

IMPACT OF REMOVAL OF TOLLS ON TRAVEL IN TIDEWATER VIRGINIA

Volume II — James River Bridge

by

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

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PREFACE

For the past two decades economists have considered the utilization of pricing in the private demand for transportation as a means to improve the efficiency of the transportation system. Recently tolls and parking charges have been discussed as a solution to the urban transportation congestion problem, but the lack of demonstration projects has largely precluded the generation of data by which the constraint induced by pricing schemes can be monitored. In order to take advantage of the "natural experiment" which the removal of tolls in Tidewater Virginia provided, case studies of three toll facilities in the area — the Hampton Roads Bridge-Tunnel, the James River Bridge and the Coleman Bridge — were undertaken. The results of these case studies are reported in three volumes, with this second volume presenting the findings for the James River facility. The results for the Hampton Roads Bridge-Tunnel and the Coleman Bridge are reported in Volumes I and III, respectively.

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ABSTRACT

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The purpose of this research was to monitor and report the effects that the removal of the tolls on the James River Bridge had upon travel activity in the Tidewater area.

Questionnaire surveys taken prior to and five months after the removal of the tolls were utilized to gather data from the motorists using the facility. Information from mechanical and manual volume counts supplemented the questionnaire data.

It was concluded that the tolls had been a barrier to travel across the James River. After the tolls were removed, traffic volumes increased by 20.9%, which was a 15.4% increase over the volumes that would have been expected had the tolls not been lifted. The percentage of delivery and tractor-trailer trucks did not increase during the after period, thus indicating that trade and services have not expanded in the area since the tolls were removed. The vehicular occupancy rate decreased and individuals made trips across the river more frequently after the tolls were removed than they did when the tolls were in force. The percentage of non-essential trips, such as those for shopping, recreation and social activity, increased after the tolls were removed. Retired persons and housewives made many of those trips. The data also indicated that some people in the area changed, or intended to change, their jobs and residences as a result of the end to tolls.

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INTRODUCTION

Travel demand in some instances is quite elastic with respect to transportation pricing and the residents of Tidewater Virginia have been paying some type of fee for the crossing of the Hampton Roads Channel and its contributory rivers since the 1600's. Figure 1 shows the highway network in the region and the location of those facilities that carried tolls prior to June 1976. Although the region is populated by approximately one million people (1970 census), the opportunities for its residents and businessmen are like those found in metropolitan areas half its size because of the vehicle travel restrictions created by the tolls.

On June 3, 1976, three of the most expensive tolls (those on the Hampton Roads Bridge-Tunnel, the James River Bridge, and the Coleman Bridge) were removed. The anticipated impacts of the removal of tolls upon traffic activity were partially predicted in the report entitled "The Hampton Roads Joint Transportation Study."⁽¹⁾ While the principal objective of that study was to determine the economic feasibility and impact of a proposed third crossing of Hampton Roads, several alternative methods of accommodating transportation demands, including an adjustment of the tolls on existing facilities, were examined. The results of the study reflected the intuitive, anticipated changes in economic growth and traffic volumes under the different toll pricing policies. Generally, the lowest toll rates accounted for the largest population and economic growth and, subsequently, an increase in travel. On the other hand, greater tolls had the impact of decreasing the rate of population and economic growth and, thus, vehicular travel.

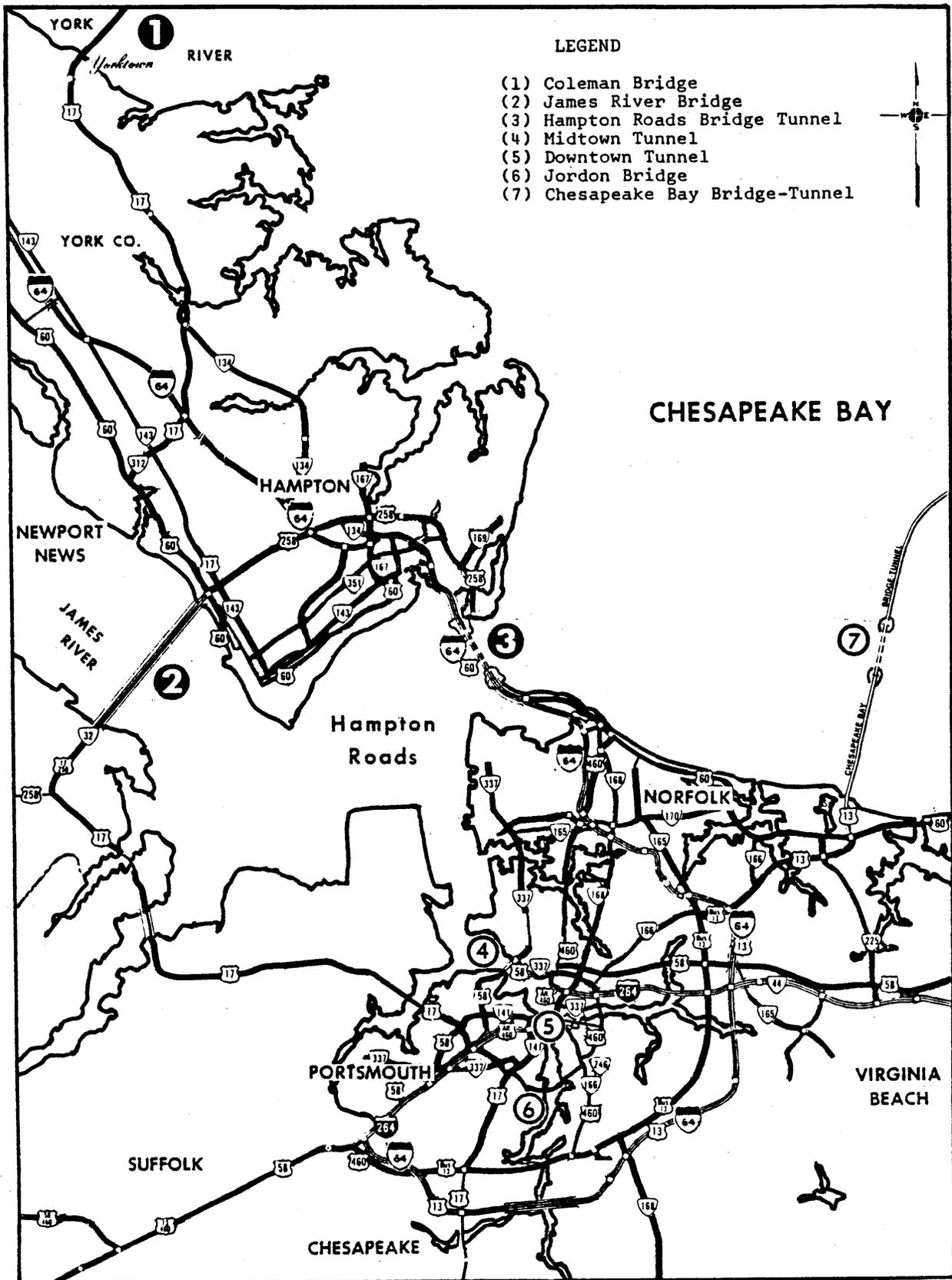


Figure 1. Existing highways and toll facilities.

PURPOSE AND SCOPE

Although studies have reported the anticipated impacts of changes in tolls upon travel activity,^(2,3) few, if any, have been based on case studies in which tolls were completely removed from transportation facilities. The removal of toll charges on the James River Bridge (Routes 17 and 258) afforded an excellent opportunity to conduct such a study, and the purpose of this research was to monitor and report the effects that the removal of tolls had upon transportation and socioeconomic activity in the region. The specific objectives were to —

1. examine the characteristics of the motorists;
2. monitor the changes in traffic volumes;
3. investigate the changes in traffic composition;
4. review the changes in vehicle occupancy rates and carpools;
5. examine the different purposes of trips; and
6. investigate the variations in travel patterns.

Although monitoring of long-range effects may be desirable at a later date, the study was restricted to the immediate impacts created by the removal of the tolls.

HISTORY

The James River Bridge connecting the city of Newport News and Isle of Wight County was constructed in 1928 by private enterprise as a part of the James River Bridge System. The System was a 26.4 kilometre (16.5 mi.) link of Route 17, commonly known as the Ocean Highway, and consisted of the subject bridge, 7.4 kilometres (4.6 mi.) in length, over the James River, two smaller bridges over the Nansemond River and Chuckatuck Creek, and approximately 17.6 kilometres (11 mi.) of 2-lane highway.

In 1949 the Board of Directors of the James River Bridge System accepted an offer from the Virginia State Highway Commission to purchase the facility for \$5,600,000. The purchase was financed by a bond issue and the payments for the bonds were provided by the tolls imposed upon the motorists using the facility. Table 1 shows the toll rates in 1976. The bonds were paid off on June 3, 1976, and subsequently the tolls were removed. The removal of the tolls meant

that the individuals who by necessity had to use the bridge daily received immediate benefits. The individual who used a commuter ticket and crossed the facility daily in traveling to and from work immediately realized a net increase in spendable income of about \$160 per year. For those who crossed eight times per week but who did not use the commuter ticket, the savings were approximately \$375 per year.

Table 1
1976 Tolls for James River Bridge
(One-way Trip)

<u>Type of Vehicle</u>	<u>Toll</u>
Automobile	
Cash	\$0.90
Commuter Ticket (sold in groups of 20)	0.30
Single Unit Trucks	
2 Ton or Less	
2 axles	1.20
3 axles	1.40
2 Ton or More	
2 axles	1.50
3 axles	1.75
Tractor Trailers	
3 axles	2.00
4 axles	2.25
5 axles	2.50

METHODOLOGY

To examine the effect of the removal of tolls, it was necessary, insofar as possible, to eliminate the impact of other factors bearing on the use of the facility. If there were discernible trends, either upward or downward, in the traffic using the bridge, these had to be taken into account by establishing historical trends based on conditions that had existed for several years prior to the removal of tolls. To eliminate distortions due to seasonal variations, monthly trends during the before and after periods were established and compared.

A case study approach was utilized, with data being collected before and after the tolls were removed. The data collection for the study included mechanical and manual volume counts, and before and after questionnaire surveys. The data collected in each phase are discussed in the following sections.

Traffic Volume Counts

The Traffic and Safety and the Toll Facilities Divisions of the Virginia Department of Highways and Transportation have secured vehicular traffic volumes at the James River Bridge for many years. For the present study the Department's data for the past eight years were obtained to establish historical trends in total volumes and the traffic composition by type of vehicle. The Toll Facilities' revenue data also reflected the commuter ticket usage before the tolls were removed.

After the removal of tolls, Council personnel secured vehicular volume counts with mechanical recorders and manual volume counts were made to obtain the composition of traffic and vehicle occupancy rates.

Before Questionnaire Survey

To acquire travel information before the tolls were removed, a questionnaire was developed and distributed to a sample of the motorists traveling across the bridge. The questionnaire requested information relative to the type of vehicle, origin and destination of trip, trip purpose, vehicle occupancy rate, socioeconomic data, aspects of latent demand, and whether or not the commuter ticket was used to pay the toll.

Approximately one-half (4,900) of the motorists who crossed the bridge on May 19, 1976, between 6:00 a.m. and 6:00 p.m., were sampled in the survey. As the travelers entered the facility to pay the toll, they were handed the questionnaires along with letters of explanation concerning the research project. (Copies of the letter and questionnaire are in Appendix A.) To facilitate the return of the questionnaire the respondent was required only to refold it after filling it in and drop it in a mailbox; it contained the return address and postage.

After Questionnaire Survey

Approximately five months after removal of the tolls, an interval that was thought to be sufficient to allow for short-range adjustments

to the removal of the tolls, an after questionnaire survey was conducted. The questionnaire developed for the after survey was similar to the one used previously; however, it contained additional questions relative to participation in carpools and changes in travel since the tolls were removed. (This questionnaire is in Appendix B.) Because of the congestion and hazardous conditions roadside surveys create, that method of distributing the questionnaires could not be used in the after survey. Consequently, a license plate survey was employed in which a random sample of license plate numbers were recorded and traced through the Division of Motor Vehicles files for names and addresses. Those motorists in the sample (2,215, or approximately one-third of the vehicles crossing the bridge during the 12-hour study period) were mailed a questionnaire with a letter of explanation requesting that they execute it and return it by mail. As in the before survey, the respondent had only to refold the questionnaire and drop it in the mail. The license plate survey is an effective procedure for securing travel information; however, it is limited to surveying vehicles licensed in Virginia, since the Division of Motor Vehicles does not have out-of-state registration information.

SURVEY RESULTS.

The analysis consisted of a comparison of the before and after data and an examination of the variations in transportation and socioeconomic activity that occurred as a result of the removal of the tolls on the James River Bridge. The results of these are presented in the following sections. The populations in many categories are unknown; therefore statistical tests were not conducted to determine the significance of the variations.

Characteristics of the Motorists

Of the 4,900 people surveyed at the James River Bridge prior to the removal of the tolls, 1,261 (25.8%) responded by returning the questionnaire. Of these respondents, 72.9% were male. In the after survey, 774 (35.0%) people in the sample population returned the questionnaire; the percentage of male motorists dropped to 68.0%.

Table 2 shows the distribution of the respondents by age groups before and after the tolls were removed. The 21-39 year age group accounted for 50.8% of the before sample and the 40-65 year group made up 40.0% of the total. In the after period the number of people in the 21-39 year group decreased while the older groups (over 40) made more trips than before the tolls were removed. A review of Table 3 reveals that the percentage of retired people crossing the facility more than doubled after the tolls were removed.

Table 2

Age Distribution of Respondents

<u>Age</u>	<u>Percentage of Respondents</u>	
	<u>Before</u>	<u>After</u>
Under 21	3.1	3.2
21-39	50.8	43.3
40-65	40.0	42.1
Over 65	4.0	6.6
No Response	2.1	4.8

Table 3

Occupation Distribution of Respondents

<u>Occupation</u>	<u>Percentage of Respondents</u>	
	<u>Before</u>	<u>After</u>
Professional	26.1	22.1
Business Manager	20.3	17.3
Clerical	5.8	4.9
Craftsman	13.4	14.2
Operator	7.3	2.7
Unskilled Laborer	5.9	5.6
Homemaker	6.9	10.6
Retired	5.9	12.1
Other	2.2	3.2
No Response	6.2	7.3

Homemakers also increased their travels during the after period. Although the percentage of professional people and business managers decreased after the tolls were lifted, they continued to make up the majority of the motorists using the James River Bridge.

It was hypothesized that more people in the lower income group would use the James River Bridge after the tolls were removed and thus constitute a larger percentage of the respondents than they did in the before survey. However, this does not appear to be the case, as is shown in Table 4. There were no statistical differences in the income distributions of the people who responded to the before and after questionnaires.

Table 4

Income Distribution of Respondents

<u>Annual Income</u> (Dollars)	<u>Percentage of Respondents</u>	
	<u>Before</u>	<u>After</u>
<9,000	11.6	12.0
9,001 - 12,000	14.4	14.5
12,001 - 15,000	14.0	16.3
15,001 - 25,000	30.7	30.9
25,001 - 30,000	11.2	6.3
>30,000	8.8	8.1
No Response	9.3	11.9

The method of toll payment — whether by commuter ticket or cash — used by the motorists during the before period was an important characteristic that was reviewed briefly because it provided insight into the relationship between out-of-pocket tolls and the number of trips taken.

Of the respondents surveyed during the 12-hour before period, 79.9% used a commuter ticket costing \$0.30 for each one-way trip. The remaining respondents traveling in passenger cars and pickups paid \$0.90 per one-way trip, while the truckers paid the appropriate truck rates.

Cross tabulations indicated that income was significantly related to the use of commuter tickets (purchased in groups of 20 for \$6.00). The data showed that there was a greater tendency to purchase the tickets among income groups earning more than \$15,000 than among lower income groups. Furthermore, clerical personnel, professionals, craftsmen, and housewives were much more likely to use the commuter ticket than were retired people, operators, and unskilled laborers. The purpose of the trip did not influence the purchase of the commuter ticket. However, the data revealed a relationship between the frequency of the trip and the commuter ticket usage of the people crossing the bridge 2 or more times a day; 93.0% used the tickets whereas only 32.0% of the people using the facility once every two weeks took advantage of the reduced fare.

With respect to vehicle occupancy rates and commuter ticket usage, it was anticipated that a relatively higher occupancy rate would exist among vehicles with reduced fare commuter ticket users than among those with regular fare patrons. The hypothesis was that if patrons attempt to minimize the cost of travel, those who cross frequently will search for carpools to take advantage of the

opportunity to spread costs of the operation. Since carpool users are likely to cross the river as frequently as noncommuters, they would further reduce the cost of travel to and from work by purchasing a commuter ticket. The data revealed that this condition did exist; 95.8% of the vehicles carrying 5 persons used the commuter ticket. Furthermore, 82.3% of the 3-occupant vehicles and 81.3% of the single-occupant vehicles used the tickets. Because of the significant reduction in the price of tolls afforded by the commuter ticket, it appears that everyone who knew about them and traveled occasionally over the facility used them.

Changes in Traffic Volumes

One of the most noticeable immediate effects of the removal of the tolls on the James River Bridge was a variation in traffic volumes. As previously mentioned, it was necessary to establish the annual growth trend in travel in order to isolate the impact of the removal of tolls.

The historical trend of total traffic crossing the facility is presented in Figure 2. The average daily traffic (ADT) volumes increased for several years prior to the removal of tolls, except for a brief period during the energy crisis when the travel in Tidewater area, as well as in the nation, was affected. As shown in Figure 2, the ADT in 1969 was approximately 8,150 vehicles. Through 1975 volumes increased at an average annual rate of 5.5% to bring the 1975 ADT to approximately 11,200 vehicles.

Assuming that the annual rate of increase in traffic would continue, the method of least squares was used to develop regression equations to project the 1976 volumes.

The traffic trend shown in Figure 2 indicates that the ADT for 1976 would have been approximately 11,850 vehicles had the tolls not been removed. However, the graph shows an increase in the total volumes for 1976, even though the tolls were in effect for five months during that year. The 1976 ADT was 12,600, a 6.4% increase over the 1975 volume and a 0.9% increase over the 1976 ADT that would have been expected had the tolls not been lifted.

Traffic volumes have been monitored since the tolls were removed and these data along with those for a corresponding period of time prior to the removal of tolls are presented in Figure 3. During the before period the ADT was 11,600 vehicles and after the tolls were removed it increased to an average of 14,000 vehicles. This represents an absolute increase of 20.9%, or a rate of increase approximately 15.4% greater than the expected growth.

Figure 3 also reveals that the lifting of the tolls has not had any significant effect upon month-to-month variations in average daily traffic. The curves for the two periods rise at approximately equivalent rates from January to July and fall together during the summer and autumn months.

Figure 4 is a graphical comparison of the trends in ADT for May, June, and July from 1971 through the after study period ending in May 1977. The topmost curve shows how the 1971 ADT for the month of July compares with the 1976 ADT for the month of July, etc. The rate of increase in the ADT for each of the months was fairly stable during the period between 1971 and the removal of tolls in June 1976. The trends, established by the least squares method, for the rates of increase for the three months were similar between 1971 through 1975; however, the similarity does not extend past June 1976, the date the tolls were lifted. The increase in volumes becomes quite apparent when the trend lines are compared with the actual volume counts recorded during the respective months after the tolls were removed. Had the tolls remained in effect, the estimated ADT in July would have been approximately 12,900 vehicles; the actual ADT was 16,000 vehicles.

The above data indicate that after the tolls were lifted there was an increase in the number of vehicles using the James River Bridge. The greatest increase in traffic occurred during the first month after the tolls were lifted; since that time only slight monthly volume increases, approximately equal to the historical growth, have been observed.

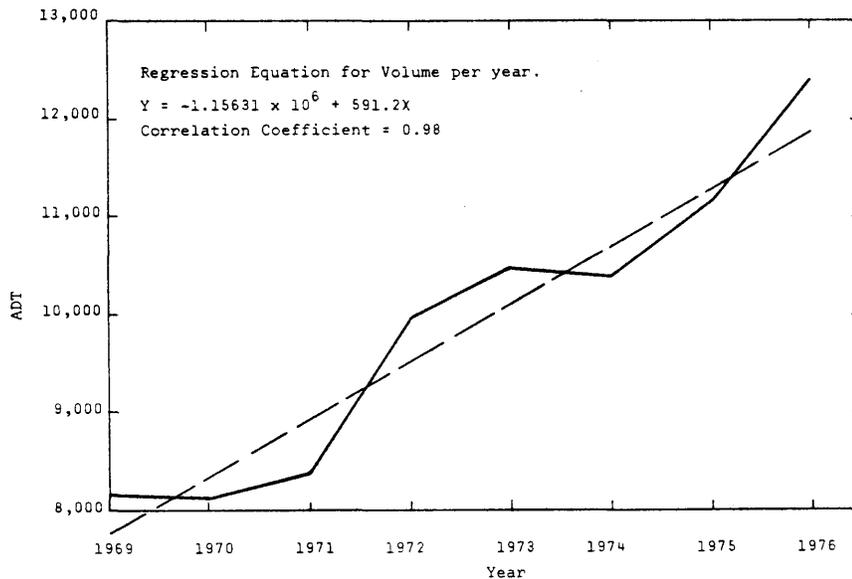


Figure 2. Average daily traffic volumes at James River Bridge.

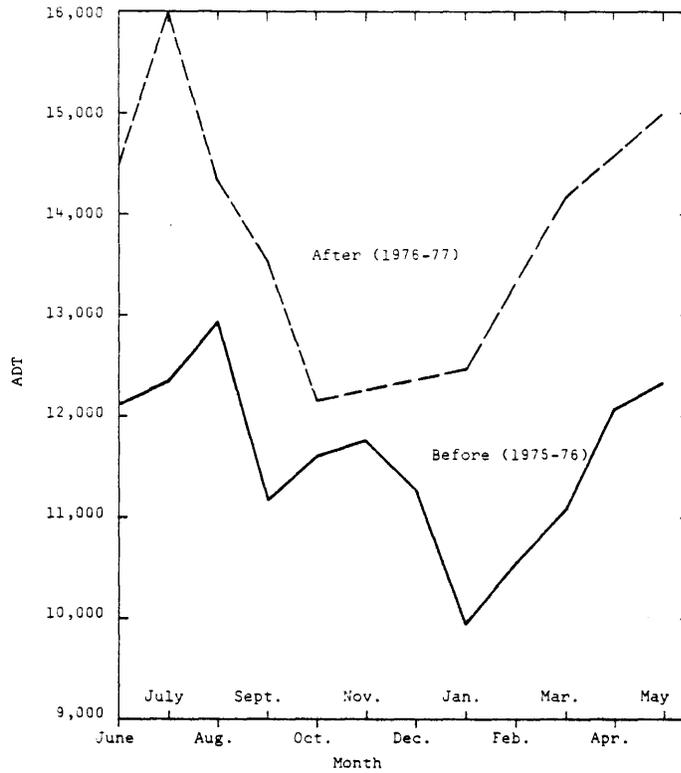


Figure 3. Monthly traffic volumes at James River Bridge before and after removal of tolls.

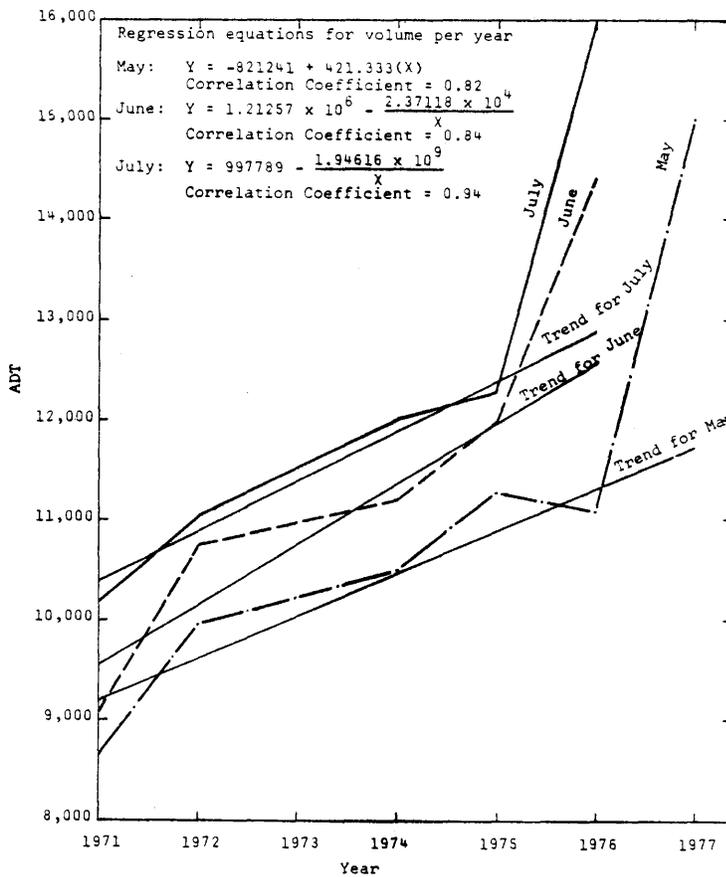


Figure 4. Monthly travel trends at James River Bridge.

Changes in Traffic Composition

Traffic composition was important in the study for two reasons. First, it was used to detect changes, if any, in the types of vehicles crossing the river after the tolls were removed. As previously mentioned, the tolls were considered to be a barrier to trade within the region and data were required to determine if truck traffic and, therefore, trade increased. Second, the information was helpful in checking the makeup of the traffic sampled in the questionnaire surveys against that of the general traffic using the facility.

After the tolls were removed, periodic manual classification counts were secured and the composition of traffic was recorded. This information is presented in Appendix C and is summarized in Table 5, along with the 1975 statistics representing the before period obtained from the Traffic and Safety Division. The data show that passenger cars now make up a slightly smaller percentage of the total traffic than they did prior to the elimination of the tolls. Whereas in 1975 cars comprised 79.7% of the ADT, they currently make up 71.8%. Pickups and vans have constituted 15% to 20% of the total volume since the tolls were lifted; however, this increase may be attributable to the initiation of several vanpool programs since June 1976 rather than to the removal of tolls.

Table 5 also shows that the percentage of trucks in the total volume has not changed significantly since the tolls were lifted. This seems to imply that the firms in the urban area around Newport News are not immediately expanding their businesses and services to the rural areas of Isle of Wight and surrounding counties.

With respect to the types of vehicles sampled in the before questionnaire survey, the data showed that of the 1,261 vehicles involved, 81.7% were passenger cars, 13.2% were pickups and vans, 1.7% were 2-axle trucks, and 2.4% were tractor-trailers. These statistics compare favorably with the before data (1975) shown in Table 5.

In the after survey, 88.2% of the respondents were traveling in passenger cars, 10.3% in pickups and vans, 0.4% in 2-axle delivery trucks, and approximately 0.1% in tractor-trailers. These statistics do not compare with the actual volume counts recorded in October 1976. One possible explanation is that in the after survey license plate numbers were recorded and the questionnaires mailed to the owners of the vehicles who, in many cases, on the day of the survey may not have been the drivers of the vehicles, particularly of the trucks and company owned and rental passenger cars.

Table 5

Traffic Composition for James River Bridge from Manual Counts
(In Percentages)

Period	Type of Vehicles					
	Cars	Trucks				Other
		Pickups & Vans	2- Axle	3- Axle	Tractor- Trailers	
1975	79.7	12.5	3.4	0.4	3.7	0.3
July 1976	75.9	16.3	2.5	1.5	2.7	1.1
August 1976	73.6	19.0	2.6	0.9	2.8	1.1
September 1976	75.3	14.8	3.8	0.8	4.8	0.5
October 1976	74.6	17.4	3.6	0.9	3.0	0.5
March 1977	72.0	20.6	3.0	0.6	3.1	0.7
May 1977	71.8	19.5	3.5	0.6	3.7	0.9

Changes in Vehicle Occupancy Rates and Carpools

One of the major objectives of the study was to determine the impact of the removal of tolls upon vehicle occupancy rates. In the manual counts made periodically after the tolls were removed the number of people riding in each vehicle was recorded. Unfortunately, no reliable data were available for the period before the removal of tolls. While the before questionnaire contained a question on vehicle occupancy, many respondents misunderstood the question, so accurate data were not obtained.

The occupancy data gathered since the removal of the toll and plotted in Figure 5 indicate that the rate declined until January 1977, when an upward trend began. Specifically, the rate of 2.04 in August 1976, two months after the tolls were removed, had dropped to 1.45 by mid-January. From January the rate increased, and the counts taken in May 1977 revealed that an average of 1.67 persons were traveling in each vehicle. Further data on vehicle occupancy are given in Appendix D.

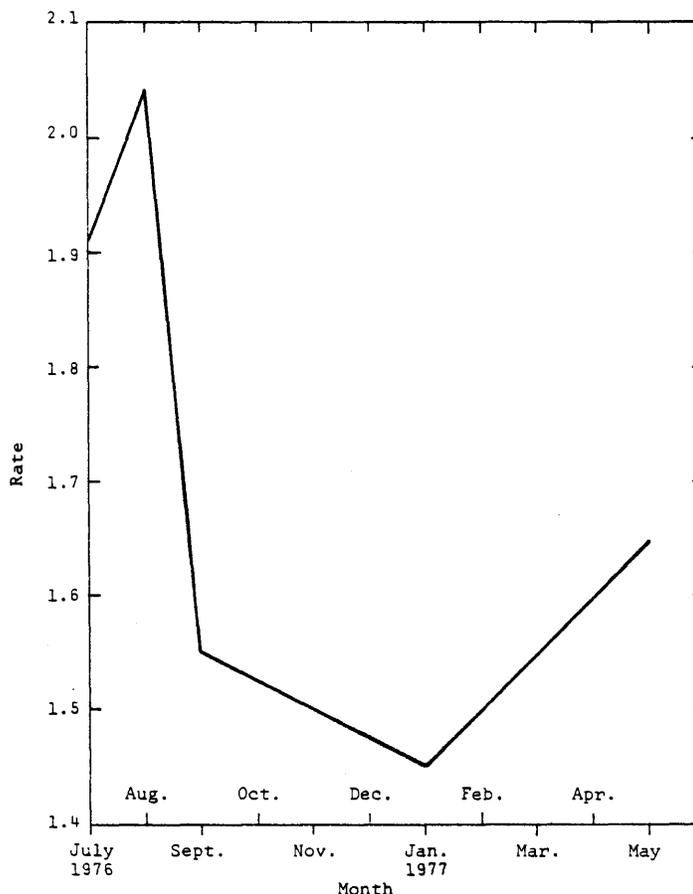


Figure 5. Vehicle occupancy rates after removal of tolls at James River Bridge.

In the absence of an established historical trend, it was difficult to determine the extent to which the data shown in Figure 5 differ from the normal monthly variations; however, one would not expect a sharp decline in occupancy rates to occur during the vacation months, August and September, under normal travel conditions. Therefore it appears that the removal of tolls probably has contributed to a reduction in the occupancy rate of the vehicles crossing the river.

Occupancy rates and commuter carpools are closely associated, therefore, additional questions relative to participation in carpools were included in the after questionnaire survey. Of the respondents, 12.3% indicated that they carpooled prior to the removal of tolls, while 13.4% replied that they continued to use carpools to and from work after the tolls were lifted. The data show that some people stopped riding in carpools after the tolls were lifted while others started. Although the absolute number of respondents the questions was relatively small, 9.5% of those

who had carpooled prior to removal of tolls indicated that they did not carpool afterwards, while 11.5% of those who had not carpooled entered a program. The changes in carpools were not significant; therefore, the removal of tolls did not appear to have a major impact upon the carpooling habits of the motorists using the bridge. In fact, a number of vanpools have been initiated since the tolls were removed and have contributed to the increase in the number of carpools. The propensity to carpool will be reviewed in greater detail in the section of the report relative to trip purpose.

In an effort to provide further insight into the changes in occupancy rates, several variables and their relationship to vehicular occupancy were examined. Among them were age, income, occupation, purpose of trip, frequency of trip, and length of trip. Only interrelationships — not before and after comparisons — were made; therefore, the after questionnaire survey results were used.

With respect to occupancy and age, the cross tabulation data showed a significant relationship. As expected, retired individuals and those under 21 years of age rode together more often than did people in the other age groups. The rate for the oldest group was 1.92 and that for the youngest was 2.16; the 40-65 year age group had a rate of 1.81, and that for the 21-39 year group was 1.73.

The relationship between occupancy rate and income was non-linear, as shown in Figure 6. The low income group had the highest occupancy rate. The rate dropped for the \$9-\$12,000 income group and then rose again for those respondents earning \$12-\$15,000 annually.

Occupation appeared to have a significant influence on the occupancy rate. From Table 6 it can be seen that clerical personnel, business managers, and operators had the lowest mean occupancy rates, while homemakers, students, and retired persons had the highest.

One might reasonably hypothesize that the occupancy rate would vary by trip purpose. Table 7 presents data consistent with this hypothesis. Work trips were characterized by a lower occupancy rate than were the other types of trips, particularly shopping. The work trips make up the large majority of the trips taken and the occupancy rate among them is the lowest of any category of trips.

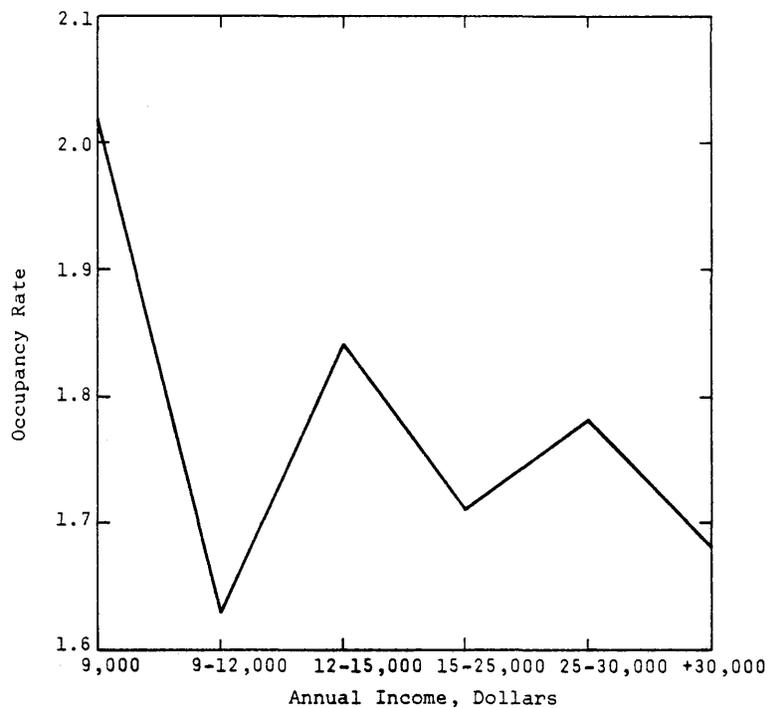


Figure 6. Vehicle occupancy rates and income in after period.

Table 6

Vehicle Occupancy by Occupation in After Period

<u>Occupation</u>	<u>Occupancy Rate</u>
Professional	1.74
Business Manager	1.45
Clerical	1.55
Craftsman	1.75
Operator	1.48
Unskilled Laborer	1.98
Homemaker	2.17
Retired	2.03
Student	2.24

Table 7

Vehicle Occupancy by Trip Purpose in After Period

	<u>Trip Purpose</u>	<u>Occupancy Rate</u>
Origin:		
Home		1.79
Work		1.58
Shopping		2.03
Other (Recreational, school, etc.)		1.85
Destination:		
Home		1.83
Work		1.30
Shopping		2.33
Other (Recreational, school, etc.)		1.99

Table 8 shows the relationship between the occupancy rate and the frequency of trips across the river. The data are consistent with those presented for trip purpose. The people who travel most frequently across the river exhibit the lowest occupancy rates.

The final relationship reviewed in this part of the analysis was that of occupancy rate and length of trip. Table 9 shows that the short trips had a relatively high occupancy rate. The rate dropped for the middle categories, and then rose for the longer trips. These findings were consistent with other data in the report which revealed that the average shopping trips usually had high occupancy rates and shorter travel times than did work trips, while the trips made in the category designated "other" (recreational, visiting, etc.) were greater in travel time than the work trips.

Table 8

Vehicle Occupancy by Number of Crossings

<u>Number of Crossings</u>	<u>Occupancy Rate</u>
> 10 per week	1.52
4-6 per week	1.78
2 per week	1.96
1 per week	2.03
2 per month	1.81
< 6 per year	2.18

Table 9

Vehicle Occupancy by Trip Time, After Period

<u>Trip Time in Minutes</u>	<u>Occupancy Rate</u>
< 20	1.78
21-25	1.58
26-35	1.74
36-45	1.62
46-60	1.92
61-75	1.84
> 75	2.11

Changes in the Purposes of Trips

Because all trip types or purposes are not equally ranked by travelers in terms of importance, the consequences of tolls cannot be summarized by simply examining the total number of trips taken before and after the tolls were removed.

The purposes of the trips made during the before and after surveys are shown in Tables 10 and 11, respectively. A comparison of the data revealed an increase in the percentage of non-work trips, particularly shopping trips, while the percentage of work trips decreased. Such a reaction to the removal of tolls is consistent with normal expectation concerning price elasticity of demand. Specifically, there is no reason to anticipate a change in the number of work oriented trips; however, shopping trips frequently provide some recreational value and as such cannot always be classified as essential. Since travel is a "good" which is to some degree a luxury item in people's budgets, a reduction in price (tolls) should increase the quantity demanded. Thus, the increase in shopping trips was expected.

Table 10

Trip Purposes, Before Period
(Percentages in Parentheses)

<u>Origin</u>	<u>Destination</u>					<u>Total</u>
	<u>Home</u>	<u>Work</u>	<u>School</u>	<u>Shopping</u>	<u>Other</u>	
Home	15 (1.2)	322 (25.8)	9 (0.7)	50 (4.0)	180 (14.4)	576 (46.1)
Work	326 (26.1)	74 (5.9)	2 (0.2)	5 (0.4)	40 (3.2)	447 (35.8)
School	8 (0.6)	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	9 (0.7)
Shopping	24 (1.9)	1 (0.1)	0 (0.0)	3 (0.2)	1 (0.1)	29 (2.3)
Other	127 (10.2)	33 (12.6)	0 (0.0)	1 (0.1)	27 (2.2)	188 (15.1)
Total	500 (40.0)	431 (34.5)	11 (0.9)	59 (4.7)	248 (19.9)	1,249 (100.0)

Table 11

Trip Purposes, After Period
(Percentages in Parentheses)

<u>Origin</u>	<u>Destination</u>					<u>Total</u>
	<u>Home</u>	<u>Work</u>	<u>School</u>	<u>Shopping</u>	<u>Other</u>	
Home	12 (1.6)	147 (19.1)	12 (1.5)	54 (7.0)	162 (21.2)	387 (50.4)
Work	149 (19.4)	20 (2.6)	0 (0.0)	1 (0.1)	22 (2.9)	192 (25.0)
School	18 (2.3)	0 (0.0)	1 (0.1)	1 (0.1)	1 (0.1)	21 (2.6)
Shopping	32 (4.2)	2 (0.3)	0 (0.0)	1 (0.1)	0 (0.0)	35 (4.6)
Other	104 (13.5)	14 (1.8)	0 (0.0)	1 (0.1)	15 (2.0)	134 (17.4)
Total	315 (41.0)	183 (23.8)	13 (1.6)	58 (7.4)	200 (26.2)	769 (100.0)

The removal of the tolls was hypothesized to have reduced the tendency of people to form carpools; however, the data show that it is not the case on the James River Bridge. It has already been noted that the number of carpools increased after the tolls were lifted, and Table 12 shows that the greatest change involved shoppers and students. A brief comment is in order concerning these results. Because of the rather slight increase in the number of carpools observed during the after period, it is suggested that participation in a carpool is a practice that tends to be less influenced by marginal changes in cost than might be expected intuitively. More specifically, carpooling is a function not only of the level of the toll, but also of trip length, trip frequency, and travel time.

Table 12

Percentage of Carpools by Trip Destination

<u>Destination</u>	<u>Percentage of Carpool</u>	
	<u>Before</u>	<u>After</u>
Home	9.3	10.3
Work	22.4	23.4
School	19.0	28.6
Shopping	5.7	11.4
Other	7.4	6.7

Changes in Travel Patterns

Since there was a high probability that the tolls were a barrier to travel across the James River, their removal should significantly alter the travel in the area. In the following sections examinations are made of the changes in frequency of crossings, length of trips, origins and destinations of trips, jobs, and residences in an attempt to determine the effects of the removal of the tolls.

Change in Frequency of Crossings

It has already been established that the removal of the tolls resulted in an increase in the total volume of vehicles crossing the bridge. This section presents a discussion of the frequency of trips made by the respondents in the before and after surveys.

The average number of trips made per week in the before period was 4.32. After the tolls were removed, the number of trips increased to an average of 5.2. Table 13 presents the data on the distribution of trips. There were significant changes in the "more than 10 per week" and "less than 6 per year" categories. The percentage of respondents who traveled infrequently during the before period made trips more frequently after the tolls were removed.

Table 13
Number of Crossings

<u>Category</u>	<u>Before</u>	<u>After</u>
> 10 per week	33.6	40.7
4-6 per week	11.2	13.7
2 per week	9.9	10.3
1 per week	10.9	11.9
2 per month	14.1	12.1
< 6 per year	20.0	10.7
No Response	0.3	0.6

A comparison of the results of the before and after surveys indicated how the tolls affected different groups of travelers. The survey showed that among respondents, the group over 65 years of age increased the frequency of their trips; that is, their trips now constitute a larger percentage of total trips taken. The before portion was 4.0%, while the after value was 6.6%.

Since occupation is correlated with the level of income and demand for travel is a function of income, it was hypothesized that low paid occupational categories might change their demand for trips after the tolls were removed. This expectation was partially supported by the data; among unskilled workers, the percentage making at least 4 trips per week increased from 51.2% to 76.7%, and among the retired people, the percentage making that number of trips increased from 17.0% to 21.3%. The results of cross tabulations between the number of crossings and income, shown in Table 14, also revealed that there was a tendency for the lower income groups to make trips more frequently after the tolls were removed.

Table 14

Number of Crossings by Annual Income
(In Percentages)

Number of Crossings	Under \$9,000		\$9,001-\$12,000		\$12,001-\$15,000		\$15,001-\$25,000		\$25,001-\$30,000		Over \$30,000	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
> 10 per week	21.4	24.7	30.4	41.1	38.9	44.5	40.1	48.9	44.9	44.8	26.9	28.6
4-6 per week	18.3	22.6	9.8	16.1	10.3	14.3	11.3	10.5	4.1	8.2	11.1	17.5
2 per week	11.8	10.8	10.7	11.6	13.5	9.5	7.1	10.9	8.2	8.2	14.3	7.9
1 per week	15.1	12.9	10.7	8.9	7.1	11.1	10.5	11.7	6.1	8.2	14.3	15.9
2 per month	14.0	11.8	14.3	10.7	13.5	13.5	13.4	8.8	12.2	16.3	17.5	19.0
< 6 per year	19.4	17.2	23.2	11.6	16.7	6.3	17.2	8.4	24.5	14.3	15.9	11.1
No response	0.0	0.0	0.9	0.0	0.0	0.8	0.4	0.8	0.0	0.0	0.0	0.0

Change in Trip Length

One would surmise that the lengths of trips would increase after the tolls were removed, because the additional operating costs for the longer trips would be compensated for by the elimination of the tolls. However this hypothesis has not been supported by the data gathered in the before and after surveys. Prior to the removal of the tolls, the average trip required 46.6 minutes of travel time. After the tolls were lifted, the travel time averaged 44.7 minutes per trip. Similar results are shown in Table 15, which gives the relationship between the number of crossings and length of trip.

Table 15

Trips by Average Trip Length

<u>Number of Trips</u>	<u>Average Length in Minutes</u>	
	<u>Before</u>	<u>After</u>
10 per week	42.3	39.3
4 per week	42.4	40.8
2 per week	47.6	44.7
1 per week	49.6	52.0
1 per month	63.9	58.9

It has already been shown that there were large increases in the numbers of shopping and recreational trips after the tolls were removed. Table 16 shows that there were no significant differences in the lengths of the shopping trips made during the before and after periods; however, the recreational trips were much longer after the tolls were removed. In the after period, the travel times for the trips destined to home and work decreased.

Table 16

Trip Length by Destination

<u>Destination</u>	<u>Average Length of Trip in Minutes</u>	
	<u>Before</u>	<u>After</u>
Home	49	46
Work	44	41
School	37	46
Shopping	38	38
Other (Recreational, visiting, etc.)	34	54

Changes in Origins and Destinations of Trips

In order to review the changes in the origin and destination patterns of the travelers, the area was divided into traffic zones as shown in Figure 7 and information was gathered through the before and after questionnaire surveys. The traffic volumes and relative trip frequencies are presented in Table 17 and trip tables showing the numbers of trips between the zones are in Appendix E.

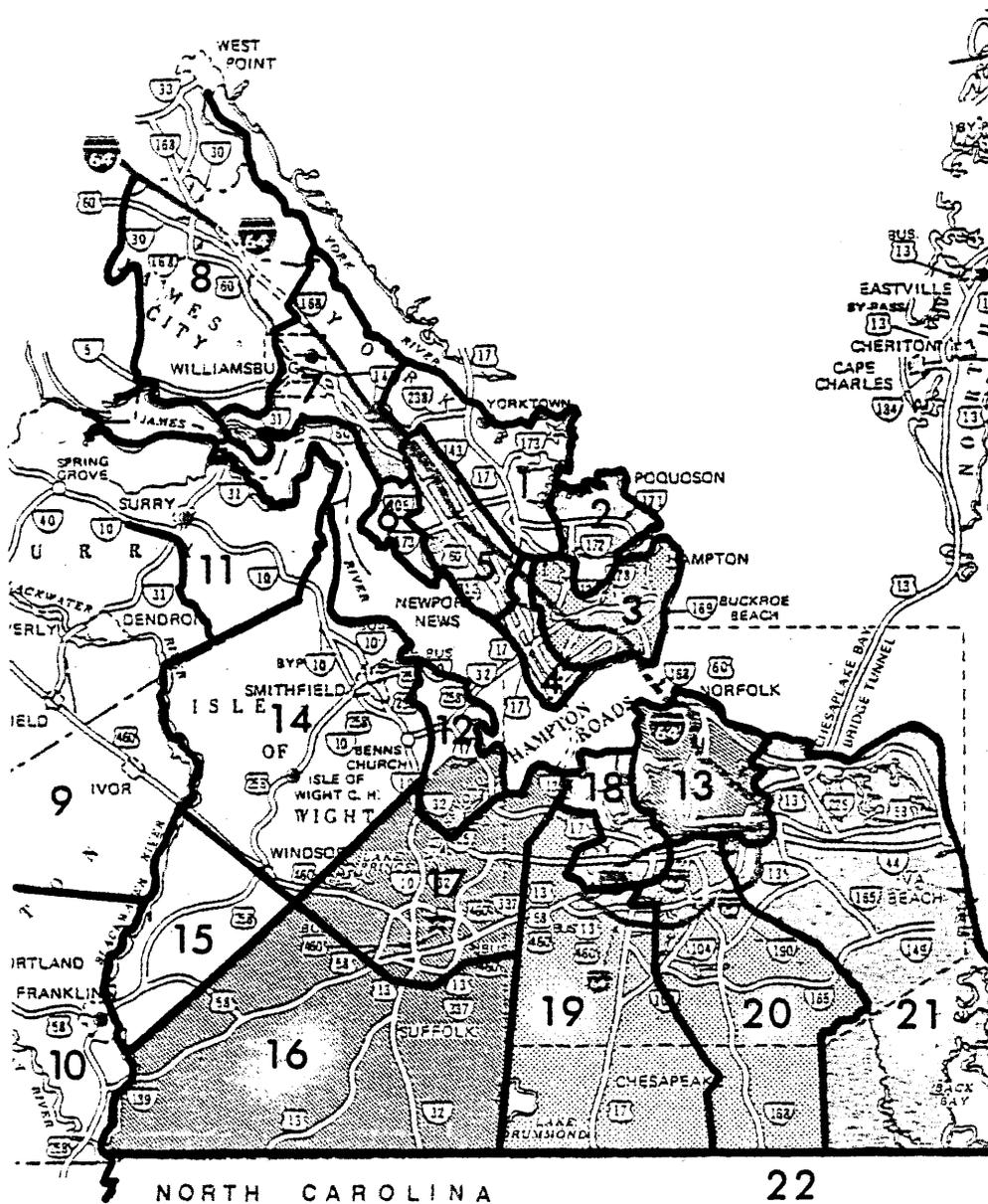


Figure 7. Traffic zones.

Table 17

Traffic Volumes by Zone of Origin and Destination

Zone	Origin				Destination			
	Volume		Relative Frequency		Volume		Relative Frequency	
	Before	After	Before	After	Before	After	Before	After
1	22	12	1.7	1.6	20	10	1.6	1.3
2	25	10	2.0	1.3	24	10	1.9	1.3
3	129	101	10.2	13.0	168	114	13.3	14.6
4	246	161	19.5	20.9	325	105	25.7	13.6
5	116	61	9.2	7.9	48	96	3.8	12.4
6	7	4	.6	.5	10	3	.8	.4
7	29	17	2.3	2.2	20	14	1.6	1.8
8	18	13	1.4	1.7	24	14	1.9	1.8
9	11	9	.9	1.2	14	4	1.1	.5
10	17	3	1.3	.4	21	6	1.7	.8
11	23	11	1.8	1.4	24	13	1.9	1.7
12	79	48	6.3	6.2	72	47	5.7	6.1
13	11	14	.9	1.8	13	9	1.0	1.2
14	155	86	12.3	11.1	125	88	9.9	11.4
16	1	1	.1	.1	1	2	.1	.3
17	71	57	5.6	7.4	1	57	.1	7.4
18	195	112	15.5	14.5	66	113	5.2	14.5
19	23	17	1.8	2.2	174	14	13.8	1.8
20	30	7	2.4	.9	21	15	1.7	1.9
21	5	1	.4	.1	26	3	2.1	.4
22	32	13	2.5	1.7	50	25	4.0	3.2
23	16	15	1.3	1.9	14	12	1.1	1.6
Total	1,261	773	100.0	100.0	1,261	774	100.0	100.0

The data show that the largest percentages of total trips originated in zones 3, 4, 14 and 18, respectively, during the before period. After the removal of tolls, most trips were generated in the same zones.

While cross tabulations between origin and destination patterns and occupancy rates, number of carpools, trip purpose, and income level were developed and may be reviewed upon request, the sampled populations by zone were considered too small to allow conclusions and thus are not presented in the report.

Changes in Jobs and Residences

Although data are limited on the subject of changes in jobs and residences, there are a few indications that these changes are taking place since the tolls have been removed. In response to a question in the after questionnaire survey, 2.2% of the respondents said they had changed jobs or planned to do so as a result of the end to tolls. Cross tabulations showed that 41.2% of those who had changed jobs had made fewer than 6 trips per year across the river in the before period. After changing jobs, 82.4% of this group were making 10 or more trips per week. The data revealed that income was not a significant influence on the decision to change jobs.

In regard to the impact of the removal of tolls upon the places where people live, the survey results showed that 2.3% of the respondents had either changed residences or intended to change as a result of the lifting of tolls.

Several variables, including income and prior and current number of crossings, were tested for their influence on changes in residences. Cross tabulations showed that people who changed residences after the tolls were lifted were in two income groups — \$9-\$12,000 and \$15-\$25,000. Further, the data indicate that these individuals made very few trips across the bridge prior to the removal of tolls. Specifically, 50.0% of those who changed residences made fewer than 2 trips per month across the facility. In the period after their move, 72.2% of this group make 10 or more crossings per week.

CONCLUSIONS

The tolls on the James River Bridge were a barrier that prevented many people from traveling across the river. The following conclusions are based on the findings from this study.

1. Since the removal of the tolls, there has been an increased tendency for persons over 65 years of age to travel across the river. The number of trips taken by the older group, as a percentage of total trips, has doubled.
2. Females in general and homemakers in particular are traveling more since the tolls have been removed. Among homemakers, the percentage increased from 6.9% to 10.6%.
3. Income does appear to be a factor in the changes that have occurred since the tolls were removed. There is a tendency for the lower income groups to make trips more frequently.
4. Changes in traffic volumes resulting from the removal of tolls have been quite pronounced. The average number of vehicles daily crossing the facility during a 12-month period prior to the removal of tolls was 11,600 as compared to 14,000 vehicles during the after period. The increase is 20.9%, or approximately 15.4% greater than the expected historical growth.
5. The removal of the tolls had an immediate impact upon traffic volumes. The greatest increase in traffic occurred during the first month after the tolls were lifted. Since that time the increases in monthly volumes have been slight, approximately equal to the historical growth.
6. Passenger cars make up a smaller percentage of the total traffic currently than they did prior to the removal of tolls. The number of pickups and vans increased after the tolls were lifted; however, there was no change in the percentage of delivery trucks. Therefore, it appears that the removal of tolls has not generated an increase in economic activity.

7. After the tolls were removed, the occupancy rate declined until January 1977, when an upward trend began. In August 1976 the rate was 2.04; by mid-January it had dropped to 1.45. In May 1977 the rate had risen to 1.67 persons per vehicle.
8. Age groups under 21 and over 65 years had the highest occupancy rates when the tolls were in force. This relationship has not been altered.
9. Shoppers had higher occupancy rates than did workers and this relationship, too, has not changed.
10. The relationship between occupancy rate and income is nonlinear. The low income group had the greatest occupancy rate,
11. The percentage of nonessential (shopping, recreational, etc.) trips has increased since the tolls were removed.
12. Removal of the tolls has had almost no effect on the propensity of people to form carpools. In fact the number of carpools increased during the after period; thus, it was concluded that the tolls were not the most significant influence in the decision to form carpools, particularly at the last level of toll charges.
13. Motorists make trips more frequently now that the tolls have been removed. The average number of trips per week prior to the removal of tolls was 4.32. In the after period the number has increased to an average of 5.2.
14. While the trips made in the after study period were generally shorter than those made prior to the removal of tolls, there were no significant differences in the lengths of the trips.
15. The origins and destinations of the trips across the James River have not been significantly altered by the lifting of tolls.
16. Of the respondents to the study questionnaire, 2.2% reported that they had changed jobs or planned to change as a result of the removal of tolls.

17. The removal of the tolls has led to some people changing their places of residence. Of the respondents in the survey, 2.3% indicated that they had either changed residences or intended to change as a result of the lifting of tolls.

ACKNOWLEDGEMENTS

The authors express appreciation to the personnel of the Transportation Planning Division of the Virginia Department of Highways and Transportation for their assistance and cooperation in this research. Specifically, Oscar K. Mabry, transportation planning engineer and head of the division, suggested that the study be undertaken; and R. E. Campbell, B. R. Clarke, and M. F. Dunn, Jr. provided valuable suggestions relative to data collection in the early stages of the study. E. G. Ketron coordinated the after phase of data collection with the Division of Motor Vehicles of Virginia.

Special thanks go to J. K. Brookshire, Jr., assistant district engineer in the Suffolk District, and his staff for providing valuable monthly traffic volume reports; to L. H. Dawson, Jr., assistant traffic and safety engineer, for making available traffic recorders; and to the staff of the Division of Motor Vehicles for generating names and addresses of those persons sampled in the after phase of the study.

Appreciation is extended to several members of the Research Council staff. In particular, acknowledgement is made of the contribution of Jerry Korf of the data systems group; John Shelor, who supervised the data collection activities; Susan Kane, our secretary; Harry T. Craft, who edited the report; and the technicians and student helpers who assisted in the data collection.

Finally, acknowledgement is made of the contribution of all the individuals who completed and returned the survey questionnaires. Without their cooperation, completion of the study would have been impossible.

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0829
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COMMONWEALTH of VIRGINIA

HIGHWAY & TRANSPORTATION RESEARCH COUNCIL

May 18, 1976

JACK H. DILLARD, HEAD
VIRGINIA HIGHWAY & TRANSPORTATION RESEARCH COUNCIL

BOX 3817 UNIVERSITY STATION
CHARLOTTESVILLE, VIRGINIA 22903
IN REPLY PLEASE REFER TO FILE NO. **30.2.6**

Dear Motorist:

As the research branch of the Virginia Department of Highways and Transportation we are conducting a study to find out how the removal of tolls on the James River Bridge will affect automobile and truck travel in the Tidewater area. The first part of the study is to collect information from the people who pay the tolls to use the facility.

In an effort to reduce or eliminate your delay and inconvenience while we are conducting this survey, the mail-back questionnaire method of data collection is being used instead of the roadside interview technique. To help us get the needed information, we are asking that you please complete the attached questionnaire and drop it in a convenient mailbox for return to us. No postage is required. IF YOU SHOULD RECEIVE MORE THAN ONE QUESTIONNAIRE FROM THIS LOCATION OR OTHER LOCATIONS DURING THE COURSE OF THIS SURVEY, PLEASE COMPLETE AND RETURN ALL OF THEM.

Thank you for your cooperation and assistance. The accuracy and success of this survey are dependent on your help.

APPENDIX A (CONT.)

This Survey is Sponsored by the Virginia Department of Highways and Transportation

THE FOLLOWING QUESTIONS CONCERN THE TRIP YOU WERE MAKING WHEN YOU RECEIVED THIS QUESTIONNAIRE ON ROUTE 17 AT THE JAMES RIVER BRIDGE TOLL PLAZA. YOU WERE TRAVELING TOWARD NEWPORT NEWS IN THE NORTH-BOUND DIRECTION.

Please Answer all Questions and Drop in Mailbox -- No Postage Required

- A. What type of vehicle did you use for this trip? (circle one)
 - 1. Passenger Car - Virginia
 - 2. Passenger Car - Out of State
 - 3. Pickup or Van
 - 4. Two-axle truck
 - 5. Three-axle truck
 - 6. Tractor-Trailer
 - 7. Other - specify _____

- B. Where were you coming from?

(Specify street no. & name, city & state)

- C. Was the place you came from? (circle one)
 - 1. Your home
 - 2. Place of work
 - 3. School
 - 4. Shopping
 - 5. Other (specify) _____

- D. Where were you going?

(Specify street no. & name, city & state)

- E. Was this place? (circle one)
 - 1. Your home
 - 2. Place of work
 - 3. School
 - 4. Shopping
 - 5. Other (specify) _____

- F. What time did this trip begin? ____ A.M. ____ P.M. and end? ____ A.M. ____ P.M.

- G. Did you use the reduced toll commuter ticket? (circle one) 1. Yes 2. No

- H. How many persons (including driver) were in your vehicle on this trip? _____

- I. How frequently do you cross the James River Bridge? Include both directions; a round trip is 2 crossings. (circle one)
 - 1. 2 or more crossings a day
 - 2. 4 crossings per week
 - 3. 2 crossings per week
 - 4. 4 crossings per month
 - 5. 2 or less crossings per month

- J. What will you do when the tolls are removed? (circle one)
 - 1. Make the same number of trips as now
 - 2. Make fewer trips
 - 3. Make more trips

- K. Please indicate your Sex. (circle one) 1. Male 2. Female

- L. Please indicate your Age. (circle one) 1. under 21 2. 21-39 3. 40-65 4. over 65

- M. What is your Occupation? _____

- N. What was the combined annual income of all members of your household in 1975? (circle one)
 - 1. under \$9,000
 - 2. \$9,001 - \$12,000
 - 3. \$12,001-\$15,000
 - 4. \$15,001-\$25,000
 - 5. \$25,001-\$30,000
 - 6. over \$30,000

- O. In general, what are your feelings toward the removal of tolls and what effects will it have upon your shopping, working, and traveling activities?

THANK YOU -- PLEASE FOLD AND MAIL

DEPARTMENT OF HIGHWAYS & TRANSPORTATION
J. E. HARWOOD, COMMISSIONER

W. S. G. BRITTON
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COMMONWEALTH of VIRGINIA

HIGHWAY & TRANSPORTATION RESEARCH COUNCIL

JACK H. DILLARD, HEAD
VIRGINIA HIGHWAY & TRANSPORTATION RESEARCH COUNCIL

October 20, 1976

BOX 3817 UNIVERSITY STATION
CHARLOTTESVILLE, VIRGINIA 22903

IN REPLY PLEASE REFER TO FILE NO. 30.2.6

Dear Car Owner:

As the research branch of the Virginia Department of Highways and Transportation, we are conducting a study to determine how the removal of tolls on several Tidewater bridges will affect automobile and truck travel in the area. The second part of this study consists of collecting information from the people who paid tolls before June 1, 1976, but who are now using the facilities toll-free.

In an effort to reduce or eliminate your delay and inconvenience while we conduct this survey, the mail-back questionnaire method of gathering information is being used instead of the roadside interview. A vehicle registered in your name was observed crossing the James River Bridge on October 20, 1976, and the attached brief questionnaire concerns that trip. To help us get the needed information, we ask that you or the person who made the trip please answer the questionnaire and drop it in a convenient mailbox for return to us. No postage is required. IF YOU SHOULD RECEIVE MORE THAN ONE QUESTIONNAIRE DURING THE COURSE OF THIS SURVEY, PLEASE COMPLETE AND RETURN ALL OF THEM.

Thank you for your cooperation. The accuracy and success of this survey are dependent on your help.

Sincerely,

Gary R. Allen
Research Economist

R. N. Robertson
Research Engineer

This Survey is Sponsored by the Virginia Department of Highways and Transportation

A VEHICLE REGISTERED IN YOUR NAME WAS OBSERVED ON ROUTE 17 AT THE JAMES RIVER BRIDGE DURING THE MORNING OF OCTOBER 20, 1976 TRAVELING TOWARD NEWPORT NEWS IN THE NORTH-BOUND DIRECTION. THE FOLLOWING QUESTIONS CONCERN THAT TRIP AND MAY BE ANSWERED BY EITHER YOU OR THE PERSON WHO WAS DRIVING THE VEHICLE.

Please Answer All Questions and Drop in Mailbox - No Postage Required

- I. Errors in recording license plates do occur. If this form was sent to you by error, please check here and return. _____
- II. What type of vehicle did you use for this trip? (circle one)
- | | |
|-------------------|---------------------------|
| 1. Passenger Car | 4. Three-Axle Truck |
| 2. Pickup or Van | 5. Tractor-Trailer |
| 3. Two-Axle Truck | 6. Other -(specify) _____ |
- III. A. At what address did this trip begin? _____
Street Number, City (County), State
- B. Was this place? (circle one) 1. Your Home 2. Work 3. School
 4. Shopping Area 5. Other (specify) _____
- IV. A. At what address did this trip end? _____
Street Number, City (County), State
- B. Was this place? (circle one) 1. Your Home 2. Work 3. School
 4. Shopping Area 5. Other (specify) _____
- C. How long did it take you to get there? (circle one)
- | | | | |
|---------------|---------------|---------------|----------------------|
| 1. 0-15 min. | 3. 21-25 min. | 5. 36-45 min. | 7. 61-75 min. |
| 2. 16-20 min. | 4. 26-35 min. | 6. 46-60 min. | 8. more than 75 min. |
- V. How many persons rode with the driver on this trip? (circle one)
- | | | | |
|-------------|-------------|-------------|----------------------|
| 1. 0 riders | 4. 3 riders | 7. 6 riders | 10. 9 or more riders |
| 2. 1 rider | 5. 4 riders | 8. 7 riders | |
| 3. 2 riders | 6. 5 riders | 9. 8 riders | |
- VI. A. About how often do you cross the James River Bridge? Include both directions; a round trip is 2 crossings. (circle one)
- | | |
|--------------------------------|------------------------------|
| 1. 10 or more crossings a week | 4. 2 crossings every 2 weeks |
| 2. 4-6 crossings a week | 5. 2 crossings a month |
| 3. 2 crossings a week | 6. less than 6 a year |
- B. About how often did you cross the James River Bridge before the toll was removed? A round trip is 2 crossings. (circle one)
- | | |
|--------------------------------|------------------------------|
| 1. 10 or more crossings a week | 4. 2 crossings every 2 weeks |
| 2. 4-6 crossings a week | 5. 2 crossings a month |
| 3. 2 crossings a week | 6. less than 6 a year |
- VII. A. Do you car pool to and from work? (circle one) 1. Yes 2. No
 B. Did you car pool before the tolls were lifted? (circle one) 1. Yes 2. No
- VIII. A. Please indicate your sex. (circle one) 1. Male 2. Female
 B. Please indicate your age. (circle one) 1. under 21 2. 21-39 3. 40-65 4. over 65
 C. What is your occupation? _____
 D. What was the combined annual income of all members of your household in 1975? (circle one)
- | | | |
|---------------------|----------------------|----------------------|
| 1. under \$9,000 | 3. \$12,001-\$15,000 | 5. \$25,001-\$30,000 |
| 2. \$9,000-\$12,000 | 4. \$15,001-\$25,000 | 6. over \$30,000 |
- IX. A. Will the removal of the toll cause you to change your residence? (circle one) 1. Yes 2. No
 B. Will the removal of the toll cause you to change jobs? (circle one) 1. Yes 2. No
- X. Comments _____

THANK YOU - PLEASE FOLD AND MAIL

APPENDIX C

CLASSIFICATION TRAFFIC VOLUMES
JAMES RIVER BRIDGE

NORTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
<u>July 21, 1976, P.M.</u>							
12:00 - 12:30	118	25	6	1	4	2	156
12:30 - 1:00	140	22	5	6	6	0	179
1:00 - 1:30	114	16	8	2	8	2	150
1:30 - 2:00	143	20	5	1	12	0	181
2:00 - 2:30	128	24	3	4	5	3	167
2:30 - 3:00	159	26	8	0	7	8	208
3:00 - 3:30	194	53	9	3	4	1	264
3:30 - 4:00	161	43	6	1	9	1	221
4:00 - 4:30	160	27	3	0	4	0	194
4:30 - 5:00	182	32	2	2	4	2	224
5:00 - 5:30	177	26	8	1	3	0	215
5:30 - 6:00	148	26	10	2	1	2	189
6:00 - 6:30	131	20	3	0	2	2	158
6:30 - 7:00	149	27	1	0	4	1	182
Subtotal	2,104	387	77	23	73	24	2,688
Percentage	78.3	14.4	2.9	0.8	2.7	0.9	100

SOUTHBOUND LANE

12:00 - 12:30	130	25	8	1	6	0	170
12:30 - 1:00	104	16	9	6	4	0	139
1:00 - 1:30	121	18	8	14	4	0	165
1:30 - 2:00	116	19	4	5	4	1	149
2:00 - 2:30	144	15	7	5	5	4	180
2:30 - 3:00	150	18	6	3	6	2	185
3:00 - 3:30	142	29	5	7	12	1	196
3:30 - 4:00	209	50	0	4	11	5	279
4:00 - 4:30	255	91	6	6	11	9	378
4:30 - 5:00	277	184	1	1	6	16	485
5:00 - 5:30	383	65	9	5	11	2	475
5:30 - 6:00	210	43	3	7	6	2	271
6:00 - 6:30	183	29	5	3	3	1	224
6:30 - 7:00	172	21	4	2	7	2	208
Subtotal	2,596	623	75	69	96	45	3,504
Percentage	74.1	17.8	2.1	2.0	2.7	1.3	100
Total	4,700	1,010	152	92	169	69	6,192
Percentage	75.9	16.3	2.5	1.5	2.7	1.1	100

NORTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
<u>August 25, 1976, P.M.</u>							
1:00 - 1:30	119	30	9	9	6	2	175
1:30 - 2:00	116	16	4	1	7	1	145
2:00 - 2:30	106	18	11	4	4	3	146
2:30 - 3:00	131	39	9	5	4	4	192
3:00 - 3:30	156	47	8	1	10	3	225
3:30 - 4:00	151	28	2	1	6	2	190
4:00 - 4:30	143	23	8	1	5	0	180
4:30 - 5:00	194	44	3	2	0	2	245
5:00 - 5:30	188	39	5	0	2	3	237
5:30 - 6:00	158	26	5	1	6	3	199
Subtotal	1,462	310	64	25	50	23	1,934
Percentage	75.6	16.0	3.3	1.3	2.6	1.2	100

SOUTHBOUND LANE

1:00 - 1:30	112	28	5	1	3	0	149
1:30 - 2:00	134	33	4	3	10	2	186
2:00 - 2:30	110	25	6	3	9	3	156
2:30 - 3:00	153	25	8	4	2	1	193
3:00 - 3:30	68	14	5	2	7	2	98
3:30 - 4:00	261	72	7	3	13	3	359
4:00 - 4:30	373	205	8	1	9	11	607
4:30 - 5:00	215	82	2	0	7	0	306
5:00 - 5:30	384	69	8	1	14	6	482
5:30 - 6:00	220	39	6	1	9	0	275
Subtotal	2,030	592	59	19	83	28	2,811
Percentage	72.2	21.1	2.1	0.6	3.0	1.0	100
Total	3,492	902	123	44	133	51	4,745
Percentage	73.6	19.0	2.6	0.9	2.8	1.1	100

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
<u>Sept. 22, 1976, A.M.</u>							
7:00 - 7:30	138	25	1	3	4	2	173
7:30 - 8:00	133	29	3	0	9	1	175
8:00 - 8:30	103	16	5	0	10	0	134
8:30 - 9:00	101	23	7	0	9	4	144
9:00 - 9:30	139	31	8	0	8	1	187
9:30 - 10:00	86	21	7	3	7	2	126
10:00 - 10:30	87	21	5	2	2	0	117
10:30 - 11:00	94	22	8	1	15	0	140
11:00 - 11:30	98	20	9	2	9	1	139
11:30 - 12:00	91	13	2	1	8	1	116
12:00 - 12:30	110	28	9	0	5	1	153
12:30 - 1:00	86	22	3	1	4	1	117
Subtotal	1,266	271	67	13	90	14	1,721
Percentage	73.6	15.7	3.9	0.8	5.2	0.8	100

NORTHBOUND LANE

7:00 - 7:30	237	53	6	0	7	2	305
7:30 - 8:00	203	33	3	0	4	2	245
8:00 - 8:30	146	17	6	2	7	2	180
8:30 - 9:00	136	30	7	2	7	0	182
9:00 - 9:30	85	19	8	2	6	1	121
9:30 - 10:00	119	21	12	0	6	0	158
10:00 - 10:30	111	11	2	3	7	1	135
10:30 - 11:00	118	18	6	1	10	0	153
11:00 - 11:30	115	18	5	5	11	1	155
11:30 - 12:00	109	22	8	0	11	1	151
12:00 - 12:30	94	24	8	0	7	0	133
12:30 - 1:00	87	17	3	1	6	2	116
Subtotal	1,560	283	74	16	89	12	2,034
Percentage	76.7	13.9	3.6	0.8	4.4	0.6	100
Total	2,826	554	141	29	179	26	3,755
Percentage	75.3	14.8	3.8	0.8	4.8	0.7	100

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
<u>October 20, 1976 A. M.</u>							
7:30 - 8:00	162	34	9	3	10	1	219
8:00 - 8:30	102	26	6	0	4	0	138
8:30 - 9:00	115	17	8	3	5	2	150
9:00 - 9:30	109	18	6	0	7	0	140
9:30 - 10:00	103	28	9	9	7	0	156
10:00 - 10:30	84	22	6	3	6	0	121
10:30 - 11:00	100	22	9	1	5	1	138
11:00 - 11:30	119	31	11	0	4	0	165
11:30 - 12:00	86	31	8	1	8	0	134
 P. M.							
1:00 - 1:30	117	17	10	0	4	0	148
1:30 - 2:00	123	23	9	2	4	1	162
2:00 - 2:30	111	21	10	0	5	0	147
2:30 - 3:00	135	20	8	2	8	0	173
3:00 - 3:30	136	32	8	1	7	0	184
3:30 - 4:00	198	49	7	1	4	1	260
4:00 - 4:30	315	190	5	0	8	5	523
4:30 - 5:00	348	117	10	0	13	7	495
5:00 - 5:30	255	37	4	1	5	2	304
Subtotal	2,718	735	143	27	114	20	3,757
Percentage	72.3	19.6	3.8	0.8	3.0	0.5	100

APPENDIX C (cont.)

NORTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
<u>October 20, 1976, A. M.</u>							
7:30 - 8:00	245	33	10	3	6	0	297
8:00 - 8:30	161	27	7	0	4	0	199
8:30 - 9:00	140	23	4	1	2	0	170
9:00 - 9:30	143	18	13	2	12	1	189
9:30 - 10:00	128	18	12	2	8	0	168
10:00 - 10:30	115	32	7	3	9	0	166
10:30 - 11:00	119	12	4	4	5	0	144
11:00 - 11:30	101	26	7	10	8	0	152
11:30 - 12:00	112	24	8	2	8	0	154
 P. M.							
1:00 - 1:30	102	20	7	1	5	0	135
1:30 - 2:00	93	21	6	1	5	0	126
2:00 - 2:30	122	22	5	2	6	1	158
2:30 - 3:00	138	33	4	1	1	3	180
3:00 - 3:30	168	51	7	2	5	0	233
3:30 - 4:00	164	40	4	0	7	0	215
4:00 - 4:30	158	26	6	2	5	1	198
4:30 - 5:00	179	40	3	2	0	1	225
5:00 - 5:30	188	36	1	0	1	1	227
Subtotal	2,576	502	115	38	97	8	3,336
Percentage	77.2	15.0	3.5	1.2	2.9	0.2	100
Total	5,294	1,237	258	65	211	28	7,093
Percentage	74.6	17.4	3.6	0.9	3.0	0.4	100

NORTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
<u>March 16, 1977 P. M.</u>							
1:15 - 1:30	47	12	6	0	4	1	70
1:30 - 1:45	44	8	5	0	7	0	64
1:45 - 2:00	51	12	2	0	5	0	70
2:00 - 2:15	49	11	4	0	1	2	67
2:15 - 2:30	93	15	6	0	5	0	119
2:30 - 2:45	61	12	5	1	2	2	83
2:45 - 3:00	67	21	6	3	2	4	103
3:00 - 3:15	78	22	3	0	4	0	107
3:15 - 3:30	101	30	4	0	7	0	142
3:30 - 3:45	102	24	3	1	5	0	135
3:45 - 4:00	82	29	6	2	0	1	120
4:00 - 4:15	86	27	3	1	4	1	122
4:15 - 4:30	85	21	1	3	3	0	113
4:30 - 4:45	112	23	2	0	2	0	139
4:45 - 5:00	136	37	6	0	0	2	181
5:00 - 5:15	126	31	1	0	0	0	158
5:15 - 5:30	91	21	1	2	1	1	117
Subtotal	1,411	356	64	13	52	14	1,910
Percentage	73.9	18.6	3.4	0.7	2.7	0.7	100

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
<u>March 16, 1977 P. M.</u>							
1:15 - 1:30	53	15	4	0	5	2	79
1:30 - 1:45	55	10	0	2	8	0	75
1:45 - 2:00	53	10	6	2	3	0	74
2:00 - 2:15	59	6	5	0	7	0	77
2:15 - 2:30	46	12	7	0	3	2	70
2:30 - 2:45	47	12	5	2	4	0	70
2:45 - 3:00	75	11	6	1	6	1	100
3:00 - 3:15	64	17	1	1	5	0	88
3:15 - 3:30	73	18	4	0	8	1	104
3:30 - 3:45	78	17	2	1	3	1	102
3:45 - 4:00	141	40	3	1	9	0	194
4:00 - 4:15	195	46	8	0	4	0	253
4:15 - 4:30	210	154	1	0	1	6	372
4:30 - 4:45	234	87	4	0	5	0	330
4:45 - 5:00	142	50	1	0	7	3	203
5:00 - 5:15	120	20	4	1	1	0	146
5:15 - 5:30	102	23	6	0	6	0	137
Subtotal	1,747	548	67	11	85	16	2,474
Percentage	70.7	22.2	2.7	0.4	3.4	0.6	100
Total	3,158	904	131	24	137	30	4,384
Percentage	72.0	20.6	3.0	0.6	3.1	0.7	100

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
<u>May 17, 1977, P. M.</u>							
1:00 - 1:15	63	10	1	1	5	1	81
1:30 - 1:45	68	7	3	0	6	0	84
2:00 - 2:15	73	17	5	0	6	0	101
2:30 - 2:45	80	13	6	1	3	1	104
3:30 - 3:45	121	31	7	0	6	0	165
3:45 - 4:00	102	42	2	0	5	1	152
4:00 - 4:15	114	28	1	1	3	6	153
4:15 - 4:30	74	47	1	0	2	1	125
4:30 - 4:45	70	74	0	0	1	1	146
4:45 - 5:00	68	56	1	0	1	3	129
5:00 - 5:15	151	60	3	0	3	2	219
5:15 - 5:30	100	28	6	0	5	4	143
5:30 - 5:45	127	21	2	0	1	4	155
5:45 - 6:00	118	25	6	2	1	2	154
Subtotal	1,329	459	44	5	48	26	1,911
Percentage	69.5	24.0	2.3	0.3	2.5	1.4	100

NORTHBOUND LANE

1:15 - 1:30	94	14	2	0	8	3	121
1:45 - 2:00	43	6	1	0	3	2	55
2:15 - 2:30	70	22	5	0	2	0	99
2:45 - 3:00	59	18	3	0	6	1	87
3:45 - 4:00	47	11	2	0	2	1	63
Subtotal	313	71	13	0	21	7	425
Percentage	73.7	16.7	3.1	0.0	4.9	1.6	100
Total Both Directions	1,642	530	57	5	69	33	2,336
Percentage	70.3	22.7	2.4	0.2	3.0	1.4	100

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
<u>May 18, 1977, A.M.</u>							
7:15 - 7:30	115	25	9	2	5	0	156
7:45 - 8:00	57	13	1	0	0	0	71
8:15 - 8:30	68	11	6	0	3	0	88
8:45 - 9:00	56	19	4	3	3	1	86
9:15 - 9:30	47	11	3	0	6	1	68
9:45 - 10:00	44	8	3	2	4	0	61
10:15 - 10:30	50	10	1	0	5	0	66
10:45 - 11:00	59	12	4	0	6	0	81
Subtotal	496	109	31	7	32	2	677
Percentage	73.3	16.1	4.6	1.0	4.7	0.3	100

NORTHBOUND LANE

7:00 - 7:15	101	33	7	0	2	2	145
7:30 - 7:45	178	32	4	4	11	1	230
8:00 - 8:15	76	17	1	1	5	0	100
8:30 - 8:45	65	10	4	0	2	0	81
9:00 - 9:15	45	8	8	0	6	0	67
9:30 - 9:45	47	6	4	0	3	2	62
10:00 - 10:15	61	16	6	2	4	2	91
10:30 - 10:45	57	19	6	0	3	0	85
Subtotal	630	141	40	7	36	7	861
Percentage	73.2	16.4	4.6	0.8	4.2	0.8	100
Total Both Directions	1,126	250	71	14	68	9	1,538
Percentage	73.2	16.3	4.6	0.9	4.4	0.6	100

0842

APPENDIX D
OCCUPANCY VOLUMES
JAMES RIVER BRIDGE

SOUTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
<u>July 21, 1976, P.M.</u>								
12:05 - 12:20	57	25	9	7	1	4	103	1.85
1:05 - 1:20	43	24	8	6	3	2	86	1.93
2:05 - 2:20	44	20	7	7	1	5	84	2.00
3:05 - 3:20	51	32	12	4	2	3	104	1.88
4:05 - 4:20	117	47	20	6	2	3	195	1.66
5:05 - 5:20	164	69	21	14	5	7	280	1.77
6:05 - 6:20	53	44	16	3	4	2	122	1.91
Subtotal	429	261	93	47	18	26	974	1.90

NORTHBOUND LANE

12:35 - 12:50	29	25	11	7	1	1	74	2.04
1:35 - 1:50	50	34	14	3	3	1	105	1.84
2:35 - 2:50	53	33	8	6	3	1	104	1.81
3:35 - 3:50	48	31	9	8	0	2	98	1.85
4:35 - 4:50	50	38	14	6	3	1	112	1.90
5:35 - 5:50	55	26	14	7	2	1	105	1.84
6:35 - 6:50	36	32	17	10	6	2	103	2.26
Subtotal	321	219	87	47	18	9	701	1.93
Total Both Directions	750	480	180	94	36	35	1,675	1.91

APPENDIX D (cont.)

NORTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
<u>August 25, 1976, P. M.</u>								
3:00 - 3:10	39	23	8	3	2	1	76	1.80
3:20 - 3:30	35	22	6	5	2	8	78	2.24
3:48 - 3:58	37	18	6	3	4	0	68	1.81
4:40 - 4:55	47	35	14	14	4	6	120	2.32
5:05 - 5:20	73	33	11	2	3	1	123	1.63
5:40 - 5:55	44	21	8	6	0	2	81	1.80
Subtotal	275	152	53	33	15	18	546	1.93

SOUTHBOUND LANE

3:30 - 3:45	123	61	17	9	5	7	222	1.70
4:00 - 4:15	113	33	24	7	1	0	178	1.59
4:18 - 4:33	132	70	22	21	7	115	367	3.12
4:40 - 4:55	65	25	18	17	8	6	139	2.32
5:00 - 5:15	176	80	18	12	3	5	294	1.69
5:20 - 5:35	111	38	10	2	4	2	167	1.54
5:40 - 5:55	71	25	12	10	4	1	123	1.81
Subtotal	791	332	121	78	32	136	1,490	2.08
Total	1,066	484	174	111	47	154	2,036	2.04

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
<u>September 22, 1976, A. M.</u>								
7:10 - 7:30	86	32	6	2	1	1	128	1.46
7:35 - 7:50	62	22	9	2	0	2	97	1.58
8:00 - 8:15	42	15	8	1	0	1	67	1.58
8:25 - 8:40	53	9	2	2	0	2	68	1.43
8:50 - 9:00	20	12	2	0	0	1	35	1.60
9:10 - 9:25	51	21	4	1	1	0	78	1.46
9:35 - 9:50	34	22	5	1	0	0	62	1.56
10:00 - 10:15	34	20	2	1	3	0	60	1.65
10:25 - 10:40	36	17	9	1	0	0	63	1.60
10:55 - 11:10	42	20	8	2	0	2	74	1.70
11:20 - 11:35	34	24	6	5	1	0	70	1.78
11:45 - 12:00	41	16	7	1	0	0	65	1.51
P. M.								
12:05 - 12:20	36	17	3	0	1	1	58	1.55
12:30 - 12:45	36	20	7	3	0	0	66	1.65
Subtotal	607	267	78	22	7	10	991	1.57

NORTHBOUND LANE

7:05 - 7:25	139	35	8	10	3	1	196	1.50
7:30 - 7:50	143	21	8	1	5	1	179	1.36
7:55 - 8:10	83	20	1	1	0	1	106	1.28
8:15 - 8:35	103	16	0	3	0	0	122	1.20
8:40 - 9:00	66	23	10	2	2	2	105	1.64
9:10 - 9:30	60	25	10	2	2	2	101	1.68
9:35 - 9:55	64	28	7	6	2	0	107	1.64
10:00 - 10:20	43	32	12	5	0	1	93	1.82
10:25 - 10:45	47	31	10	2	0	2	92	1.73
10:50 - 11:10	57	41	6	5	0	0	109	1.62
11:15 - 11:35	51	36	10	3	0	1	101	1.69
11:40 - 12:00	84	44	7	1	0	1	137	1.48
P. M.								
12:05 - 12:27	63	26	12	0	1	1	103	1.57
12:30 - 12:50	41	32	6	2	1	0	82	1.66
Subtotal NBL	1,044	410	107	43	16	13	1,633	1.54
Subtotal SBL	607	267	78	22	7	10	991	1.57
Total Both Directions	1,651	677	185	65	23	23	2,624	1.55

APPENDIX D (cont.)

SOUTHBOUND LANE								
Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
<u>January 13, 1977, A. M.</u>								
7:00 - 7:15	66	17	6	0	0	0	89	1.33
7:15 - 7:30	75	25	8	4	2	1	115	1.57
7:30 - 7:45	71	19	5	5	0	0	100	1.44
7:45 - 8:00	45	7	3	1	0	0	56	1.29
8:00 - 8:15	37	15	3	0	0	0	55	1.38
8:15 - 8:30	42	17	3	1	0	0	63	1.41
8:30 - 8:45	51	13	1	2	1	2	70	1.50
8:45 - 9:00	46	16	3	0	1	0	66	1.39
9:00 - 9:15	36	21	7	1	0	0	65	1.58
9:15 - 9:30	36	19	5	1	0	0	61	1.52
9:30 - 9:45	38	12	3	2	0	0	55	1.44
9:45 - 10:00	28	18	6	0	0	0	52	1.58
10:00 - 10:15	31	15	4	1	0	0	51	1.51
10:15 - 10:30	43	17	3	2	2	0	67	1.55
Subtotal	645	231	60	20	6	3	965	1.47
NORTHBOUND LANE								
7:00 - 7:15	78	30	8	6	1	2	125	1.62
7:15 - 7:30	82	22	8	7	1	0	120	1.53
7:30 - 7:45	123	24	8	8	2	0	165	1.44
7:45 - 8:00	89	12	1	2	1	0	105	1.23
8:00 - 8:15	74	10	3	2	0	0	89	1.25
8:15 - 8:30	64	15	0	1	0	0	80	1.23
8:30 - 8:45	54	17	3	3	0	1	78	1.47
8:45 - 9:00	69	14	5	0	1	0	89	1.31
9:00 - 9:15	50	12	5	0	0	0	67	1.33
9:15 - 9:30	45	14	1	0	0	0	60	1.27
9:30 - 9:45	67	21	5	2	0	2	97	1.48
9:45 - 10:00	40	26	4	2	1	2	75	1.72
10:00 - 10:15	29	15	3	1	0	0	38	1.37
10:15 - 10:30	72	35	9	1	0	0	117	1.48
Subtotal NBL	936	257	63	35	7	7	1,305	1.42
Subtotal SBL	645	231	60	20	6	3	965	1.47
Total Both Directions	1,581	488	123	55	13	10	2,270	1.45

APPENDIX D (cont.)

NORTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
<u>May 17, 1977, P.M.</u>								
1:00 - 1:15	60	31	8	1	0	1	101	1.54
1:15 - 1:30	67	27	11	4	1	1	111	1.63
1:30 - 1:45	53	17	4	0	0	0	74	1.34
1:45 - 2:00	34	18	4	1	0	0	57	1.51
2:00 - 2:15	53	27	10	4	2	1	97	1.74
2:15 - 2:30	65	25	6	2	1	0	99	1.47
2:30 - 2:45	65	16	2	4	1	0	88	1.41
2:45 - 3:00	54	24	4	4	0	1	87	1.56
3:00 - 3:15	64	34	6	3	0	1	108	1.56
3:15 - 3:30	90	22	8	1	0	8	129	1.63
3:30 - 3:45	81	45	11	7	1	9	154	1.89
3:45 - 4:00	48	14	2	0	2	0	66	1.39
4:00 - 4:15	76	37	11	6	1	2	133	1.68
4:15 - 4:30	68	38	9	1	1	3	120	1.65
4:30 - 4:45	67	27	9	5	0	0	108	1.56
4:45 - 5:00	63	31	9	11	1	3	118	1.86
5:00 - 5:15	37	4	12	5	0	0	58	1.74
5:15 - 5:30	52	24	5	10	1	6	98	2.00
5:30 - 5:45	59	19	12	2	1	3	96	1.71
5:45 - 6:00	86	29	8	8	1	2	134	1.62
Subtotal	1,242	509	151	79	14	41	2,036	1.64
Total Both Directions	2,651	1,092	321	169	52	224	4,509	1.79

APPENDIX D (cont.)

SOUTHBOUND LANE								
Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
<u>May 17, 1977 P. M.</u>								
1:00 - 1:15	53	23	4	4	0	0	84	1.51
1:15 - 1:30	44	20	6	1	0	1	72	1.56
1:30 - 1:45	43	28	6	3	2	0	82	1.70
1:45 - 2:00	53	30	6	3	1	0	93	1.59
2:00 - 2:15	68	17	10	3	1	0	99	1.50
2:15 - 2:30	64	35	7	2	0	0	108	1.51
2:30 - 2:45	58	34	6	2	1	0	101	1.55
2:45 - 3:00	69	23	7	2	2	0	103	1.50
3:00 - 3:15	62	26	6	3	0	4	101	1.66
3:15 - 3:30	72	27	7	4	2	2	114	1.62
3:30 - 3:45	106	38	7	6	3	2	162	1.57
3:45 - 4:00	101	36	7	6	0	1	151	1.48
4:00 - 4:15	104	27	14	4	1	6	156	1.65
4:15 - 4:30	45	28	6	1	5	28	113	2.80
4:30 - 4:45	39	22	11	9	8	62	151	3.74
4:45 - 5:00	45	23	9	11	4	38	130	3.15
5:00 - 5:15	101	45	20	14	7	25	212	2.32
5:15 - 5:30	88	35	13	4	0	7	147	1.73
5:30 - 5:45	100	35	7	5	1	3	151	1.55
5:45 - 6:00	94	31	11	3	0	4	143	1.57
Subtotal	1,409	583	170	90	38	183	2,473	1.91

APPENDIX D (cont.)

NORTHBOUND LANE								
Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
<u>May 18, 1977, A.M.</u>								
7:00 - 7:15	104	25	9	1	0	0	139	1.33
7:15 - 7:30	83	25	5	2	2	0	117	1.42
7:30 - 7:45	152	26	17	14	4	0	213	1.55
7:45 - 8:00	85	20	1	4	0	0	110	1.31
8:00 - 8:15	81	10	3	2	1	1	98	1.32
8:15 - 8:30	78	18	8	3	0	2	109	1.49
8:30 - 8:45	62	13	5	2	0	0	82	1.35
8:45 - 9:00	67	26	3	1	0	1	98	1.41
9:00 - 9:15	49	10	6	1	0	2	68	1.51
9:15 - 9:30	69	30	11	1	0	0	111	1.50
9:30 - 9:45	37	14	7	0	0	2	60	1.63
9:45 - 10:00	67	35	12	4	0	0	118	1.60
10:00 - 10:15	45	20	6	5	0	1	77	1.68
10:15 - 10:30	47	24	6	1	0	0	78	1.50
10:30 - 10:45	48	22	11	3	1	0	85	1.67
10:45 - 11:00	39	25	6	1	1	0	72	1.61
Subtotal	1,113	343	116	45	9	9	1,635	1.48
Total Both Directions	1,981	661	207	88	18	15	2,970	1.50

APPENDIX D (cont.)

SOUTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
<u>May 18, 1977, A. M.</u>								
7:00 - 7:15	81	28	10	3	0	0	122	1.47
7:15 - 7:30	89	38	8	8	3	3	149	1.70
7:30 - 7:45	85	13	4	5	2	1	110	1.44
7:45 - 8:00	49	10	5	4	0	0	68	1.47
8:00 - 8:15	55	12	8	2	0	0	77	1.44
8:15 - 8:30	51	28	3	4	0	0	86	1.53
8:30 - 8:45	50	26	2	3	0	1	82	1.54
8:45 - 9:00	55	24	5	2	0	1	87	1.52
9:00 - 9:15	44	18	11	3	0	0	76	1.64
9:14 - 9:30	46	14	7	1	0	0	68	1.46
9:30 - 9:45	39	10	6	1	0	0	56	1.45
9:45 - 10:00	51	8	3	0	0	0	62	1.22
10:00 - 10:15	48	23	3	6	0	0	80	1.59
10:15 - 10:30	33	25	5	1	1	0	65	1.65
10:30 - 10:45	40	20	6	0	1	0	67	1.54
10:45 - 11:00	52	21	5	0	2	0	80	1.49
Subtotal	868	318	91	43	9	6	1,335	1.52

APPENDIX E
TRIP TABLES - BEFORE PERIOD

Zones	Destination Zone													Total	
	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	22.		
1.	0	1	0	1	3	3	0	0	0	8	1	1	4	22	
	0	4.5	0	4.5	13.6	13.6	0	0	0	36.4	4.5	4.5	18.2	3.6	
2.	0	1	1	3	0	6	0	0	2	8	0	1	2	24	
	0	4.2	4.2	12.5	0	25.0	0	0	8.3	33.3	0	4.2	8.3	4.0	
3.	4	6	10	17	1	23	0	0	16	39	1	3	9	129	
	3.1	4.7	7.8	13.2	.8	17.8	0	0	12.4	30.2	.8	2.3	7.0	21.3	
4.	10	8	7	33	3	57	1	1	31	52	10	15	17	245	
	4.1	3.3	2.9	13.5	1.2	23.3	.4	.4	12.7	21.2	4.1	6.1	6.9	40.4	
5.	0	3	6	16	3	30	0	0	10	30	6	4	8	116	
	0	2.6	5.2	13.8	2.6	25.9	0	0	8.6	25.9	5.2	3.4	6.9	19.1	
6.	0	0	0	0	0	1	0	0	0	5	0	1	0	7	
	0	0	0	0	0	14.3	0	0	0	71.4	0	14.3	0	1.2	
7.	0	2	0	0	2	2	0	0	4	14	1	1	3	29	
	0	6.9	0	0	6.9	6.9	0	0	13.8	48.3	3.4	3.4	10.3	4.8	
8.	0	0	0	0	1	1	0	0	3	11	1	0	1	18	
	0	0	0	0	5.6	5.6	0	0	16.7	61.1	5.6	0	5.6	3.0	
23.	0	0	0	2	0	1	0	0	0	6	1	0	6	16	
	0	0	0	12.5	0	6.3	0	0	0	37.5	6.3	0	37.5	2.6	
Total	14	21	24	72	13	124	1	1	66	173	21	26	50	606	
	2.3	3.5	4.0	11.9	2.1	20.5	.2	.2	10.9	28.5	3.5	4.3	8.3	100.0	

Origin Zone

11

0852

TRIP TABLES - BEFORE PERIOD

Zones	Destination Zone									Total	
	1.	2.	3.	4.	5.	6.	7.	8.	23.		
Origin Zone	9.	0	0	5	6	0	0	0	0	0	11
		0	0	45.5	54.5	0	0	0	0	0	1.7
	10.	0	0	9	5	1	0	1	0	1	17
		0	0	52.9	29.4	5.9	0	5.9	0	5.9	2.6
	11.	0	1	3	17	2	0	0	0	0	23
		0	4.3	13.0	73.9	8.7	0	0	0	0	3.5
	12.	3	5	17	48	3	1	0	2	0	79
		3.8	6.3	21.5	60.8	3.8	1.3	0	2.5	0	12.1
	13.	0	0	1	4	2	1	0	3	0	11
		0	0	9.1	36.4	18.2	9.1	0	27.3	0	1.7
	14.	2	3	41	90	14	1	2	1	1	155
		1.3	1.9	26.5	58.1	9.0	.6	1.3	.6	.6	23.7
16.	0	0	1	0	0	0	0	0	0	1	
	0	0	100.0	0	0	0	0	0	0	.2	
17.	2	3	18	40	6	0	1	1	0	71	
	2.8	4.2	25.4	56.3	8.5	0	1.4	1.4	0	10.9	
18.	6	9	53	74	16	5	8	15	9	195	
	3.1	4.6	27.2	37.9	8.2	2.6	4.1	7.7	4.6	29.8	
19.	1	1	6	13	0	0	1	1	0	23	
	4.3	4.3	26.1	56.5	0	0	4.3	4.3	0	3.5	
20.	4	1	5	12	2	1	5	0	0	30	
	13.3	3.3	16.7	40.0	6.7	3.3	16.7	0	0	4.6	
21.	2	0	0	2	0	1	0	0	0	5	
	40.0	0	0	40.0	0	20.0	0	0	0	.8	
22.	0	1	9	14	2	0	2	1	3	32	
	0	3.1	28.1	43.8	6.3	0	6.3	3.1	9.4	4.9	
Total	20	24	168	325	48	10	20	24	14	653	
	3.1	3.7	25.7	49.7	7.3	1.5	3.1	3.7	2.1	100.0	

APPENDIX E (cont.)

TRIP TABLES - AFTER PERIOD

Zones	Destination Zone												Total		
	9.	10.	11.	12.	13.	14.	16.	17.	18.	19.	20.	21.		22.	
1.	0	0	1	1	0	4	0	2	3	0	0	0	0	1	12
	0	0	8.3	8.3	0	33.3	0	16.7	25.0	0	0	0	0	8.3	3.0
2.	0	0	0	2	0	3	0	1	3	0	0	0	0	0	10
	0	0	0	20.0	0	30.0	0	10.0	30.0	0	0	0	0	0	2.5
3.	0	2	4	10	3	20	0	16	33	1	6	0	0	6	101
	0	2.0	4.0	9.9	3.0	19.8	0	15.8	32.7	1.0	5.9	0	0	5.9	25.6
4.	4	2	6	25	2	35	1	28	36	8	5	1	7	161	
	2.5	1.2	3.7	16.1	1.2	21.7	.6	17.4	22.4	5.0	3.1	.6	4.3	40.9	
5.	0	2	2	7	1	19	1	4	16	1	1	0	7	61	
	0	3.3	3.3	11.5	1.6	31.1	1.6	6.6	26.2	1.6	1.6	0	11.5	15.5	
6.	0	0	0	0	0	1	0	0	0	1	1	0	1	4	
	0	0	0	0	0	25.0	0	0	0	25.0	25.0	0	25.0	1.0	
7.	0	0	0	0	1	2	0	2	8	1	1	0	2	17	
	0	0	0	0	5.9	11.8	0	11.8	47.1	5.9	5.9	0	11.8	4.3	
8.	0	0	0	0	2	1	0	2	7	0	0	0	1	13	
	0	0	0	0	15.4	7.7	0	15.4	53.8	0	0	0	7.7	3.3	
23.	0	0	0	1	0	2	0	2	7	2	0	1	0	15	
	0	0	0	6.7	0	13.3	0	13.3	46.7	13.3	0	6.7	0	3.8	
Total	4	6	13	47	9	87	2	57	113	14	15	2	25	394	
	1.0	1.5	3.3	11.9	2.3	22.1	.5	14.5	28.7	3.6	3.8	.5	6.3	100.0	

0854

TRIP TABLES - AFTER PERIOD

Zones		Destination Zone									Total
		1.	2.	3.	4.	5.	6.	7.	8.	23.	
Origin Zone	9.	0	0	4	3	2	0	0	0	0	9
		0	0	44.4	33.3	22.2	0	0	0	0	2.4
	10.	0	0	0	1	1	1	0	0	0	3
		0	0	0	33.3	33.3	33.3	0	0	0	.8
	11.	0	0	3	5	3	0	0	0	0	11
		0	0	27.3	45.5	27.3	0	0	0	0	2.9
	12.	0	3	9	19	15	0	1	0	0	47
		0	6.3	18.8	39.6	31.3	0	2.1	0	0	12.7
	13.	0	0	1	4	7	0	1	1	0	14
		0	0	7.1	28.6	50.0	0	7.1	7.1	0	3.7
	14.	3	2	32	23	23	0	3	0	0	86
		3.5	2.3	37.2	26.7	26.7	0	3.5	0	0	22.7
15.	0	0	0	1	0	0	0	0	0	1	
	0	0	0	100.0	0	0	0	0	0	.3	
17.	3	1	16	24	9	1	1	1	1	57	
	5.3	1.8	28.1	42.1	15.8	1.8	1.8	1.8	1.8	15.0	
18.	3	3	33	20	28	1	6	9	9	112	
	2.7	2.7	29.5	17.9	25.0	.9	5.4	8.0	8.0	29.6	
19.	0	1	5	4	4	0	2	1	0	17	
	0	5.9	29.4	23.5	23.5	0	11.8	5.9	0	4.5	
20.	0	0	3	1	1	0	0	1	1	7	
	0	0	42.9	14.3	14.3	0	0	14.3	14.3	1.8	
21.	0	0	0	0	0	0	0	1	0	1	
	0	0	0	0	0	0	0	100.0	0	.3	
22.	1	0	8	0	3	0	0	0	1	13	
	7.7	0	61.5	0	23.1	0	0	0	7.7	3.4	
Total		10	10	114	105	96	3	14	14	12	378
		2.6	2.6	30.1	27.7	25.3	.8	3.7	3.7	3.2	100.0