ",WHICHONE
2180 CLS
2190 ON WHICHONE GOTO 2200,2230,2260
2200 LOCATE 13,15,0
2210 INPUT "What is the number of this route ? ",ROUTENO
2220 GOTO 2050
2230 LOCATE 13,15,0
2240 INPUT "What is the name of the route ? ",ROUTENAME$
2250 GOTO 2050
2260 LOCATE 13,5,0
2270 PRINT "If you change the number of stops, you will have to create a new fil
e."
2280 LOCATE 15,5,1 :PRINT "Enter Y to change the number of stops and create a ne
w file"
2290 LOCATE 16,5,1 :INPUT "Enter N to leave the number of stops unchanged ",
      CHANGES
2300 IF CHANGES = "y" OR CHANGES = "Y" THEN 1840
2310 GOTO 2050
2320 '
2330 CLS
2340 PAGE = PAGE + 1
2350 LOCATE 2,20,0 :PRINT "STOP NAMES FILE FOR ROUTE NUMBER";ROUTENO
2360 LOCATE 4,20,0 : PRINT TAB(20) "STOP NUMBER" ;: PRINT TAB(38) "STOP NAME"
2370 LOCATE 5,20,0
2380 IF PAGE > 1 THEN 2390 ELSE 2400

```



```

3010 FOR J = 1 TO TIMEPTS
3020     INPUT #1,TIMEPT(J)
3030 NEXT J
3040 FOR I = 1 TO LOOPS
3050     FOR J = 1 TO TIMEPTS
3060         INPUT #1,SCHED(I,J)
3070         HOUR = INT(SCHED(I,J)/240)
3080         MINIT = INT(.01 + ((SCHED(I,J)/240 - HOUR) * 60))
3090         TEMP$(I,J) = STR$(HOUR) + ":" + RIGHT$(STR$(MINIT),2)
3100     NEXT J
3110 NEXT I
3120 CLOSE #1
3130 HOUR = INT(STARTTIME/240)
3140 MINIT = INT(.01 + ((STARTTIME/240 - HOUR) * 60))
3150 TSTARTTIME$ = STR$(HOUR) + ":" + RIGHT$(STR$(MINIT),2)
3160 HOUR = INT(ENDTIME/240)
3170 MINIT = INT(.01 + ((ENDTIME/240 - HOUR) * 60))
3180 TENDTIME$ = STR$(HOUR) + ":" + RIGHT$(STR$(MINIT),2)
3190 B$ = F$
3200 GOTO 3630
3210 '
3220 '-----make schedule (block) reference file-----
3230 '
3240 CLS
3250 COLOR 6,0,0
3260 LOCATE 5,10,1
3270 INPUT "What is the block number ";BLOCK
3280 LOCATE 7,10,1
3290 INPUT "How many loops are there ";LOOPS
3300 LOCATE 9,10,1
3310 INPUT "How many timepoints are there ";TIMEPTS
3320 DIM TIMEPT(TIMEPTS),SCHED(LOOPS,TIMEPTS),TEMP$(LOOPS,TIMEPTS)
3330 FOR J = 1 TO TIMEPTS
3340     CLS: LOCATE 11,10,1
3350     PRINT "What is the stop number of timepoint #";J ;: INPUT ";:TIMEPT(J)
3360 NEXT J
3370 LOCATE 11,10,1
3380 PRINT "What is the earliest scheduled stop in the morning ?"
3390 LOCATE 12,10,1
3400 INPUT "(Enter the hour, followed by a comma, and then the minute) ",
        HOUR,MINIT
3410 STARTTIME = INT((MINIT/60 + HOUR) * 240)
3420 TSTARTTIME$ = STR$(HOUR) + ":" + RIGHT$(STR$(MINIT),2)
3430 LOCATE 14,10,1
3440 PRINT "What is the time of the last scheduled stop in the evening "
3450 LOCATE 15,10,1
3460 INPUT "(Enter the hour, followed by a comma, and then the minute) ",
        HOUR,MINIT
3470 ENDTIME = INT((MINIT/60 + HOUR) * 240)
3480 TENDTIME$ = STR$(HOUR) + ":" + RIGHT$(STR$(MINIT),2)
3490 '
3500 FOR I = 1 TO LOOPS
3510     FOR J = 1 TO TIMEPTS
3520         CLS : LOCATE 10,10,0
3530         PRINT "Enter the scheduled arrival time for LOOP ";I ;
3540         PRINT "at TIMEPOINT ";J
3550         LOCATE 11,10,1
3560         INPUT "(Enter the hour, followed by a comma, and then the minute) "
        HOUR,MINIT
3570         TEMP$(I,J) = STR$(HOUR) + ":" + RIGHT$(STR$(MINIT),2)
3580         SCHED(I,J) = INT((MINIT/60 + HOUR) * 240)
3590     NEXT J
3600 NEXT I
3610 B$ = BLOCKDRV$ + "BLOCK" + RIGHT$(STR$(BLOCK),LEN(STR$(BLOCK)) - 1) + ".REF"
3620 '

```

```

3630 '-----view and/or edit the data-----
3640 '
3650 CLS
3660 LOCATE 3,10,0 :PRINT "SCHEDULE (BLOCK) REFERENCE FILE - GENERAL INFORMATION
"
3670 LOCATE 6,10,0 :PRINT "1 - The block number is ";BLOCK
3680 LOCATE 9,10,0 :PRINT "2 - The number of loops ";LOOPS
3690 LOCATE 12,10,0 :PRINT "3 - The number of timepoints is ";TIMEPTS
3700 LOCATE 15,10,0 :PRINT "4 - The earliest scheduled stop is at ";TSTARTTIME$
3710 LOCATE 18,10,0 :PRINT "5 - The latest scheduled stop is at ";TENDTIME$
3720 LOCATE 25,10,0 :INPUT "DO YOU WANT TO CHANGE ANY OF THE ABOVE VALUES (Y OR
N) ? ",CHANGE$
3730 IF CHANGE$ = "Y" OR CHANGE$ = "y" THEN 3760
3740 IF CHANGE$ = "N" OR CHANGE$ = "n" THEN 3990
3750 LOCATE 23,10,0 :PRINT "INVALID CHOICE - ENTER EITHER Y OR N - TRY AGAIN "
: GOTO 3720
3760 LOCATE 25,10,0 : PRINT "
";
3770 LOCATE 25,10,1 : INPUT "ENTER THE LINE NUMBER (ABOVE) OF THE VARIABLE YOU W
ANT TO CHANGE ",CHOICE
3780 ON CHOICE GOTO 3790,3820,3850,3880,3930
3790 CLS : LOCATE 13,10,1
3800 INPUT "What is the block number ? ",BLOCK
3810 GOTO 3630
3820 CLS : LOCATE 13,10,1
3830 INPUT "What is the number of loops ? ",LOOPS
3840 GOTO 3630
3850 CLS : LOCATE 13,10,1
3860 INPUT "What is the number of timepoints ? ",TIMEPTS
3870 GOTO 3630
3880 CLS : LOCATE 13,10,1
3890 PRINT "What is the earliest scheduled stop ? "
3900 LOCATE 14,10,1 :INPUT "Enter the hour, followed by a comma, and then the mi
nute. ",HOURL,MINIT
3910 STARTTIME = INT(((MINIT/60) + HOURL) * 240) : TSTARTTIME$ = STR$(HOURL) + " : "
+ RIGHT$(STR$(MINIT),2)
3920 GOTO 3630
3930 CLS : LOCATE 13,10,1
3940 PRINT "What is the latest scheduled stop ? "
3950 LOCATE 14,10,1 :INPUT "Enter the hour, followed by a comma, and then the mi
nute. ",HOURL,MINIT
3960 ENDTIME = INT(((MINIT/60) + HOURL) * 240) : TENDTIME$ = STR$(HOURL) + " : "
+ RIGHT$(STR$(MINIT),2)
3970 GOTO 3630
3980 '
3990 '-----view and or edit timepoint data-----
4000 '
4010 CLS
4020 LOCATE 3,30,0 :PRINT "TIMEPOINT LOCATIONS" :LOCATE 5,1,0
4030 FOR J = 1 TO TIMEPTS
4040 PRINT TAB(20) "TIMEPOINT # ";J ;:PRINT TAB(45) "STOP # ";TIMEPT(J)
4050 NEXT J
4060 LOCATE 25,10,0 :INPUT "DO YOU WANT TO CHANGE ANY OF THE TIMEPOINT LOCATIONS
(Y OR N) ? ",CHANGE$
4070 IF CHANGE$ = "Y" OR CHANGE$ = "y" THEN 4100
4080 IF CHANGE$ = "N" OR CHANGE$ = "n" THEN 4180
4090 LOCATE 23,10,0 :PRINT "INVALID INPUT - ENTER EITHER Y OR N - TRY AGAIN"
:GOTO 4060
4100 '
4110 LOCATE 25,1,0 :PRINT "
";
4120 LOCATE 25,15,1 :INPUT "Which timepoint do you want to change ? ",J
4130 LOCATE 25,1,0 :PRINT "
";
4140 LOCATE 25,15,1 :PRINT "What is the stop number for timepoint # ";J ;
4150 INPUT " ? ",TIMEPT(J)

```

```

4160 GOTO 3990
4170 '
4180 '-----view and/or edit schedule data-----
4190 '
4200 CHANGES$ = " "
4210 CLS
4220 LOCATE 2,15,0 :PRINT "SCHEDULED ARRIVAL TIMES FOR BLOCK ";BLOCK
4230 PAGE = PAGE + 1 : IF PAGE = 1 THEN 4250 ELSE 4240
4240 LNUM = 0 : LOCATE 4,1,0 :GOTO 4310
4250 LOCATE 4,1,0
4260 FOR I = 1 TO LOOPS
4270     FOR J = 1 TO TIMEPTS
4280         PRINT "          LOOP # ";I ;:PRINT "    TIMEPOINT ";J ;
          :PRINT " ",TEMP$(I,J)
4290         LNUM = LNUM + 1
4300         IF LNUM/18 - INT(LNUM/18) = 0 THEN 4350
4310         'CONTINUE
4320     NEXT J
4330 NEXT I
4340 LAST = 1
4350 LOCATE 25,3,0
4360 INPUT "DO YOU WANT TO CHANGE ANY OF THE ABOVE SCHEDULED ARRIVAL TIMES (Y OR
N) ? ",CHANGES$
4370 IF LAST = 1 THEN 4380 ELSE 4390
4380 IF CHANGES$ = "N" OR CHANGES$ = "n" THEN 4580
4390 IF CHANGES$ = "Y" OR CHANGES$ = "y" THEN 4420
4400 IF CHANGES$ = "Y" OR CHANGES$ = "y" THEN 4420
4410 GOTO 4350
4420 '
4430 LOCATE 25,1,0 :PRINT "
";
4440 LOCATE 25,10,1
4450 INPUT "Which loop ? ",L
4460 LOCATE 25,40,1
4470 INPUT "Which timepoint ? ",T
4480 LOCATE 25,1,0 :PRINT "
";
4490 LOCATE 25,5,1
4500 INPUT "What is the correct time (remember - hour,minute) ? ",HOUR,MINIT
4510 SCHED(L,T) = INT((MINIT/60 + HOUR) * 240)
4520 TEMP$(L,T) = STR$(HOUR) + ":" + RIGHT$(STR$(MINIT),2)
4530 I = I - INT(18/TIMEPTS) : IF I < 1 THEN I = 1
4540 J = J - TIMEPTS* INT((18/TIMEPTS - INT(18/TIMEPTS)))
4550 PAGE = PAGE - 1
4560 GOTO 4210
4570 '
4580 '-----store the schedule reference file-----
4590 '
4600 CLS
4610 LOCATE 13,15,1 :PRINT "This file will be named ";B$
4620 LOCATE 14,15,1 :INPUT "Is this the name you wish (Y or N) ? ",C$
4630 IF C$ = "y" OR C$ = "Y" THEN 4660
4640 IF C$ = "N" OR C$ = "n" THEN 4650
4650 LOCATE 16,15,1 : INPUT "What name do you prefer ? ",B$
4660 LOCATE 18,15,0
4670 PRINT "Storing ";B$
4680 OPEN B$ FOR OUTPUT AS #1
4690 WRITE #1,BLOCK,LOOPS,TIMEPTS,STARTTIME,ENDTIME
4700 FOR J = 1 TO TIMEPTS
4710     WRITE #1,TIMEPT(J)
4720 NEXT J
4730 FOR I = 1 TO LOOPS
4740     FOR J = 1 TO TIMEPTS
4750         WRITE #1, SCHED(I,J)
4760     NEXT J
4770 NEXT I

```

```
4780 CLOSE #1
4790 GOTO 10
4800 COLOR 7,0,0 :CLS :KEY ON
4810 END
```



```

660 '-----allow user to view the data-----
670 '
680 LOCATE 14,10,1
690 INPUT "Would you like to view the raw data (Y or N)";A$
700 IF A$ = "Y" OR A$ = "y" THEN 740
710 IF A$ = "N" OR A$ = "n" THEN 890
720 LOCATE 15,10,1 :PRINT "INVALID CHOICE - ENTER EITHER Y OR N - TRY AGAIN"
730 PRINT :GOTO 680
740 CLS
750 FOR I = 1 TO NUMLOGS
760 PRINT USING "#####";TYPE(I);TIME(I);DIST(I);ONS(I);OFFS(I)
770 NUMPRINT = NUMPRINT + 1
780 IF NUMPRINT = 20 THEN 800 ELSE 850
790 W$ = ""
800 PRINT : PRINT "Strike Q to quit viewing the data - strike any other key
to continue."
810 W$ = INKEY$: IF W$ = "" THEN 810
820 IF W$ = "q" OR W$ = "Q" THEN 890
830 CLS: PRINT
840 NUMPRINT = 0
850 NEXT I
860 W$ = "" : PRINT: PRINT "strike any key to continue"
870 W$ = INKEY$: IF W$ = "" THEN 870
880 '
890 W$ = ""
900 '-----create activity records from raw data-----
910 '
920 CLS
930 Z = ACTNO
940 DIM ACTTYPE(Z),ACTTIME(Z),ACTDIST(Z),LSTDIST(Z),ACTONS(Z),ACTOFFS(Z),
PASSLOAD(Z)
950 STRTIME = HOURS*240 + MINUTES*4 - TOTTIME
960 K = 0
970 LOCATE 13,15,0 : PRINT "Creating activity records from raw data - Please wai
t."
980 FOR I = 1 TO NUMLOGS - 3
990 CUMTIME = CUMTIME + TIME(I)
1000 CUMDIST = CUMDIST + DIST(I)
1010 ON TYPE(I) GOTO 1180,1020,1040,1030,1040,1040,1180,1180,1180,1180,1040,
1180
1020 CUMTIME = CUMTIME + 240 :GOTO 1180
1030 CUMDIST = CUMDIST + 256 :GOTO 1180
1040 K = K + 1
1050 ACTTYPE(K) = TYPE(I)
1060 ACTTIME(K) = STRTIME + CUMTIME
1070 ACTDIST(K) = CUMDIST
1080 IF K = 1 THEN LSTDIST(K) = CUMDIST :GOTO 1180
1090 LSTDIST(K) = ACTDIST(K) - ACTDIST(K-1)
1100 IF ACTTYPE(K) = 5 THEN 1130
1110 IF ACTTYPE(K) = 3 OR ACTTYPE(K) = 6 OR ACTTYPE(K) = 11 THEN PASSLOAD(K)
= PASS
1120 GOTO 1160
1130 ACTONS(K) = ONS(I)
1140 ACTOFFS(K) = OFFS(I)
1150 PASSLOAD(K) = PASS + ONS(I) - OFFS(I)
1160 IF PASSLOAD(K) < 0 THEN PASSLOAD(K) = 0
1170 PASS = PASSLOAD(K)
1180 NEXT I
1190 ERASE TYPE,TIME,DIST,ONS,OFFS
1200 '
1210 '-----retrieve distance and schedule reference files-----
1220 '
1230 CLS :PRINT
1240 D$ = DISTDRV$ + DISTBASE$ + RIGHT$(STR$(ROUTENO),LEN(STR$(ROUTENO)) - 1)
+ ".REF"
1250 OPEN D$ FOR INPUT AS 2

```

```

1260 IF DAYOFWK = 6 THEN 1270 ELSE 1280
1270 S$ = BLOCKDRV$ + BLOCKBASE$ + "6" + RIGHT$(STR$(BLOCK),LEN(STR$(BLOCK))-1)
      + ".REF" : GOTO 1310
1280 IF DAYOFWK = 7 THEN 1290 ELSE 1300
1290 S$ = BLOCKDRV$ + BLOCKBASE$ + "7" + RIGHT$(STR$(BLOCK),LEN(STR$(BLOCK))-1)
      + ".REF" : GOTO 1310
1300 S$ = BLOCKDRV$ + BLOCKBASE$ + RIGHT$(STR$(BLOCK),LEN(STR$(BLOCK))-1)
      + ".REF"
1310 LOCATE 11,20,0 :PRINT "Reference files will be the following:"
1320 LOCATE 12,20,0 :PRINT D$; " "; S$
1330 LOCATE 14,20,0 :INPUT "Are these the files you wish (Y or N) ? ",A$
1340 IF A$ = "y" OR A$ = "Y" THEN 1410
1350 IF A$ = "n" OR A$ = "N" THEN 1370
1360 LOCATE 16,20,0 :PRINT "INVALID INPUT - ENTER EITHER Y OR N - TRY AGAIN" :GO
TO 1330
1370 CLS : LOCATE 11,10,1
1380 INPUT "What distance reference file do you prefer ? ",D$
1390 LOCATE 13,10,1
1400 INPUT "What schedule (block) reference file do you prefer ? ",S$
1410 CLS
1420 OPEN S$ FOR INPUT AS 3
1430 LOCATE 11,20,0
1440 PRINT "Retrieving reference files "
1450 INPUT #2,ROUTENO,ROUTENAME$,NOSTOPS,TURNPOINT
1460 DIM DFLS(NOSTOPS)
1470 FOR I = 1 TO NOSTOPS
1480     INPUT #2,JUNK,DFLS(I)
1490     DFLS(I) = DFLS(I) - AF
1500     TEMP = TEMP + DFLS(I)
1510     IF I = TURNPOINT THEN TRIPDIST = TEMP
1520 NEXT I
1530 LOOPDIST = TEMP
1540 CLOSE #2
1550 '
1560 INPUT #3,BLOCKNO,LOOPS,TIMEPTS,STARTTIME,ENDTIME
1570 DIM TIMEPT(TIMEPTS)
1580 FOR K = 1 TO TIMEPTS
1590     INPUT #3,TIMEPT(K)
1600 NEXT K
1610 DIM SCHED(LOOPS,TIMEPTS)
1620 FOR I = 1 TO LOOPS
1630     FOR J = 1 TO TIMEPTS
1640         INPUT #3,SCHED(I,J)
1650     NEXT J
1660 NEXT I
1670 '
1680 CLOSE #3
1690 '
1700 '-----MATCH ACTIVITIES TO STOPS-----
1710 '
1720 CLS
1730 LOCATE 10,15,0
1740 PRINT "Matching activities to stops - please wait "
1750 DIM STOPNUM(ACTNO),MATCH(ACTNO),SCHEDTIME(ACTNO),BEGLOOP(LOOPS),BESTMATCH(L
OOPS),ENDLOOP(LOOPS),TENDLOOP(LOOPS),TBEGLOOP(LOOPS),MATCHRATIO(LOOPS)
1760 '
1770 '-----locate activities with time near scheduled time for stop #1-----
1780 '
1790 IF SCHED(1,1) > 0 THEN L = 1 ELSE L = 2
1800 REFTIME = SCHED(L,1)
1810 '
1820 TIMEDIFF = ABS(ACTTIME(I) - REFTIME)
1830 IF TIMEDIFF < DELTAT THEN 1890
1840 IF ACTTIME(I) > REFTIME THEN 1870
1850 I = I + 1 : IF I > ACTNO THEN 2200
1860 GOTO 1820

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```

1870 L = L + 1
1880 REFTIME = SCHED(L,1) : IF L > LOOPS THEN 2200 ELSE 1820
1890 GOTO 1900
1900 '
1910 '-----calculate the match ratio for the potential loop-----
1920 K = I
1930 TBEGLOOP(L) = K
1940 REFSUM = 0 : LDIST = 0 : J = 1 : MATCHES = 0 : LOOPSUM = 0
1950 FOR I = K TO 1000
1960     GOTO 1990
1970     J = J + 1 : IF J > NOSTOPS THEN 2110
1980     REFSUM = REFSUM + DFLS(J) : GOTO 2030
1990     IF I = ACTNO THEN 2200
2000     LDIST = LDIST + LSTDIST(I)
2010     LOOPSUM = LOOPSUM + LSTDIST(I)
2020     IF LOOPSUM > LOOPDIST + DELTAL THEN 2110
2030     DIFF = ABS(LDIST - REFSUM)
2040     IF DIFF < DELTAS1 THEN 2060
2050     IF LDIST < REFSUM THEN 2100 ELSE 1970
2060 '
2070     MATCHES = MATCHES + 1
2080     REFSUM = 0 : LDIST = 0
2090 '
2100 NEXT I
2110 TENDLOOP(L) = I - 1
2120 MATCHRATIO(L) = MATCHES/(TENDLOOP(L) - TBEGLOOP(L))
2130 IF MATCHRATIO(L) > BESTMATCH(L) AND MATCHRATIO(L) > .5 THEN 2160 ELSE 2140
2140 I = K + 1 : TRIPSUM = 0
2150 IF I = ACTNO THEN 2200 ELSE 1820
2160 BESTMATCH(L) = MATCHRATIO(L) : BEGLOOP(L) = TBEGLOOP(L)
2170 ENDLOOP(L) = TENDLOOP(L) : TRIPSUM = 0
2180 I = K + 1 : GOTO 1820
2190 '
2200 '-----match the activities within the good loops-----
2210 '
2220 FOR L = 1 TO LOOPS
2230     IF BEGLOOP(L) = 0 THEN 2540
2240     REFSUM = 0 : LDIST = 0 : J = 1
2250     FOR I = BEGLOOP(L) TO ENDLOOP(L)
2260         GOTO 2290
2270         J = J + 1 : IF J > NOSTOPS THEN 2540
2280         REFSUM = REFSUM + DFLS(J) : GOTO 2300
2290         LDIST = LDIST + LSTDIST(I)
2300         DIFF = ABS(LDIST - REFSUM)
2310         IF DIFF < DELTAS1 THEN 2350
2320         IF DIFF > LASTDIFF AND LASTDIFF > 0 THEN 2430
2330         LASTDIFF = DIFF : GOTO 2270
2340 '
2350         assign stop number and match value to activity i
2360 '
2370         STOPNUM(I) = J : JAY = J : MATCH(I) = 2
2380         IF STOPNUM(I) = NOSTOPS THEN STOPNUM(I) = 1
2390         IF ABS(LDIST - REFSUM) < DELTAS2 THEN MATCH(I) = 4
2400         LDIST = 0 : REFSUM = 0 : LASTDIFF = 0
2410         GOTO 2470
2420 '
2430         STOPNUM(I) = J - 1 : MATCH(I) = 0 : JAY = J - 1 : LASTDIFF = 0
2440 '
2450         assign schedtime to activity i if stop is a timepoint
2460 '
2470         FOR K = 1 TO TIMEPTS
2480             IF STOPNUM(I) = TIMEPT(K) THEN 2490 ELSE 2520
2490             SCHEDTIME(I) = SCHED(L,K)
2500             IF SCHEDTIME(I) = 0 AND STOPNUM(I) = 1 THEN SCHED(L,K)
                = SCHED(L+1,1)
2510             SCHEDTIME(I) = SCHED(L,K)

```

```

2520         NEXT K
2530     NEXT I
2540 NEXT L
2550 '
2560 '-----back match the stray data -----
2570 '
2580 FOR L = 1 TO LOOPS
2590     IF BEGLOOP(L) = 0 THEN 2930
2600 '
2610 '    match activities to stops
2620 '
2630     J = NOSTOPS : REFSUM = 0 : BDIST = 0 : LASTDIFF = 0
2640     FOR I = BEGLOOP(L) TO 2 STEP -1
2650         GOTO 2680
2660         J = J - 1 : IF J = 0 THEN J = NOSTOPS
2670         REFSUM = REFSUM + DFLS(J) : GOTO 2690
2680         BDIST = BDIST + LSTDIST(I)
2690         DIFF = ABS(BDIST-REFSUM)
2700         IF STOPNUM(I-1) > 0 AND I-1 < BEGLOOP(L) THEN 2930
2710         IF ACTTIME(I) < STARTTIME - DELTAT/2 THEN 2950
2720         IF ABS(BDIST - REFSUM) < DELTAS1 THEN 2760
2730         IF DIFF > LASTDIFF AND LASTDIFF > 0 THEN 2820
2740         LASTDIFF = DIFF : GOTO 2660
2750 '
2760 '    assign stop number and match value to activity i
2770 '
2780         JAY = J - 1 : LASTDIFF = 0
2790         STOPNUM(I-1) = JAY : MATCH(I-1) = 1 : REFSUM = 0 : BDIST = 0
2800         GOTO 2840
2810 '
2820         STOPNUM(I-1) = J : MATCH(I-1) = 0 : JAY = J : LASTDIFF = 0
2830 '
2840         IF STOPNUM(I) = NOSTOPS THEN STOPNUM(I) = 1
2850 '    assign schedtime to activity i if j is a timepoint
2860 '
2870         FOR K = 1 TO TIMEPTS
2880             IF JAY = TIMEPT(K) THEN 2890 ELSE 2910
2890             IF L = 1 THEN 2920
2900             SCHEDTIME(I-1) = SCHED(L-1,K)
2910         NEXT K
2920     NEXT I
2930 NEXT L
2940 '
2950 '-----front match remaining stray data-----
2960 '
2970 FOR L = 1 TO LOOPS - 1
2980 '    match activities to stops
2990 '
3000 '
3010     IF ENDLOOP(L) = 0 THEN 3320
3020     J = 1 : REFSUM = 0 : FDIST = 0 : LASTDIFF = 0
3030     FOR I = ENDLOOP(L) TO ACTNO
3040         IF I = 0 OR I = ACTNO THEN 3320 ELSE 3070
3050         J = J + 1 : IF J > NOSTOPS THEN J = 1
3060         REFSUM = REFSUM + DFLS(J) : GOTO 3080
3070         FDIST = FDIST + LSTDIST(I)
3080         DIFF = ABS(FDIST - REFSUM)
3090         IF ACTTIME(I) > ENDTIME + DELTAT/2 THEN 3340
3100         IF I > ENDLOOP(L) AND MATCH(I) > 0 THEN 3320
3110         IF DIFF < DELTAS1 THEN 3150
3120         IF DIFF > LASTDIFF AND LASTDIFF > 0 THEN 3220
3130         LASTDIFF = DIFF : GOTO 3050
3140 '
3150 '    assign stop number and match value to activity i
3160 '
3170         JAY = J : LASTDIFF = 0

```



```

3790 LOCATE 20,15,0 :PRINT "What file do you prefer ? "
3800 LOCATE 21,15,1 :INPUT "(Remember to indicate the drive and extension) ",N$

3810 OPEN N$ FOR INPUT AS #2
3820 INPUT #2,ROUTENO,ROUTENAMES,NOSTOPS
3830 DIM STOPNAMES(NOSTOPS)
3840 FOR J = 1 TO NOSTOPS
3850     INPUT #2,STOPNAMES(J)
3860 NEXT J
3870 CLOSE #2
3880 '
3890 '-----prepare and print bus stop listing-----
3900 CLS
3910 '
3920 IF C$ = "s" OR C$ = "S" THEN 3930 ELSE 4460
3930 CLS
3940 LOCATE 1,3,1
3950 PRINT SYST$;" ";;PRINT "BUS STOP LISTING"
3960 LOCATE 1,44,1
3970 PRINT ROUTENAMES$;" ";; PRINT DATADATES$
3980 LOCATE 3,1,1
3990 PRINT "STOP#   STOP NAME           M   DIST   DEPART   SCHED   DEV   ON
S OFFS PASS"
4000 LNUM = 5
4010 PRINT
4020 PAGE = PAGE + 1
4030 IF PAGE > 1 THEN 4300
4040 FOR I = 1 TO ACTNO
4050     IF ACTTYPE(I) = 1 OR ACTTYPE(I) = 3 THEN 4410
4060     IF ACTTYPE(I) = 6 OR ACTTYPE(I) = 11 THEN 4410
4070     J = STOPNUM(I)
4080     IF J = 0 THEN SNAME$ = " " ELSE SNAME$ = STOPNAMES(J)
4090     REALDIST = ACTDIST(I)* CLICK/5280
4100     ATIME = ACTTIME(I)
4110     GOSUB 4940
4120     REALTIMES$ = TEMP$
4130     IF SCHEDTIME(I) = 0 THEN 4210
4140     ATIME = SCHEDTIME(I)
4150     GOSUB 4940
4160     REALSCHED$ = TEMP$
4170     ATIME = SCHEDTIME(I) - ACTTIME(I)
4180     GOSUB 4940
4190     SCHEDDEV$ = TEMP$
4200     GOTO 4220
4210     REALSCHED$ = " " : SCHEDDEV$ = " "
4220 '
4230     LNUM = LNUM + 1
4240     IF LNUM > 23 THEN 4250 ELSE 4300
4250     W$ = ""
4260     LOCATE 25,5,0 : PRINT "Strike Q to quit - strike any other key to conti
nue" ;
4270     W$ = INKEY$ : IF W$ = "" THEN 4270
4280     IF W$ = "q" OR W$ = "Q" THEN 4450
4290     GOTO 3930
4300     IF STOPNUM(I) > 0 THEN 4310 ELSE 4320
4310     PRINT USING "###";STOPNUM(I);: PRINT " " ;:GOTO 4330
4320     PRINT " " ;
4330     PRINT USING "\          \";SNAME$;
4340     PRINT USING"###";MATCH(I);
4350     PRINT " " ;: PRINT USING "####.##";REALDIST;: PRINT " " ;
4360     PRINT USING"\          \";REALTIMES;REALSCHED$;
4370     PRINT USING"\          \";SCHEDDEV$;
4380     PRINT USING"###";ACTONS(I);
4390     PRINT USING"####";ACTOFFS(I);
4400     PRINT USING"#####";PASSLOAD(I)
4410 NEXT I

```



```
5040 MINIT = 0 : HR = HR + 1
5050 IF HR = 0 THEN 5060 ELSE 5090
5060 TEMP$ = RIGHT$(STR$(MINIT),2) + ":" + RIGHT$(STR$(SEC),2)
5070 IF SIGN = -1 THEN TEMP$ = "-" + TEMP$ ELSE TEMP$ = " " + TEMP$
5080 GOTO 5100
5090 TEMP$ = RIGHT$(STR$(HR),2) + ":" + RIGHT$(STR$(MINIT),2) + ":" +
        RIGHT$(STR$(SEC),2)
5100 RETURN
5110 STOP
5120 COLOR 7,0,0 :CLS :END
```



```

620 LOCATE 18,1,0 : PRINT "
"
630 LOCATE 15,15,0 : INPUT "Is this the file you wish (Y or N) ? ",R$
640 IF R$ = "y" OR R$ = "Y" THEN 700
650 IF R$ = "n" OR R$ = "N" THEN 670
660 LOCATE 18,15,0 :PRINT "INVALID CHOICE - CHOOSE EITHER Y OR N - TRY AGAIN" :
GOTO 620
670 LOCATE 18,15,0 : PRINT "(Remember to indicate the drive and extension) ",N$
680 LOCATE 17,15,1 : INPUT "Which file do you prefer ? ",N$
690 '
700 '
710 IF C$ = "p" OR C$ = "P" THEN 720 ELSE 750
720 CLS: LOCATE 13,15,0 : PRINT "Ready printer - strike any key to begin printin
g "
730 W$ = ""
740 W$ = INKEY$ : IF W$="" THEN 740
750 OPEN N$ FOR INPUT AS #3
760 INPUT #3,ROUTENO,ROUTENAME$,NOSTOPS
770 DIM STOPNAME$(NOSTOPS)
780 FOR J = 1 TO NOSTOPS
790 INPUT #3,STOPNAME$(J)
800 NEXT J
810 CLOSE #3
820 '
830 '-----accumulate statistics between the stops -----
840 '
850 I = 1 : N = 1
860 I = I + 1
870 IF I + 1 = ACTNO THEN 1970
880 '
890 ONSBET = ONSBET + ACTONS(I)
900 OFFSBET = OFFSBET + ACTOFFS(I)
910 STOPSBET = STOPSBET + 1
920 IF PASSLOAD(I) > MAXLOAD THEN 930 ELSE 940
930 MAXLOAD = PASSLOAD(I) : MAXSTOP = STOPNUM(I)
940 IF SCHEDTIME(I) > 0 AND STOPNUM(I+1) <> STOPNUM(I) THEN 950 ELSE 860
950 '
960 '-----compute and print timepoint information-----
970 '
980 ' convert times to hours,minutes,seconds
990 ATIME = ACTTIME(I)
1000 GOSUB 2020
1010 ARRIVE$ = TEMP$
1020 ATIME = SCHEDTIME(I)
1030 GOSUB 2020
1040 SCHEDTIME$ = TEMP$
1050 ATIME = SCHEDTIME(I) - ACTTIME(I)
1060 GOSUB 2020
1070 SCHEDDEV$ = TEMP$
1080 IF X = 0 THEN 1460
1090 ATIME = ACTTIME(I) - LASTTIME : TIMEBET = ATIME
1100 GOSUB 2020
1110 TIMEBET$ = RIGHT$(TEMP$,5)
1120 '
1130 DISTBET = (ACTDIST(I) - LASTDIST) * CLICK /5280
1140 SPEED = DISTBET/(TIMEBET/240)
1150 IF STOPNUM(I) = 0 THEN 1160 ELSE 1170
1160 SNAME$ = " " : GOTO 1190
1170 SNAME$ = STOPNAME$(STOPNUM(I))
1180 IF C$ = "p" OR C$ = "P" THEN 1330
1190 '
1200 PRINT " ";
1210 PRINT USING "#####";ONSBET;OFFSBET;
1220 PRINT USING "#####";MAXLOAD;MAXSTOP;: PRINT USING "#####";STOPSBET;
1230 PRINT USING "#####.##";DISTBET ;: PRINT TAB(62) TIMEBET$ ;:
1240 PRINT USING "#####.##";SPEED

```

```

1250 IF STOPNUM(I) = 0 THEN 1260 ELSE 1270
1260 PRINT " "; GOTO 1280
1270 PRINT STOPNUM(I);
1280 PRINT TAB(6) " " ;PRINT USING "\          \";SNAME$;: PRINT " ";

1290 PRINT USING "####";PASSLOAD(I) ;:PRINT " ";
1300 PRINT USING "\          \";ARRIVE$;SCHEDTIME$;
1310 PRINT USING "\          \";SCHEDDEV$
1320 GOTO 1460
1330 LPRINT " ";
1340 LPRINT USING "####";ONSBET;OFFSBET;
1350 LPRINT USING "#####";MAXLOAD;MAXSTOP;:LPRINT USING "#####";STOPSBET;
1360 LPRINT USING "#####.##";DISTBET ;: LPRINT TAB(62) TIMEBET$ ;:
1370 LPRINT USING "#####.##";SPEED
1380 IF STOPNUM(I) = 0 THEN 1390 ELSE 1400
1390 LPRINT " ";: GOTO 1410
1400 LPRINT STOPNUM(I);
1410 LPRINT TAB(6) " " ;:LPRINT USING "\          \";SNAME$;: LPRINT " ";
1420 LPRINT USING "####";PASSLOAD(I) ;:LPRINT " ";
1430 LPRINT USING "\          \";ARRIVE$;SCHEDTIME$;
1440 LPRINT USING "\          \";SCHEDDEV$
1450 '
1460 '-----reset values-----'
1470 '
1480 LASTDIST = ACTDIST(I) : LASTTIME = ACTTIME(I) : MAXLOAD = PASSLOAD(I)
1490 MAXSTOP = STOPNUM(I) : ONSBET = 0 : OFFSBET = 0 : STOPSBET = 0
1500 TIMEBET = 0 : DISTBET = 0 : SPEED = 0
1510 '
1520 IF X = 0 THEN 1620
1530 IF STOPNUM(I) = 1 THEN 1560 ELSE 860
1540 '
1550 '
1560 IF X = 0 THEN 1630
1570 IF C$ = "p" OR C$ = "P" THEN 1620
1580 LOCATE 25,5,0 : PRINT "Strike Q to quit - strike any other key to continue."
1590 W$ = ""
1600 W$ = INKEY$ : IF W$ = "" THEN 1600
1610 IF W$ = "Q" OR W$ = "q" THEN 50
1620 X = X + 1
1630 IF C$ = "p" OR C$ = "P" THEN 1790
1640 CLS:PRINT
1650 PRINT TAB(2) SYST$;:PRINT TAB(28) "TIME POINT PROFILE REPORT";: PRINT TAB(
60) "PREPARED ";DATE$
1660 PRINT " BLOCK #";BLOCK; " ROUTE #";ROUTENO ;: PRINT TAB(28) ROUTENAME$ ;: P
RINT TAB(59) DATADATE$
1670 PRINT: PRINT " STOP#      STOP NAME          LOAD      DEPART      SCHED
DEV "
1680 LOCATE 6,2,0 : PRINT "      ONS OFFS MAXLOAD MAXSTOP # STOPS      DIST
TIME      SPEED" : PRINT
1690 IF STOPNUM(I) = 0 THEN 1700 ELSE 1720
1700 PRINT " ";: GOTO 1740
1710 SNAME$ = " "
1720 PRINT STOPNUM(I);
1730 SNAME$ = STOPNAME$(STOPNUM(I))
1740 PRINT TAB(6) " " ;:PRINT USING "\          \";SNAME$;: PRINT " ";

1750 PRINT USING "####";PASSLOAD(I) ;: PRINT " ";
1760 PRINT USING "\          \";ARRIVE$;SCHEDTIME$;
1770 PRINT USING "\          \";SCHEDDEV$
1780 GOTO 1940
1790 IF X > 1 THEN 1830
1800 LPRINT : LPRINT : LPRINT : LPRINT
1810 LPRINT TAB(2) SYST$;:LPRINT TAB(28) "TIME POINT PROFILE REPORT";: LPRINT T
AB(60) "PREPARED ";DATE$

```



```

2420 FOR I = 1 TO ACTNO
2430     INPUT #2,ACTTYPE(I),STOPNUM(I),ACTDIST(I),ACTTIME(I),SCHEDTIME(I),
           ACTONS(I),ACTOFFS(I),PASSLOAD(I),MATCH(I)
2440 NEXT I
2450 CLOSE #2
2460 LOCATE 17,15,0 : PRINT "Creating the report - Please wait. " ;
2470 '
2480 '-----set limits according to the day of the week-----

2490 ON DAYOFWK GOTO 2500,2500,2500,2500,2500,2590,2650
2500 '   weekdays
2510 L = 1
2520 LIMIT(1) = AMPEAK
2530 LIMIT(2) = MIDDAY
2540 LIMIT(3) = PMPEAK
2550 LIMIT(4) = NIGHT
2560 LIMIT(5) = WKDYEND
2570 ENDLIMIT = 5
2580 GOTO 2710
2590 '   saturdays
2600 L = 5
2610 LIMIT(5) = SATBEGIN
2620 LIMIT(6) = SATEND
2630 ENDLIMIT = 6
2640 GOTO 2710
2650 '   sundays
2660 L = 6
2670 LIMIT(6) = SUNBEGIN
2680 LIMIT(7) = SUNEND
2690 ENDLIMIT = 7
2700 GOTO 2710
2710 '
2720 '-----locate the trips within the time period-----

2730 I = 0
2740 I = I + 1
2750 IF I > ACTNO THEN 3170
2760 IF ACTTIME(I) < LIMIT(L) THEN 2790 ELSE 2770
2770 L = L + 1
2780 IF L = ENDLIMIT THEN 3170 ELSE 2740
2790 IF STOPNUM(I) = 1 OR STOPNUM(I) = TURNPOINT THEN 2800 ELSE 2740
2800 IF STOPNUM(I) = 1 THEN 2810 ELSE 2820
2810 REFDIST = TRIPDIST : TRIPEND = TURNPOINT : GOTO 2840
2820 IF STOPNUM(I) = TURNPOINT THEN 2830 ELSE 2740
2830 REFDIST = LOOPDIST - TRIPDIST : TRIPEND = 1
2840 BEGLOOP = I
2850 I = I + 1
2860 IF I > ACTNO THEN 3170
2870 TRIPSUM = ACTDIST(I) - ACTDIST(BEGLOOP)
2880 IF ABS(TRIPSUM - REFDIST) < DELTAL THEN 2920
2890 IF TRIPSUM < REFDIST THEN 2850
2900 I = BEGLOOP : GOTO 2740
2910 '
2920 IF STOPNUM(I) = TRIPEND THEN 2930 ELSE 2850
2930 ENDLOOP = I
2940 '
2950 '-----determine variable values for section 15 daily report-----
2960 '
2970 NOTRIPS(L) = NOTRIPS(L) + 1
2980 FOR I = BEGLOOP TO ENDLOOP
2990     PASSONS(L) = PASSONS(L) + ACTONS(I)
3000     PASS = PASSLOAD(I)
3010     IF I = ENDLOOP THEN 3140
3020     PASSBOARD(L) = PASSBOARD(L) + PASS
3030     DIST = (ACTDIST(I+1) - ACTDIST(I)) * CLICK / 5280
3040     TDIST(L) = TDIST(L) + DIST

```

```

3050     TIME = (ACTTIME(I+1) - ACTTIME(I)) / 4
3060     TTIME(L) = TTIME(L) + TIME
3070     PASSMILE(L) = PASSMILE(L) + PASS * DIST
3080     PASSMIN(L) = PASSMIN(L) + PASS * TIME / 4
3090     CAPMILE(L) = CAPMILE(L) + CAP * DIST
3100     SEATMILE(L) = SEATMILE(L) + SEATS * DIST
3110     UNPASSTRIP(L) = PASSONS(L)/NOTRIPS(L)
3120     PASSMITRIP(L) = PASSMILE(L)/NOTRIPS(L)
3130     UNPASSTIME(L) = PASSMIN(L)/NOTRIPS(L)
3140     NEXT I
3150     I = ENDLOOP - 1
3160     GOTO 2740
3170     '-----store the daily report file-----
3180     '
3190     S$ = SECT15DRV$ + OUTPUT$ + ".15"
3200     PRINT " Storing ";S$
3210     OPEN S$ FOR OUTPUT AS #3
3220     FOR L = 2 TO 7
3230         WRITE #3,PASSONS(L),PASSBOARD(L),TDIST(L),PASSMILE(L),TTIME(L),
                PASSMIN(L),CAPMILE(L),SEATMILE(L),NOTRIPS(L)
3240     NEXT L
3250     CLOSE #3
3260     '
3270     '-----print the daily report file-----
3280     '
3290     CLS : LOCATE 9,10,0 : PRINT "The report will be displayed on the screen. "
3300     LOCATE 11,10,0 : PRINT "For a hard copy of the report, ready the printer -
3310     IF C$ = "s" OR C$ = "S" THEN 3350
3320     LOCATE 12,10,0 : PRINT "Then press the right shift key along with the PrtSc
    key. "
3330     LOCATE 14,10,0 : PRINT "When you have finished printing or viewing the repo
    rt, "
3340     LOCATE 15,10,0 : PRINT "strike any key to return to the menu. "
3350     LOCATE 17,10,0 : PRINT "Strike any key to begin."
3360     '
3370     '-----print to screen-----
3380     W$ = ""
3390     '
3400     W$ = INKEY$ : IF W$ = "" THEN 3400
3410     CLS
3420     PRINT:PRINT : PRINT TAB(5) SYST$ ;: PRINT TAB(28) "SECTION 15 DAILY REPOR
    T" ;: PRINT TAB(60) "PREPARED ";DATE$
3430     LOCATE 4,5,0 : PRINT "ROUTE # ";ROUTENO ;: PRINT " ";ROUTENAME$
    ;
3440     ON DAYOFWK GOTO 3450,3460,3470,3480,3490,3500,3510
3450     PRINT TAB(60) "MONDAY ";: GOTO 3520
3460     PRINT TAB(60) "TUESDAY ";: GOTO 3520
3470     PRINT TAB(60) "WEDNESDAY ";: GOTO 3520
3480     PRINT TAB(60) "THURSDAY ";: GOTO 3520
3490     PRINT TAB(60) "FRIDAY ";: GOTO 3520
3500     PRINT TAB(60) "SATURDAY ";: GOTO 3520
3510     PRINT TAB(60) "SUNDAY ";: GOTO 3520
3520     PRINT TAB(70) DATADATE$
3530     LOCATE 5,5,0 : PRINT "BUS # ";BUSID ;: PRINT TAB(28) "SEATED CAPACITY ";
    SEATS ;: PRINT TAB(60) "TOTAL CAPACITY";CAP : PRINT
3540     LOCATE 7,40,0 : PRINT "WEEKDAY ";: PRINT TAB(67) "WEEKEND"
3550     PRINT " TIME PERIOD ";: PRINT TAB(27) "AM PEAK " ;:PRINT "MIDDAY "
    ;:PRINT "PM PEAK " ;: PRINT "NIGHT " ;: PRINT "SATURDAY";: PRINT " SUNDAY"
3560     PRINT:PRINT " Passengers Boarded ";: PRINT TAB(25) "";
3570     FOR L = 2 TO 7
3580         PRINT USING "#####";PASSONS(L) ;: PRINT " " ;
3590     NEXT L
3600     PRINT " Passengers On Board ";: PRINT TAB(25) "";
3610     FOR L = 2 TO 7
3620         PRINT USING "#####";PASSBOARD(L) ;: PRINT " " ;
3630     NEXT L

```



```

                                PASSMIN(L),CAPMILE(L),SEATMILE(L),NOTRIPS(L)
4290 NEXT L
4300 CLOSE #1
4310 '
4320 '-----retrieve the section 15 cumulative data file-----
4330 '
4340 C$ = SECT15DRV$ + SECT15BASE$ + ".15A"
4350 OPEN C$ FOR INPUT AS #2
4360 FOR L = 2 TO 7
4370     INPUT #2,CPASSONS(L),CPASSBOARD(L),CTDIST(L),CPASSMILE(L),CTTIME(L),
                                CPASSMIN(L),CCAPMILE(L),CSEATMILE(L),CNOTRIPS(L)
4380 NEXT L
4390 CLOSE #2
4400 '
4410 '-----compute and store the new values in the cumulative file-----
4420 '
4430 OPEN C$ FOR OUTPUT AS #3
4440 FOR L = 2 TO 7
4450     CPASSONS(L) = PASSONS(L) + CPASSONS(L)
4460     CPASSBOARD(L) = PASSBOARD(L) + CPASSBOARD(L)
4470     CTDIST(L) = TDIST(L) + CTDIST(L)
4480     CPASSMILE(L) = PASSMILE(L) + CPASSMILE(L)
4490     CTTIME(L) = TTIME(L) + CTTIME(L)
4500     CPASSMIN(L) = PASSMIN(L) + CPASSMIN(L)
4510     CCAPMILE(L) = CAPMILE(L) + CCAPMILE(L)
4520     CSEATMILE(L) = SEATMILE(L) + CSEATMILE(L)
4530     CNOTRIPS(L) = NOTRIPS(L) + CNOTRIPS(L)
4540     WRITE #3,CPASSONS(L),CPASSBOARD(L),CTDIST(L),CPASSMILE(L),CTTIME(L),
                                CPASSMIN(L),CCAPMILE(L),CSEATMILE(L),CNOTRIPS(L)
4550 NEXT L
4560 CLS
4570 LOCATE 13,15,0
4580 INPUT "Do you want print the cumulative file (Y or N) ? ",P$
4590 IF P$ = "Y" OR P$ = "y" THEN 4620
4600 IF P$ = "n" OR P$ = "N" THEN 50
4610 LOCATE 15,15,0 : PRINT "INVALID INPUT - ENTER EITHER Y OR N - TRY AGAIN" :
GOTO 4570
4620 '
4630 '-----calculate averages and annual totals-----
4640 '
4650 LOCATE 17,15,1 : INPUT "Do you want to include the annual totals (Y or N) ?
",
ANTOT$
4660 IF ANTOT$ = "Y" OR ANTOT$ = "y" THEN 4690
4670 IF ANTOT$ = "N" OR ANTOT$ = "n" THEN 4760
4680 LOCATE 15,15,0 : PRINT "INVALID INPUT - ENTER EITHER Y OR N - TRY AGAIN" :
GOTO 4650
4690 CLS :
4700 LOCATE 6,10,1 : INPUT "What is the total number of trips in the a.m. peak ?
",
TOTTRIPS(2)
4710 LOCATE 8,10,1 : INPUT "What is the total number of trips in the midday ? "
,TOTTRIPS(3)
4720 LOCATE 10,10,1 : INPUT "What is the total number of trips in the p.m. peak
? "
,TOTTRIPS(4)
4730 LOCATE 12,10,1 : INPUT "What is the total number of trips in the night ? "
,TOTTRIPS(5)
4740 LOCATE 14,10,1 : INPUT "What is the total number of trips on Saturday ? "
,TOTTRIPS(6)
4750 LOCATE 16,10,1 : INPUT "What is the total number of trips on Sunday ? "
,TOTTRIPS(7)
4760 CLS
4770 FOR L = 2 TO 7
4780     IF CNOTRIPS(L) = 0 THEN 4790 ELSE 4800
4790     CUNPASS(L) = 0 : CPASSMITRIP(L) = 0 : CUNPASSTIME(L) = 0 : GOTO 4830
4800     CUNPASS(L) = CPASSONS(L)/CNOTRIPS(L)
4810     CPASSMITRIP(L) = CPASSMILE(L)/CNOTRIPS(L)
4820     CUNPASSTIME(L) = CPASSMIN(L)/CNOTRIPS(L)

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```

4830     TOTUNPASS(L) = TOTTRIPS(L) * CUNPASS(L)
4840     TOTPASSMILE(L) = TOTTRIPS(L) * CPASSMITRIP(L)
4850 NEXT L
4860 '
4870 '-----print a hardcopy of the cumulative section 15 report-----

4880 '
4890 CLS
4900 LOCATE 13,15,0 : PRINT "Ready printer - strike any key when ready."
4910 W$ = ""
4920 W$ = INKEY$ : IF W$ = "" THEN 4920
4930 LPRINT : LPRINT : LPRINT : LPRINT : LPRINT : LPRINT
4940 LPRINT TAB(5) SYST$ ;; LPRINT TAB(30) "SECTION 15 ANNUAL REPORT" ;; LPRINT
    TAB(60) "PREPARED "; DATE$
4950 LPRINT TAB(5) "TRANSIT ID "; TRANSITID$;; LPRINT TAB(30) "NON-RAIL MODES";:
    LPRINT TAB(60) "MODE "; MODE$
4960 LPRINT TAB(5) "FISCAL YEAR END "; FISCALYR$;; LPRINT TAB(30) "FORM 406A";:
    LPRINT TAB(60) "LEVEL "; LEVEL$
4970 :LPRINT : LPRINT
4980 LPRINT "    TIME PERIOD" ;; LPRINT TAB(23) "AM PEAK " ;;LPRINT "MIDDAY
    " ;;LPRINT "PM PEAK " ;; LPRINT "NIGHT ";; LPRINT "SATDAY ";; LPRINT "SUNDA
    Y " ;;LPRINT " TOTAL"
4990 LPRINT :LPRINT: LPRINT " Passengers Boarded ";; LPRINT TAB(21) "";
5000 FOR L = 2 TO 7
5010 IF L < 5 THEN 5020 ELSE 5030
5020     LPRINT USING "#####";CPASSONS(L) ; : GOTO 5040
5030     LPRINT USING "#####";CPASSONS(L) ;
5040     SUM = SUM + CPASSONS(L)
5050 NEXT L
5060 LPRINT USING "#####";SUM; : SUM = 0
5070 LPRINT :LPRINT " Pass. On Board";: LPRINT TAB(21) "";
5080 FOR L = 2 TO 7
5090 IF L < 5 THEN 5100 ELSE 5110
5100     LPRINT USING "#####";CPASSBOARD(L) ; :GOTO 5120
5110     LPRINT USING "#####";CPASSBOARD(L) ;
5120     SUM = SUM + CPASSBOARD(L)
5130 NEXT L
5140 LPRINT USING "#####";SUM; : SUM = 0
5150 LPRINT : LPRINT " Bus Trip Distance ";; LPRINT TAB(21) "";
5160 FOR L = 2 TO 7
5170 IF L < 5 THEN 5180 ELSE 5190
5180     LPRINT USING "#####";CTDIST(L) ;;GOTO 5200
5190     LPRINT USING "#####";CTDIST(L) ;
5200     SUM = SUM + CTDIST(L)
5210 NEXT L
5220 LPRINT USING "#####";SUM; : SUM = 0
5230 LPRINT :LPRINT " Passenger Miles ";; LPRINT TAB(21) "";
5240 FOR L = 2 TO 7
5250 IF L < 5 THEN 5260 ELSE 5270
5260     LPRINT USING "#####";CPASSMILE(L) ; :GOTO 5280
5270     LPRINT USING "#####";CPASSMILE(L) ;
5280     SUM = SUM + CPASSMILE(L)
5290 NEXT L
5300 LPRINT USING "#####";SUM; : SUM = 0
5310 LPRINT :LPRINT " Bus Trip Time ";; LPRINT TAB(21) "";
5320 FOR L = 2 TO 7
5330 IF L < 5 THEN 5340 ELSE 5350
5340     LPRINT USING "#####";CTTIME(L) ; :GOTO 5360
5350     LPRINT USING "#####";CTTIME(L) ;
5360     SUM = SUM + CTTIME(L)
5370 NEXT L
5380 LPRINT USING "#####";SUM; : SUM = 0
5390 LPRINT :LPRINT " Passenger Minutes ";; LPRINT TAB(21) "";
5400 FOR L = 2 TO 7
5410 IF L < 5 THEN 5420 ELSE 5430
5420     LPRINT USING "#####";CPASSMIN(L) ; : GOTO 5440

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5430     LPRINT USING "*****";CPASSMIN(L) ;
5440     SUM = SUM + CPASSMIN(L)
5450 NEXT L
5460 LPRINT USING "*****";SUM; : SUM = 0
5470 LPRINT: LPRINT " Capacity Miles ";: LPRINT TAB(21) "";
5480 FOR L = 2 TO 7
5490     IF L < 5 THEN 5500 ELSE 5510
5500     LPRINT USING "*****";CCAPMILE(L) ; :GOTO 5520
5510     LPRINT USING "*****";CCAPMILE(L) ;
5520     SUM = SUM + CCAPMILE(L)
5530 NEXT L
5540 LPRINT USING "*****";SUM; : SUM = 0
5550 LPRINT :LPRINT " Seat Miles ";: LPRINT TAB(21) "";
5560 FOR L = 2 TO 7
5570     IF L < 5 THEN 5580 ELSE 5590
5580     LPRINT USING "*****";CSEATMILE(L) ; :GOTO 5600
5590     LPRINT USING "*****";CSEATMILE(L) ;
5600     SUM = SUM + CSEATMILE(L)
5610 NEXT L
5620 LPRINT USING "*****";SUM; : SUM = 0
5630 LPRINT :LPRINT " Trips in Sample ";: LPRINT TAB(21) "";
5640 FOR L = 2 TO 7
5650     IF L < 5 THEN 5660 ELSE 5670
5660     LPRINT USING "*****";CNOTRIPS(L) ; :GOTO 5680
5670     LPRINT USING "*****";CNOTRIPS(L) ;
5680     SUM = SUM + CNOTRIPS(L)
5690 NEXT L
5700 LPRINT USING "*****";SUM; : SUM = 0
5710 IF ANTOT$ = "n" OR ANTOT$ = "N" THEN 5800
5720 LPRINT :LPRINT " Total Trips ";: LPRINT TAB(21) "";
5730 FOR L = 2 TO 7
5740     IF L < 5 THEN 5750 ELSE 5760
5750     LPRINT USING "*****";TOTTRIPS(L) ; :GOTO 5770
5760     LPRINT USING "*****";TOTTRIPS(L) ;
5770     SUM = SUM + TOTTRIPS(L)
5780 NEXT L
5790 LPRINT USING "*****";SUM; : SUM = 0
5800 LPRINT :LPRINT " SAMPLE AVERAGES" ;
5810 LPRINT :LPRINT " Unl. Pass./Trip";: LPRINT TAB(21) "";
5820 FOR L = 2 TO 7
5830     IF L < 5 THEN 5840 ELSE 5850
5840     LPRINT USING "*****";CUNPASS(L) ; :GOTO 5860
5850     LPRINT USING "*****";CUNPASS(L) ;
5860     SUM = SUM + CUNPASS(L)
5870 NEXT L
5880 LPRINT USING "*****";SUM; : SUM = 0
5890 LPRINT :LPRINT " Pass. Miles/Trip";: LPRINT TAB(21) "";
5900 FOR L = 2 TO 7
5910     IF L < 5 THEN 5920 ELSE 5930
5920     LPRINT USING "*****";CPASSMITRIP(L) ; :GOTO 5940
5930     LPRINT USING "*****";CPASSMITRIP(L) ;
5940     SUM = SUM + CPASSMITRIP(L)
5950 NEXT L
5960 LPRINT USING "*****";SUM; : SUM = 0
5970 LPRINT :LPRINT " Unl Pass Trip Time";: LPRINT TAB(21) "";
5980 FOR L = 2 TO 7
5990     IF L < 5 THEN 6000 ELSE 6010
6000     LPRINT USING "*****";CUNPASSTIME(L) ; :GOTO 6020
6010     LPRINT USING "*****";CUNPASSTIME(L) ;
6020     SUM = SUM + CUNPASSTIME(L)
6030 NEXT L
6040 LPRINT USING "*****";SUM; : SUM = 0
6050 IF ANTOT$ = "n" OR ANTOT$ = "N" THEN 6230
6060 LPRINT :LPRINT " ANNUAL TOTALS" ;
6070 LPRINT :LPRINT " Unl. Pass. Trips";: LPRINT TAB(21) "";
6080 FOR L = 2 TO 7

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6090     IF L < 5 THEN 6100 ELSE 6110
6100     LPRINT USING "*****";TOTUNPASS(L) ; :GOTO 6120
6110     LPRINT USING "*****";TOTUNPASS(L) ;
6120     SUM = SUM + TOTUNPASS(L)
6130     NEXT L
6140     LPRINT USING "*****";SUM; : SUM = 0
6150     LPRINT :LPRINT " Passenger Miles";: LPRINT TAB(21) " ";
6160     FOR L = 2 TO 7
6170         IF L < 5 THEN 6180 ELSE 6190
6180         LPRINT USING "*****";TOTPASSMILE(L) ; :GOTO 6200
6190         LPRINT USING "*****";TOTPASSMILE(L) ;
6200         SUM = SUM + TOTPASSMILE(L)
6210     NEXT L
6220     LPRINT USING "*****";SUM; : SUM = 0
6230     LPRINT: PRINT;:PRINT;: GOTO 50
6240     COLOR 7,0,0 :CLS

```



```

1270 F$ = OUTDRV$ + OUTFILES$ + ".OUT"
1280 LOCATE 15,25,0 :PRINT "Retrieving ";F$
1290 OPEN F$ FOR INPUT AS # 1
1300 INPUT # 1,ROUTENO,ROUTENAMES$,NOSTOPS,TRIPDIST,LOOPDIST,TURNPOINT
1310 INPUT # 1,ACTNO,DATADATE$,BLOCK,DAYOFWK,BUSID,SEATS,CAP,CLICK
1320 Z = ACTNO
1330 DIM ACTTIME(Z),ACTONS(Z)
1340 FOR I = 1 TO Z
1350     INPUT #1,A,B,C,ACTTIME(I),D,ACTONS(I),E,F,G
1360 NEXT I
1370 '
1380 CLS
1390 '
1400 '----- display instructions for obtaining a hardcopy -----
1410 '
1420 LOCATE 10,10,0 :
1430 PRINT "The plot will be displayed on the screen."
1440 LOCATE 12,10,0:PRINT "For a printed copy, wait until the plot is complete -
"
1450 LOCATE 13,10,0 :PRINT"Then press the left Shift key together with the Prtsc
key."
1460 LOCATE 15,10,0:PRINT"When you have finished viewing or printing the plot,
1470 LOCATE 16,10,0:PRINT"strike any key to return to the menu. "
1480 LOCATE 18,10,0:PRINT"Strike any key to begin plotting. "
1490 W$ = ""
1500 W$ = INKEY$ :IF W$ ="" THEN 1500
1510 '
1520 '----- SET THE AXES AND PRINT LABELS -----
1530 '
1540 SCREEN 2
1550 LOCATE 1,16,0 : PRINT SYST$;"     ROUTE DEMAND PLOT           ";DATADATE$
1560 LOCATE 2,16,0 : PRINT "ROUTE #";ROUTENO;"     "ROUTENAMES;"     "     BLOCK #";
;BLOCK
1570 LOCATE 2,1,0 :PRINT "P"
1580 LOCATE 3,1,0 :PRINT "A"
1590 LOCATE 4,1,0 :PRINT "S"
1600 LOCATE 5,1,0 :PRINT "S"
1610 LOCATE 6,1,0 :PRINT "E"
1620 LOCATE 7,1,0 :PRINT "N"
1630 LOCATE 8,1,0 :PRINT "G"
1640 LOCATE 9,1,0 :PRINT "E"
1650 LOCATE 10,1,0 :PRINT "R"
1660 LOCATE 11,1,0 :PRINT "S"
1670 LOCATE 14,1,0 :PRINT "P"
1680 LOCATE 15,1,0 :PRINT "E"
1690 LOCATE 16,1,0 :PRINT "R"
1700 LOCATE 19,1,0 :PRINT "H"
1710 LOCATE 20,1,0 :PRINT "O"
1720 LOCATE 21,1,0 :PRINT "U"
1730 LOCATE 22,1,0 :PRINT "R"
1740 LOCATE 3,4,0 :PRINT "50"
1750 LOCATE 7,4,0 :PRINT "40"
1760 LOCATE 10,4,0 :PRINT "30"
1770 LOCATE 14,4,0 :PRINT "20"
1780 LOCATE 18,4,0 :PRINT "10"
1790 LOCATE 22,4,0 :PRINT " 0"
1800 LINE(60,5)-(60,170)
1810 M = 5
1820 LINE (54,M)-(66,M)
1830 LINE (57,M+3)-(63,M+3)
1840 LINE (57,M+6)-(63,M+6)
1850 LINE (57,M+9)-(63,M+9)
1860 LINE (57,M+12)-(63,M+12)
1870 FOR M = 20 TO 150 STEP 30
1880     LINE (50,M)-(70,M)
1890     LINE (57,M+3)-(63,M+3)

```

```

1900     LINE (57,M+6)-(63,M+6)
1910     LINE (57,M+9)-(63,M+9)
1920     LINE (57,M+12)-(63,M+12)
1930     LINE (54,M+15)-(66,M+15)
1940     LINE (57,M+18)-(63,M+18)
1950     LINE (57,M+21)-(63,M+21)
1960     LINE (57,M+24)-(63,M+24)
1970     LINE (57,M+27)-(63,M+27)
1980 NEXT M
1990 '           x - axis
2000 LINE (50,170)-(636,170)
2010 FOR N = 28 TO 572 STEP 64
2020     LINE(N+32,168)-(N+32,174)
2030     LINE(N+64,168)-(N+64,172)
2040 NEXT N
2050     LINE(636,168)-(636,174)
2060 LOCATE 23,8,0
2070 PRINT "4           6           8           10           12           14           16           18           20
.
2080 PRINT "                                     TIME OF DAY (HOURS)";
2090 '
2100 '----- calculate and print the hourly demand -----
2110 '
2120 DIM HOURDEM(24)
2130 I = 1
2140 FOR T = 4 TO 20
2150     IF ACTTIME(I)/240 < T + I THEN HOURDEM(T) = HOURDEM(T) + ACTONS(I)
        ELSE 2170
2160     I = I + 1 : IF I > ACTNO THEN 2180 ELSE 2150
2170 NEXT T
2180 FOR T = 4 TO 21
2190     LINE(32 * T - 65,170) - (32 * (T + 1) - 71, 170 - 3*HOURDEM(T)), ,B
2200 NEXT T
2210 W$ = ""
2220 W$ = INKEY$ : IF W$ = "" THEN 2220
2230 CLS :PRINT : PRINT : PRINT : GOTO 60
2240 SCREEN 0 :KEY ON :COLOR 7,0,0 :CLS :END

```

APPENDIX G. DUMP PROGRAM

```
10 '          <<< DUMP >>>
20 '
30 OPTION BASE 1
40 DIM B(132)
50 DIM C(24)
60 KEY OFF
70 OPEN "COM1:4800,0,8,1,RS,CS,CD,DS"AS #1
80 DEFSTR R
90 REM OPTION BASE 1
100 CLS
110 REM
120 REM
130 REM
140 LOCATE 5,20,1
150 PRINT "L-----DISPLAY # OF LOGS(F001)
160 LOCATE 7,20,1
170 PRINT "D-----DIAG DISPLAY OF LOGS
180 LOCATE 9,20,1
190 PRINT "C-----CLOSE ALL FILES
200 LOCATE 11,20,1
210 PRINT "R-----RESET CSM DATA,TIME,DISTANCE AND LOGS(F002)
220 LOCATE 13,20,1
230 PRINT "T-----TRANSFER DATA FROM CSM(BUS) TO DISK
240 LOCATE 15,20,1
250 PRINT "7-----INSERT TYPE 7/8 LOG
260 LOCATE 17,20,1
270 PRINT "E-----EXIT PROGRAM
280 REM
290 LOCATE 20,20,1
300 PRINT "TYPE SELECTION FOLLOWED BY RETURN
310 LOCATE 21,20,1
320 INPUT "OPTION ";RPLY
330 REM
340 REM
350 IF RPLY="L" OR RPLY="1" THEN GOTO 670
360 IF RPLY="D" OR RPLY="d" THEN GOTO 1610
370 IF RPLY="C" OR RPLY="c" THEN GOTO 1840
380 IF RPLY="7" THEN HI=&HF0:LO=&H0:GOTO 460
390 IF RPLY="R" OR RPLY="r" THEN HI=&HF0:LO=&H2:GOTO 460
400 IF RPLY="T" OR RPLY="t" THEN GOTO 950
410 IF RPLY="E" OR RPLY="e" THEN GOTO 1910
420 CLS
430 PRINT "          INVALID INPUT*****TRY AGAIN*****
440 FOR I=1 TO 100:NEXT I
450 GOTO 130
460 REM THIS SECTION WILL RESET THE CSM MODULE(F002) OR SEND 7 TYPE
470 REM MSG FF FF F0 02 CKSUM OR FF FF F0 00 CKSUM
480 REM RESPONSE MUST BE A1 HEX OR 161 DECIMAL
490 GOSUB 1920
500 A$=INPUT$(5,1)
510 A1$=MID$(A$,1,1):A2$=MID$(A$,2,1):A3$=MID$(A$,3,1)
520 A4$=MID$(A$,4,1):A5$=MID$(A$,5,1)
530 SUM=ASC(A3$)+ASC(A4$)
540 CKSUM=ASC(A5$)
550 GOSUB 2060
560 CLS
570 REM IF STAT$="F" THEN 100
580 LOCATE 1,1,1
590 PRINT STAT$
600 IF ASC(A4$)=161 THEN 610 ELSE 130
610 LOCATE 24,1,1
620 PRINT ASC(A4$)
630 IF RPLY="7" THEN PRINT "TYPE 7 ENTERED, ANY KEY TO CONTINUE":GOTO 650
640 PRINT "CSM RESET A-OK, HIT ANY KEY TO CONTINUE"
650 I$=INKEY$:IF I$="" THEN 650
660 GOTO 670
```

```

670 REM SECTION TO DISPLAY THE NUMBER OF LOGS PRESENT
680 REM INDICATES TOTAL LENGTH OF LOG TABLE
690 REM GIVES THE ADDRESS OF THE LAST BYTE FOR THE LAST LOG
700 REM INITIATED BY SENDING F001 TO CSM
710 REM
720 REM RESPONSE IS HILO ADDRESS OF LAST BYTE--MULTIPLE OF 5
730 REM
740 HI=&HF0
750 LO=&H1
760 GOSUB 1920
770 A$=INPUT$(6,1)
780 A1$=MID$(A$,1,1):A2$=MID$(A$,2,1):A3$=MID$(A$,3,1)
790 A4$=MID$(A$,4,1):A5$=MID$(A$,5,1):A6$=MID$(A$,6,1)
800 SUM=ASC(A3$)+ASC(A4$)+ASC(A5$)
810 CKSUM=ASC(A6$)
820 GOSUB 2060
830 IF STAT$="F" THEN 130
840 CLS
850 LOCATE 2,5,1
860 PRINT "NUMBER OF LOGS
870 LOCATE 2,30,1
880 PRINT "LAST HEX LOCATION
890 LOCATE 3,10,1
900 NUMLOG=(ASC(A4$)*256+ASC(A5$))/5
910 PRINT NUMLOG
920 LOCATE 3,35,1
930 PRINT HEX$(ASC(A4$));HEX$(ASC(A5$))
940 II$=INKEY$:IF II$="Q" OR II$="q" THEN 130 ELSE 670
950 REM THIS SECTION DUMPS LOGS TO SCREEN AND FILE
960 REM STARTS AT FIRST LOG AND GOES UNTIL A TYPE 8 LOG
970 REM OR A LOG TYPE OF 0
980 LOCATE 24,1,1
990 PRINT "S-SCREEN ONLY****D-DISK ONLY****B-BOTH, ENTER CHOICE "
1000 I$=INKEY$:IF I$="" THEN 1000
1010 IF I$="S" OR I$="s" THEN MODE=1:GOTO 1050
1020 IF I$="D" OR I$="d" THEN MODE=2:GOTO 1050
1030 IF I$="B" OR I$="b" THEN MODE=3:GOTO 1050
1040 GOTO 130
1050 IF ((MODE=2) OR (MODE=3)) THEN 1060 ELSE 1160
1060 CLS
1070 INPUT "OUTPUT FILE NAME ",Q$
1080 Q$ = "B:" + Q$ + ".DAT"
1090 OPEN Q$ FOR OUTPUT AS #2
1100 INPUT "24 HR REAL TIME HOUR ",HR$
1110 INPUT "24 HR REAL TIME MINUTES ",MIN$
1120 HI=&HF0
1130 LO=&H0
1140 GOSUB 1920
1150 A$=INPUT$(LOC(1),1)
1160 OFFSET=&H7D
1170 FOR BLK=&H0 TO &H17FF STEP OFFSET
1180 HI=BLK\256
1190 LO=BLK MOD 256
1200 PRINT HEX$(HI),HEX$(LO)
1210 GOSUB 1920
1220 A$=INPUT$(132,1)
1230 FOR I=1 TO 132
1240 B(I)=ASC(MID$(A$,I,1))
1250 NEXT I
1260 REM
1270 SUM =0
1280 FOR J=3 TO 131
1290 SUM=SUM+B(J)
1300 NEXT J
1310 CKSUM=B(132)
1320 GOSUB 2060

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1330 REM IF STAT$="F" THEN CLOSE #2:GOTO 100
1340 CLS
1350 FOR LN =1 TO 25
1360 LNN=1+5*(LN-1)+3
1370 IF B(LNN)=0 THEN GOTO 1430
1380 IF ((MODE=1)OR(MODE=3)) THEN PRINT B(LNN);B(LNN+1);B(LNN+2);B(LNN+3);B(LNN+4)
)
1390 IF ((MODE=2)OR(MODE=3)) THEN PRINT #2,B(LNN);B(LNN+1);B(LNN+2);B(LNN+3);B(LNN
+4)
1400 REM IF B(LNN)=6 THEN GOTO 3380
1410 NEXT LN
1420 NEXT BLK
1430 IF ((MODE=2)OR(MODE=3)) THEN 1440 ELSE 1600
1440 INPUT "INPUT MONTH ",MO$
1450 INPUT "INPUT DAY ",DA$
1460 INPUT "INPUT YEAR ",YR$
1470 INPUT "ROUTE ID ",ID$
1480 INPUT "DAY OF WEEK*1=MON,2=TUE,3=WED,4=THR,5=FRI,6=SAT,7=SUN ",DOW$
1490 INPUT "BLOCK NUMBER ",BLK$
1500 INPUT "VEHICLE NUMBER ",BUSID$
1510 PRINT #2,"12 ";MO$;" "+DA$;" "+YR$;" "+ID$
1520 PRINT "12 ";MO$;" "+DA$;" "+YR$;" "+ID$
1530 PRINT #2,"12 "+DOW$;" "+BLK$;" "+HR$;" "+MIN$
1540 PRINT #2,"12 ";BUSID$;" 0 0 0 "
1550 PRINT "12 ";BUSID$;" 0 0 0 "
1560 PRINT "12 "+DOW$;" "+BLK$;" "+HR$;" "+MIN$
1570 CLOSE #2
1580 IS=INKEY$:IF IS="" THEN 1580
1590 CLS
1600 GOTO 130
1610 HI=&HF0
1620 LO=&H3
1630 REM
1640 GOSUB 1920
1650 A$=INPUT$(24,1)
1660 FOR I=1 TO 24
1670 C(I)=ASC(MID$(A$,I,1))
1680 NEXT I
1690 CLS
1700 PRINT "F DOOR ON",C(1),HEX$(C(1))
1710 PRINT "F DOOR OFF",C(2),HEX$(C(2))
1720 PRINT "R DOOR ON",C(3),HEX$(C(3))
1730 PRINT "R DOOR OFF",C(4),HEX$(C(4))
1740 REM
1750 PRINT "TOT DIST SIN LAST DUMP",C(5),C(6),C(7)
1760 PRINT "TOT TIME SIN LAST DUMP",C(8),C(9),C(10)
1770 REM
1780 PRINT "TIME SIN LAST LOG-15 SEC UNITS",C(11),HEX$(C(11))
1790 PRINT "DIST SIN LAST LOG",C(12),HEX$(C(12))
1800 PRINT "IDLE TIME",C(13),C(14),C(15),C(16)
1810 PRINT "F DOOR OPEN-1 SEC UNITS",C(17),C(18)
1820 PRINT "R DOOR OPEN-1 SEC UNITS",C(19),C(20)
1830 IS=INKEY$:IF IS="Q" THEN 130 ELSE 1610
1840 REM SECTION TO FORCE ALL FILES TO CLOSE AND START FRESH
1850 REM
1860 CLOSE
1870 LOCATE 24,1,1
1880 PRINT "ALL FILES HAVE BEEN CLOSED, HIT ANY KEY TO CONTINUE"
1890 IS=INKEY$:IF IS="" THEN 1890
1900 GOTO 70
1910 STOP
1920 REM SENDING MESSAGE TO CSM
1930 REM FORMAT FF FF HI LO CKSUM
1940 REM HI=HIGHBYTE LO=LOWBYTE CKSUM=CHECKSUM
1950 REM HI AND LO MUST BE SET BEFORE CALLING
1960 IF ((HI=0)AND(LO=0)) THEN CK3=0:GOTO 2010

```

```

1970 CK1=LO+HI:IF CK1>255 THEN CK1=CK1 XOR 256
1980 CK2= NOT(CK1)
1990 CK2=CK2+1
2000 CK3=CK2+256
2010 REM
2020 PRINT#1,CHR$(255);CHR$(255);CHR$(HI);CHR$(LO);CHR$(CK3);
2030 REM SHORT DELAY FOR CSM TO RESPOND
2040 FOR K=1 TO 50:NEXT K
2050 RETURN
2060 REM THIS ROUTINE COMPARES THE CHECKSUM FOR THE RECEIVED MSG
2070 REM IF IT IS A MATCH STAT$="T",IF NOMATCH STAT$="F"
2080 REM EXPECTS VARIABLE SUM TOBE SUM OF THE DATA BYTES
2090 REM EXPECTS CKSUM VARIABLE TOBE THE RECEIVED CHECKSUM
2100 REM
2110 CK5=128
2120 CK5=CK5+SUM
2130 CK6=CK5
2140 IF CK6>255 THEN CK6=CK6 AND 255
2150 CK7=NOT(CK6):CK7=CK7+1
2160 CK8=CK7+256+128
2170 IF CK8=CKSUM THEN STAT$="T":RETURN
2180 STAT$="F":RETURN
2190 REM
2200 REM
2210 LIST 670-950

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Attention Patron:

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numbering

Attention Patron:

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numbering

3 0 0 0 0
5 6 169 1 0
4 5 1 0 0
5 5 211 2 0
5 4 196 1 0
4 4 5 0 0
5 1 55 1 0
5 2 39 3 0
5 4 90 1 1
5 2 75 1 0
5 2 52 1 0
5 5 209 0 1
4 3 0 0 0
4 6 1 0 0
5 5 213 0 1
5 2 76 2 0
4 6 3 0 0
4 5 1 0 0
4 6 0 0 0
5 7 90 3 4
3 6 54 0 0
5 2 2 6 1
4 11 2 0 0
5 2 53 1 1
4 6 5 0 0
4 4 0 0 0
5 2 27 0 1
5 2 52 1 0
5 3 118 0 1
5 4 154 1 0
5 4 219 0 1
5 5 152 0 1
5 5 177 2 0
5 3 191 0 1
4 5 3 0 0
5 2 90 0 2
5 5 216 0 1
11 5 166 0 1
3 2 0 0 0
6 18 1 0 0
5 0 0 1 2
4 10 3 0 0
4 2 0 0 0
3 6 99 0 0
6 5 2 0 0
5 0 1 2 1
4 4 2 0 0
4 3 5 0 0
4 5 1 0 0
4 5 3 0 0
5 2 95 0 1

```

4 4 0 0 0
4 5 2 0 0
4 4 3 0 0
4 4 1 0 0
4 7 2 0 0
4 3 3 0 0
4 8 0 0 0
3 7 93 0 0
6 7 1 0 0
5 3 52 0 2
4 14 1 0 0
4 6 5 0 0
4 10 4 0 0
4 2 4 0 0
4 9 1 0 0
5 3 173 0 1
4 5 1 0 0
4 5 1 0 0
4 5 4 0 0
4 4 2 0 0
4 3 3 0 0
4 5 7 0 0
11 5 210 0 1
3 2 0 0 0
6 8 2 0 0
5 4 104 1 0
4 5 3 0 0
4 10 5 0 0
4 3 0 0 0
4 4 1 0 0
5 2 63 1 0
3 9 234 0 0
4 7 3 0 0
5 2 21 0 3
5 4 161 0 1
5 3 134 1 0
4 7 2 0 0
5 4 252 1 0
4 5 1 0 0
4 5 0 0 0
4 8 2 0 0
3 10 138 0 0
5 4 2 10 4
5 2 26 0 1
5 4 110 1 0
5 4 70 1 0
4 4 0 0 0
4 4 1 0 0
5 4 144 0 1
5 3 109 0 1
4 4 2 0 0

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5 2 80 0 2
5 7 244 0 1
5 4 177 0 2
5 4 191 0 1
5 5 205 0 1
5 4 145 0 5
4 5 0 0 0
4 7 2 0 0
11 2 13 0 1
3 2 0 0 0
6 19 1 0 0
5 1 0 6 2
5 10 224 1 0
4 5 2 0 0
4 6 1 0 0
5 1 5 1 0
4 5 3 0 0
4 4 2 0 0
4 3 5 0 0
4 4 2 0 0
5 3 98 1 0
5 3 18 4 0
4 6 3 0 0
4 5 1 0 0
4 4 2 0 0
4 6 0 0 0
4 4 4 0 0
4 6 0 0 0
5 5 114 0 2
3 6 90 0 0
5 1 3 2 2
5 10 123 3 0
4 9 0 0 0
5 8 254 1 0
4 8 0 0 0
5 1 57 0 1
5 3 124 0 1
4 9 0 0 0
5 2 86 0 1
4 4 0 0 0
5 3 113 0 1
4 3 1 0 0
4 5 3 0 0
4 3 1 0 0
4 3 5 0 0
11 1 83 0 1
4 6 6 0 0
5 7 232 2 0
5 3 97 3 0
5 3 115 0 1
5 4 86 0 1

5	5	155	2	0
5	3	182	1	0
4	4	1	0	0
4	5	0	0	0
5	0	2	2	0
5	3	130	1	0
4	4	4	0	0
4	6	4	0	0
4	4	0	0	0
5	1	26	1	2
5	8	185	2	0
5	3	146	1	1
4	4	3	0	0
5	4	149	1	0
4	8	0	0	0
5	9	194	0	4
3	8	62	0	0
6	4	2	0	0
5	0	0	8	4
5	3	20	2	0
4	8	3	0	0
5	2	30	0	2
4	6	0	0	0
4	8	3	0	0
5	3	27	0	4
4	4	1	0	0
4	3	0	0	0
4	7	0	0	0
4	3	1	0	0
4	7	0	0	0
5	1	39	0	1
4	5	4	0	0
5	5	156	2	1
5	5	60	0	5
11	7	143	0	1
3	1	0	0	0
6	15	1	0	0
5	0	0	5	3
3	8	143	0	0
5	9	188	1	0
4	6	4	0	0
4	3	3	0	0
5	4	255	1	0
4	4	4	0	0
4	4	2	0	0
4	4	3	0	0
4	6	3	0	0
4	5	0	0	0
4	5	4	0	0
4	7	3	0	0
4	5	1	0	0

4 7 4 0 0
 5 4 125 0 2
 3 7 86 0 0
 5 0 3 1 4
 5 4 49 2 0
 5 5 76 5 0
 4 8 2 0 0
 5 7 143 1 0
 4 5 3 0 0
 4 3 4 0 0
 5 7 205 0 1
 5 2 25 0 1
 5 2 38 0 3
 5 4 135 0 1
 5 3 123 1 0
 5 3 54 0 1
 5 2 52 0 1
 4 5 5 0 0
 4 4 1 0 0
 4 3 0 0 0
 4 3 0 0 0
 4 8 4 0 0
 4 3 2 0 0
 11 6 166 0 1
 3 3 0 0 0
 6 9 2 0 0
 5 0 1 1 0
 5 3 98 1 0
 5 5 111 2 2
 4 6 0 0 0
 4 4 1 0 0
 4 4 2 0 0
 4 4 0 0 0
 5 4 41 0 1
 4 4 3 0 0
 4 5 4 0 0
 4 7 0 0 0
 4 11 2 0 0
 4 2 3 0 0
 4 7 0 0 0
 4 7 1 0 0
 3 7 113 0 0
 5 6 77 0 2
 5 2 5 1 0
 3 6 52 0 0
 6 10 2 0 0
 5 0 0 3 2
 5 8 134 0 1
 4 7 2 0 0
 4 4 0 0 0
 4 8 2 0 0

5 7 168 1 0
4 5 3 0 0
4 7 9 0 0
4 3 10 0 0
5 8 216 1 0
4 5 10 0 0
4 7 2 0 0
5 5 47 0 1
11 7 140 0 1
5 1 1 1 4
3 4 0 0 0
4 14 0 0 0
5 4 68 0 1
4 7 1 0 0
5 4 40 1 0
4 3 8 0 0
5 1 20 1 0
5 6 153 2 0
5 5 219 1 0
5 7 151 1 0
4 4 6 0 0
4 5 4 0 0
5 1 35 1 0
5 3 55 1 1
4 6 2 0 0
5 0 5 0 1
4 5 5 0 0
4 6 1 0 0
4 6 7 0 0
4 4 0 0 0
5 3 112 3 0
5 7 110 0 1
5 4 87 1 6
5 3 50 0 1
5 5 69 4 1
4 10 3 0 0
5 2 40 0 1
4 6 5 0 0
4 4 9 0 0
5 4 226 0 1
5 3 80 0 1
4 6 2 0 0
5 3 61 2 0
5 2 55 0 1
4 5 6 0 0
4 5 1 0 0
5 1 52 1 0
5 3 47 0 2
11 2 99 0 1
5 1 2 0 1
4 3 4 0 0

4 3 1 0 0
 4 6 1 0 0
 5 4 203 1 0
 5 4 170 0 3
 4 11 0 0 0
 4 5 0 0 0
 4 4 5 0 0
 5 3 133 1 0
 4 3 4 0 0
 5 3 14 0 1
 5 2 72 2 0
 4 5 2 0 0
 4 4 7 0 0
 5 1 59 1 0
 4 5 5 0 0
 4 3 3 0 0
 5 3 157 0 2
 5 2 86 0 1
 4 6 0 0 0
 4 9 4 0 0
 5 2 59 0 2
 3 6 59 0 0
 6 16 2 0 0
 5 0 1 6 2
 5 6 54 1 0
 5 7 146 0 1
 4 4 16 0 0
 4 3 1 0 0
 5 2 123 0 1
 5 2 49 0 1
 5 3 66 0 1
 4 4 5 0 0
 4 5 1 0 0
 4 4 11 0 0
 4 4 3 0 0
 4 4 12 0 0
 4 7 2 0 0
 5 4 50 3 0
 5 4 58 1 1
 3 8 143 0 0
 11 3 0 0 1
 6 2 1 0 0
 5 0 1 2 4
 4 8 2 0 0
 4 8 8 0 0
 5 4 94 1 0
 5 3 89 1 0
 4 4 7 0 0
 5 4 137 3 0
 5 3 169 1 0
 5 7 238 2 0

5	4	128	1	0
5	3	104	1	0
5	4	152	1	0
5	4	140	2	0
4	5	7	0	0
4	4	2	0	0
4	7	0	0	0
4	6	5	0	0
4	4	5	0	0
5	1	16	0	1
4	10	3	0	0
5	5	37	3	6
5	4	52	1	4
5	6	71	6	1
4	10	1	0	0
5	6	93	0	1
5	5	164	0	1
4	8	8	0	0
5	2	50	0	1
4	6	1	0	0
5	2	46	0	1
5	6	162	0	1
5	4	31	0	2
5	3	126	0	1
5	3	106	0	1
4	6	0	0	0
5	3	138	0	1
5	2	56	0	1
4	4	1	0	0
5	2	128	0	1
4	4	3	0	0
4	4	0	0	0
5	4	217	0	1
5	5	147	3	0
3	6	96	0	0
11	1	0	0	1
5	2	2	4	0
5	5	112	2	2
4	8	5	0	0
4	3	5	0	0
5	2	101	0	1
4	4	1	0	0
5	6	189	0	1
4	3	0	0	0
5	7	129	1	0
5	3	106	0	1
4	4	1	0	0
4	7	4	0	0
4	5	5	0	0
5	2	63	1	0
5	3	87	1	0

4 6 5 0 0
 5 7 240 0 1
 3 10 132 0 0
 6 7 2 0 0
 5 0 2 5 7
 5 1 19 1 0
 5 4 31 2 1
 4 9 1 0 0
 4 3 3 0 0
 4 4 4 0 0
 5 6 248 0 1
 4 5 1 0 0
 4 6 2 0 0
 4 3 0 0 0
 4 8 9 0 0
 5 3 58 0 1
 4 8 4 0 0
 5 5 158 1 0
 3 7 59 0 0
 5 1 2 1 4
 3 7 142 0 0
 11 15 0 0 1
 6 3 1 0 0
 5 0 1 7 4
 4 8 7 0 0
 4 9 1 0 0
 5 2 61 1 0
 5 4 34 4 0
 5 5 175 2 0
 5 3 113 1 0
 5 3 77 1 0
 4 5 13 0 0
 5 3 176 0 1
 4 5 0 0 0
 5 3 215 1 0
 3 7 138 0 0
 5 1 1 6 1
 4 7 0 0 0
 5 3 94 0 2
 4 4 1 0 0
 4 8 1 0 0
 4 4 1 0 0
 4 6 2 0 0
 5 3 77 0 1
 5 10 156 2 8
 5 3 52 1 4
 5 7 77 3 2
 4 8 7 0 0
 5 6 136 0 1
 4 8 2 0 0
 4 3 4 0 0

5 2 27 1 1
4 11 0 0 0
5 5 196 1 0
4 5 1 0 0
5 3 159 0 1
5 3 71 0 1
5 2 62 1 0
5 4 81 0 1
5 3 91 0 1
4 4 13 0 0
5 3 198 0 1
4 6 7 0 0
4 3 0 0 0
5 2 17 0 1
5 4 146 0 1
11 2 93 0 1
3 9 113 0 0
5 1 1 5 2
5 2 91 0 1
5 8 38 0 1
4 7 8 0 0
5 4 227 1 0
4 3 5 0 0
5 4 185 0 1
4 4 0 0 0
4 5 1 0 0
5 2 114 0 1
5 3 123 0 1
4 10 3 0 0
4 3 4 0 0
4 6 10 0 0
4 6 3 0 0
5 5 128 0 1
5 8 134 2 1
5 3 21 2 0
5 6 177 0 1
5 4 109 0 1
4 4 1 0 0
4 4 2 0 0
4 6 16 0 0
4 3 6 0 0
5 7 251 0 1
4 3 0 0 0
3 6 108 0 0
4 10 1 0 0
3 4 34 0 0
5 1 3 0 1
4 7 1 0 0
5 5 123 2 0
11 6 143 0 1
3 3 0 0 0

5 2 2 3 0
3 11 137 0 0
4 6 5 0 0
4 4 9 0 0
5 2 43 1 0
4 3 5 0 0
4 4 10 0 0
4 4 7 0 0
4 4 3 0 0
4 4 1 0 0
5 2 24 1 0
4 5 8 0 0
4 5 5 0 0
4 5 3 0 0
4 3 8 0 0
5 4 151 1 0
4 6 3 0 0
5 4 64 2 0
5 6 88 1 2
5 2 46 2 0
4 14 0 0 0
5 1 25 1 0
4 7 5 0 0
5 1 47 0 1
4 7 5 0 0
5 3 176 0 1
5 6 180 1 1
4 6 5 0 0
5 5 220 0 1
5 2 51 0 1
4 4 6 0 0
5 2 80 0 1
4 4 7 0 0
5 3 50 0 1
4 3 3 0 0
4 5 9 0 0
4 3 4 0 0
3 7 164 0 0
5 1 2 0 2
3 6 97 0 0
11 3 0 0 1
6 10 2 0 0
5 0 1 2 2
4 7 2 0 0
4 4 4 0 0
4 3 3 0 0
4 3 0 0 0
5 7 220 1 0
4 4 0 0 0
4 4 2 0 0
4 8 0 0 0

4 5 11 0 0
 4 6 0 0 0
 4 4 2 0 0
 4 8 1 0 0
 3 12 159 0 0
 5 2 2 4 0
 5 4 6 1 0
 4 8 13 0 0
 5 2 139 0 1
 4 6 0 0 0
 5 6 189 0 2
 4 4 5 0 0
 4 4 2 0 0
 5 2 69 0 1
 4 7 8 0 0
 4 2 2 0 0
 5 5 119 0 1
 4 5 5 0 0
 5 8 249 1 0
 11 8 201 0 1
 3 1 0 0 0
 5 4 3 2 1
 4 12 1 0 0
 4 6 1 0 0
 4 2 1 0 0
 4 3 3 0 0
 5 4 241 0 1
 4 5 2 0 0
 5 3 161 0 1
 4 5 0 0 0
 5 1 31 0 1
 4 5 3 0 0
 4 3 1 0 0
 4 7 1 0 0
 4 6 0 0 0
 5 4 127 0 1
 5 10 235 1 1
 3 8 82 0 0
 6 35 1 0 0
 5 0 0 1 0
 7 2 0 191 163
 8 0 1 207 93
 3 3 0 0 0
 12 7 17 86 1
 12 4 16 19 13
 12 194 0 0 0

H.2 B17JUL25.DAT

1 0 0 0 0
11 6 42 0 1
3 2 0 0 0
6 58 1 0 0
5 0 0 3 2
4 5 5 0 0
4 5 2 0 0
4 6 0 0 0
4 8 2 0 0
4 6 0 0 0
4 3 0 0 0
4 4 1 0 0
11 5 140 0 1
4 5 5 0 0
4 5 3 0 0
4 5 0 0 0
4 3 4 0 0
4 4 4 0 0
4 3 1 0 0
4 3 3 0 0
5 3 125 1 0
5 6 248 1 0
4 4 2 0 0
5 4 164 0 1
4 4 1 0 0
5 2 51 1 0
4 4 0 0 0
5 1 9 2 0
5 5 183 1 0
5 2 72 1 0
4 5 2 0 0
4 4 4 0 0
5 8 241 0 1
5 2 37 1 0
4 3 1 0 0
5 5 242 1 0
4 5 0 0 0
4 6 2 0 0
5 3 42 0 1
3 11 131 0 0
5 1 1 4 0
3 6 6 0 0
6 16 2 0 0
5 0 1 7 1
5 4 169 0 4
5 5 235 0 1
5 6 224 1 1

5 5 220 1 0
4 4 2 0 0
4 3 2 0 0
5 2 75 1 0
4 5 4 0 0
4 3 2 0 0
5 1 17 0 1
4 6 1 0 0
4 6 2 0 0
5 2 67 0 2
11 3 95 0 1
3 3 0 0 0
6 44 2 0 0
5 0 1 2 3
4 8 5 0 0
4 6 4 0 0
5 3 172 1 0
4 5 3 0 0
5 3 103 1 0
4 3 1 0 0
4 5 1 0 0
4 3 4 0 0
5 2 66 1 0
4 6 3 0 0
4 4 1 0 0
4 3 4 0 0
4 6 3 0 0
4 3 4 0 0
4 3 3 0 0
5 7 151 0 1
3 5 48 0 0
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3 8 59 0 0
6 6 1 0 0
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5 4 194 0 2
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4 5 2 0 0
5 2 64 0 1
4 6 0 0 0
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4 10 2 0 0
5 1 14 1 0
4 3 0 0 0

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12 5 17 18 58
12 194 0 0 0

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APPENDIX I. BUS STOP LISTINGS

ROANOKE VALLEY METRO
BLOCK # 16 ROUTE # 1

BUS STOP LISTING PREPARED 08-25-1986 PAGE 1
COVE ROAD - PROSPECT HILLS 7-17-86

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
41	JEFFERSON & MAPLE	0	0.07	5:37:30			1	1	0
102	ROUTT & BLACK OAK	0	6.55	5:49:15			1	0	1
105	FERNCLIFF APTS. S.	0	6.67	5:53:30			1	0	2
113	COVE ROAD & FRESNO	0	7.51	5:56:30			1	0	3
129	STAUNTON & 21 st	0	8.95	5:59:15			1	0	4
132	STAUNTON & 18 th	0	9.20	6: 0:15			1	0	5
139	STAUNTON & 12 th	0	9.76	6: 2:30			5	0	10
154	JEFFERSON & WELLS	0	11.26	6: 6:45			1	0	11
160	SALEM & 1 st	0	11.87	6: 9:30			0	1	10
161	JEFFERSON & CAMPBEL	0	12.00	6:10:15			0	3	7
164	JEFFERSON & FRANKLI	0	12.09	6:16:30			3	3	7
165	JEFFERSON & BULLIT	0	12.18	6:17: 0			1	0	8
179	JEFFERSON & MC CLAN	0	13.47	6:20: 0			0	5	3
180	JEFFERSON & 22 nd	0	13.56	6:20:45			0	1	2
190	26 th & AVENHAM	0	14.32	6:23:15			1	0	3
204	FRANKLIN & PENARTH	0	15.61	6:26: 0			0	1	2
1	BRENDLES	4	16.25	6:35:45	6:30: 0	- 5:45	3	3	2
9	FRANKLIN (COLONY HO	4	17.39	6:39:15			1	0	3
32	JEFFERSON & YELLOW	4	19.33	6:43:15			1	0	4
41	JEFFERSON & MAPLE	0	21.48	6:49:45			0	2	2
42	JEFFERSON & ALBEMAR	2	21.68	6:50:45			1	0	3
50	CAMPBELL & MARKET S	0	22.16	6:57: 0			1	3	1
51	WILLIAMSON (YELLOW	0	22.37	6:58: 0			1	0	2
74	STAUNTON & 16 th	2	24.72	7: 7:30			1	0	3
103	ROUTT & FERNCLIFF	2	27.57	7:14:30			0	1	2
106	FERNCLIFF (RUFFNER	2	27.95	7:17:30			1	0	3
113	COVE ROAD & FRESNO	0	28.72	7:20: 0			2	0	5
117	COVE ROAD & FAIRLAN	0	29.03	7:21: 0			1	0	6
122	LAFAYETTE & DELAWAR	0	29.55	7:22:15			1	0	7
123	LAFAYETTE & CLIFTON	0	29.61	7:22:45			3	0	10
125	LAFAYETTE & STAUNTO	0	29.76	7:23:45			1	1	10
126	STAUNTON & 24 th	2	29.88	7:24:15			1	0	11
127	STAUNTON & 23 rd	4	29.96	7:24:45			1	0	12
131	STAUNTON & 19 th	4	30.30	7:26: 0			0	1	11
144	ORANGE & 8 th	0	31.48	7:29:30			0	1	10
145	ORANGE & 5 th	4	31.61	7:30: 0			2	0	12
161	JEFFERSON & CAMPBEL	0	33.01	7:36: 0			3	4	11
162	JEFFERSON & CHURCH	4	33.10	7:38: 0	7:35: 0	- 3: 0	6	1	16
169	JEFFERSON & ALBEMAR	4	33.60	7:41:15			1	1	16
178	JEFFERSON & WELLER	2	34.49	7:44:15	7:42: 0	- 2:15	0	1	15
179	JEFFERSON & MC CLAN	2	34.57	7:44:45			1	0	16
181	JEFFERSON & 23 rd	4	34.76	7:45:30			0	1	15
184	JEFFERSON & 26 th	2	35.01	7:46:30			1	0	16
189	26 th & WYCLIFF	2	35.37	7:47:30			0	1	15
192	AVENHAM & 28 th	4	35.62	7:48:45			0	1	14
195	AVENHAM & CASSELL	4	35.90	7:50: 0			2	0	16
198	AVENHAM & WHITE OAK	4	36.21	7:50:45			0	1	15
204	FRANKLIN & PENARTH	4	36.78	7:52:30			0	2	13
205	FRANKLIN (TANGLEWOO	0	37.13	7:53:45			0	1	12
1	BRENDLES	3	37.40	8: 0: 0	7:55: 0	- 5: 0	1	2	11
7	FRANKLIN (SHELL)	3	38.41	8: 5:45			2	1	12

ROANOKE VALLEY METRO
BLOCK # 16 ROUTE # 1

BUS STOP LISTING
COVE ROAD - PROSPECT HILLS

PREPARED 08-25-1986

PAGE 2
7-17-86

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
29	JEFFERSON & 24 th	3	40.24	8:10:30			0	1	11
50	CAMPBELL & MARKET S	0	43.41	8:23:30			0	2	9
73	STAUNTON & 15 th	0	45.80	8:34:30			0	1	8
105	FERNCLIFF APTS. S.	0	48.83	8:46:0			1	0	9
121	LAFAYETTE & MASSACH	0	50.62	8:52:0			1	0	10
131	STAUNTON & 19 th	0	51.45	8:56:30			0	3	7
134	STAUNTON & 16 th	0	51.71	8:57:30			0	1	6
137	STAUNTON & 14 th	0	51.93	8:58:15			1	0	7
145	ORANGE & 5 th	0	52.76	9:1:0			1	0	8
163	JEFFERSON (HEIRONIM	0	54.24	9:9:0			10	4	14
164	JEFFERSON & FRANKLI	0	54.28	9:9:30			0	1	13
165	JEFFERSON & BULLIT	0	54.46	9:10:30			1	0	14
167	JEFFERSON & MOUNTAI	0	54.57	9:11:30			1	0	15
178	JEFFERSON & WELLER	0	55.64	9:14:30	9:12:0 - 2:30		0	1	14
180	JEFFERSON & 22 nd	0	55.82	9:15:15			0	1	13
187	26 th & ROSALIND	0	56.37	9:16:45			0	2	11
192	AVENHAM & 28 th	0	56.76	9:18:30			0	1	10
195	AVENHAM & CASSELL	0	57.05	9:19:30			0	2	8
198	AVENHAM & WHITE OAK	0	57.36	9:20:30			0	1	7
202	FRANKLIN (K-MART)	0	57.70	9:21:45			0	1	6
204	FRANKLIN & PENARTH	0	57.93	9:22:45			0	5	1
1	BRENDES	4	58.79	9:31:45	9:25:0 - 6:45		6	2	5
3	FRANKLIN & ELM VIEW	4	59.15	9:34:15			1	0	6
10	FRANKLIN (BERGLUND	4	60.00	9:37:15			1	0	7
32	JEFFERSON & YELLOW	0	61.84	9:42:0			1	0	8
33	JEFFERSON & WELLER	0	61.87	9:42:45			4	0	12
46	JEFFERSON (LIBRARY)	0	64.57	9:51:45			0	2	10
49	JEFFERSON & CAMPBEL	0	64.72	9:53:30			2	2	10
50	CAMPBELL & MARKET S	0	64.92	9:56:0			3	0	13
59	GAINSBORO & MADISON	2	65.75	10:0:15			1	0	14
63	ORANGE & 5 th	4	66.26	10:2:30			0	1	13
64	ORANGE & 8 th	4	66.46	10:3:15			0	1	12
70	STAUNTON & 13 th	4	67.01	10:6:0			0	1	11
78	STAUNTON & 20 th	4	67.61	10:7:45			0	1	10
104	FERNCLIFF APTS. N.	4	70.23	10:14:45	10:10:0 - 4:45		2	0	12
105	FERNCLIFF APTS. S.	4	70.39	10:15:30			3	0	15
107	FERNCLIFF (HILLS)	4	70.58	10:16:15			0	1	14
108	FERNCLIFF & HERSHBE	2	70.72	10:17:15			0	1	13
110	HERSHBERGER & COVE	4	70.97	10:18:30			2	0	15
113	COVE ROAD & FRESNO	4	71.26	10:19:15			1	0	16
122	LAFAYETTE & DELAWAR	4	72.10	10:21:30			2	0	18
125	LAFAYETTE & STAUNTO	4	72.31	10:22:15			1	0	19
141	11 th & HANOVER	4	73.61	10:26:0			1	2	18
144	ORANGE & 8 th	4	73.91	10:28:0			2	0	20
145	ORANGE & 5 th	4	74.15	10:28:45			1	1	20
151	GAINSBORO & PATTON	4	74.81	10:30:45			1	0	21
161	JEFFERSON & CAMPBEL	2	75.55	10:35:0			0	4	17
162	JEFFERSON & CHURCH	4	75.65	10:38:0	10:35:0 - 3:0		8	4	21
163	JEFFERSON (HEIRONIM	2	75.68	10:38:45			2	0	23
169	JEFFERSON & ALBEMAR	2	76.15	10:41:15			0	2	21
178	JEFFERSON & WELLER	0	77.03	10:45:30	10:42:0 - 3:30		0	4	17
203	FRANKLIN & TOWNSIDE	4	79.18	10:51:45			0	1	16

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
206	SUPER X	4	79.86	10:54:15			2	1	17
207	PENNEY'S	2	79.95	10:55:30			0	5	12
1	BRENDLES	3	80.19	11: 1:15	10:55: 0	- 6:15	5	3	14
5	FRANKLIN & TANGLEWO	4	80.73	11: 5:30			1	0	15
16	AVENHAM & CASSELL	4	81.98	11: 8:45			1	0	16
46	JEFFERSON (LIBRARY)	0	85.97	11:21:30			0	2	14
49	JEFFERSON & CAMPBEL	0	86.11	11:23:15			1	4	11
50	CAMPBELL & MARKET S	0	86.19	11:24:15			2	0	13
51	WILLIAMSON (YELLOW	0	86.32	11:25:30			5	0	18
57	GAINSBORO & PATTON	2	86.97	11:29:15			1	0	19
66	ORANGE & 11 th	4	88.14	11:33: 0			0	1	18
67	11 th & HANNOVER	4	88.19	11:33:30			0	1	17
68	11 th & STAUNTON	4	88.25	11:34: 0	11:28: 0	- 6: 0	0	3	14
71	STAUNTON & 14 th	4	88.47	11:35: 0			0	1	13
74	STAUNTON & 16 th	2	88.67	11:35:45			1	0	14
75	STAUNTON & 17 th	4	88.75	11:36:30			0	1	13
76	STAUNTON & 18 th	4	88.84	11:37: 0			0	1	12
104	FERNCLIFF APTS. N.	4	91.63	11:48: 0	11:40: 0	- 8: 0	1	0	13
105	FERNCLIFF APTS. S.	4	91.79	11:48:45			1	0	14
107	FERNCLIFF (HILLS)	4	91.97	11:50: 0			2	2	14
125	LAFAYETTE & STAUNTO	4	93.70	11:55:30			0	1	13
161	JEFFERSON & CAMPBEL	2	96.95	12: 9:30			0	2	11
161	JEFFERSON & CAMPBEL	2	96.95	12:10: 0			1	0	12
164	JEFFERSON & FRANKLI	0	97.04	12:14: 0			3	2	13
165	JEFFERSON & BULLIT	0	97.26	12:16: 0			0	1	12
182	JEFFERSON & 24 th	0	98.79	12:22:30			1	0	13
201	FRANKLIN & DUKE OF	0	100.42	12:28:15			1	0	14
207	PENNEY'S	2	101.35	12:32:30			0	1	13
1	BRENDLES	4	101.58	12:34:30	12:30: 0	- 4:30	1	4	10
5	FRANKLIN & TANGLEWO	0	102.11	12:40: 0			0	1	9
7	FRANKLIN (SHELL)	2	102.59	12:42:45			1	0	10
13	AVENHAM & SOMERSET	2	103.05	12:43:45			1	0	11
15	AVENHAM & CLYDESDAL	4	103.30	12:45:15			2	0	13
19	AVENHAM & 28th	4	103.65	12:46:30			1	0	14
22	26 th & WYCLIFFE	4	103.90	12:48:15			1	0	15
33	JEFFERSON & WELLER	4	104.80	12:50:45			1	0	16
34	ROANOKE MEMORIAL (1	4	104.89	12:51:30	12:45: 0	- 6:30	1	1	16
38	BELLEVIEW & LAUREL	0	105.32	12:53: 0			0	1	15
44	JEFFERSON & MOUNTAI	0	107.19	12:59: 0			3	0	18
46	JEFFERSON (LIBRARY)	2	107.37	13: 0:45			0	1	17
48	JEFFERSON & CHURCH	4	107.51	13: 1:45	12:55: 0	- 6:45	1	6	12
49	JEFFERSON & CAMPBEL	4	107.59	13: 2:30			0	1	11
50	CAMPBELL & MARKET S	2	107.70	13: 3:45			4	1	14
54	WELLS & JEFFERSON	0	108.19	13: 6:45			0	1	13
65	ORANGE & 10 th	2	109.41	13:10:15			0	1	12
66	ORANGE & 11 th	2	109.54	13:11: 0			0	1	11
74	STAUNTON & 16 th	4	110.06	13:13:15			2	0	13
75	STAUNTON & 17 th	4	110.15	13:13:45			0	1	12
86	LAFAYETTE & DELAWAR	4	111.08	13:16:30			1	0	13
87	LAFAYETTE & MASSACH	4	111.15	13:17:15			0	2	11
88	LAFAYETTE & FLORIDA	4	111.32	13:18: 0			0	1	10
103	ROUTT & FERNCLIFF	4	112.90	13:22: 0			1	0	11

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
105	FERNCLIFF APTS. S.	4	113.18	13:23: 0			0	3	8
120	LAFAYETTE & FLORIDA	4	114.65	13:28:45			1	0	9
125	LAFAYETTE & STAUNTO	4	115.10	13:30:15			0	1	8
126	STAUNTON & 24 th	4	115.21	13:30:45			2	0	10
138	STAUNTON & 13 th	4	116.16	13:33:15			1	0	11
147	ORANGE & GAINSBORO	2	117.26	13:36: 0			0	2	9
149	GAINSBORO & MADISON	2	117.40	13:36:30			0	1	8
161	JEFFERSON & CAMPBEL	0	118.33	13:40:45			0	2	6
162	JEFFERSON & CHURCH	4	118.43	13:46:15	13:40: 0	- 6:15	6	2	10
164	JEFFERSON & FRANKLI	2	118.52	13:47:45			1	0	11
167	JEFFERSON & MOUNTAI	4	118.76	13:49:30			0	1	10
178	JEFFERSON & WELLER	2	119.82	13:51:45	13:47: 0	- 4:45	0	1	9
179	JEFFERSON & MC CLAN	4	119.90	13:52:15			0	1	8
180	JEFFERSON & 22 nd	2	120.00	13:53: 0			0	1	7
206	SUPER X	4	122.64	14: 1: 0			3	0	10
207	PENNEY'S	4	122.73	14: 2: 0			1	1	10
1	BRENDALES	3	122.97	14: 5:15	14: 0: 0	- 5:15	2	4	8
7	FRANKLIN (SHELL)	4	123.97	14:10:15			1	0	9
9	FRANKLIN (COLONY HO	4	124.11	14:11: 0			1	0	10
16	AVENHAM & CASSELL	4	124.76	14:13: 0			3	0	13
19	AVENHAM & 28th	2	125.04	14:13:45			1	0	14
24	26 th & ROSALIND	4	125.42	14:15:30			2	0	16
27	26 th & JEFFERSON	4	125.63	14:16:30			1	0	17
29	JEFFERSON & 24 th	4	125.80	14:17:15			1	0	18
32	JEFFERSON & YELLOW	4	126.05	14:18:15			1	0	19
34	ROANOKE MEMORIAL (1	4	126.27	14:19:15	14:15: 0	- 4:15	2	0	21
42	JEFFERSON & ALBEMAR	4	128.41	14:26: 0			0	1	20
48	JEFFERSON & CHURCH	0	128.89	14:29:45	14:25: 0	- 4:45	3	6	17
49	JEFFERSON & CAMPBEL	0	128.98	14:30:45			1	4	14
50	CAMPBELL & MARKET S	0	129.09	14:32:15			6	1	19
55	JEFFERSON & GILMER	0	129.66	14:36:15			0	1	18
59	GAINSBORO & MADISON	2	129.93	14:37:30			0	1	17
63	ORANGE & 5 th	4	130.44	14:40: 0			0	1	16
66	ORANGE & 11 th	4	130.93	14:42: 0			0	1	15
70	STAUNTON & 13 th	4	131.19	14:43:30			0	1	14
71	STAUNTON & 14 th	4	131.24	14:44:30			0	2	12
74	STAUNTON & 16 th	4	131.45	14:45:15			0	1	11
76	STAUNTON & 18 th	4	131.62	14:46: 0			0	1	10
83	STAUNTON & LAFAYETT	4	132.26	14:48:15			0	1	9
84	LAFAYETTE (B&G GROC	4	132.35	14:48:45			0	1	8
91	COVE ROAD & FAIRLAN	4	132.98	14:50:15			0	1	7
101	COVE ROAD & ROUTT	4	134.17	14:53:15			0	1	6
104	FERNCLIFF APTS. N.	4	134.41	14:54:30	14:45: 0	- 9:30	3	0	9
105	FERNCLIFF APTS. S.	4	134.56	14:56:45			4	0	13
107	FERNCLIFF (HILLS)	4	134.75	14:58: 0			2	2	13
117	COVE ROAD & FAIRLAN	4	135.76	15: 1:15			0	1	12
125	LAFAYETTE & STAUNTO	4	136.48	15: 3:45			0	1	11
132	STAUNTON & 18 th	4	137.11	15: 6:15			1	0	12
134	STAUNTON & 16 th	4	137.28	15: 7: 0			0	1	11
147	ORANGE & GAINSBORO	4	138.65	15:11:30			1	0	12
149	GAINSBORO & MADISON	4	138.79	15:12:15			1	0	13
160	SALEM & 1 st	0	139.60	15:15:30			0	1	12

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
162	JEFFERSON & CHURCH	4	139.82	15:19:45	15:15: 0	- 4:45	5	7	10
163	JEFFERSON (HEIRONIM)	2	139.86	15:20: 0			1	0	11
164	JEFFERSON & FRANKLI	4	139.91	15:21: 0			2	1	12
182	JEFFERSON & 24 th	2	141.57	15:26:30			0	1	11
203	FRANKLIN & TOWNSIDE	2	143.35	15:32:45			0	1	10
206	SUPER X	4	144.03	15:36: 0			1	0	11
207	PENNEY'S	4	144.13	15:38: 0			1	4	8
1	BRENDLES	3	144.36	15:44:15	15:40: 0	- 4:15	7	4	11
6	FRANKLIN (TEXACO)	4	145.30	15:49: 0			1	0	12
7	FRANKLIN (SHELL)	4	145.36	15:50: 0			4	0	16
11	FRANKLIN & WILLOW O	4	145.64	15:51:15			2	0	18
13	AVENHAM & SOMERSET	4	145.83	15:52: 0			1	0	19
14	AVENHAM (MIDBLOCK)	4	145.95	15:52:45			1	0	20
22	26 th & WYCLIFFE	4	146.68	15:54:45			0	1	19
32	JEFFERSON & YELLOW	4	147.44	15:56:45			1	0	20
34	ROANOKE MEMORIAL (1	4	147.67	15:58:45	15:55: 0	- 3:45	6	1	25
39	BELIEVIEW & WALNUT	4	148.24	16: 1:15			0	2	23
45	JEFFERSON & ELM AVE	4	150.03	16: 7:30			0	1	22
48	JEFFERSON & CHURCH	4	150.29	16:10: 0	16: 5: 0	- 5: 0	2	8	16
49	JEFFERSON & CAMPBEL	4	150.37	16:10:45			1	4	13
50	CAMPBELL & MARKET S	2	150.50	16:12:30			3	2	14
57	GAINSBORO & PATTON	4	151.14	16:16: 0			0	1	13
64	ORANGE & 8 th	4	152.03	16:19:15			1	1	13
73	STAUNTON & 15 th	2	152.76	16:23:15			1	0	14
81	STAUNTON & 23 rd	2	153.44	16:25:15			0	1	13
82	STAUNTON & 24 th	2	153.56	16:26: 0			0	1	12
83	STAUNTON & LAFAYETT	2	153.66	16:26:30			1	0	13
85	LAFAYETTE & CLIFTON	4	153.79	16:27:30			0	1	12
87	LAFAYETTE & MASSACH	4	153.94	16:28:15			0	1	11
95	COVE ROAD & COVELAN	4	154.70	16:30: 0			0	1	10
101	COVE ROAD & ROUTT	4	155.57	16:32:45			0	1	9
104	FERNCLIFF APTS. N.	4	155.80	16:33:45	16:24:45	- 9: 0	0	1	8
107	FERNCLIFF (HILLS)	4	156.14	16:36:45			5	2	11
108	FERNCLIFF & HERSHBE	4	156.29	16:37:15			0	1	10
109	HERSHBERGER & SWART	4	156.35	16:39:15			0	1	9
117	COVE ROAD & FAIRLAN	0	157.15	16:42: 0			1	0	10
125	LAFAYETTE & STAUNTO	2	157.87	16:43:45			0	1	9
137	STAUNTON & 14 th	4	158.89	16:46:30			0	1	8
140	STAUNTON & 11 th	4	159.09	16:47:15			0	1	7
160	SALEM & 1 st	0	161.00	16:54:45			0	1	6
162	JEFFERSON & CHURCH	0	161.21	16:56:45	16:50: 0	- 6:45	2	1	7
163	JEFFERSON (HEIRONIM)	4	161.25	16:57:30			2	0	9
167	JEFFERSON & MOUNTAI	4	161.53	16:59: 0			0	1	8
169	JEFFERSON & ALBEMAR	4	161.71	17: 0: 0			0	1	7
193	AVENHAM & 29 th	4	163.82	17: 6: 0			0	1	6
204	FRANKLIN & PENARTH	2	164.89	17:12: 0			0	1	5
207	PENNEY'S	4	165.51	17:15: 0			2	0	7
1	BRENDLES	3	165.75	17:17:45	17:10: 0	- 7:45	3	0	10
9	FRANKLIN (COLONY HO	4	166.89	17:23:30			1	0	11
34	ROANOKE MEMORIAL (1	4	169.06	17:28:45	17:25: 0	- 3:45	1	0	12
41	JEFFERSON & MAPLE	0	171.00	17:34:15			1	0	13
46	JEFFERSON (LIBRARY)	2	171.53	17:36:45			2	0	15

ROANOKE VALLEY METRO
BLOCK # 16 ROUTE # 1

BUS STOP LISTING PREPARED 08-25-1986 PAGE 6
COVE ROAD - PROSPECT HILLS 7-17-86

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
48	JEFFERSON & CHURCH	4	171.67	17:38:15	17:35: 0	- 3:15	1	2	14
49	JEFFERSON & CAMPBEL	2	171.75	17:38:45			2	0	16
52	WELLS & COMMONWEALT	0	172.20	17:42:30			1	0	17
59	GAINSBORO & MADISON	0	172.70	17:44:30			0	1	16
64	ORANGE & 8 th	0	173.41	17:47: 0			0	1	15
66	ORANGE & 11 th	0	173.71	17:48:30			1	1	15
77	STAUNTON & 19 th	0	174.49	17:51:15			0	1	14
78	STAUNTON & 20 th	2	174.57	17:51:45			0	1	13
84	LAFAYETTE (B&G GROC	4	175.13	17:53:15			0	1	12
90	LAFAYETTE & COVE RO	4	175.63	17:55: 0			0	1	11
104	FERNCLIFF APTS. N.	4	177.18	17:59:45	17:55: 0	- 4:45	0	2	9
105	FERNCLIFF APTS. S.	4	177.34	18: 4:30			2	2	9
126	STAUNTON & 24 th	4	179.38	18:10:30			1	0	10
163	JEFFERSON (HEIRONIM	0	182.58	18:23:45			4	0	14
164	JEFFERSON & FRANKLI	0	182.59	18:24:45			1	0	15
171	DETOUR STOP 2	2	183.25	18:27:15			0	1	14
178	JEFFERSON & WELLER	0	183.97	18:30:15	18:27: 0	- 3:15	0	2	12
190	26 th & AVENHAM	4	184.93	18:32:45			0	1	11
201	FRANKLIN & DUKE OF	4	185.97	18:36:15			0	1	10
206	SUPER X	4	186.80	18:39:30			1	0	11
1	BRENDLES	3	187.13	18:42:45	18:40: 0	- 2:45	2	1	12
19	AVENHAM & 28th	3	189.20	18:49:30			0	1	11
28	JEFFERSON & 25 th	3	189.88	18:51:30			0	1	10
33	JEFFERSON & WELLER	3	190.34	18:53: 0			0	1	9
		0	192.22	18:59:15			0	1	8
		0	192.60	19: 1:45			1	1	8
		0	192.74	19:12:30			1	0	9

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
40	DETOUR STOP 1	0	0.07	5:53:45			3	2	1
101	COVE ROAD & ROUTT	1	6.37	6:12:0			1	0	2
105	FERNCLIFF APTS. S.	1	6.78	6:13:30			1	0	3
111	COVE ROAD & GUILDHA	1	7.46	6:15:30			0	1	2
117	COVE ROAD & FAIRLAN	1	7.96	6:17:0			1	0	3
121	LAFAYETTE & MASSACH	1	8.39	6:18:15			2	0	5
125	LAFAYETTE & STAUNTO	1	8.69	6:19:30			1	0	6
126	STAUNTON & 24 th	1	8.81	6:20:0			1	0	7
141	11 th & HANOVER	0	10.04	6:24:15			0	1	6
142	ORANGE & 10 th	1	10.10	6:24:45	6:22:0	- 2:45	1	0	7
148	GAINSBORO & McDOWEL	1	10.91	6:26:45			1	0	8
160	SALEM & 1 st	1	11.82	6:30:15			0	1	7
162	JEFFERSON & CHURCH	0	12.03	6:33:15	6:35:0	1:45	4	0	11
162	JEFFERSON & CHURCH	1	12.04	6:38:45	6:35:0	- 3:45	7	1	17
166	JEFFERSON & ELM AVE	1	12.32	6:39:45			0	4	13
171	DETOUR STOP 2	1	12.70	6:41:0			0	1	12
176	DETOUR STOP 7	0	13.07	6:42:30			1	1	12
178	JEFFERSON & WELLER	0	13.42	6:43:45	6:42:0	- 1:45	1	0	13
190	26 th & AVENHAM	1	14.38	6:46:0			1	0	14
199	AVENHAM & FRANKLIN	1	15.25	6:48:15			0	1	13
206	SUPER X	0	16.20	6:51:45			0	2	11
1	BRENDLES	4	16.36	7: 4:15	7: 0: 0	- 4:15	2	3	10
9	FRANKLIN (COLONY HO	0	17.48	7: 8:30			1	0	11
15	AVENHAM & CLYDESDAL	4	18.07	7:10:30			1	0	12
32	JEFFERSON & YELLOW	4	19.44	7:13:45			1	0	13
47	JEFFERSON & FRANKLI	4	22.21	7:21:45			0	1	12
48	JEFFERSON & CHURCH	4	22.29	7:25:0	7:20:0	- 5:0	2	2	12
62	ORANGE & QUARRY	2	23.66	7:32:0			1	0	13
64	ORANGE & 8 th	4	24.03	7:33:15			1	0	14
76	STAUNTON & 18 th	4	25.02	7:36:0			0	1	13
83	STAUNTON & LAFAYETT	4	25.66	7:38:15			1	0	14
101	COVE ROAD & ROUTT	4	27.57	7:42:0			1	0	15
103	ROUTT & FERNCLIFF	2	27.70	7:42:45			0	1	14
105	FERNCLIFF APTS. S.	0	27.81	7:44:30			1	0	15
106	FERNCLIFF (RUFFNER	2	28.07	7:45:30			3	0	18
107	FERNCLIFF (HILLS)	4	28.15	7:45:45			0	1	17
114	COVE ROAD & ABBOTT	2	28.94	7:48:30			1	0	18
121	LAFAYETTE & MASSACH	4	29.59	7:50:30			2	0	20
122	LAFAYETTE & DELAWAR	4	29.68	7:51:0			1	0	21
124	LAFAYETTE & NEW YOR	4	29.80	7:51:45			3	0	24
130	STAUNTON & 20 th	2	30.35	7:53:30			1	0	25
134	STAUNTON & 16 th	4	30.69	7:54:30			1	0	26
137	STAUNTON & 14 th	4	30.91	7:55:30			1	0	27
142	ORANGE & 10 th	4	31.30	7:57:15	7:52:0	- 5:15	1	0	28
143	ORANGE (FAR SIDE STO	4	31.35	7:57:45			1	0	29
145	ORANGE & 5 th	0	31.63	7:58:30			0	1	28
146	ORANGE & QUARRY	0	31.74	7:59:0			1	0	29
147	ORANGE & GAINSBORO	2	32.06	8: 0:0			0	1	28
160	SALEM & 1 st	0	33.02	8: 3:45			1	1	28
161	JEFFERSON & CAMPBEL	0	33.14	8: 5:15			5	0	33
162	JEFFERSON & CHURCH	4	33.24	8: 8:45	8: 4: 0	- 4:45	5	0	38

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
164	JEFFERSON & FRANKLI	4	33.33	8: 9:30			1	0	39
165	JEFFERSON & BULLIT	0	33.41	8:10: 0			0	1	38
168	JEFFERSON & HIGHLAN	4	33.65	8:11: 0			0	1	37
178	JEFFERSON & WELLER	2	34.62	8:13:45	8:12: 0	- 1:45	0	1	36
180	JEFFERSON & 22 nd	0	34.81	8:14:30			0	1	35
182	JEFFERSON & 24 th	0	34.99	8:15:15			0	2	33
183	JEFFERSON & 25 th	0	35.08	8:15:45			0	1	32
185	26 th & RICHELIEU	0	35.23	8:16:45			0	1	31
186	26 th & CRYSTAL SPR	0	35.29	8:17: 0			0	1	30
190	26 th & AVENHAM	0	35.58	8:18: 0			0	1	29
192	AVENHAM & 28 th	0	35.76	8:19: 0			0	2	27
195	AVENHAM & CASSELL	0	36.05	8:20: 0			0	2	25
198	AVENHAM & WHITE OAK	0	36.36	8:21: 0			0	2	23
199	AVENHAM & FRANKLIN	0	36.40	8:21:15			0	1	22
204	FRANKLIN & PENARTH	0	36.93	8:23: 0			0	1	21
1	BRENDES	3	37.55	8:34:45	8:25: 0	- 9:45	0	4	17
4	FRANKLIN & AVENHAM	4	38.00	8:37:30			1	0	18
7	FRANKLIN (SHELL)	4	38.55	8:38:45			1	0	19
9	FRANKLIN (COLONY HO	4	38.69	8:39:45			2	0	21
32	JEFFERSON & YELLOW	4	40.63	8:43:45			1	0	22
41	JEFFERSON & MAPLE	0	42.81	8:50: 0			1	0	23
47	JEFFERSON & FRANKLI	4	43.39	8:52:30			0	2	21
48	JEFFERSON & CHURCH	2	43.47	8:53:45	8:50: 0	- 3:45	2	2	21
49	JEFFERSON & CAMPBEL	4	43.56	8:54:30			1	0	22
50	CAMPBELL & MARKET S	4	43.68	8:55:45			0	1	21
67	11 th & HANNOVER	2	45.55	9: 3: 0			1	0	22
75	STAUNTON & 17 th	4	46.12	9: 4:30			0	2	20
83	STAUNTON & LAFAYETT	4	46.84	9: 6:30			0	2	18
87	LAFAYETTE & MASSACH	4	47.12	9: 7:30			1	0	19
90	LAFAYETTE & COVE RO	4	47.45	9: 8:30			0	1	18
91	COVE ROAD & FAIRLAN	0	47.52	9: 9: 0			0	1	17
104	FERNCLIFF APTS. N.	4	48.99	9:14:15	9:10: 0	- 4:15	3	0	20
105	FERNCLIFF APTS. S.	4	49.15	9:15:15			3	0	23
106	FERNCLIFF (RUFFNER	4	49.26	9:15:45			0	1	22
107	FERNCLIFF (HILLS)	4	49.33	9:16:15			0	1	21
108	FERNCLIFF & HERSHBE	4	49.48	9:17: 0			1	0	22
116	COVE ROAD & ASPEN	2	50.24	9:19:15			1	0	23
122	LAFAYETTE & DELAWAR	0	50.88	9:21: 0			1	0	24
124	LAFAYETTE & NEW YOR	0	50.98	9:21:30			1	0	25
142	ORANGE & 10 th	0	52.47	9:27: 0	9:22: 0	- 5: 0	1	0	26
144	ORANGE & 8 th	4	52.68	9:27:45			0	1	25
154	JEFFERSON & WELLS	4	53.74	9:31: 0			0	1	24
161	JEFFERSON & CAMPBEL	4	54.30	9:34:45			3	5	22
162	JEFFERSON & CHURCH	2	54.40	9:37: 0	9:35: 0	- 2: 0	10	6	26
163	JEFFERSON (HEIRONIM	4	54.44	9:38:30			1	1	26
167	JEFFERSON & MOUNTAI	2	54.73	9:40: 0			0	2	24
179	JEFFERSON & MC CLAN	4	55.87	9:43:15			0	1	23
184	JEFFERSON & 26 th	4	56.31	9:45:15			0	1	22
185	26 th & RICHELIEU	0	56.39	9:45:45			0	2	20
198	AVENHAM & WHITE OAK	2	57.52	9:49:15			0	1	19
200	AVENHAM (WOODCRAFT	2	57.70	9:50:15			0	1	18
202	FRANKLIN (K-MART)	4	57.86	9:51: 0			0	1	17

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
204	FRANKLIN & PENARTH	0	58.09	9:52:15			0	2	15
207	PENNEY'S	4	58.71	9:55:30			0	3	12
1	BRENDLES	3	58.95	9:58:0	9:55:0	- 3:0	0	4	8
7	FRANKLIN (SHELL)	4	59.94	10:5:15			1	1	8
38	BELLEVIEW & LAUREL	4	62.69	10:13:15			2	0	10
39	BELLEVIEW & WALNUT	4	62.82	10:14:0			1	0	11
40	DETOUR STOP 1	4	63.40	10:16:0			0	2	9
47	JEFFERSON & FRANKLI	0	64.78	10:21:30			0	1	8
48	JEFFERSON & CHURCH	2	64.87	10:22:45	10:20:0	- 2:45	0	1	7
49	JEFFERSON & CAMPBEL	4	64.96	10:23:45			3	0	10
50	CAMPBELL & MARKET S	4	65.08	10:24:45			1	0	11
61	GAINSBORO & ORANGE	4	66.13	10:30:0			1	0	12
74	STAUNTON & 16 th	4	67.43	10:34:30			0	1	11
77	STAUNTON & 19 th	4	67.69	10:35:30			0	1	10
101	COVE ROAD & ROUTT	2	70.15	10:41:30			0	1	9
103	ROUTT & FERNCLIFF	4	70.27	10:42:0			1	0	10
104	FERNCLIFF APTS. N.	4	70.38	10:43:45	10:40:0	- 3:45	1	1	10
107	FERNCLIFF (HILLS)	4	70.73	10:45:0			0	2	8
108	FERNCLIFF & HERSHBE	4	70.87	10:46:15			3	0	11
120	LAFAYETTE & FLORIDA	4	72.02	10:49:45			0	1	10
124	LAFAYETTE & NEW YOR	4	72.38	10:50:45			1	0	11
130	STAUNTON & 20 th	2	72.92	10:53:0			2	0	13
137	STAUNTON & 14 th	4	73.48	10:54:45			1	0	14
139	STAUNTON & 12 th	4	73.61	10:55:30			1	0	15
140	STAUNTON & 11 th	4	73.69	10:56:0			1	0	16
151	GAINSBORO & PATTON	4	74.98	11:0:15			1	0	17
160	SALEM & 1 st	2	75.59	11:3:30			0	3	14
162	JEFFERSON & CHURCH	4	75.80	11:7:30	11:5:0	- 2:30	4	3	15
164	JEFFERSON & FRANKLI	4	75.89	11:8:45			1	1	15
167	JEFFERSON & MOUNTAI	4	76.13	11:10:0			0	1	14
178	JEFFERSON & WELIER	4	77.19	11:13:15	11:12:0	- 1:15	0	1	13
202	FRANKLIN (K-MART)	0	79.26	11:19:45			0	1	12
206	SUPER X	0	80.02	11:23:30			0	2	10
207	PENNEY'S	0	80.11	11:24:45			1	1	10
1	BRENDLES	3	80.35	11:27:45	11:25:0	- 2:45	2	4	8
7	FRANKLIN (SHELL)	4	81.34	11:38:0			1	1	8
9	FRANKLIN (COLONY HO	4	81.49	11:38:30			1	0	9
32	JEFFERSON & YELLOW	4	83.42	11:43:0			2	0	11
40	DETOUR STOP 1	4	84.80	11:47:45			2	0	13
45	JEFFERSON & ELM AVE	4	86.02	11:52:30			0	2	11
48	JEFFERSON & CHURCH	2	86.27	11:54:30	11:50:0	- 4:30	0	2	9
49	JEFFERSON & CAMPBEL	4	86.36	11:55:15			1	1	9
50	CAMPBELL & MARKET S	4	86.48	11:57:45			7	2	14
64	ORANGE & 8 th	4	88.02	12:4:45			0	1	13
71	STAUNTON & 14 th	2	88.63	12:7:15			0	2	11
75	STAUNTON & 17 th	2	88.92	12:8:15			0	1	10
82	STAUNTON & 24 th	4	89.54	12:10:15			2	0	12
83	STAUNTON & LAFAYETT	4	89.65	12:11:0			0	1	11
87	LAFAYETTE & MASSACH	4	89.92	12:12:0			0	2	9
93	COVE ROAD & WELLSLE	4	90.53	12:13:45			0	1	8
98	COVE ROAD & HERSHBE	4	90.98	12:15:0			0	1	7
107	FERNCLIFF (HILLS)	4	92.13	12:19:45			0	4	3

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
126	STAUNTON & 24 th	4	93.98	12:25:15			1	0	4
160	SALEM & 1 st	0	96.98	12:37: 0			0	1	3
162	JEFFERSON & CHURCH	4	97.20	12:42: 0	12:40: 0	- 2: 0	7	0	10
163	JEFFERSON (HEIRONIM)	4	97.24	12:43:30			2	0	12
169	JEFFERSON & ALBEMAR	0	97.72	12:45:45			1	0	13
178	JEFFERSON & WELLER	4	98.59	12:48: 0	12:47: 0	- 1: 0	0	1	12
179	JEFFERSON & MC CLAN	4	98.67	12:48:45			0	1	11
192	AVENHAM & 28 th	4	99.72	12:52: 0			1	0	12
198	AVENHAM & WHITE OAK	4	100.32	12:53:30			0	1	11
202	FRANKLIN (K-MART)	2	100.66	12:56: 0			0	1	10
203	FRANKLIN & TOWNSIDE	2	100.74	12:56:30			0	1	9
204	FRANKLIN & PENARTH	4	100.89	12:57:30			1	0	10
207	PENNEY'S	4	101.51	13: 1:30			4	3	11
1	BRENDLES	3	101.75	13: 3:15	13: 0: 0	- 3:15	0	1	10
4	FRANKLIN & AVENHAM	2	102.19	13: 6: 0			0	1	9
16	AVENHAM & CASSELL	2	103.54	13:10:15			1	0	10
24	26 th & ROSALIND	4	104.21	13:12: 0			1	0	11
27	26 th & JEFFERSON	4	104.41	13:13: 0			0	1	10
48	JEFFERSON & CHURCH	4	107.68	13:26:30	13:25: 0	- 1:30	0	2	8
49	JEFFERSON & CAMPBEL	4	107.76	13:27:15			0	1	7
50	CAMPBELL & MARKET S	4	107.88	13:28:45			2	1	8
53	WELLS & HOTEL ROANO	4	108.29	13:32:15			1	0	9
65	ORANGE & 10 th	4	109.58	13:35:45			0	1	8
66	ORANGE & 11 th	2	109.71	13:36:45			2	1	9
74	STAUNTON & 16 th	4	110.23	13:38:45			1	0	10
76	STAUNTON & 18 th	4	110.40	13:39:30			0	1	9
77	STAUNTON & 19 th	4	110.49	13:40:15			0	1	8
82	STAUNTON & 24 th	4	110.94	13:41:30			0	1	7
100	COVE ROAD & (Midblo	4	112.78	13:46:15			0	4	3
105	FERNCLIFF APTS. S.	2	113.35	13:49: 0			2	0	5
107	FERNCLIFF (HILLS)	4	113.53	13:49:45			1	1	5
125	LAFAYETTE & STAUNTO	2	115.26	13:54:15			1	0	6
127	STAUNTON & 23 rd	4	115.46	13:55: 0			0	1	5
132	STAUNTON & 18 th	4	115.89	13:57: 0			2	0	7
144	ORANGE & 8 th	4	116.87	14: 1: 0			0	1	6
145	ORANGE & 5 th	4	117.11	14: 1:45			1	0	7
147	ORANGE & GAINSBORO	4	117.42	14: 2:45			0	1	6
155	WELLS & HOTEL ROANO	0	118.02	14: 5: 0			0	1	5
161	JEFFERSON & CAMPBEL	0	118.51	14: 9:15			0	1	4
162	JEFFERSON & CHURCH	4	118.59	14:10:30	14:10: 0	- 0:30	1	1	4
164	JEFFERSON & FRANKLI	0	118.60	14:16:30			5	5	4
165	JEFFERSON & BULLIT	0	118.61	14:16:45			1	0	5
167	JEFFERSON & MOUNTAI	2	118.93	14:18:15			1	0	6
178	JEFFERSON & WELLER	2	119.98	14:22: 0	14:17: 0	- 5: 0	0	3	3
186	26 th & CRYSTAL SPR	0	120.64	14:23:45			0	1	2
200	AVENHAM (WOODCRAFT	0	121.91	14:28: 0			0	1	1
204	FRANKLIN & PENARTH	2	122.28	14:29:15			0	2	0
206	SUPER X	0	122.81	14:31:45			1	0	1
207	PENNEY'S	4	122.90	14:33: 0			1	0	2
1	BRENDLES	3	123.14	14:37:45	14:30: 0	- 7:45	4	0	6
7	FRANKLIN (SHELL)	2	124.15	14:44:15			1	0	7
13	AVENHAM & SOMERSET	4	124.61	14:45:30			1	0	8

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
27	26 th & JEFFERSON	4	125.81	14:48:30			2	0	10
32	JEFFERSON & YELLOW	0	126.23	14:50:15			1	1	10
34	ROANOKE MEMORIAL (1	2	126.45	14:51:45	14:45: 0	- 6:45	2	0	12
38	BELLEVIEW & LAUREL	4	126.89	14:53:15			1	0	13
48	JEFFERSON & CHURCH	2	129.08	15: 0:30	14:55: 0	- 5:30	2	10	5
49	JEFFERSON & CAMPBEL	4	129.16	15: 1:15			3	0	8
50	CAMPBELL & MARKET S	4	129.29	15: 3: 0			3	2	9
59	GAINSBORO & MADISON	4	130.11	15: 7:15			0	1	8
66	ORANGE & 11 th	4	131.11	15:11: 0			1	0	9
71	STAUNTON & 14 th	4	131.43	15:12:30			0	1	8
72	STAUNTON & EUREKA C	4	131.50	15:13: 0			0	1	7
73	STAUNTON & 15 th	2	131.55	15:13:15			1	0	8
74	STAUNTON & 16 th	4	131.63	15:13:45			0	1	7
77	STAUNTON & 19 th	4	131.89	15:15: 0			1	0	8
78	STAUNTON & 20 th	4	131.98	15:15:30			0	1	7
82	STAUNTON & 24 th	4	132.34	15:16:15			0	1	6
87	LAFAYETTE & MASSACH	4	132.73	15:17:45			0	1	5
101	COVE ROAD & ROUTT	0	134.34	15:22: 0			0	2	3
105	FERNCLIFF APTS. S.	2	134.75	15:23:30			2	0	5
107	FERNCLIFF (HILLS)	4	134.93	15:24:30			4	1	8
110	HERSHBERGER & COVE	4	135.33	15:26:30			0	1	7
119	LAFAYETTE MIDBLOCK	0	136.12	15:28:15			0	1	6
121	LAFAYETTE & MASSACH	4	136.37	15:29: 0			1	0	7
127	STAUNTON & 23 rd	2	136.87	15:31: 0			0	1	6
141	11 th & HANOVER	4	137.97	15:34: 0			1	0	7
155	WELLS & HOTEL ROANO	4	139.44	15:39: 0			1	0	8
160	SALEM & 1 st	4	139.78	15:41:45			0	1	7
161	JEFFERSON & CAMPBEL	4	139.91	15:42:30			1	0	8
162	JEFFERSON & CHURCH	4	140.01	15:44:15	15:40: 0	- 4:15	5	1	12
163	JEFFERSON (HEIRONIM	4	140.04	15:48:15			3	2	13
167	JEFFERSON & MOUNTAI	4	140.34	15:50:15			2	0	15
171	DETOUR STOP 2	0	140.69	15:51:15			0	1	14
178	JEFFERSON & WELLER	0	141.35	15:53:15	15:47: 0	- 6:15	0	2	12
182	JEFFERSON & 24 th	4	141.76	15:54:45			0	1	11
183	JEFFERSON & 25 th	4	141.84	15:55:30			1	1	11
206	SUPER X	4	144.21	16: 2:45			2	1	12
207	PENNEY'S	4	144.31	16: 4:15			1	3	10
1	BRENDLES	3	144.55	16: 7: 0	16: 0: 0	- 7: 0	6	2	14
4	FRANKLIN & AVENHAM	4	144.99	16:12: 0			0	1	13
5	FRANKLIN & TANGLEWO	4	145.08	16:13: 0			2	0	15
5	FRANKLIN & TANGLEWO	4	145.08	16:14:15			2	0	17
7	FRANKLIN (SHELL)	2	145.55	16:15:15			7	0	24
17	AVENHAM & AUDUBON	2	146.43	16:17:15			1	0	25
19	AVENHAM & 28th	4	146.62	16:18: 0			1	0	26
32	JEFFERSON & YELLOW	2	147.63	16:20:45			1	0	27
34	ROANOKE MEMORIAL (1	4	147.86	16:22: 0	16:15: 0	- 7: 0	2	0	29
39	BELLEVIEW & WALNUT	4	148.43	16:24: 0			0	1	28
40	DETOUR STOP 1	0	149.02	16:26: 0			1	0	29
41	JEFFERSON & MAPLE	4	149.93	16:29:30			0	1	28
42	JEFFERSON & ALBEMAR	4	149.99	16:30: 0			0	1	27
48	JEFFERSON & CHURCH	4	150.49	16:32:15	16:24:45	- 7:30	3	8	22
49	JEFFERSON & CAMPBEL	4	150.57	16:33: 0			1	8	15

STOP#	STOP NAME	M	DIST	DEPART	SCHED	DEV	ONS	OFFS	PASS
50	CAMPBELL & MARKET S	4	150.69	16:34:45			6	1	20
53	WELLS & HOTEL ROANO	4	151.10	16:36:45			1	0	21
66	ORANGE & 11 th	2	152.51	16:42:0			0	1	20
71	STAUNTON & 14 th	0	152.84	16:43:45			0	1	19
72	STAUNTON & EUREKA C	0	152.91	16:44:0			0	1	18
75	STAUNTON & 17 th	2	153.13	16:44:45			1	0	19
76	STAUNTON & 18 th	4	153.21	16:45:15			0	1	18
78	STAUNTON & 20 th	2	153.38	16:46:15			1	0	19
80	STAUNTON & 22 nd	4	153.55	16:47:0			0	1	18
83	STAUNTON & LAFAYETT	4	153.86	16:48:15			0	2	16
88	LAFAYETTE & FLORIDA	4	154.29	16:49:30			1	0	17
92	COVE ROAD & ASPEN	4	154.66	16:50:30			0	1	16
93	COVE ROAD & WELLSLE	4	154.73	16:51:15			0	3	13
102	ROUTT & BLACK OAK	4	155.83	16:53:45			0	1	12
105	FERNCLIFF APTS. S.	4	156.16	16:54:45			0	1	11
106	FERNCLIFF (RUFFNER	4	156.27	16:55:15			0	1	10
107	FERNCLIFF (HILLS)	4	156.34	16:56:0			2	2	10
110	HERSHBERGER & COVE	4	156.74	16:58:15			1	0	11
121	LAFAYETTE & MASSACH	4	157.78	17:0:30			1	0	12
161	JEFFERSON & CAMPBEL	2	161.31	17:15:15			3	1	14
162	JEFFERSON & CHURCH	0	161.40	17:17:0	17:10:0	- 7:0	1	1	14
163	JEFFERSON (HEIRONIM	0	161.42	17:19:0			2	0	16
166	JEFFERSON & ELM AVE	4	161.69	17:20:45			1	0	17
171	DETOUR STOP 2	0	162.08	17:21:45			0	1	16
190	26 th & AVENHAM	0	163.76	17:27:30			0	2	14
196	AVENHAM & WHITE OAK	0	164.29	17:29:15			0	1	13
201	FRANKLIN & DUKE OF	0	164.80	17:31:30			0	1	12
202	FRANKLIN (K-MART)	0	164.87	17:32:0			0	1	11
1	BRENDES	3	165.95	17:46:30	17:40:0	- 6:30	4	3	12
2	OGDEN & FRANKLIN	3	166.25	17:49:0			0	1	11
25	26 th & CRYSTAL SPR	3	168.49	17:55:0			1	0	12
34	ROANOKE MEMORIAL (1	3	169.26	17:57:45	17:55:0	- 2:45	1	0	13
46	JEFFERSON (LIBRARY)	3	171.74	18:5:15			0	1	12
48	JEFFERSON & CHURCH	3	171.88	18:8:0	18:5:0	- 3:0	3	1	14
66	ORANGE & 11 th	3	173.91	18:18:0			0	1	13
91	COVE ROAD & FAIRLAN	0	175.97	18:23:45			0	1	12
101	COVE ROAD & ROUTT	3	177.15	18:27:0			0	1	11
103	ROUTT & FERNCLIFF	0	177.28	18:27:30			1	0	12
105	FERNCLIFF APTS. S.	3	177.55	18:28:30			0	1	11
107	FERNCLIFF (HILLS)	3	177.74	18:29:30			0	1	10
108	FERNCLIFF & HERSHBE	3	177.88	18:30:15			1	0	11
114	COVE ROAD & ABBOTT	3	178.53	18:33:15			1	0	12
131	STAUNTON & 19 th	3	180.02	18:36:45			0	1	11
141	11 th & HANOVER	0	180.82	18:39:15			0	1	10
144	ORANGE & 8 th	3	181.09	18:40:30			0	1	9
		0	183.44	18:50:45			2	2	9
		0	183.45	18:54:30			3	1	11

APPENDIX J. TIMEPOINT PROFILE REPORTS

ROANOKE VALLEY METRO
BLOCK # 16 ROUTE # 1

TIME POINT PROFILE REPORT
COVE ROAD - PROSPECT HILLS

PREPARED 08-25-1986
7-17-86

STOP#	STOP NAME	LOAD	DEPART	SCHED	DEV	SPEED
ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME
104	FERNCLIFF APTS. N.	1	5:53:30	5:50: 0	- 3:30	
	10 4 11 154			9	5.41	18:15
162	JEFFERSON & CHURCH	7	6:11:45	6:10: 0	- 1:45	
	8 13 8 165			11	4.16	24: 0
1	BRENDELES	2	6:35:45	6:30: 0	- 5:45	

STOP#	STOP NAME	LOAD	DEPART	SCHED	DEV	SPEED
ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME
1	BRENDELES	2	6:35:45	6:30: 0	- 5:45	
	3 2 4 32			5	5.91	17:30
48	JEFFERSON & CHURCH	3	6:53:15	6:50: 0	- 3:15	
	3 4 3 48			7	5.52	22:45
104	FERNCLIFF APTS. N.	2	7:16: 0	7:10: 0	- 6: 0	
	22 8 16 162			14	5.42	22: 0
162	JEFFERSON & CHURCH	16	7:38: 0	7:35: 0	- 3: 0	
	1 2 16 162			2	1.39	6:15
178	JEFFERSON & WELLER	15	7:44:15	7:42: 0	- 2:15	
	5 9 16 179			13	2.92	15:45
1	BRENDELES	11	8: 0: 0	7:55: 0	- 5: 0	

STOP#	STOP NAME	LOAD	DEPART	SCHED	DEV	SPEED
ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME
1	BRENDELES	11	8: 0: 0	7:55: 0	- 5: 0	
	2 2 12 7			5	5.92	21: 0
48	JEFFERSON & CHURCH	11	8:21: 0	8:19: 0	- 2: 0	
	0 3 11 48			6	5.34	24: 0
104	FERNCLIFF APTS. N.	8	8:45: 0	8:40: 0	- 5: 0	
	4 4 10 121			8	5.57	23: 0
162	JEFFERSON & CHURCH	8	9: 8: 0	9: 5: 0	- 3: 0	
	12 6 15 167			5	1.41	6:30
178	JEFFERSON & WELLER	14	9:14:30	9:12: 0	- 2:30	
	6 15 14 178			11	3.15	17:15
1	BRENDELES	5	9:31:45	9:25: 0	- 6:45	

STOP#	STOP NAME	LOAD	DEPART	SCHED	DEV	SPEED
ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME
1	BRENDELES	5	9:31:45	9:25: 0	- 6:45	
	7 2 12 33			6	5.92	21:30
48	JEFFERSON & CHURCH	10	9:53:15	9:50: 0	- 3:15	
	8 6 14 59			9	5.52	21:30
104	FERNCLIFF APTS. N.	12	10:14:45	10:10: 0	- 4:45	
	22 13 21 151			15	5.42	23:15
162	JEFFERSON & CHURCH	21	10:38: 0	10:35: 0	- 3: 0	
	2 6 23 163			3	1.38	7:30
178	JEFFERSON & WELLER	17	10:45:30	10:42: 0	- 3:30	
	7 10 17 178			7	3.15	15:45
1	BRENDELES	14	11: 1:15	10:55: 0	- 6:15	

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		
1	BRENDES				14	11: 1:15	10:55: 0	- 6:15	
	2	2	16	16	5		5.92	22: 0	16.15
48	JEFFERSON & CHURCH				14	11:23:15	11:20: 0	- 3:15	
	9	9	19	57	7		2.14	10:45	11.94
68	11 th & STAUNTON				14	11:34: 0	11:28: 0	- 6: 0	
	2	3	14	68	8		3.38	14: 0	14.49
104	FERNCLIFF APTS. N.				13	11:48: 0	11:40: 0	- 8: 0	
	4	5	14	105	7		5.41	23:30	13.81
162	JEFFERSON & CHURCH				12	12:11:30	12:10: 0	- 1:30	
	6	8	14	201	9		4.54	24: 0	11.35
1	BRENDES				10	12:35:30	12:30: 0	- 5:30	

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		
1	BRENDES				10	12:35:30	12:30: 0	- 5:30	
	8	2	16	33	8		3.31	16: 0	12.43
34	ROANOKE MEMORIAL (1)				16	12:51:30	12:45: 0	- 6:30	
	4	8	18	44	4		2.61	10:15	15.31
48	JEFFERSON & CHURCH				12	13: 1:45	12:55: 0	- 6:45	
	18	20	14	50	23		10.92	44:30	14.73
162	JEFFERSON & CHURCH				10	13:46:15	13:40: 0	- 6:15	
	1	2	11	164	3		1.38	5:30	15.10
178	JEFFERSON & WELLER				9	13:51:45	13:47: 0	- 4:45	
	6	7	10	206	8		3.15	13:30	14.00
1	BRENDES				8	14: 5:15	14: 0: 0	- 5:15	

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		
1	BRENDES				8	14: 5:15	14: 0: 0	- 5:15	
	13	0	21	34	9		3.31	14: 0	14.18
34	ROANOKE MEMORIAL (1)				21	14:19:15	14:15: 0	- 4:15	
	3	7	21	34	2		2.62	10:30	14.96
48	JEFFERSON & CHURCH				17	14:29:45	14:25: 0	- 4:45	
	10	18	19	50	15		5.51	24:45	13.37
104	FERNCLIFF APTS. N.				9	14:54:30	14:45: 0	- 9:30	
	14	13	13	105	14		5.42	25:15	12.88
162	JEFFERSON & CHURCH				10	15:19:45	15:15: 0	- 4:45	
	12	11	12	164	11		4.54	24:30	11.11
1	BRENDES				11	15:44:15	15:40: 0	- 4:15	

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		
1	BRENDES				11	15:44:15	15:40: 0	- 4:15	
	16	2	25	34	9		3.31	14:30	13.68
34	ROANOKE MEMORIAL (1)				25	15:58:45	15:55: 0	- 3:45	
	2	11	25	34	3		2.62	11:15	13.97
48	JEFFERSON & CHURCH				16	16:10: 0	16: 5: 0	- 5: 0	
	7	15	16	48	13		5.52	23:45	13.94
104	FERNCLIFF APTS. N.				8	16:33:45	16:24:45	- 9: 0	
	8	9	11	107	11		5.41	23: 0	14.11
162	JEFFERSON & CHURCH				7	16:56:45	16:50: 0	- 6:45	
	7	4	10	1	11		4.53	21: 0	12.95

1 BRENDLES 10 17:17:45 17:10: 0 - 7:45

STOP#	STOP NAME				LOAD	DEPART	SCHED		DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME			
1	BRENDLES				10	17:17:45		17:10: 0	- 7:45	
	2	0	12	34	10					
34	ROANOKE MEMORIAL (1)				12	17:28:45	3.31	17:25: 0	- 3:45	18.05
	4	2	15	46	12			9:30		16.52
48	JEFFERSON & CHURCH				14	17:38:15	2.62	17:35: 0	- 3:15	15.37
	4	9	17	52	14		5.51	21:30		15.37
104	FERNCLIFF APTS. N.				9	17:59:45		17:55: 0	- 4:45	
	3	2	10	126	9		5.40	23:30		13.77
162	JEFFERSON & CHURCH				10	18:23:15		18:20: 0	- 3:15	
	5	3	15	164	10		1.40	7: 0		11.99
178	JEFFERSON & WELLER				12	18:30:15		18:27: 0	- 3:15	
	3	3	12	178	12		3.16	12:30		15.16
1	BRENDLES				12	18:42:45		18:40: 0	- 2:45	

STOP#	STOP NAME				LOAD	DEPART	SCHED		DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME			
1	BRENDLES				12	18:42:45		18:40: 0	- 2:45	

STOP#	STOP NAME				LOAD	DEPART	DIST	SCHED	TIME	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS						
68	11	th	&	STAUNTON	1	6: 4:15		5:58: 0		- 6:15	
	8	2	7	126	9		6.88	20:30			20.12
142	ORANGE	&	10	th	7	6:24:45		6:22: 0		- 2:45	
	12	2	17	162	7		1.94	14: 0			8.33
162	JEFFERSON	&	CHURCH		17	6:38:45		6:35: 0		- 3:45	
	2	6	17	162	4		1.38	5: 0			16.54
178	JEFFERSON	&	WELLER		13	6:43:45		6:42: 0		- 1:45	
	3	6	14	190	7		2.93	20:30			8.59
1	BRENDLES				10	7: 4:15		7: 0: 0		- 4:15	

STOP#	STOP NAME				LOAD	DEPART	DIST	SCHED	TIME	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS						
1	BRENDLES				10	7: 4:15		7: 0: 0		- 4:15	
	5	3	13	32	7		5.93	20:45			17.15
48	JEFFERSON	&	CHURCH		12	7:25: 0		7:20: 0		- 5: 0	
	4	2	15	101	9		5.52	19:15			17.19
104	FERNCLIFF	APTS. N.			14	7:44:15		7:40: 0		- 4:15	
	15	1	28	142	11		3.50	13: 0			16.13
142	ORANGE	&	10	th	28	7:57:15		7:52: 0		- 5:15	
	13	3	38	162	9		1.94	11:30			10.11
162	JEFFERSON	&	CHURCH		38	8: 8:45		8: 4: 0		- 4:45	
	1	3	39	164	4		1.38	5: 0			16.59
178	JEFFERSON	&	WELLER		36	8:13:45		8:12: 0		- 1:45	
	0	19	36	178	15		2.93	21: 0			8.38
1	BRENDLES				17	8:34:45		8:25: 0		- 9:45	

STOP#	STOP NAME				LOAD	DEPART	DIST	SCHED	TIME	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS						
1	BRENDLES				17	8:34:45		8:25: 0		- 9:45	
	8	4	23	41	7		5.92	19: 0			18.69
48	JEFFERSON	&	CHURCH		21	8:53:45		8:50: 0		- 3:45	
	6	7	22	49	12		5.52	20:30			16.15
104	FERNCLIFF	APTS. N.			20	9:14:15		9:10: 0		- 4:15	
	8	2	26	142	9		3.48	12:45			16.36
142	ORANGE	&	10	th	26	9:27: 0		9:22: 0		- 5: 0	
	13	13	26	142	4		1.94	10: 0			11.62
162	JEFFERSON	&	CHURCH		26	9:37: 0		9:35: 0		- 2: 0	
	1	19	26	162	14		4.55	21: 0			12.99
1	BRENDLES				8	9:58: 0		9:55: 0		- 3: 0	

STOP#	STOP NAME				LOAD	DEPART	DIST	SCHED	TIME	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS						
1	BRENDLES				8	9:58: 0		9:55: 0		- 3: 0	
	4	5	11	39	9		5.92	24:45			14.36
48	JEFFERSON	&	CHURCH		7	10:22:45		10:20: 0		- 2:45	
	7	4	12	61	10		5.51	21: 0			15.75
104	FERNCLIFF	APTS. N.			10	10:43:45		10:40: 0		- 3:45	

48	4	11	29	34	5	2.63	10:15	15.38
	JEFFERSON &	CHURCH			22	16:32:15	16:24:45	- 7:30
	19	27	22	48	23	10.91	44:45	14.63
162	JEFFERSON &	CHURCH			14	17:17: 0	17:10: 0	- 7: 0
	7	9	17	166	11	4.56	29:30	9.27
1	BRENDLES				12	17:46:30	17:40: 0	- 6:30

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		
1	BRENDLES				12	17:46:30	17:40: 0	- 6:30	
	2	1	13	34	3	3.31	11:15	17.64	
34	ROANOKE MEMORIAL (1)				13	17:57:45	17:55: 0	- 2:45	
	3	2	14	48	4	2.62	10:15	15.35	
48	JEFFERSON &	CHURCH			14	18: 8: 0	18: 5: 0	- 3: 0	

162	14	9	17	151	13	5.41	23:45	13.68
	JEFFERSON & CHURCH				15	11: 7:30	11: 5: 0	- 2:30
	1	3	15	162	3	1.40	5:45	14.57
178	JEFFERSON & WELLER				13	11:13:15	11:12: 0	- 1:15
	3	8	13	178	6	3.15	14:30	13.04
1	BRENDLES				8	11:27:45	11:25: 0	- 2:45

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		
1	BRENDLES				8	11:27:45	11:25: 0	- 2:45	
	6	5	13	40	8	5.93	26:45	13.29	
48	JEFFERSON & CHURCH				9	11:54:30	11:50: 0	- 4:30	
	10	12	14	50	12	5.52	23:30	14.08	
104	FERNCLIFF APTS. N.				7	12:18: 0	12:10: 0	- 8: 0	
	8	5	10	162	6	5.41	24: 0	13.54	
162	JEFFERSON & CHURCH				10	12:42: 0	12:40: 0	- 2: 0	
	3	1	13	169	3	1.39	6: 0	13.89	
178	JEFFERSON & WELLER				12	12:48: 0	12:47: 0	- 1: 0	
	6	8	12	178	9	3.16	15:15	12.42	
1	BRENDLES				10	13: 3:15	13: 0: 0	- 3:15	

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		
1	BRENDLES				10	13: 3:15	13: 0: 0	- 3:15	
	2	4	11	24	6	5.93	23:15	15.30	
48	JEFFERSON & CHURCH				8	13:26:30	13:25: 0	- 1:30	
	6	11	10	74	12	5.51	21:15	15.55	
104	FERNCLIFF APTS. N.				3	13:47:45	13:45: 0	- 2:45	
	8	7	7	132	12	5.41	24:15	13.39	
162	JEFFERSON & CHURCH				4	14:12: 0	14:10: 0	- 2: 0	
	7	8	6	167	5	1.38	10: 0	8.31	
178	JEFFERSON & WELLER				3	14:22: 0	14:17: 0	- 5: 0	
	6	4	6	1	9	3.16	15:45	12.03	
1	BRENDLES				6	14:37:45	14:30: 0	- 7:45	

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		
1	BRENDLES				6	14:37:45	14:30: 0	- 7:45	
	7	1	12	34	6	3.31	14: 0	14.19	
34	ROANOKE MEMORIAL (1)				12	14:51:45	14:45: 0	- 6:45	
	3	10	13	38	2	2.63	8:45	18.02	
48	JEFFERSON & CHURCH				5	15: 0:30	14:55: 0	- 5:30	
	24	17	12	162	25	10.92	43:45	14.98	
162	JEFFERSON & CHURCH				12	15:44:15	15:40: 0	- 4:15	
	5	5	15	167	6	1.35	9: 0	8.99	
178	JEFFERSON & WELLER				12	15:53:15	15:47: 0	- 6:15	
	10	8	14	1	7	3.19	13:45	13.94	
1	BRENDLES				14	16: 7: 0	16: 0: 0	- 7: 0	

STOP#	STOP NAME				LOAD	DEPART	SCHED	DEV	SPEED
	ONS	OFFS	MAXLOAD	MAXSTOP	# STOPS	DIST	TIME		
1	BRENDLES				14	16: 7: 0	16: 0: 0	- 7: 0	
	16	1	29	34	9	3.31	15: 0	13.25	
34	ROANOKE MEMORIAL (1)				29	16:22: 0	16:15: 0	- 7: 0	

APPENDIX K. SECTION 15 DAILY REPORTS

ROANOKE VALLEY METRO
ROUTE # 1
BUS # 194

SECTION 15 DAILY REPORT
COVE RD./PROSPECT HILLS
SEATED CAPACITY 42

PREPARED 08-25-1986
THURSDAY 7-17-86
TOTAL CAPACITY 66

TIME PERIOD	AM PEAK	WEEKDAY			NIGHT	WEEKEND	
		MIDDAY	PM PEAK	SATURDAY		SUNDAY	
Passengers Boarded	9	126	66	0	0	0	
Passengers On Board	32	1664	950	0	0	0	
Bus Trip Distance	11	64	43	0	0	0	
Passenger Miles	32	872	509	0	0	0	
Bus Trip Time	47	283	178	0	0	0	
Passenger Minutes	31	948	527	0	0	0	
Capacity Miles	755	4236	2823	0	0	0	
Seat Miles	480	2696	1796	0	0	0	
Trips in Sample	1	6	4	0	0	0	
SAMPLE AVERAGES							
Unlinked Pass/Trip	9	21	17	0	0	0	
Pass. Miles/Trip	32	145	127	0	0	0	
Unl. Pass. Trip Time	31	158	132	0	0	0	

ROANOKE VALLEY METRO
 ROUTE # 1
 BUS # 194

SECTION 15 DAILY REPORT
 COVE RD./PROSPECT HILLS
 SEATED CAPACITY 42

PREPARED 08-25-1986
 FRIDAY 7-25-86
 TOTAL CAPACITY 66

TIME PERIOD	WEEKDAY			NIGHT	WEEKEND	
	AM PEAK	MIDDAY	PM PEAK		SATURDAY	SUNDAY
Passengers Boarded	22	112	0	0	0	0
Passengers On Board	605	1653	0	0	0	0
Bus Trip Distance	23	74	0	0	0	0
Passenger Miles	377	798	0	0	0	0
Bus Trip Time	98	321	0	0	0	0
Passenger Minutes	396	849	0	0	0	0
Capacity Miles	1511	4894	0	0	0	0
Seat Miles	961	3114	0	0	0	0
Trips in Sample	2	7	0	0	0	0
SAMPLE AVERAGES						
Unlinked Pass/Trip	11	16	0	0	0	0
Pass. Miles/Trip	188	114	0	0	0	0
Unl. Pass. Trip Time	198	121	0	0	0	0

APPENDIX L. SECTION 15 ANNUAL REPORTS

ROANOKE VALLEY METRO SECTION 15 ANNUAL REPORT PREPARED 08-25-1986
 TRANSIT ID 3007 NON-RAIL MODES MODE MB
 FISCAL YEAR END 6/30/86 FORM 406A LEVEL R

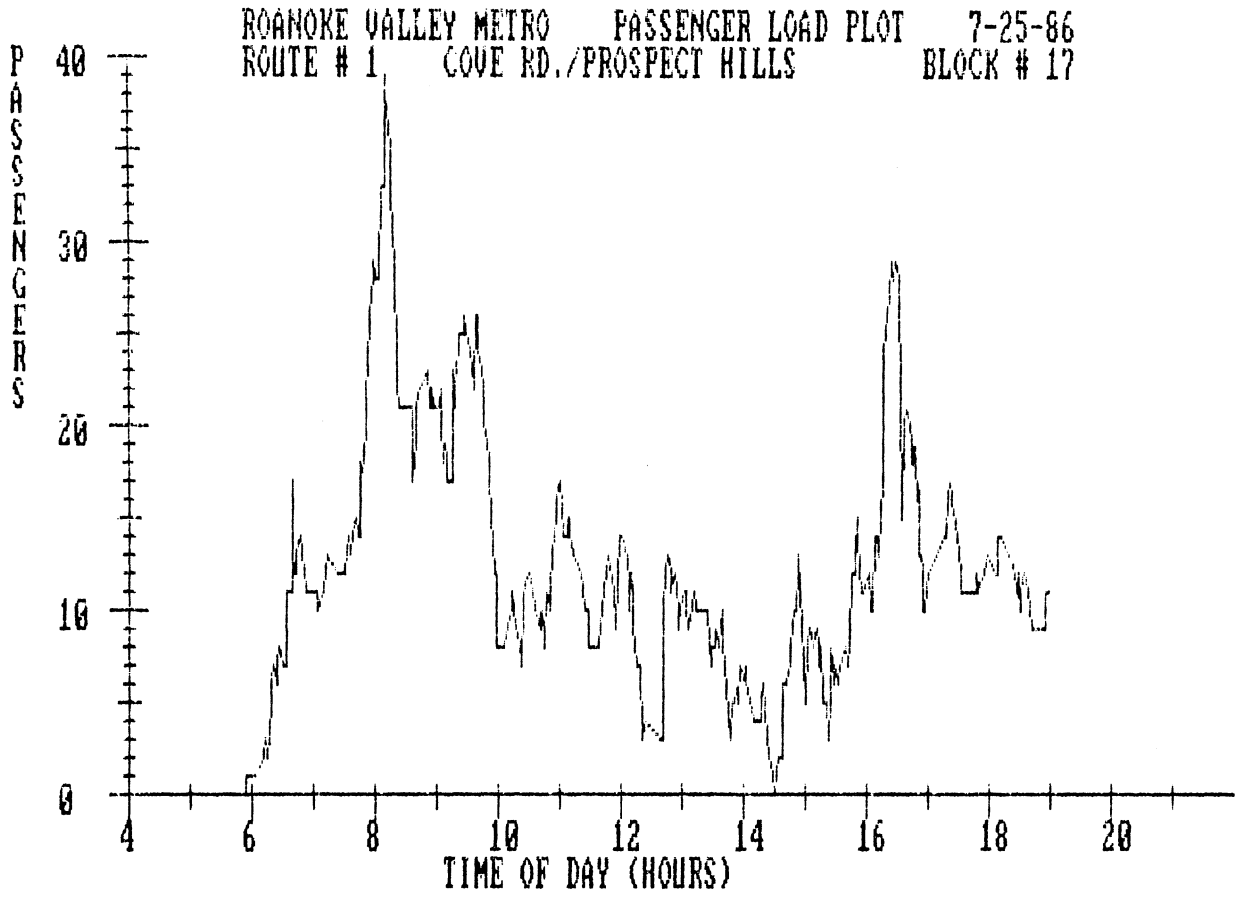
TIME PERIOD	AM PEAK	MIDDAY	PM PEAK	NIGHT	SATDAY	SUNDAY	TOTAL
Passengers Boarded	9	126	66	0	0	0	201
Pass. On Board	32	1664	950	0	0	0	2646
Bus Trip Distance	11	64	43	0	0	0	118
Passenger Miles	32	872	509	0	0	0	1414
Bus Trip Time	47	283	178	0	0	0	509
Passenger Minutes	31	948	527	0	0	0	1506
Capacity Miles	755	4236	2823	0	0	0	7814
Seat Miles	480	2696	1796	0	0	0	4972
Trips in Sample	1	6	4	0	0	0	11
Total Trips	500	900	200	0	800	0	2400
SAMPLE AVERAGES							
Unl. Pass./Trip	9	21	17	0	0	0	47
Pass. Miles/Trip	32	145	127	0	0	0	305
Unl Pass Trip Time	31	158	132	0	0	0	321
ANNUAL TOTALS							
Unl. Pass. Trips	4500	18900	3300	0	0	0	26700
Passenger Miles	16122	130832	25454	0	0	0	172408

ROANOKE VALLEY METRO
 TRANSIT ID 3007
 FISCAL YEAR END 6/30/86

SECTION 15 ANNUAL REPORT
 NON-RAIL MODES
 FORM 406A

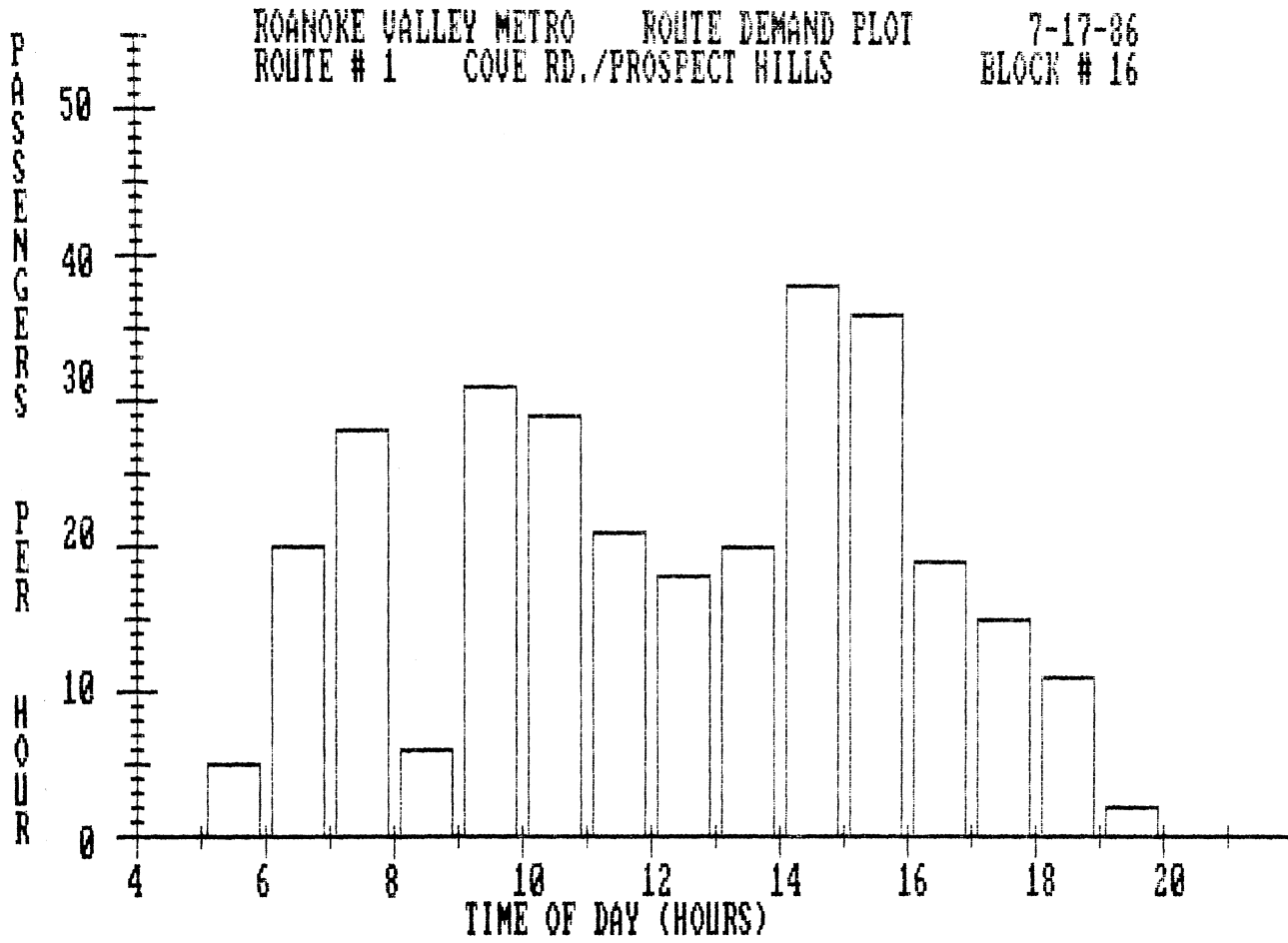
PREPARED 08-25-1986
 MODE MB
 LEVEL R

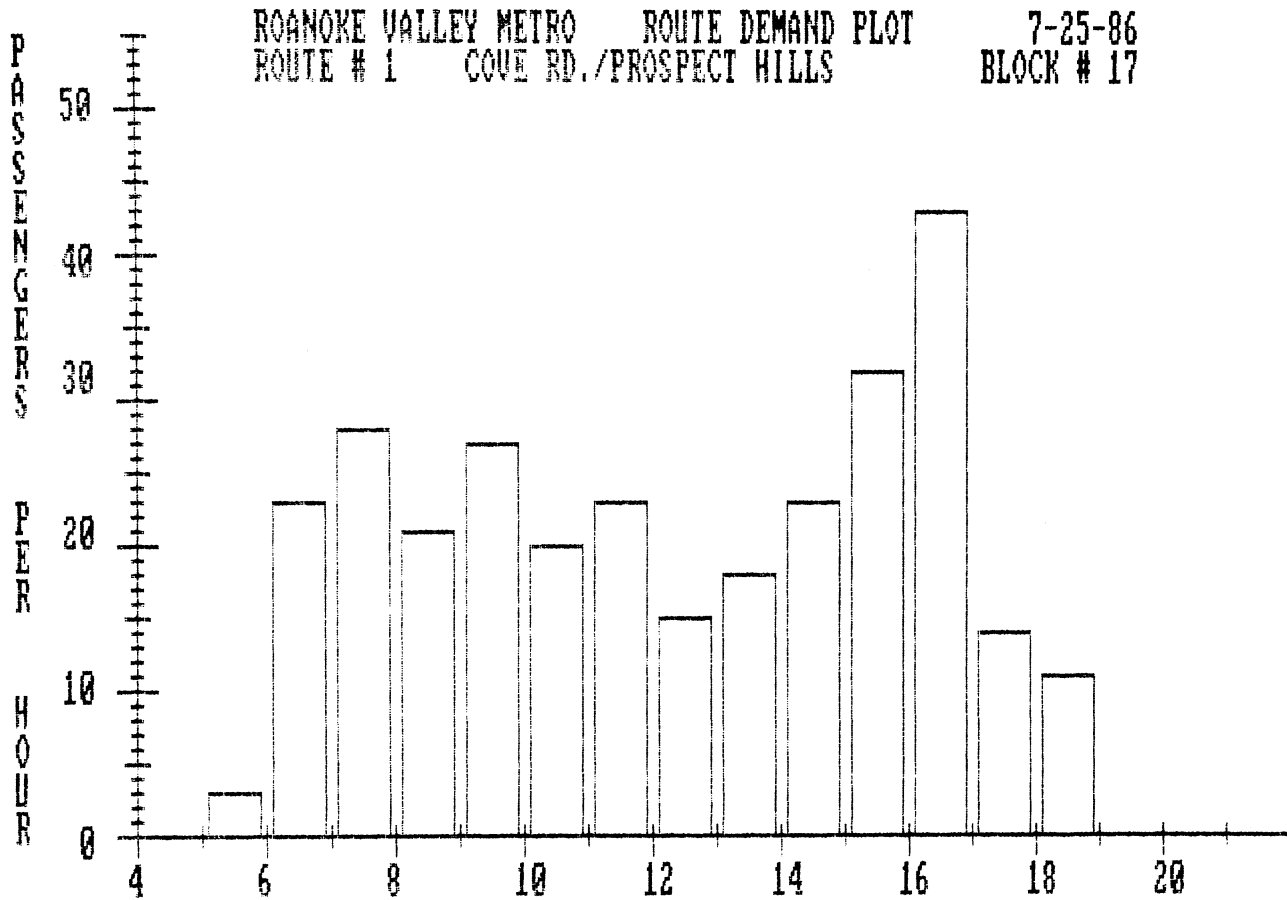
TIME PERIOD	AM PEAK	MIDDAY	PM PEAK	NIGHT	SATDAY	SUNDAY	TOTAL
Passengers Boarded	31	238	66	0	0	0	335
Pass. On Board	637	3317	950	0	0	0	4904
Bus Trip Distance	34	138	43	0	0	0	215
Passenger Miles	409	1670	509	0	0	0	2589
Bus Trip Time	146	605	178	0	0	0	928
Passenger Minutes	427	1797	527	0	0	0	2751
Capacity Miles	2265	9130	2823	0	0	0	14218
Seat Miles	1442	5810	1796	0	0	0	9048
Trips in Sample	3	13	4	0	0	0	20
Total Trips	500	900	200	0	800	0	2400
SAMPLE AVERAGES							
Unl. Pass./Trip	10	18	17	0	0	0	45
Pass. Miles/Trip	136	128	127	0	0	0	392
Unl Pass Trip Time	142	138	132	0	0	0	412
ANNUAL TOTALS							
Unl. Pass. Trips	5167	16477	3300	0	0	0	24944
Passenger Miles	68197	115642	25454	0	0	0	209293

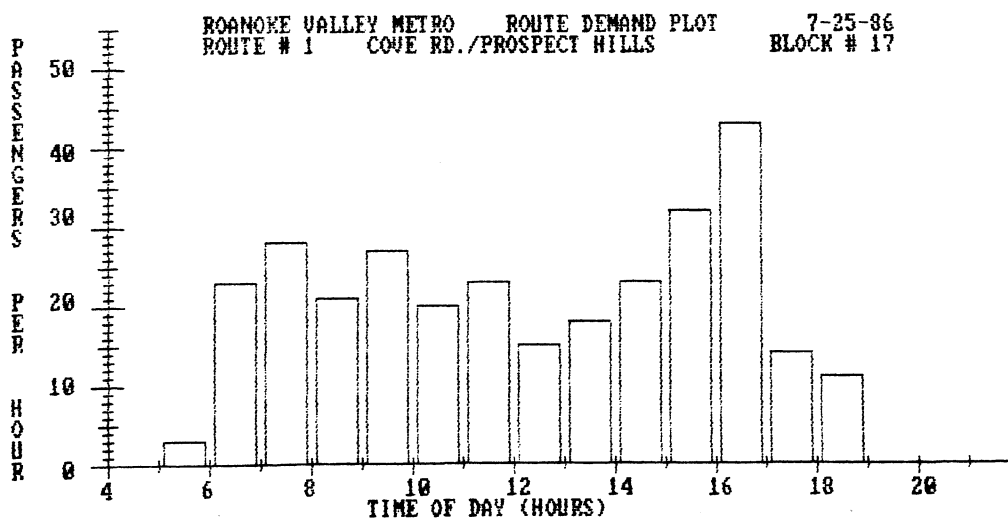
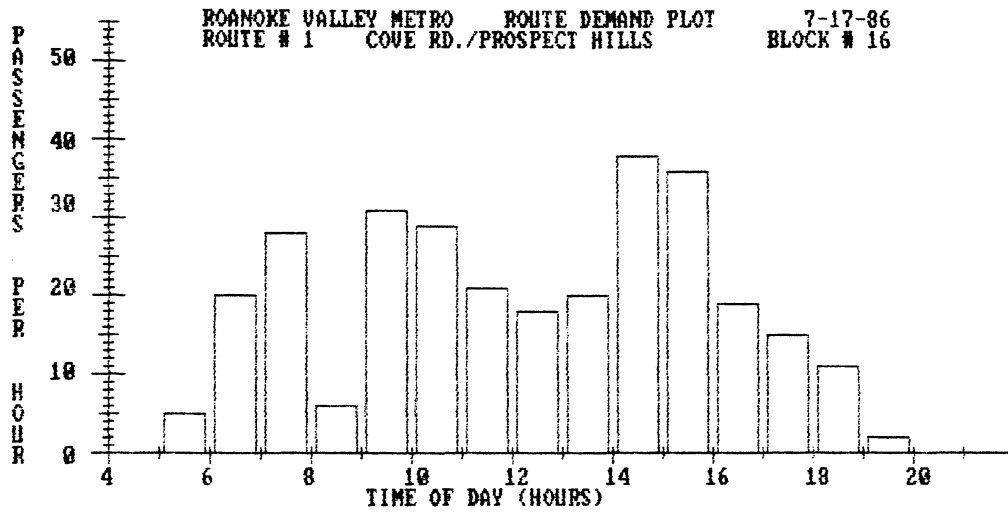


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