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# Findings of Preliminary Analyses of the Trenton Off-Peak Fare-Free Transit Demonstration

Interim Report  
January 1979

Service and Methods Demonstration Program

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U.S. DEPARTMENT OF TRANSPORTATION  
Urban Mass Transportation Administration and  
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Transportation Systems Center

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16. Abstract  This report was prepared as an interim informational summary of the progress of the Trenton Fare-Free Demonstration. It presents findings of interim analyses regarding ridership impacts; passenger profiles and trip characteristics; and transportation supply and cost impacts. Because of various limitations, the findings presented herein are for information only; definitive evaluation findings will be presented in the project's final report.					
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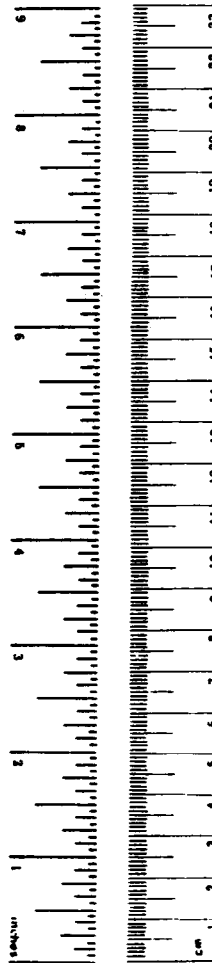
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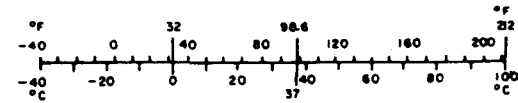
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
<b>LENGTH</b>				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
<b>AREA</b>				
in <sup>2</sup>	square inches	6.5	square centimeters	cm <sup>2</sup>
ft <sup>2</sup>	square feet	0.09	square meters	m <sup>2</sup>
yd <sup>2</sup>	square yards	0.8	square meters	m <sup>2</sup>
mi <sup>2</sup>	square miles	2.6	square kilometers	km <sup>2</sup>
	acres	0.4	hectares	ha
<b>MASS (weight)</b>				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
<b>VOLUME</b>				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft <sup>3</sup>	cubic feet	0.03	cubic meters	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.76	cubic meters	m <sup>3</sup>
<b>TEMPERATURE (exact)</b>				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
<b>LENGTH</b>				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
<b>AREA</b>				
cm <sup>2</sup>	square centimeters	0.16	square inches	in <sup>2</sup>
m <sup>2</sup>	square meters	1.2	square yards	yd <sup>2</sup>
km <sup>2</sup>	square kilometers	0.4	square miles	mi <sup>2</sup>
ha	hectares (10,000 m <sup>2</sup> )	2.5	acres	
<b>MASS (weight)</b>				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
<b>VOLUME</b>				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m <sup>3</sup>	cubic meters	35	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	cubic meters	1.3	cubic yards	yd <sup>3</sup>
<b>TEMPERATURE (exact)</b>				
c	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



## PREFACE

This document is a summary of interim analyses of the Trenton, New Jersey Free-Fare Transit Demonstration; it is not intended to be a comprehensive interim report. The Evaluation Plan for this project did not include preparation of an interim report, however, during the course of the demonstration the need for some compilation of interim findings became apparent. Accordingly, a limited-scope effort was authorized to prepare this document to at least partially satisfy that need. It was prepared using available data with the intention of informing elected officials and public agencies regarding the progress of the project.

The data used for the preparation of this report had some limitations. At the time of these analyses, the "before" data set was not completely weighted because of incomplete ridership data. Much of the "during" data was derived from a mini on-board survey conducted in May 1978. That survey was only half as large as the before survey and no attempt was made to correct for either that variation or for potential seasonality differences. In addition, because of incomplete data, some issues which are important to the full evaluation are not discussed in this report.

Given the limitation of this report, it can be useful as an interim informational summary pending completion of the full evaluation and preparation of the final project report. Care must be taken, however, to avoid over-extending these early data or findings.

It is appropriate to acknowledge the constructive contributions of three people in the preparation of this report. They are: Carla Heaton and Larry Doxsey of the Transportation Systems Center and Bob Knight, De Leuw, Cather's Principal Investigator for SMD projects.



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## 1.0 INTRODUCTION

This report presents preliminary findings of interim analyses of the Mercer County Off-Peak Fare-Free Transit Demonstration. This material, because of various data limitations which are discussed later, is presented for purposes of discussion only and remains subject to revision and/or adjustment as dictated by continuing analyses.

The report is organized into the five following sections:

- Introduction
- The Demonstration - a description of the demonstration program and the evaluation, including discussion of the limitations of this report
- Conclusions - a summary of major findings
- Ridership Impacts - a discussion of the changes in passenger volume and composition
- Operational Impacts - a discussion of the effects on transit operations and costs.

## 2.0 THE DEMONSTRATION

The Mercer County Fare-Free Transit Demonstration is one of two tests of the effects of eliminating system-wide off-peak fares. (The other demonstration was run concurrently in Denver, Colorado.) It is sponsored by the Service and Methods Demonstration (SMD) Program of the Urban Mass Transportation Administration (UMTA) and the New Jersey Department of Transportation (NJDOT). Evaluation of the project is being conducted by De Leuw, Cather and Company under the direction of the Transportation Systems Center (TSC). It is being conducted on the Mercer Metro bus system (a division of the Mercer County Improvement Authority) in Mercer County, New Jersey.

Mercer County is located directly between Philadelphia and New York. Covering some 226 square miles, the county is approximately 12 x 20 miles in size. Its major city, Trenton, lies on one edge of the county on the Delaware River, across from Pennsylvania. The countryside is generally flat or rolling, without mountainous terrain or other major natural obstacles to internal circulation. The county's roadway system is well developed, with high-speed access to all parts of the county. Trenton is also on the main Amtrak rail line between New York and Philadelphia.

The county's population in 1970 was approximately 304,000, up about 14 percent since 1960. Trenton, which is the capital of New Jersey as well as the county's largest city, had about 104,000 residents, a loss of about 8.3 percent during the same period. Other urbanized centers include the municipalities of Hamilton (80,000), Ewing (33,000), Princeton (26,000), and several smaller towns.

Because of the state capital, governmental employment is an important component of the economy. Educational services, including Princeton University, constitute another major employment sector. In addition, the county has a long history of diversified manufacturing.

Trenton is experiencing many of the typical problems of older northeastern cities. Many jobs, retail trade activity, and most of the more affluent population have gradually shifted from the city to the more attractive suburban areas of the county. Left behind are a disproportionate number of the county's poor, elderly, and others without access to automobiles, leaving Trenton with a large low-mobility population.

Based on 1970 Census data, almost 13 percent of the city's population was below the poverty level, compared to only 3.4 percent elsewhere in the county. Over 12 percent were elderly, and 3.1 percent were under 18. Most striking, however, is Trenton's incidence of carless households: 35 percent of all occupied housing units in the city had no auto available in 1970.

Mercer Metro is the principal supplier of public transportation in the county. Providing essentially all of the county bus service since 1969, Mercer Metro derives non-fare funding assistance from the county, the State and the federal government. It operates over a basic fixed-route system of some 280 route miles on sixteen routes and provides approximately seven million vehicle-miles of service annually. Before the free fare program began, base fares were 30 cents during the peak hours and 15 cents during off-peak hours; in addition, there were some extra zone charges for very long trips. Transfers were sold at a cost of five cents.

The free-fare demonstration began March 1, 1978. Off-peak fares were eliminated on ten intra-county routes and three loop routes (shuttles); only a few inter-county routes were excluded. The program established free service during what were previously the half-fare hours on Mercer Metro (10 A.M. - 2 P.M. and after 6 P.M. Monday through Saturday, and all day on Sundays and major holidays). For most passengers, the fare saving amounts to 15 cents per trip.

The ultimate basis for evaluation of this demonstration is comparison of a pair of comprehensive data sets; one assembled in October-November 1977 (before off-peak fares were eliminated) and the other in October-November 1978 (after off-peak fares were eliminated). In this way, the effects of seasonal variations on the data and subsequent conclusions are minimized. The two data sets each consist of the results of a comprehensive on-board survey (approximately 4500 "before" samples and 4900 "after" samples), a telephone survey (approximately 500 households each), and personal interviews at a suburban shopping center and a downtown Trenton shopping area (approximately 300 at each location during each period). In addition, the survey data sets were supplemented by seven passenger volume observations conducted periodically throughout the demonstration; two before and five following the elimination of fares.

The analyses conducted for this document are not based on the above described data. Data taken from the Fall 1977 surveys (see Appendix A for on-board survey instrument) were analyzed to estimate "before" conditions; however, in some cases, those data are not completely adjusted and weighted to reflect total ridership and therefore may be modified in subsequent analyses. The "after" data are taken from an interim on-board survey conducted in May 1978 (see Appendix B for survey instrument). These data have the same adjustment shortcomings described for the "before" data. In addition, there are two inherent limitations on the use of the May data: first, the sample size is less than half as large as the Fall 1977 on-board survey, and second, the effects of seasonality (i.e., May versus November) are accounted for.

An additional shortcoming of these interim analyses is that, because of May 1978 data limitations, they do not address a number of important issues which are scheduled for investigation in the evaluation. In particular, some key issues which cannot yet be discussed include: how many persons were attracted to the off-peak bus service for the first time by the fare-free program, what are their characteristics, and do they differ from prior off-peak bus users; what have been the effects of the program on group ridership; what have been the effects of the program on trip patterns; what have been the effects of the program on commercial/retail centers; and what are the public's attitudes toward the fare-free program and transit in general.

### 3.0 CONCLUSIONS

The following summarizes major points of this report and itemizes general findings and conclusions of the preliminary analyses completed to date. Page references for further details are also provided.

- Increases in Bus Use: Since implementation of the free service, Mercer Metro off-peak ridership has increased approximately 45-50 percent during all free-fare periods. This has contributed to a net (all-times) ridership increase of approximately 10-15 percent (See page 6). Some of the additional bus trips are a result of increased trip frequency (See page 6).
- Former Means of Travel: It appears that slightly less than half of the new off-peak bus trips would not have been made at all if fares had been charged. The remainder of the new bus trips would have been made using other modes. (See page 8)
- Purpose of New Trips: In general, a larger share of the new bus trips appear to be for discretionary purposes than was found with previous off-peak bus trips. (See page 9)
- Age of New Riders: There appears to be clear differences in the time of bus use by age for new bus trips; for example older people tend to use the bus more during the mornings while younger riders use it more in the evenings. Overall, the average age of off-peak riders appears to have increased. (See page 10)
- Problems on Buses: Increased use of the bus service by young people has been associated with increased complaints regarding on-board rowdyism and harassment, especially on particular routes in the evening hours. This appears to be mostly a change in atmosphere caused by boisterous, inconsiderate, and unruly youths riding to/from suburban shopping malls, rather than a real increase in serious on-board incidents. Complaints regarding these problems seem to have ended after the first few months of the program. (See page 11)
- Effects on Bus Drivers: Bus drivers have been particularly vocal about the rowdyism issue. They have also complained that the program has caused them to be late more often and to miss breaks because of more passengers and additional stops, which is substantiated by schedule adherence data. (See page 12)
- Effects on On-Time Performance: One effect on Mercer Metro operations has been an increase in the run time of buses and accompanying increases in the occurrence and length of bus delays in the downtown area. The proportion of late buses during the off-peaks (weekday) has increased over ten percent, (See page while the average delay during the free service periods has increased about two minutes (See page 13)

- Effects on Passenger Comfort: The fare-free program has substantially increased passenger crowding on buses during the off-peaks. The proportion of buses with standees has changed from approximately 10%, before the demonstration, to over 50% after the fares were eliminated. (See page 15)
- Effects on Annual Peak Period Ridership: Although the causes are not yet conclusive, there appears to be about six percent fewer peak period passengers than would have been expected if the free fare program had not been instituted. This is composed of an estimated absolute decrease of about 177,000 annual passengers compared with before the free-fare program (from 4.377 million to 4.2 million); and about 101,000 additional annual passengers which would have been expected due to normal growth. (See page 17)
- Effects on Annual Off-Peak Ridership: There appears to be an increase of approximately 46 percent in annual off-peak ridership beyond what would have been expected due to normal growth, a total of about 1,038,000 passengers. (See page 17)
- Effects on Annual Revenue: The major cost impact of the program has been the loss of revenue; based on projected annual ridership the total revenue loss is estimated to be \$342,000; \$274,000 is attributable to the revenue loss from regular off-peak riders, and \$68,000 is attributable to a loss in peak period ridership. (See page 17)
- Effects on Annual Costs: There has been some need for increased bus and driver assignments to carry large passenger volumes during free-fare periods. The cost of additional service has not yet been estimated. (See page 17)

#### 4.0 RIDERSHIP IMPACTS

Ridership impacts can be divided into five groups:

- Passenger volumes
- Trip frequency
- Means of travel
- Trip purposes
- Passenger ages
- Youth rowdyism
- Effects on drivers

Following is a description of each of these impact groups.

#### 4.1 Passenger Volume Changes

Since implementation of the free service, Mercer Metro off-peak ridership has increased on the order 45-50 percent overall during free-fare periods. This has contributed to an overall system ridership increase of approximately 10-15 percent. Figure 1 illustrates the estimated trend of monthly Mercer Metro ridership. A detailed discussion of observed ridership changes, with an accompanying description of estimation methodology, is presented in Appendix C.

Figure 1  
MONTHLY RIDERSHIP TRENDS

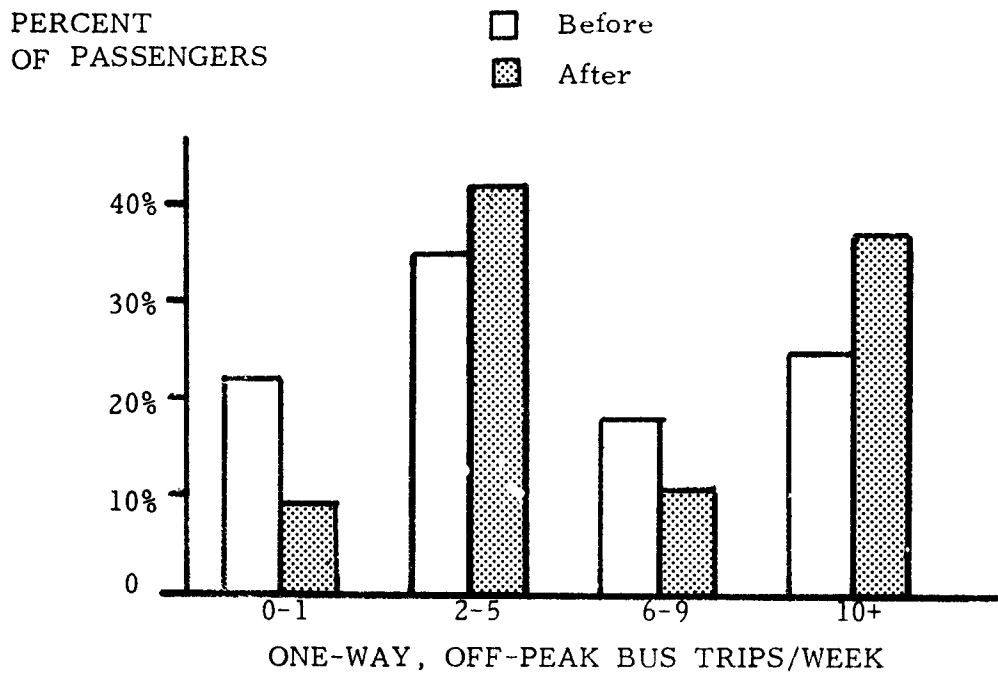




## 4.2 Trip Frequency Changes

Both the before and after on-board surveys included a question about the frequency of the respondent's bus trips, measured by the number of one-way bus trips in a typical week. The reported trip frequencies are shown on Figure 2 for the period before fares were eliminated ("with fares") and the period after fares were eliminated. Since fare elimination, there has been an apparent increase in the frequency of bus travel by Mercer Metro users, with large increases in the number of people reporting the "10 or more" trips per week category, and decreases in the number of people reporting the "0-1" trip category. See Appendix D for tabular data on trip frequency.

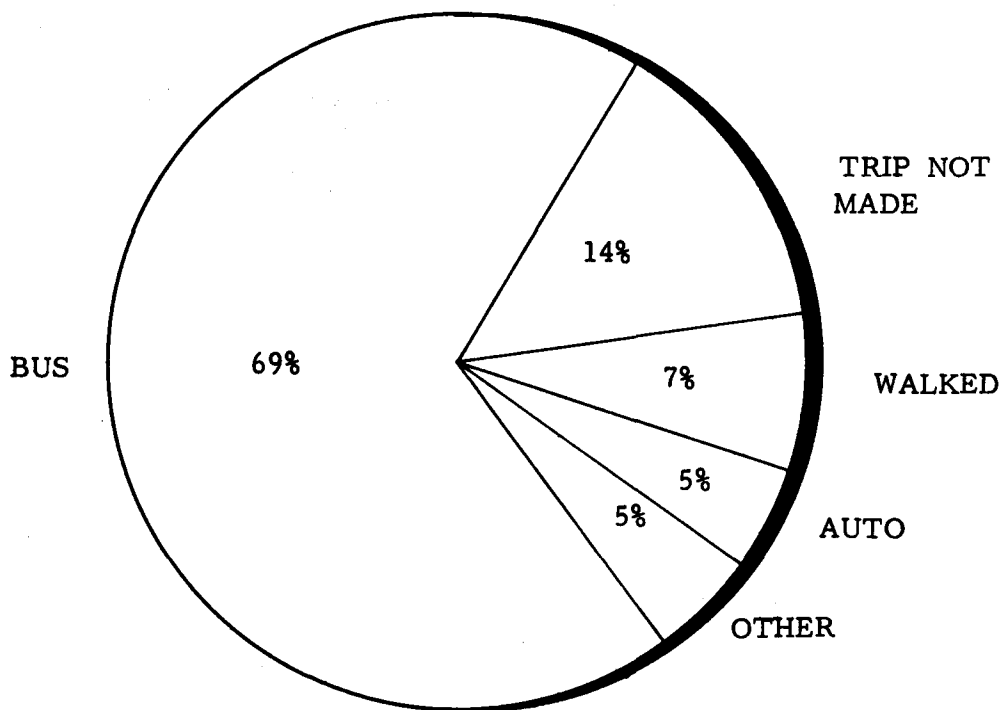
Figure 2  
OFF-PEAK BUS TRIP FREQUENCY



### 4.3 Effects on Means of Travel

Respondents to the May 1978 mini-survey were asked to indicate what mode they would have used for that particular trip if the bus service had not been free; the responses to this question indicate the sources of off-peak bus trips after fares were eliminated. Some portion of the prior bus users were people who shifted their time of travel from the peak periods in order to avail themselves of the free bus service. Based on total ridership changes, it is estimated that approximately 2000 passengers per week have changed their time of travel from peak to off-peak, representing approximately three percent of the total trips. Figure 3 graphically illustrates the share of weekly passengers by all alternate modes. Fourteen percent of the total trips after fares were eliminated were reported to be trips which would not have been made at all before the fare-free program; this indicates some increased mobility for persons in the service area. Seven percent would have been made by walking; many of these are probably short, parallel-route trips in the downtown area. Five percent were diverted from auto and another five percent from "other" modes. A tabular breakdown of alternate mode by time periods is presented in Appendix E.

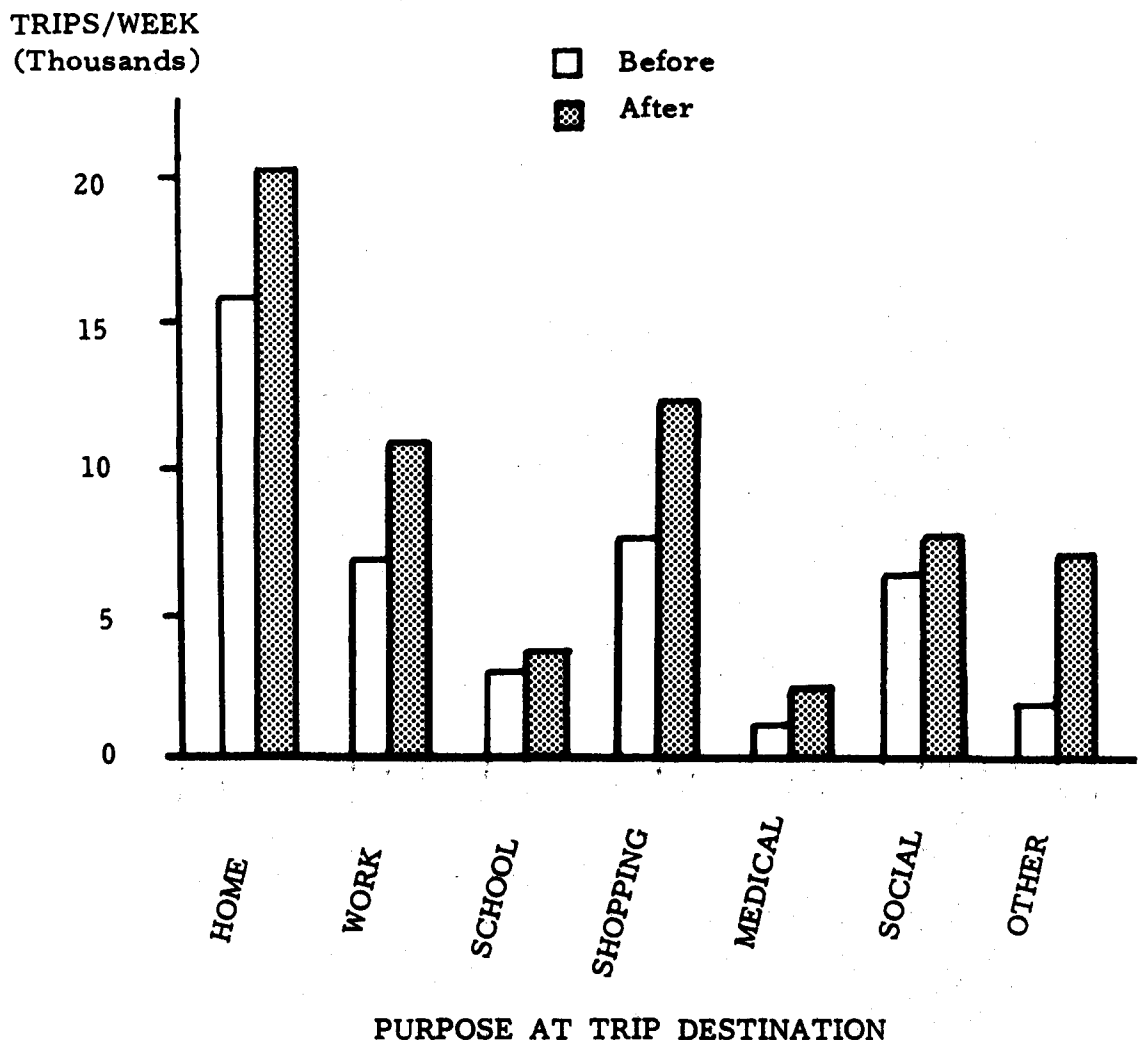
Figure 3  
HOW TRIPS WERE MADE BEFORE FREE FARES



#### 4.4 Trip Purpose Changes

Figure 4 depicts the purposes of trips made by Mercer Metro passengers during the off-peak hours as reported in the November 1977 and May 1978 surveys. All of the trip purpose categories exhibited increases in the absolute number of trips made after off-peak fare elimination, with only a couple of significant changes in the share of the total. The "other" category, which includes personal business (banking, legal aid, welfare, unemployment office, etc.), church, lunch, etc. increased in share by approximately seven percentage points, while homebound trips decreased approximately six percent as a portion of the total. That "home" did not maintain its share of total trip destinations indicates that relatively fewer trip makers use the free bus to return home. They may be either traveling home during peak periods or by another mode. Appendix F presents additional detail on trip purpose data.

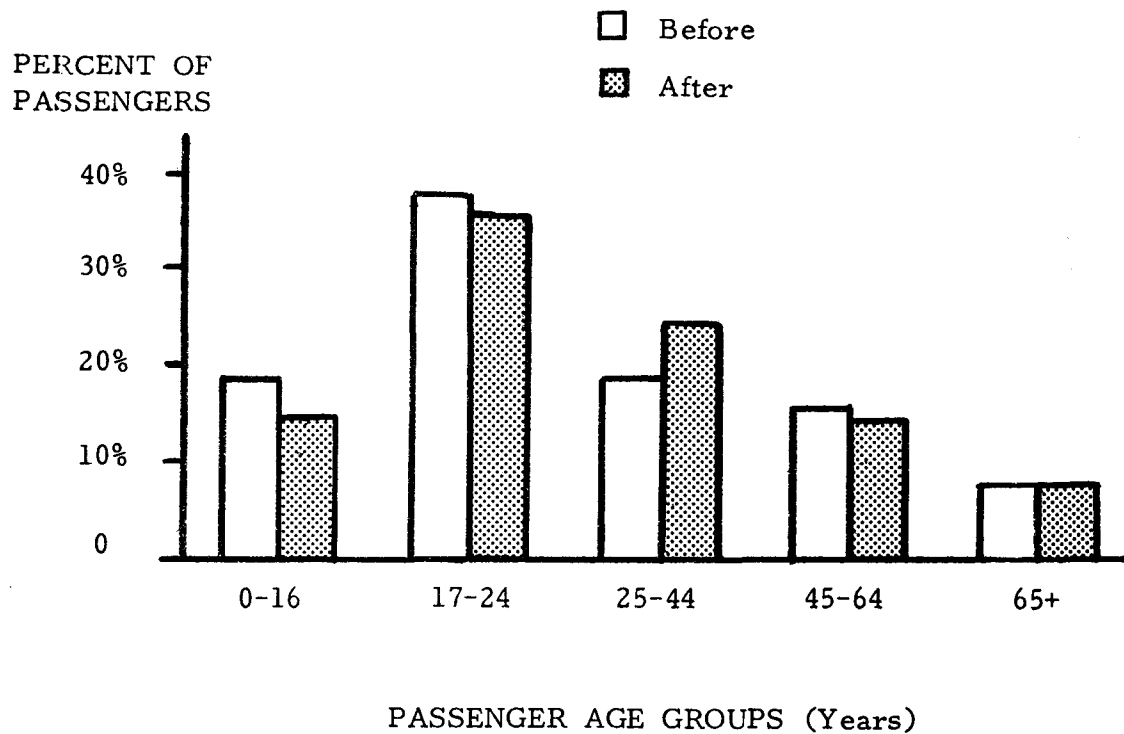
Figure 4  
OFF-PEAK TRIP PURPOSES



#### 4.5 Ages of Passengers

Comparing overall age distributions before and after the elimination of fares gives an indication of the way in which the program is being used by persons in various age groups. Figure 5 illustrates the portion of overall estimated ridership by age group. (Caution must be taken because these computations are based on the assumption that survey responses regarding age are representative of the total ridership.) Based on these data, it appears that younger people have lost representation in the share of total weekly ridership. This is to be expected since a disproportionate amount of the free bus service is provided during weekday mornings when much of this group is occupied in school. The middle age group (25-44), on the other hand, has gained as a percent of the total ridership and the 65-or-over group has maintained its share of the total. Appendix G presents detailed passenger age data.

Figure 5  
AGES OF PASSENGERS



#### 4.6 Youth Rowdyism

Perhaps the most surprising observation regarding the demonstration has been the reaction of bus drivers, a very few passengers, and the management of a suburban shopping mall regarding a purported increase in rowdyism on the buses by young riders. Bus drivers have complained that evening runs, especially on Saturdays were particularly troubled by disorderly young people. As a result of a specific on-board incident, the local press joined the drivers in a protest against the rowdyism which was perceived to be a result of the free-fare program.

Special data were assembled from a variety of sources to investigate the juvenile rowdyism issue. Mercer Metro driver report records were reviewed and incidents were tabulated and categorized by type; data from suburban shopping centers were reviewed to identify the rate of occurrence of incidents by juveniles; and special on-board observations of selected routes were performed by the Office of Investigative Services of the New Jersey Department of Transportation. The following summarizes these investigations.

##### On-Board Incidents:

Based on tabulations of Mercer Metro driver reports for 1977 and the first five months of 1978, there has been an overall increase in vandalism, abuse of passengers, and abuse of drivers; however, that increase began around September 1977 - six months before the free-fare program began (March 1, 1978). Until early summer, there was no additional significant increase in the absolute numbers or rate of occurrence of vandalism, passenger abuse, operator abuse, or personal property damage incidents. Data from subsequent months are as yet not analyzed.

Investigators from the New Jersey Department of Transportation's Bureau of Investigative Services made unannounced checks of on-board conditions on Route K and at the Quaker Bridge Mall bus stop. Two incident types were observed during the fare-free periods: 1) smoking/eating on the bus, and 2) use of profane/loud language. These incidents occurred on the average of three times per trip; no data are available to indicate if this represents an increase since the free-fare program began. Mercer Metro management has indicated that such incidents have always occurred to some degree on the buses as might be expected in any public place. The observed rate of occurrence of these incidents does not appear to be extraordinary. No incidents were noted in the more serious categories involving property damage and personal harassment.

## Off-Bus Incidents:

Statistics on the rate of incidence of security violations involving juveniles at suburban shopping centers served by Mercer Metro routes indicate that since the free bus service began in March 1978, there has been a perceptible increase in the rate of juvenile incidents; however, the magnitude of the increase is not extraordinary relative to some prior months, including February 1978, before free bus service began. The rate for May 1978, the last month with available data, is in fact, lower than the rate in seven of the 14 months just before free bus service began. The nature of juvenile incidents tend to be principally retail theft (55 percent) and disorderly conduct (25 percent).

While bus drivers and shopping mall management contend that there has been a significant increase in youth-related incidents on or near the free buses, available statistical data do not support this contention. It is clear that there is a slight increase in some types of incidents, but nothing which would be unexpected in light of the increased ridership. There is a distinct possibility that what is occurring is a change in the on-board atmosphere (increased noise, profanity, or other nuisance-type annoyances), probably concentrated on particular routes and at particular times, which is offensive or threatening to certain passengers and drivers. It is also possible that nuisance incidents at shopping centers have increased but have not been documented. It is likely that much of the complaint has been prompted by the actions of relatively few individuals on specific routes, during particular times, rather than an overall breakdown of order on the buses.

### 4.7 Effects on Bus Drivers

A sample of Mercer Metro drivers, who have collectively driven all fare-free times and routes, were interviewed regarding their experiences with the program. Their responses are summarized below:

- Nearly all drivers (95 percent) interviewed reported having received bad comments from passengers regarding the fare-free program; 89 percent said they frequently received bad comments.
- Good comments about the program were reported by 31 percent of the drivers; only six percent said good comments were received frequently.
- Ninety-two percent of the drivers said the program has made their job less enjoyable, while the remainder said it was made more enjoyable or not affected by the demonstration.

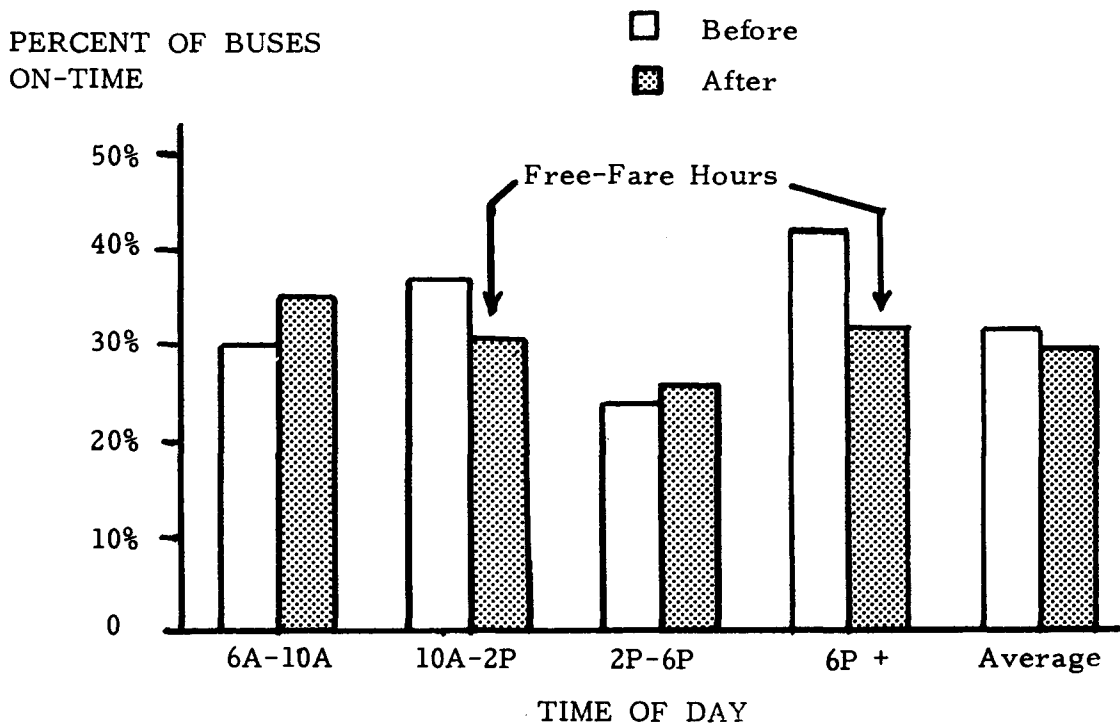
## 5.0 OPERATIONAL IMPACTS

Perhaps the most clearly definable free-fare results with respect to the transportation operations of Mercer Metro are the effects of the program on schedule adherence, delay, and crowding. The major operational impact of the demonstration has been, as might be expected given the increased passenger loads, an increase in the run times of the buses. In the bus driver's interview, 64 percent indicated that they were experiencing longer trip times as a result of the free-fare program; 61 percent said they had shorter, or missed, layovers; and 53 percent said they had problems staying on schedule.

### 5.1 On-Time Performance

Analysis of the on-time performance of the Mercer Metro buses indicates an overall increase in the occurrence of late bus arrivals with a comparable decrease in the percent of buses arriving early, and a slight decrease in the overall percent on-time (0.3 minutes late). Figure 6 illustrates the observed on-time performance for the respective time periods. The data indicate that there has been measurable improvement in the peak-periods schedule adherence with a degradation of off-peak schedule adherence. This is indicative of a balancing of on-time performance over the day. Appendix H presents corresponding tabular data

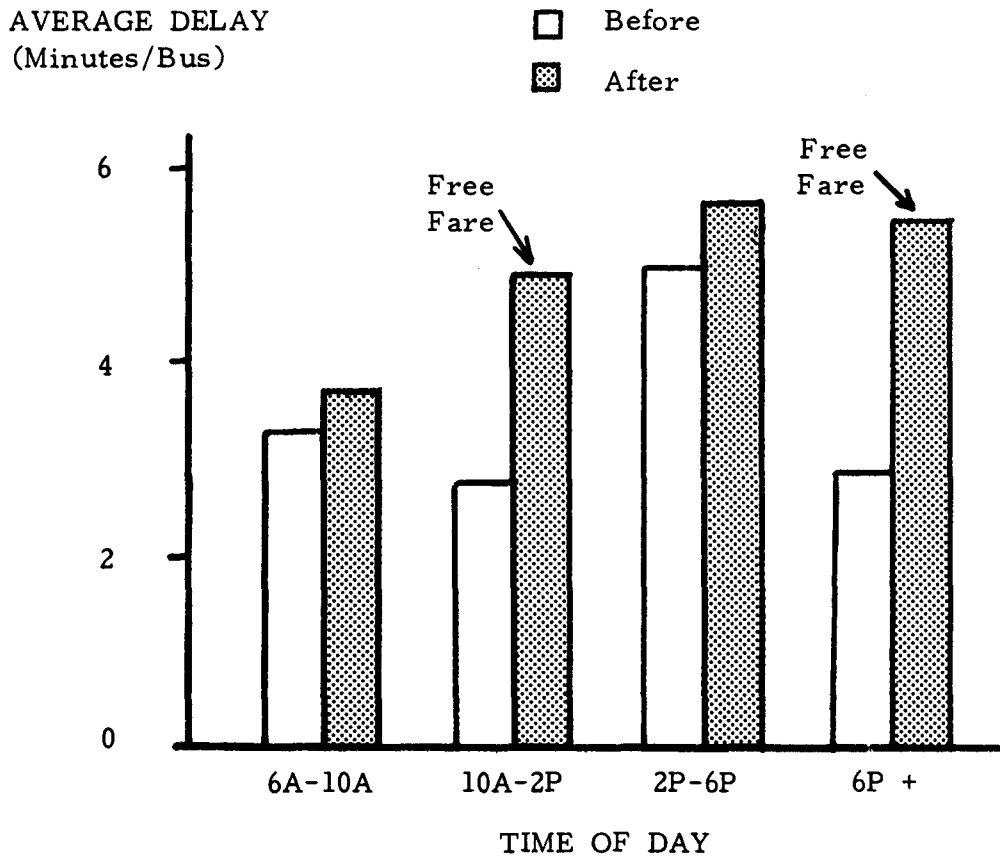
Figure 6  
MERCER METRO ON-TIME PERFORMANCE



## 5.2 Delay

There appear to be clear indications that the amount of bus delay in the off-peak periods has increased since fares were eliminated. Figure 7 illustrates the change in average bus delay during the peak and off-peaks; although there has been an observed increase in delay in all time periods, the off-peak delays have increased significantly more on a relative basis (75% and 90% increases) than have the peak periods (12% and 14% increases). (See Appendix I for numerical data).

Figure 7  
AVERAGE BUS DELAY





### 5.3 Crowding

Figure 8 presents findings on changes in weekday bus occupancy since implementation of the free bus service. Load factor, a measure of vehicle productivity, is the ratio of passenger load to seated capacity at a point in time. The figures in the table indicate that since fares were eliminated, average off-peak bus loads have increased sharply, both relative to previous levels and relative to peak periods. The discomfort to passengers implied by this can be further measured by examining the rate of occurrence of buses which are loaded at or above seated capacity. Figure 9 presents statistics on the extent of capacity loads (i.e. 40 or more passengers) observed before and after fare elimination. While weekday peak period changes have been small, it is clear that the occurrence of capacity loads during the off-peak free-fare periods has been significantly higher since fares were eliminated. Similar changes have been observed during weekend free-fare periods. Appendix J presents details on crowding data.

Figure 8  
AVERAGE WEEKDAY LOAD FACTORS

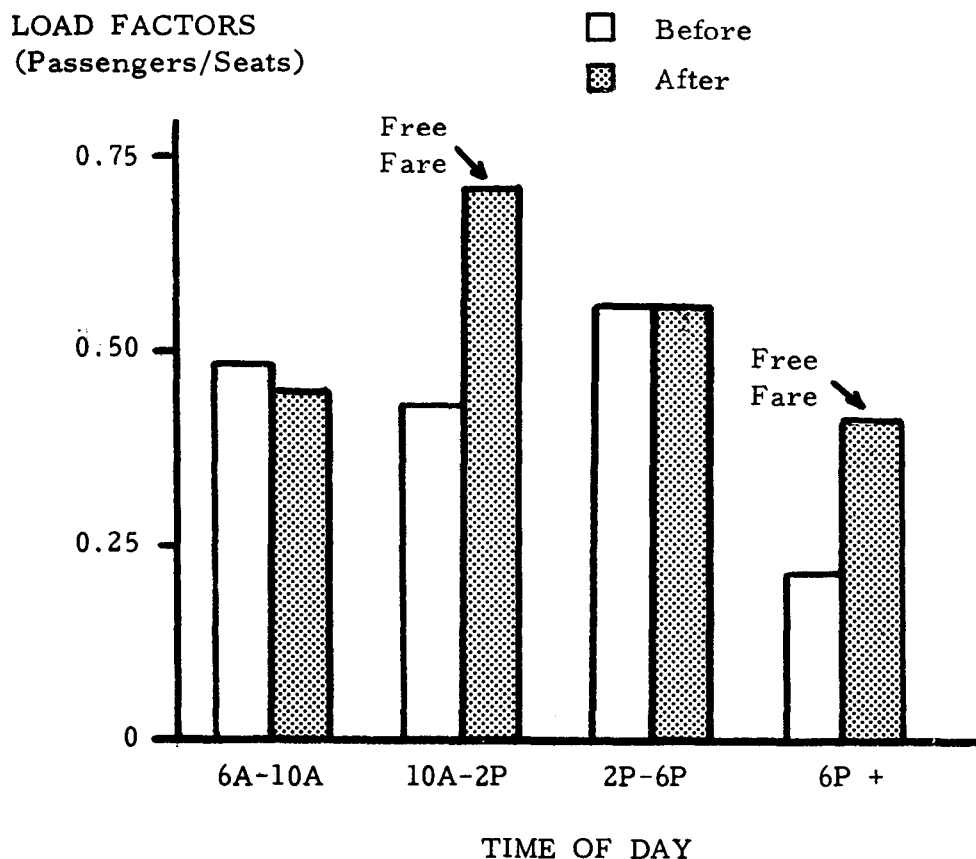
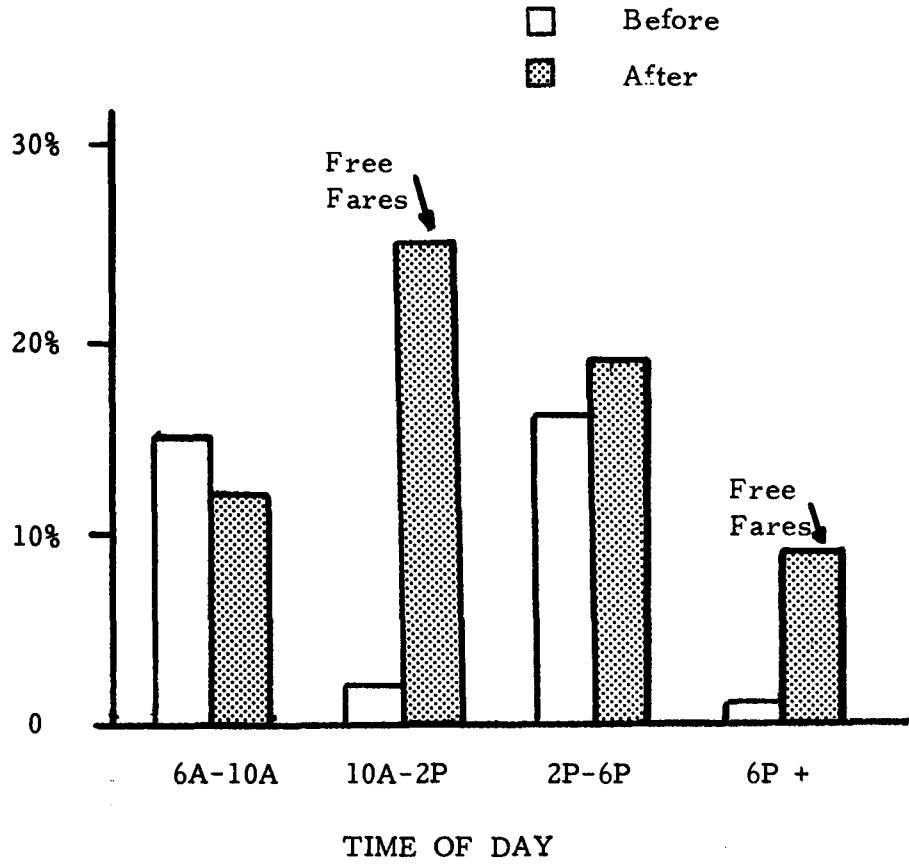


Figure 9  
CAPACITY-LOADED BUSES (WEEKDAY)

PERCENT OF BUS TRIPS OBSERVED  
AT OR ABOVE CAPACITY LOAD



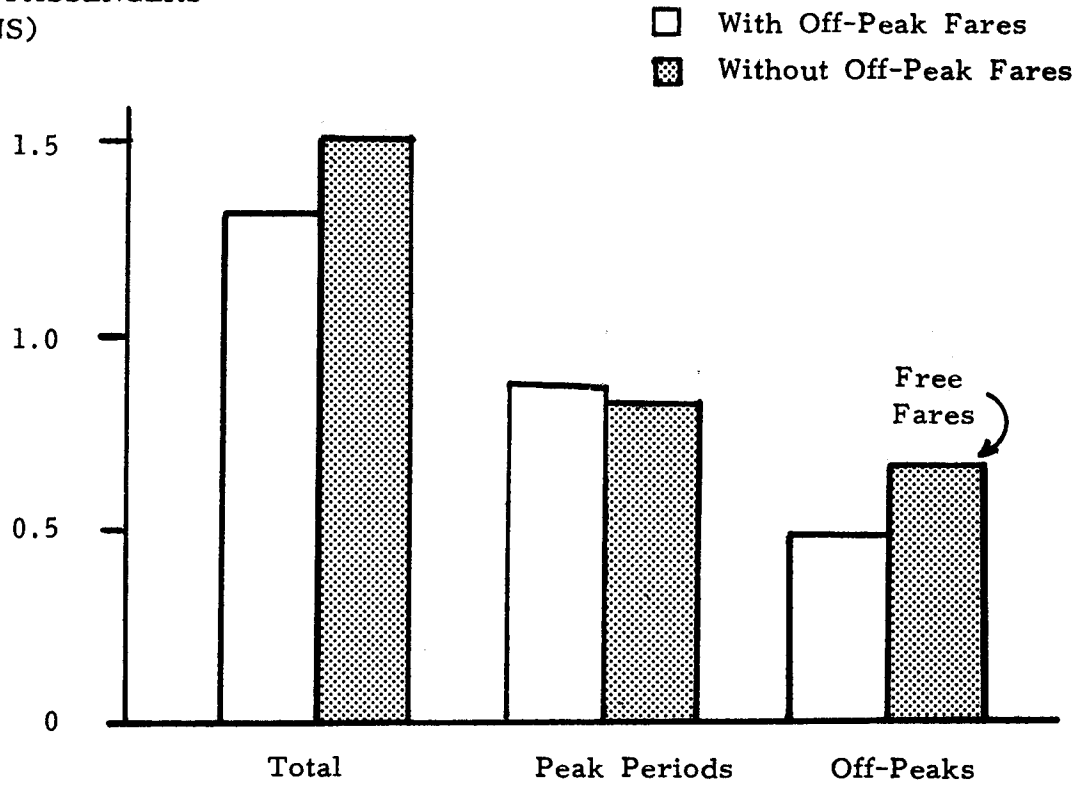
#### 5.4 Cost Impacts

The major cost element of the demonstration has been the loss of revenue resulting from off-peak fare elimination. Farebox receipts for regular route service during the twelve month period from March 1977 through February 1978 totaled approximately \$1,340,000. Based on an annual growth factor of 1.023 (as determined by average compound factor for observed annual revenue growth), the expected revenue for the demonstration period would have been about \$1,368,000. Projected revenue through the demonstration period is expected to total approximately \$1,030,000 (excluding the effects of a recent increase in peak period fare). The difference of \$338,000 represents the expected net revenue loss to Mercer Metro. Approximately \$280,000 of the loss is attributable to loss of revenue from regular off-peak passengers (including estimated normal growth), while \$58,000 is attributable to a net loss in revenue from peak-period ridership decreases. Figure 10 summarizes the projected annual ridership and revenue impacts of the program. Appendix K presents details on the annual passenger and revenue projections.

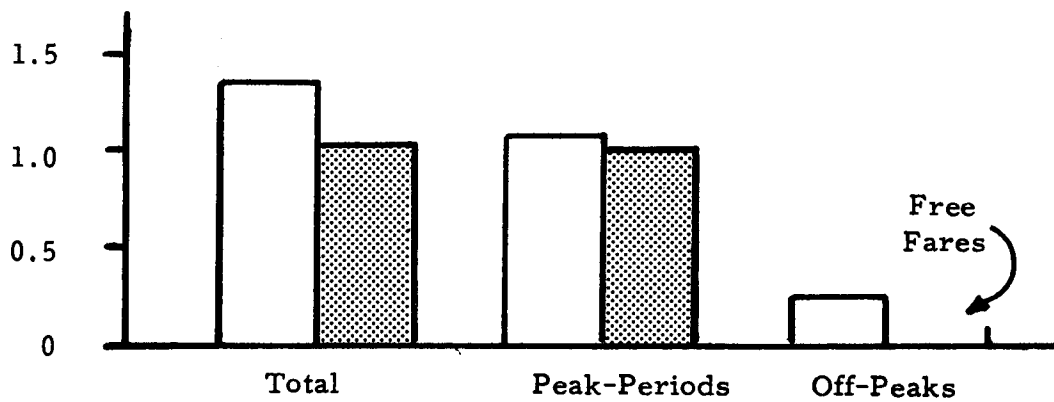
Mercer Metro has found it necessary, during the course of the demonstration, to provide additional bus service, in the form of trailer buses, to meet excessively high passenger demands during some free-fare hours. The cost of this additional service has not yet been estimated, nor have any other areas of potential cost increase been investigated as yet. However, based on discussions with Mercer Metro management, it is not expected that these costs will be substantial relative to the revenue loss.

Figure 10  
EFFECTS ON RIDERSHIP AND REVENUE

ANNUAL PASSENGERS  
(MILLIONS)



ANNUAL REVENUE (\$)  
(MILLIONS)



APPENDICES



**MERCER METRO BUS SURVEY**

sponsored by  
**New Jersey Department of Transportation**  
 in cooperation with  
**Urban Mass Transportation Administration**  
**Mercer County Improvement Authority**

OFFICE USE ONLY

GRP   
 C E O   
 AGE

Dear Rider:

Your answers to these few questions will help us plan for a future bus service in Mercer County. Please return this form with your answers before you get off.

1. I AM COMING FROM (CHECK ONE):  
 Home.....  Work.....  School.....  Shopping.....   
 Medical..  Recreational..  Social/Visiting..  Other (what?)..

2. THAT PLACE WAS AT \_\_\_\_\_ IN \_\_\_\_\_  
 (address or nearest corner) (city)

3. I GOT TO THIS BUS BY (CHECK ONE):  
 Walking.....  Driving a car..  Riding in a car..  Taxi..   
 Another Bus..  (What Route? \_\_\_\_\_) Other (What?) \_\_\_\_\_

4. I GOT ON THIS BUS AT \_\_\_\_\_ IN \_\_\_\_\_  
 (address or nearest corner) (city)

5. I WILL GET OFF THIS BUS AT \_\_\_\_\_ IN \_\_\_\_\_  
 (address or nearest corner) (city)

6. I AM NOW GOING TO (CHECK ONE):  
 Home.....  Work.....  School.....  Shopping.....   
 Medical..  Recreational..  Social/Visiting..  Other (What?)..

7. THIS WILL BE AT \_\_\_\_\_ IN \_\_\_\_\_  
 (address or nearest corner) (city)

8. I WILL GET THERE FROM THIS BUS BY (CHECK ONE):  
 Walking.....  Driving a car..  Riding in a car..  Taxi..   
 Another Bus..  (What Route? \_\_\_\_\_) Other (What?) \_\_\_\_\_

9. I WOULD HAVE MADE THIS TRIP EVEN IF THE BUS HAD NOT BEEN RUNNING: True..   
 False..

10. THE NUMBER OF CARS OWNED OR OPERATED BY MEMBERS OF MY HOUSEHOLD IS:  
 None..  1..  2..  3 Or More..

11. THE NUMBER OF PEOPLE IN MY HOUSEHOLD IS:  
 1...  2..  3..  4..  5..  6 Or More..

12. I AM (CHECK ONE): Male..  Female..

13. MY AGE IS (CHECK ONE):  
 16 Or Under..  17-24..  25-44..  45-64..  65 & Over..

14. THE NUMBER OF BUS TRIPS (ONE-WAY) I MAKE WHICH START BETWEEN 10:00 AM AND 2:00 PM OR AFTER 6:00 PM IS (CHECK ONE):  
 Less Than 2 Per Week..  2-5 Per Week.....   
 6-9 Per Week.....  10 Or More Per Week..

15. THE TOTAL ANNUAL INCOME OF ALL MEMBERS OF MY HOUSEHOLD IS (CHECK ONE):  
 \$ 0-\$5,000.....  \$5,001-\$10,000..  \$10,001-\$15,000..   
 \$15,001-\$25,000..  Over \$25,001....

THANK YOU FOR YOUR COOPERATION!

T   
 D/E   
 N





**MERCER METRO BUS SURVEY**

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**New Jersey Department of Transportation**  
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**Urban Mass Transportation Administration**  
**Mercer County Improvement Authority**

OFFICE USE ONLY

GRP     
           C    E    O  
 NO.      
        I    O  
 DIR

Dear Rider:

Your answers to these few questions will help us to plan for improved bus service in Mercer County. Please return this form with your answers before you get off.

1. I AM COMING FROM (CHECK ONE):  
 Home    Work    School    Shopping  
 Medical    Recreational    Social/Visiting    Other

2. I AM NOW GOING TO (CHECK ONE):  
 Home    Work    School    Shopping  
 Medical    Recreational    Social/Visiting    Other

3. I CHANGED THE TIME THAT I STARTED MY TRIP IN ORDER TO TAKE ADVANTAGE OF THE FREE BUS SERVICE?  
 Yes    No

4. IF THE BUS SERVICE WERE NOT FREE FOR THIS TRIP, I WOULD HAVE . . . . .  
 Not Made The Trip    Taken The Bus Anyway  
 Driven Or Ridden In An Auto    Walked  
 Taken A Taxi    Other (Explain \_\_\_\_\_)

5. THE NUMBERS OF TRIPS I TYPICALLY MAKE USING THE FREE BUS SERVICE FOR:  

	<u>Number of One-Way</u> <u>Trips Per Week</u>
Trips To Work Or School Is	_____
Shopping Trips Is	_____
Other Trips Is	_____

6. I FIRST LEARNED ABOUT THE FREE BUS SERVICE FROM:  
 Radio    Television    Friend Or Relative  
 Bus Signs    Newspapers    Other (Explain \_\_\_\_\_)

7. THE NUMBER OF CARS OWNED OR OPERATED BY MEMBERS OF MY HOUSEHOLD IS:  
 None    1    2    3 Or More

8. THE NUMBER OF PEOPLE IN MY HOUSEHOLD IS:  
 1    2    3    4    5    6 Or More

9. I AM (CHECK ONE):    Male    Female

10. MY AGE IS (CHECK ONE):  
 16 Or Under    17-24    25-44    45-64    65 And Over

11. THE TOTAL ANNUAL INCOME OF ALL MEMBERS OF MY HOUSEHOLD IS (CHECK ONE):  
 \$ 0-\$5,000    \$5,001-\$10,000    \$10,001-\$15,000  
 \$15,001-\$25,000    Over \$25,001


T					
D/E					
N					

WE MAY NEED ADDITIONAL INFORMATION ABOUT YOUR BUS TRAVEL,  
 IF SO CAN WE CONTACT YOU BY PHONE?  
 Telephone Number \_\_\_\_\_  Day    Evening  
 Whom Should We Ask For (First Name) \_\_\_\_\_



## MERCER METRO RIDERSHIP ESTIMATES

The following summarizes the methodology used in estimating ridership on the Mercer Metro system for the periods before and after fare elimination. In general, the ridership estimates have been developed principally using the demonstration corner counts (DCC), supplemented by Mercer Metro corner counts (MCC), revenue records, and on-board head counts. Demonstration corner counts were taken seven times during the demonstration; twice before fares were eliminated (11/77 and 2/78), and five times after (twice in 3/78 and once in 5/78, 7/78 and 10/78). Counts were taken at three locations at various times as shown below:

COUNT LOCATIONS	TIME OF COUNTS			
	Weekdays	Saturdays		Sunday
	6a - 10p	10a-2p	6p-10p	10a-6p
State & Clinton	X	X	X	X
State & Calhoun	X			
Brunswick & Olden	X	X	X	X

In general, it is a process of estimating ridership once for an initial base period relating that estimate to a corresponding set of corner counts, and estimating ridership in subsequent periods by measuring changes in the corner counts and applying them to the base estimate. The following outlines the procedure used to expand and factor corner counts to estimate ridership.

### RIDERSHIP ESTIMATION PROCEDURE

- Step 1 - Expand on-board passenger counts to estimate base off-peak ridership for 11/77.
- Step 2 - Adjust all (before and after) corner count sets (DCC) for missing observations; tally by route and time period.
- Step 3 - Estimate 11/77 peak period ridership (by route and time period) by factoring corner counts:

$$PR_{ij} = \frac{OR_i}{OC_i} \times PC_{ij}$$

Where:

- $PR_{ij}$  = Peak period riderships for each route and time period
- $i$  = Each route

j = Peak period (am & pm)  
 OR = Sum of off-peak riderships (from Step 1)  
 OC = Sum of adjusted off-peak corner counts  
 (from Step 2).  
 PC = Peak period corner counts (am & pm).

Step 4 - Estimate route - and time-specific ridership for remaining "before" corner count sets:

$$R_{ij} = \frac{CC_{ij}}{IC_{ij}} \times BR_{ij}$$

Where:

R<sub>ij</sub> = Ridership by route and time period  
 i = Route  
 j = Time period (two peak and two off-peak)  
 CC = Corner Counts for new estimate period (2/78)  
 IC = Corner Counts for initial (base) estimate  
 period (11/77)  
 BR = Base Ridership (11/77)

Step 5 - Aggregate "before" ridership estimates, adjust for seasonal variation:

$$AER = (R_1 + R_2) \div 2$$

$$TAR = 10(AER) + 2(AER)(0.8)$$

Where:

AER = Average Estimated Ridership  
 R<sub>1</sub> = Estimated Ridership for 11/77  
 R<sub>2</sub> = Estimated Ridership for 2/78  
 TAR = Typical Annual Ridership (10 months  
 @ AER plus 2 summer months @ 80%  
 of AER).

Step 6 - Reconcile adjusted ridership estimate with revenue experience:

- Weekday off-peak passengers equal 30% of total;  
Saturday off-peak passengers equal 45% of total.
- Weekday off-peak revenue equals 18% of total;  
Saturday off-peak revenue equals 29% of total.

- Average unit revenue per peak period passenger equals \$0.244; average revenue per off-peak passenger equals \$0.120.
- Using average unit revenue figures, adjust periodic passenger estimates, to reconcile with average revenue experience.

- Step 7 - Repeat Step 4 for each "after" corner count set (excluding first 3/78), using respective counts.
- Step 8 - Aggregate and seasonally adjust "after" ridership estimates by repeating Step 5, where:

$$\text{AER} = (R_3 + R_4 + R_5) \div 3$$

$$\text{TAR} = 10(\text{AER}) + 2(R_6)$$

Where:

R <sub>3</sub>	=	Ridership Estimate for	3/78
R <sub>4</sub>	=	"	" " 5/78
R <sub>5</sub>	=	"	" " 7/78
R <sub>6</sub>	=	"	" " 10/78

- Step 9 - Reconcile "after" ridership estimate with average revenue experience:
- Average unit revenue per peak period passenger remains the same; average revenue per off-peak passenger equals zero.

### DISCUSSION OF PROCEDURE

The Step 1 procedure is expansion based on the proportion of total service observed in the on-board surveys. "Minutes of service" were calculated for the free-fare hours for all bus runs. The observed route-specific passenger volumes were then factored upward by the ratio of total bus minutes to surveyed bus minutes for the respective routes. The opportunities for error or bias in this step are the chance of data collection error in the passenger counts and the presumption that ridership is evenly distributed within free-fare times. These biases were accounted for by checking the results for reasonableness of distribution with Mercer Metro estimates. In a few cases on-board timing

counts were added to on-board survey counts if that seemed more reasonable than the expansion process. (On-board timing counts were not used as a primary data source for two reasons: 1) based on field observations during 1977 data collection, the general quality of the on-board timing counts was suspect; and 2) there are no comparable counts for 1978.)

The procedure used in Step 2 was to factor recorded corner counts (by route and hour) based on the ratio of the number of scheduled buses (for each route and hour) to the number of observed buses (for the same route and hour). This presumes that the buses which were not observed had passenger loads equal to the average of the ones which were observed. Given an average off-peak load of about 20 passengers, and an average of about 10 percent missed buses, at the worst case (i.e., all missed buses either full or empty) the potential error resulting from this presumption is only about three percent.

The purpose of Step 3 is to develop a relationship between the corner count data (samples) and the total system ridership. The opportunities for error result from common sampling error (using a few days to represent a "typical" day) and a presumption that the ridership-corner count relationship is the same during peak period as it is during off-peak periods. Daily variation (weekday) is accounted for in the data collection technique by staging corner counts over a three-day period (Tuesday through Thursday), and by a revenue-reconciliation procedure later in the procedure. The historical stability of the peak/off-peak ridership relationship on Mercer Metro tends to support the validity of the constant sample basis, to the extent major discrepancies had been encountered they would have been identified and corrected by revenue reconciliation.

Step 4 is a factoring procedure producing ridership estimates for each subsequent corner count set by factoring the November 1977 estimates, on the basis of the changes in corner counts. It has the same uncertainties as in Step 3 and they are adjusted for in the same way.

Step 5 is included to account for gross seasonal variation between summer months and other months. Based on Mercer Metro corner counts, summer ridership (one-day) is typically 80 percent of the average of other months. Thus, Step 5 accounts for two months at 80 percent ridership before fares were eliminated.

Step 6 is a final seasonal adjustment based on farebox revenue. Once a "typical one-day ridership" (before) is estimated, the average annual one-day revenue is used to reconcile the estimate. In practice, the

average revenue figure(s) used was for the nine months from March through November since they were the most stable months, with least exogenous effects, both before and after fare elimination. (January and February 1978 had new bus promotion efforts, and December through February 1979 all have a different peak period fare than other months.) This final adjustment, reconciling ridership estimate with reliably recorded revenue data, offsets and eliminates gross (i.e., total ridership) biases which may result from sample expansion.

Steps 7, 8, and 9 are continuation of the procedure for "after" conditions. A summer corner count (7/78) is used as the measure of gross seasonal variation rather than the 80 percent factor. Revenue reconciliation is limited to the relationship between average and estimated peak ridership. Sunday revenue reconciliation includes elimination of extraneous (not-free-fare) revenue (about \$70).

It should be noted that the "before" estimates are in fact estimates of the "typical" ridership before fares were eliminated (i.e. basically 1977). They are used in the expansion of "before" survey data and do not represent projected baseline ridership (i.e. 1978 ridership without the free fare program).

In order to evaluate the passenger volume impacts of the demonstration, it is necessary to account for what would be normal expected ridership growth if there had been no free-fare program. After examining historical ridership and revenue records, it was concluded that revenue would be the most reliable measure of annual change since it is a recorded figure, while Mercer Metro ridership is estimated. Between 1977 and 1974, Mercer Metro revenue increased from about \$1,287,000 to \$1,377,000, about seven percent. This is equivalent to an average annual growth factor (compound factor) of about 2.3 percent. Presuming this growth is distributed evenly over all time periods, the "before" ridership figures are multiplied by a factor of 1.023 to estimate projected ridership had there been no free-fare program.

In general, the protections against bias in the sampling procedure are: 1) the spreading of corner counts over a few days; 2) correcting for missed observations; and 3) reconciling each corner count set to actual revenue experience. The corrections used for gross seasonal adjustment are derived from Mercer Metro historical records and finer seasonal adjustments result from revenue reconciliation. The revenue correction is considered to be the best adjustment for linking the estimates with actual experience. Finally, the estimates were compared with Mercer Metro estimates and judgmentally evaluated for reasonableness.

Table A.1 presents summaries of the finally adjusted ridership estimates for the "with fare" and "without fare" conditions. Tables A.2 through A.14 present ridership estimates for individual count periods. Deviations from the above described procedures for Saturday and Sunday estimates are noted on the tables.



Table A.1  
ESTIMATED TYPICAL RIDERSHIP

<u>PERIOD</u>	<u>TYPICAL RIDERSHIP<sup>(1)</sup></u>		
	<u>Projected<sup>(2)</sup> With Fares</u>	<u>Estimated<sup>(3)</sup> Without Fares</u>	<u>Percent Change</u>
Weekday:			
Before 10AM	7,300	6,600	-10
10AM - 2PM	6,000	8,600*	+43
2PM - 6PM	8,900	8,300	- 7
After 6PM	1,200	1,900*	+58
<u>TOTAL</u>	<u>23,400</u>	<u>25,400</u>	<u>+ 9</u>
Saturday:			
Before 10AM	1,700	2,200	+29
10AM - 2PM	4,000	4,500*	+13
2PM - 6PM	4,600	5,900	+28
After 6PM	1,200	2,300*	+92
<u>TOTAL</u>	<u>11,500</u>	<u>14,900</u>	<u>+30</u>
Sunday:	3,900	6,600*	+69
Weekly:			
Peak Periods	87,300	82,600	- 5
Off-Peaks	45,100	65,900*	+46
<u>TOTAL</u>	<u>132,400</u>	<u>148,500</u>	<u>+12</u>
Annual:			
Peak Periods	4,459,000	4,221,000	- 5
Off-Peaks	2,333,000	3,414,000*	+46
<u>TOTAL</u>	<u>6,792,000</u>	<u>7,635,000</u>	<u>+12</u>

- (1) Based on averages of "Before" and "after" corner counts, seasonally adjusted and reconciled with revenue experience.  
(2) Projected "typical" ridership if there had been no free-fare program.  
(3) Estimated "typical" ridership with free-fare program.  
(4) \* = Free-Fare periods.

Table A.2

ESTIMATED WEEKDAY BASE RIDERSHIP - 11/77

Pre-Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				A l l
	Before 10AM (2)	10AM - 2PM (1)	2PM - 6PM (2)	After 6 PM (1)	
G	590	260	700	20	1,570
H (3)	500	230	600	20	1,350
K	660	950	990	360	2,960
L (3)	600	650	710	40	2,000
P	1,020	1,050	1,460	350	3,880
Q (3)	740	480	800	100	2,120
R	650	430	670	20	1,770
S	840	650	820	130	2,440
T	1,520	1,170	1,440	220	4,300
X	100	40	160	-	300
POL	40	50	100	-	190
<b>TOTAL</b>	<b>7,260</b>	<b>5,910</b>	<b>8,450</b>	<b>1,260</b>	<b>22,880</b>

(1) Expanded passenger counts from 11/77 on-board surveys.

(2) Calculated by:

$$(TOPP_i \div (TOPC_i)) \times PPC_{ij}$$

Where:

- $TOPP_i$  = The sum of the off-peak (i.e. 10AM-2PM and after 6PM) passenger estimates for each route (i).  
 $TOPC_i$  = The sum of the adjusted off-peak corner counts for each route (i).  
 $PPC_{ij}$  = The peak period corner count for each route (i) and the time period (j).

(3) Peak period estimates derived as factors of other similar routes as shown by historical Mercer Metro records:

- Route H = 85% of Route G
- Route L = 113% of Route R
- Route Q = 87% of Route S

Table A.3  
ESTIMATED WEEKDAY RIDERSHIP - 2/78

Pre-Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				
	Before 10AM	10AM - 2PM	2PM - 6PM	After 6 PM	A l l
G	510	280	750	20	1,560
H <sup>(2)</sup>	430	240	630	20	1,320
K	410	810	960	290	2,470
L <sup>(2)</sup>	710	610	900	40	2,260
P	950	910	1,490	290	3,640
Q <sup>(2)</sup>	650	580	900	90	2,220
R	630	550	790	40	2,010
S	750	670	1,030	100	2,550
T	2,110	1,100	1,650	110	4,970
X	90	30	110	--	230
POL	30	40	70	--	140
TOTAL	7,270	5,820	9,280	1,000	23,370

(1) Calculated by:  $\frac{SCC_{ij}}{BCC_{ij}} \times TP_{ij}$

Where:

SCC<sub>ij</sub> = The adjusted corner counts for the specified month (2/78) for each route (i) and time period (j).

BCC<sub>ij</sub> = The corresponding corner counts for the base period (11/77) for each route (i) and time period (j).

TP<sub>ij</sub> = The estimated base ridership (11/77) for each route (i) and time period (j).

(2) See Note #3, Table A.2.

Table A.4

ESTIMATED WEEKDAY RIDERSHIP - 3/78<sup>(1)</sup>

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD <sup>(2)</sup>				A I I
	Before 10AM	10AM - 2PM	2PM - 6PM	After 6 PM	
G H <sup>(3)</sup>	650	530	540	70	1,790
H K <sup>(3)</sup>	440	230	680	30	1,380
K L <sup>(3)</sup>	480	2,250	1,540	530	4,800
L P <sup>(3)</sup>	540	860	490	100	1,990
P Q <sup>(3)</sup>	1,170	1,460	1,470	700	4,800
Q R	880	600	860	140	2,480
R S	480	1,090	700	50	2,320
S T	720	1,460	880	260	3,320
T X	910	1,770	1,410	230	4,320
X POL	100	60	150	-	310
POL	40	90	90	-	220
TOTAL	6,410	10,400	8,810	2,110	27,730

(1) From second March 1978 counts; at end of month.

(2) See Note #1, Table A.3.

(3) Calculated by:

$$\frac{C_1}{C_2} \times P_{ij}$$

Where:

$C_1$  = Mercer Metro Corner Counts for March 1978.

$C_2$  = Mercer Metro Corner Counts for Oct. 1977.

$P_{ij}$  = Base passenger estimate (11/77) for each route (i = H, L, & Q) and time period (j).

Table A.5  
 ESTIMATED WEEKDAY RIDERSHIP - 5/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD <sup>(1)</sup>				A I I
	Before 10AM <sup>(2)</sup>	10AM - 2PM <sup>(1)</sup>	2PM - 6PM <sup>(2)</sup>	After 6 PM <sup>(1)</sup>	
G	490	460	680	20	1,650
H <sup>(2)</sup>	430	230	550	40	1,250
K	630	1,040	1,010	550	3,230
L <sup>(2)</sup>	530	910	680	60	2,180
P	1,190	1,260	1,350	490	4,290
Q <sup>(2)</sup>	810	530	560	140	2,040
R	470	790	790	110	2,160
S	770	970	840	140	2,720
T	1,360	1,590	1,520	200	4,670
X	180	50	120	-	350
POL	70	70	80	-	220
TOTAL	6,930	7,900	8,180	1,750	24,760

(1) See Note #1, Table A.3

(2) See Note #3, Table A.4;  $C_1 = 5/78$

Table A.6  
 ESTIMATED WEEKDAY RIDERSHIP - 7/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD (1)				A I I
	Before 10AM (2)	10AM - 2PM (1)	2PM - 6PM (2)	After 6 PM (1)	
G	570	440	680	20	1,710
H(2)	450	210	580	30	1,270
K	520	1,160	1,150	520	3,350
L(2)	430	730	800	100	2,060
P	1,140	1,500	1,170	590	4,400
Q(2)	830	460	550	180	2,020
R	470	830	630	120	2,050
S	660	1,440	870	250	3,220
T	1,540	1,940	1,160	260	4,900
X	100	60	140	-	300
POL	40	90	90	-	220
TOTAL	6,750	8,860	7,820	2,070	25,500

(1) See Note #1, Table A.3

(2) See Note #3, Table A.6;  $C_1 = (5/78) \times (8/77)$ ,  $C_2 = (5/77) \times (10/77)$ .

Table A.7  
 ESTIMATED WEEKDAY RIDERSHIP - 10/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD <sup>(1)</sup>				A l l
	Before 10AM	10AM - 2PM	2PM - 6PM	After 6 PM	
G	470	430	530	10	1,440
H(2)	420	220	690	60	1,390
K	520	1,020	1,210	500	3,250
L(2)	600	900	1,000	120	2,620
P	1,140	1,330	1,520	600	4,590
Q(2)	780	660	790	130	2,360
R	580	700	590	70	1,940
S	600	900	840	150	2,490
T	1,300	1,430	1,340	260	4,330
X	140	50	220	-	410
POL	50	70	120	-	240
<b>TOTAL</b>	<b>6,600</b>	<b>7,710</b>	<b>8,850</b>	<b>1,900</b>	<b>35,060</b>

(1) See Note #1, Table A.3.

(2) See Note #3, Table A.5;  $C_1 = 9/78$

Table A.8  
 ESTIMATED SATURDAY RIDERSHIP - 11/77

Pre-Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				A I I
	Before 10AM	10AM - 2PM	2PM - 6PM	After 6 PM	
G	60	90	170	-	320
H(3)	50	10	140	10	210
K	130	660	970	180	1,940
L(3)	200	490	470	20	1,180
P	280	750	490	300	1,870
Q(3)	190	400	300	50	940
R	180	300	410	20	910
S	220	340	370	50	980
T	370	780	1,150	270	2,570
TOTAL	1,680	3,820	4,470	900	10,870

(1) See Note #1, Table A.2.

(2) See Note #2, Table A.2.

(3) See Note #3, Table A.2.



Table A.9  
ESTIMATED SATURDAY RIDERSHIP - 2/78

Pre-Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				A I I
	Before 10AM (2)	10AM - 2PM (1)	2PM - 6PM (2)	After 6 PM (1)	
G	70	180	180	-	430
H	60	10	160	20	250
K	150	870	1,120	230	2,370
L	230	530	540	30	1,330
P	320	660	570	410	1,960
Q	210	440	360	80	1,090
R	200	340	470	30	1,040
S	250	400	420	100	1,170
T	400	790	1,320	620	3,130
<b>TOTAL</b>	<b>1,890</b>	<b>4,220</b>	<b>5,140</b>	<b>1,520</b>	<b>12,770</b>

(1) For Routes G,K,P,R,S,T: See Note #1, Table A.2.  
For Routes H,L,Q:

$$OP_{ij} = \frac{P_1}{P_2} \times P_{2,i,j}$$

Where:

- OP<sub>ij</sub> = Off-Peak passengers for each route and off-peak time period.
- i = Route
- j = Off-peak period
- P<sub>1</sub> = Sum of off-peak passengers in 2/78 for all routes except H,L, & Q
- P<sub>2</sub> = Sum of off-peak passengers in 11/77 for all routes except H,L, & Q
- P<sub>2i,j</sub> = Route and time-specific ridership for 11/77

(2) Total peak revenue, divided by unit revenue, and distributed to period and route based on 11/77 proportions.

Table A.10

ESTIMATED SATURDAY RIDERSHIP - 3/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				A l l
	Before 10AM	10AM - 2PM <sup>(1)</sup>	2PM - 6PM	After 6 PM <sup>(1)</sup>	
G	80	190	240	-	510
H	70	40	210	30	360
K	190	940	1,400	340	2,870
L	290	610	680	60	1,640
P	400	870	700	910	2,880
Q	270	510	450	120	1,350
R	250	490	600	60	1,400
S	320	510	530	110	1,470
T	520	700	1,660	650	3,530
TOTAL	2,390 <sup>(2)</sup>	4,860	6,470 <sup>(2)</sup>	2,280	16,010

(1) See Note #1, Table A.9;  $P_i = 3/78$ .

(2) See Note #2, Table A.9; Revenue = \$2,163.

Table A.11  
 ESTIMATED SATURDAY RIDERSHIP - 5/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				A l l
	Before 10AM	10AM - 2PM <sup>(1)</sup>	2PM - 6PM	After 6 PM <sup>(1)</sup>	
G	80	140	220	-	440
H	60	40	190	30	330
K	170	820	1,280	360	2,630
L	260	500	620	50	1,430
P	370	690	640	580	2,280
Q	250	410	400	110	1,170
R	230	350	540	30	1,150
S	290	320	480	120	1,210
T	470	690	1,510	810	3,480
TOTAL	2,180 <sup>(2)</sup>	3,960	5,880 <sup>(2)</sup>	2,090	14,120

(1) See Note #1, Table A.9; P = 5/78.

(2) See Note #2, Table A.9; Revenue = \$1,967.

Table A.12

ESTIMATED SATURDAY RIDERSHIP - 7/78Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				A l l
	Before 10AM	10AM - 2PM <sup>(1)</sup>	2PM - 6PM	After 6 PM <sup>(1)</sup>	
G	70	150	190	-	410
H	60	40	170	30	310
K	150	830	1,140	250	2,370
L	230	580	560	50	1,420
P	330	880	570	800	2,580
Q	220	480	360	110	1,170
R	200	390	490	50	1,130
S	260	380	430	100	1,170
T	420	860	1,350	660	3,290
TOTAL	1,940 <sup>(2)</sup>	4,590	5,260 <sup>(2)</sup>	2,050	13,850

(1) See Note #1, Table A.9;  $P_1 = 7/78$

(2) See Note #2, Table A.9; Revenue = \$1,757

Table A.13

## ESTIMATED SATURDAY RIDERSHIP - 10/78

Free-Fare

ROUTE	ESTIMATED PASSENGERS BY TIME PERIOD				A l l
	Before 10AM	10AM - 2PM	2PM - 6PM	After 6 PM	
G	80	360	220	-	660
H	60	40	180	40	330
K	170	780	1,260	280	2,490
L	260	600	610	70	1,540
P	360	720	630	820	2,530
Q	240	500	400	140	1,280
R	230	530	540	60	1,360
S	290	360	480	80	1,210
T	460	880	1,490	1,290	4,120
<u>TOTAL</u>	<u>2,150</u>	<u>4,770</u>	<u>5,810</u>	<u>2,780</u>	<u>15,520</u>

(1) See Note #1, Table A.9; P. = 10/78

(2) See Note #2, Table A.9; Revenue = \$1,943

Table A.14

ESTIMATED SUNDAY RIDERSHIP - BeforePre-Free-Fare

<u>ROUTE</u>	<u>ESTIMATED PASSENGERS</u>	
	<u>11/77</u> (1)	<u>2/78</u> (2)
K	1,050	960
P	1,060	1,210
QH <sup>(3)</sup>	360	430
RL	100	70
S	530	650
T	640	770
TOTAL	3,740	4,090

---

(1) From on-board survey (11/77) control count expansion.

(2) See Note 1, Table A.3.

(3) 67% of Route S.

Table A.15

ESTIMATED SUNDAY RIDERSHIP - AfterFree-Fare

<u>ROUTE</u>	<u>ESTIMATED PASSENGERS</u>			
	<u>3/78 (1)</u>	<u>5/78 (1)</u>	<u>7/78 (1)</u>	<u>10/78 (1)</u>
K	1,110	1,720	910	1,200
P	1,860	2,170	1,380	2,110
QH(2)	650	730	710	690
RL	170	240	140	210
S	970	1,090	1,050	1,030
T	1,180	1,230	1,310	1,510
<b>TOTAL</b>	<b>5,940</b>	<b>7,180</b>	<b>5,500</b>	<b>6,750</b>

(1) See Note #1, Table A.3.

(2) 67% of Route S.





OFF-PEAK TRIP FREQUENCY<sup>(1)</sup>

One-Way Trips/Week	PERCENT OF OFF-PEAK TRIPS			
	With Fares <sup>(2)</sup>	Without Fares <sup>(3)</sup>		
		Prior Trips <sup>(4)</sup>	New Trips <sup>(5)</sup>	All
0-1	22	11	6	9
2-5	35	45	35	42
6-9	18	11	13	11
10+	25	33	46	37

(1) Percent of off-peak trips made by persons reporting respective trip frequencies. Source: On-board surveys during 11/77 and 5/78; unadjusted for seasonal variations.

(2) Before fare elimination

(3) After fare elimination

(4) Trips which were reported to have been made by bus regardless of the free service

(5) Trips which were reported to be new to the off-peak bus service (either previously not made or made via other modes).



ALTERNATE MODE IF BUS WAS NOT FREE<sup>(1)</sup>

<u>ALTERNATE MODE</u>	<u>PERCENT OF RESPONDENTS</u>					<u>WEEKLY<sup>(2)</sup></u>
	<u>Weekdays</u>		<u>Saturday</u>		<u>Sunday</u>	
	<u>10a-2p</u>	<u>After 6p</u>	<u>10a-2p</u>	<u>After 6p</u>		
Bus Anyway	72	63	67	58	64	69
Not Made Trip	13	13	16	19	14	14
Walked	5	14	8	11	11	7
Drove or Rode Auto	5	6	6	5	7	5
Other (Taxi, Bike, etc.)	5	4	3	7	4	5
	—	—	—	—	—	
Total Respondents	450	340	440	310	470	

(1) Source: May 1978 Mini-Survey

(2) Percentages for individual time periods weighted by respective passenger volumes; weekday factored by five. Total weekly trips are estimated to be approximately 150,000.



OFF-PEAK TRIP DESTINATIONS<sup>(1)</sup>

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<u>PURPOSE AT DESTINATION</u>	<u>PERCENT OF TRIPS<sup>(2)</sup></u>		<u>NET CHANGE<sup>(3)</sup></u>	
	<u>Before</u>	<u>After</u>	<u>Trips/Week</u>	<u>Percent</u>
Home	37	31	+3700	+ 22
Work	16	17	+4000	+ 55
School	7	6	+ 800	+ 25
Shopping	18	19	+4400	+ 54
Medical	3	4	+1300	+ 95
Social/Recreational	15	12	+1100	+ 17
Other	4	11	+5500	+302
	<hr/>	<hr/>	<hr/>	<hr/>
Total Trips/Week	45,100	65,900	20,800	+ 46

(1) Source: On-board surveys in 11/77 and 5/78

(2) "Before" fare elimination; "after" fare elimination.

(3) Based on average before and after passenger estimates.



MERCER METRO RIDERSHIP AGE PROFILE<sup>(1)</sup>

AGE GROUP	PERCENT OF FREE-FARE RIDERS <sup>(2)</sup>				
	Weekday		Saturday		Sunday
	AM	PM	AM	PM	
16 or under	18/9	19/21	23/22	26/32	25/25
17-24	37/35	47/45	30/35	47/43	35/34
25-44	19/27	20/24	19/20	16/18	16/22
45-64	17/18	12/9	17/15	8/6	19/14
60 or over	9/11	2/1	11/8	3/1	5/5

(1) Source: On-board surveys during 11/77 and 5/78. These figures are representative of survey respondents and do not necessarily reflect the age distribution of all riders since non-respondents may exhibit a different age breakdown.

(2) Before/After

MERCER METRO PASSENGER AGES<sup>(1)</sup>

AGE GROUP	With Fares	PERCENT OF OFF-PEAK TRIPS		
		Without Fares		
		Prior Trips	New Trips	All
16 or under	19	14	17	15
17-24	38	34	41	36
25-44	19	25	26	25
45-64	16	17	11	15
65 or over	8	10	6	8

(1) Source: On-board surveys during 11/77 and 5/78. These figures are representative of survey respondents and do not necessarily reflect the age distribution of all riders since non-respondents may exhibit a different age breakdown.





MERCER METRO SCHEDULE ADHERENCE <sup>(1)</sup>

TIME	PERCENT OF BUSES OBSERVED <sup>(2)</sup>					
	LATE		EARLY		ON-TIME <sup>(3)</sup>	
	Before	After	Before	After	Before	After
6-10 am	28	38	25	21	43	33
10-2 pm	32	46*	31	23*	37	31*
2-6 pm	49	47	27	27	24	26
6-10 pm	31	43*	27	25*	42	32*
Average	36	44	32	26	32	30

(1) Observations at State & Clinton and State & Calhoun (Weekday)

(2) "Before" and "after" data are averages of weekday observations taken prior to and following fare elimination

(3) Never early; 0-3 minutes late

(\*) Fare-Free Time Periods



MERCER METRO DELAY (at State & Clinton)<sup>(1)</sup>

<u>TIME PERIOD</u> <sup>(2)</sup>	<u>AVERAGE DELAY (MINS.)</u> <sup>(3)</sup>		<u>PERCENT CHANGE</u>
	<u>Before</u>	<u>After</u>	
6-10 am	3.3	3.7	+12
10-2 pm*	2.8	4.9	+75
2-6 pm	5.0	5.7	+14
6-10 pm*	2.9	5.5	+90

(1) Source: Averages of observed delays from corner count data "before" and "after" fare elimination.

(2) Weekdays only

(3) Calculated by sum of the total observed minutes of delays divided by the number of scheduled buses.

(\*) Fare-Free Periods



MERCER METRO LOAD FACTORS<sup>(1)</sup>

	AVERAGE LOAD FACTORS <sup>(2)</sup>		PERCENT CHANGE
	<u>BEFORE</u> <sup>(3)</sup>	<u>AFTER</u> <sup>(3)</sup>	
<u>WEEKDAY:</u>			
6 am - 10 am	0.49	0.45	- 8
10 am - 2 pm*	0.44	0.72	+64
2 pm - 6 pm	0.57	0.57	- -
6 pm - 10 pm*	<u>0.22</u>	<u>0.42</u>	<u>+91</u>
TOTAL	0.47	0.56	+19
<u>SATURDAY:</u>			
10 am - 2 pm*	0.42	0.59	+40
6 pm - 10 pm*	0.20	0.33	+65
<u>SUNDAY: *</u>	0.35	0.50	+43

(1) Source: Averaged observations from corner count data

(2) Calculated by dividing observed passenger load by seated capacity (number of buses x 40 seats)

(3) Averages of two observations "before" (11/77 and 2/78) and two "after" (3/78 and 10/78) fare elimination.

(\*) Fare-Free periods

OBSERVED CAPACITY-LOADED BUSES<sup>(1)</sup>

PERCENT OF BUSES OBSERVED  
AT OR ABOVE CAPACITY LOAD<sup>(2)</sup>

	<u>Before</u>	<u>After</u>
<u>WEEKDAY:</u>		
6 am - 10 am	15	12
10 am - 2 pm*	2	25
2 pm - 6 pm	16	19
6 pm - 10 pm*	1	9
<u>SATURDAY:</u>		
10 am - 2 pm *	6	15
6 pm - 10 pm	2	11
<u>SUNDAY:*</u>	9	13

(1) Source: Averaged observations from corner count data "before" (11/77 and 2/78) and "after" (3/78 and 10/78) fare elimination.

(2) Capacity is defined as 40 or more passengers per bus

(\*) Fare-Free Periods

ESTIMATED ANNUAL PASSENGER AND REVENUE IMPACTS (\*)

<u>PERIOD</u>	<u>TOTALS WITHOUT FARE-FREE PROGRAM<sup>(1)</sup></u>		<u>TOTALS WITH FARE-FREE PROGRAM<sup>(1)</sup></u>	
	<u>Passengers</u>	<u>Revenue</u>	<u>Passengers</u>	<u>Revenue</u>
Peaks	4,459,000 <sup>(2)</sup>	\$ 1,088,000 <sup>(3)</sup>	4,221,000 <sup>(5)</sup>	\$1,030,000 <sup>(3)</sup>
Off-Peaks	2,333,000 <sup>(2)</sup>	\$ 280,000 <sup>(4)</sup>	3,414,000 <sup>(5)</sup>	\$ ----
TOTAL	6,792,000	\$ 1,368,000	7,635,000	\$1,030,000

(\*) Preliminary

(1) For 12-month period from March 1978 through February 1979.

(2) Estimated totals for prior 12-months plus growth of 2.3%.

(3) Passengers times unit revenue of \$0.244.

(4) Passengers times unit revenue of \$0.120.

(5) Estimated ridership in Table 1 expanded to annual basis.





**REPORT OF INVENTIONS**

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The work performed under this contract, while not leading to any significant inventions, discoveries, or innovations, has made use of state-of-the-art methodologies to complete an analysis of findings available on the implementation and operation of the demonstration project. These findings will be useful to other communities throughout the United States in the planning and design of improved public transportation services.

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