IMPACT OF REMOVAL OF TOLLS ON TRAVEL IN TIDEWATER VIRGINIA

Volume I — Hampton Roads Bridge-Tunnel

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

Academic economists have written and spoken for the past two decades about utilizing 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 an alternative 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 first volume presenting the findings for the Hampton Roads facility. The results for the James River Bridge and the Coleman Bridge are reported in Volumes II and III, respectively.

ABSTRACT

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

Before and after questionnaire surveys were utilized to gather data from the motorists using the facility. Information from mechanical and manual volume counts and telephone contacts with many officials from local governments, retail associations, real estate agencies, etc. supplemented the questionnaire data.

It was concluded that the tolls had been a barrier to travel across Hampton Roads. After the tolls were removed traffic volumes increased by 41%, which was a 33.3% increase over the volumes that would have been expected had the tolls not been lifted. The increase in the percentage of trucks using the facility during the after period indicated increased trade and services in the region. The vehicular occupancy rate decreased and individuals made trips across the facility more frequently after the tolls were removed than they did when the tolls were in force. The percentage of nonessential trips, such as those for shopping, recreation, and social activity, increased after the tolls were removed. Young people (less than 21 years), 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 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. As a result, the tolls have acted to prevent the Hampton Roads region from achieving its full economic and social potential. Figure 1 shows the highway network in the region and the location of facilities carrying tolls prior to June 1976. Although the region is composed of approximately one million persons (1970 census), the opportunities for its residents and businessmen are like those found in metropolitan areas of half its size.

An indication of the transportation constraint created by Hampton Roads and the toll charges was revealed in the comprehensive transportation studies conducted in the 1960's.[1,2] The traffic within the region, as measured by origin-destination studies, was approximately 1,300,000 vehicle trips on an average day. These trips were made for a variety of purposes and were generated by the residents and businesses of the jurisdictions within the region. Of the total vehicular trips only 18,474 (1.4%) were crossings of the Hampton Roads channel — 77% being by automobiles and 23% by trucks. In addition, it was found that the average occupancy rate for the automobiles making the crossing was 2.40 persons. This occupancy rate was much higher than the region-wide average and was an indication of the barrier imposed by the tolls.

On June 3, 1976, three of the most expensive tolls (Hampton Roads Bridge-Tunnel, the James River Bridge and the Coleman Bridge) were removed. The anticipated impacts of the removal of the tolls upon travel activity were partially predicted in the report entitled "The Hampton Roads Joint Transportation Study."[3] 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.

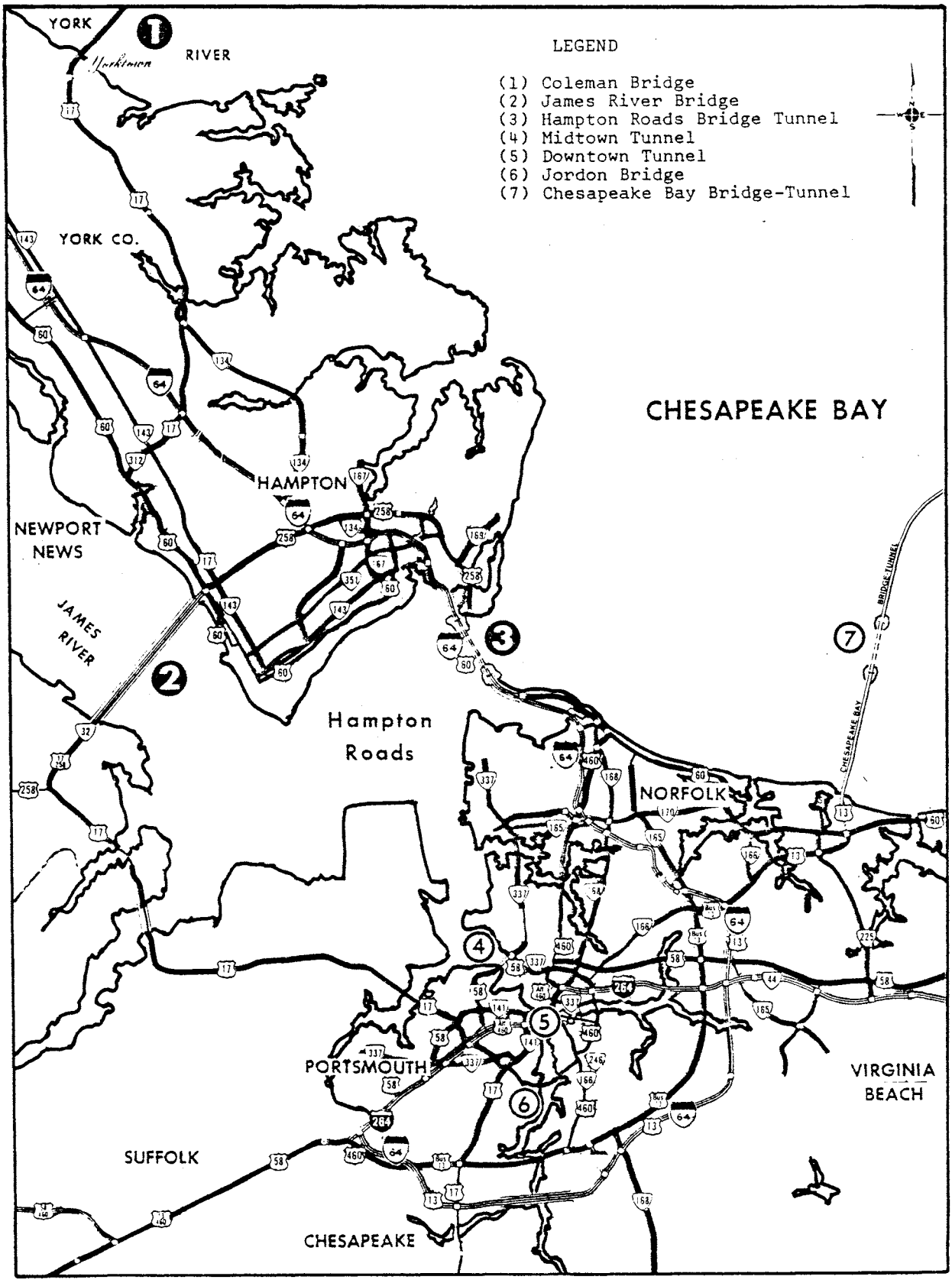

Figure 1. Existing highways and toll facilities.

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, as well as an increase in the number of vehicles crossing Hampton Roads. On the other hand, greater tolls had the impact of decreasing the rate of population and economic growth and, thus, vehicular travel.

PURPOSE AND SCOPE

Although studies have reported the anticipated impacts of changes in tolls upon traffic parameters and socioeconomic activity,[4,5] 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 Hampton Roads Bridge-Tunnel (Interstate Route 64 in Norfolk and Hampton) 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 Hampton Roads 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. Furthermore, the effects of the increased vehicular capacity at the Hampton Roads Bridge-Tunnel crossing afforded by the new parallel facility were not considered in this study, because the after data were collected during the time the old facility was closed for maintenance and all traffic was utilizing the new facility under two-way traffic conditions.

HISTORY

In the early 1950's traffic was accommodated across Hampton Roads by ferry lines operating between Pine Beach in Norfolk and Boat Harbor in Newport News and Willoughby in Norfolk and Old Point in Hampton. These ferry lines were replaced in 1957 by a bridge-tunnel structure financed by a bond issue. The structure, 5.47 km (3.4 mi.) in length, was constructed at a cost of $62 million and connected the cities of Hampton and Norfolk. 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.

Table 1

1976 Tolls for Hampton Roads Bridge-Tunnel
(one-way trip)

Type of Vehicle	Toll
Automobile	
Cash	$1.25
Commuter Ticket (Sold in groups of 12)	0.75
Commercial	
2 ton or less	
2 axles	1.50
3 axles	1.75
2 ton or more	
2 axles	1.75
3 axles	2.25
Tractor Trailer	
3 axles	2.50
4 axles	3.00
5 axles	3.50

In 1975, the 8,774,271 vehicles using the Bridge-Tunnel paid toll revenues exceeding $10 million. The traffic demand frequently exceeded the capacity of the two-lane facility, with resulting traffic jams, particularly during commuter peak periods and holiday weekends.

A second tunnel was proposed and subsequently constructed as a part of Interstate Route 64. Largely financed by the federal government, the $96 million project was completed at approximately the same time the bonds for the original tunnel were paid off. Consequently,

on June 3, 1976, the entire facility was opened to traffic toll free. This was the first time that the residents of the area were afforded a free crossing of the channel. The removal of tolls meant that the individuals who by necessity had to use the Bridge-Tunnel 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 almost $400 per year. For those who crossed eight times per week, but who did not use the commuter ticket, the savings were approximately $520 per year.

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-Tunnel, 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, the monthly trends during the before and after periods were established and compared.

The methodology employed by the study involved mechanical and manual volume counts, a before questionnaire survey, an after questionnaire survey, and telephone contacts with many officials from local governments, retail associations and firms, and real estate agencies. The results of the data analysis are discussed in the following sections.

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 Hampton Roads Bridge-Tunnel 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 composition by type of vehicle. Toll Facilities revenue data also reflected the commuter ticket usage before the tolls were removed.

After the removal of tolls, the Toll Facilities Division continued to secure vehicular volume counts with mechanical recorders; these data were made available to the researchers. In addition, manual volume counts were made by Council personnel to determine the composition of traffic and the 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-Tunnel. The questionnaire requested information about the type of vehicle, origin and destination of trip, trip purpose, vehicle occupancy rate, respondent characteristics, aspects of latent demand, and whether or not the commuter ticket was used to pay the toll.

Of the 24,000 vehicles which daily crossed the facility, approximately one-third (6,995) were sampled on May 18, 1976. 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 absence of tolls, an after questionnaire survey was conducted. This survey was conducted during the time when the old tunnel was closed for maintenance and all traffic was utilizing the new facility under two-way traffic conditions. Consequently, the capacity of the Bridge-Tunnel was essentially the same during the before and after surveys.

The questionnaire developed for the after survey was similar to the one used previously; however, it contained additional questions concerning participation in carpools and changes in travel since the tolls were removed. (The questionnaire is in Appendix B.) Because of the congestion and hazardous conditions roadside surveys create on interstate highways, that method of distributing the questionnaires was not 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 Vehicle files for names and addresses. Those motorists in the sample (3,526) were mailed a questionnaire with a letter of explanation requesting that they execute and return it by mail. As in the before survey, the respondent had only to refold the questionnaire and drop it in the mail. While the license plate survey is an effective procedure for securing travel information; it is limited to the vehicles licensed in Virginia, since the Division of Motor Vehicles does not have out-of-state registration information.

Telephone Survey

Officials of several real estate agencies, chambers of commerce, retail merchants associations, department stores, and multiple listing services, were contacted by telephone to seek information relative to resident and employment relocations which may be attributed to the removal of tolls on the Hampton Roads Bridge-Tunnel. While all of the agencies expressed an interest in the study only one, the Penisula Apartment Council, was able to provide data pertinent to the study.

SURVEY RESULTS

Characteristics of the Motorists

Of the 6,995 people surveyed at Hampton Roads prior to the removal of the tolls, 2,008 (29%) responded by returning the questionnaire. Of these respondents, 79% were male. In the after survey, 1,384 (39%) people in the sample population returned the questionnaire; however, the percentage of male motorists responding dropped to 72%.

Table 2 shows the distribution of age groups before and after the tolls were removed. The 21-39 year age group accounted for 54% of the before sample and the 40-65 year group made up 39% of the total. In the after period the number of people in the 21-39 year group decreased while the younger (under 21) and older (over 65) groups made more trips than before the tolls were removed. A review of Table 3 also reveals that these age groups increased their travels. The percentage of retired people crossing the facility more than doubled after the tolls were removed while there was a drastic increase in the group designated "other," made up mostly of students.

Other occupational groups which increased their travels during the after period were unskilled workers and homemakers. 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 Bridge-Tunnel.

It was hypothesized that the number of people in the lower income group would increase their travels after the tolls were removed, and thus constitute a larger percentage of the respondents than they did in the before survey. However, this did not appear to be the case, as 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 2

Age Distributions of Respondents

Age	Percentage of Respondents	
	Before	After
Under 21	3.1	5.2
21-39	53.8	45.5
40-65	39.2	40.1
Over 65	2.4	5.0
No response	1.5	4.2

Table 3

Occupation Distributions of Respondents

Occupation	Percentage of Respondents	
	Before	After
Professional	30.0	26.8
Business Manager	28.8	22.5
Clerical	4.0	3.7
Craftsman	9.7	9.7
Operator	9.0	2.9
Unskilled	2.3	4.8
Homemaker	3.7	5.8
Retired	2.8	6.8
Other	9.7	17.0

Table 4

Income Distributions of Respondents

Income (Dollars)	Percentage of Respondents	
	Before	After
< 9,000	12.6	12.5
9,001 - 12,000	12.6	13.3
12,001 - 15,000	12.0	13.7
15,001 - 25,000	31.7	30.0
25,001 - 30,000	11.6	8.8
>30,000	12.7	11.5
No response	6.8	10.2

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.

Prior to the removal of tolls, 24-hour counts showed that approximately 40.0% of the traffic used reduced fare commuter tickets. Of the respondents surveyed during the 12-hour before period, 59.5% used a commuter ticket costing $0.75 for each one-way trip. The remaining respondents traveling in passenger cars and pickups paid $1.25 per one-way trip, while the truckers paid the appropriate truck rates. Because the survey period included the peak morning and afternoon hours for travel to and from work, it is understandable that a higher percentage of those surveyed used the ticket than did the population in general.

Cross tabulations indicated that income was significantly related to the use of commuter tickets (purchased in groups of 12 for $9.00). While it was hypothesized that respondents in high income groups might have little tendency to purchase commuter tickets because the cost of tolls would represent a small portion of their budget, this expectation was not supported. 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, business managers, professionals, and clerical workers were much more likely to use the commuter ticket than were craftsman, operators, and unskilled laborers. Among travelers whose trips originated at school, a large majority (70.0%) used commuter tickets. Those whose trips originated in shopping areas, on the other hand, did not exhibit a strong tendency to use commuter tickets. The relative infrequency of shopping trips was initially thought to be the controlling influence here; however, the numbers of school and shopping trips were almost identical. The significant difference may be explained by noting that the regularity of the trips rather than the frequency was the likely determining factor in the decision to use tickets.

With respect to vehicle occupancy rates and commuter ticket usage, a significant relationship was found; viz., drivers alone in their vehicles were more likely to use the commuter ticket than were drivers with one or two passengers. Only the drivers of vehicles carrying four passengers used the ticket as extensively as did the lone drivers. Intuitively, one would surmise a relatively higher occupancy rate 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 harbor as frequently as noncommuters, they would further reduce the cost of travel to and from work by

purchasing a commuter ticket. However, no such relationship was found. While discussion in later sections may provide insight into this finding, it is sufficient at this point to suggest that the level of toll (even $1.25 per trip) might not significantly enter into a commuter's decision, because the toll represents a relatively small portion of the total cost of an essential work trip.

Changes in Traffic Volumes

One of the most noticeable immediate effects of the removal of the tolls on the Hampton Roads Bridge-Tunnel 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 at a fairly stable rate for several years prior to the removal of tolls, except for a brief period during the energy crisis when travel in Tidewater area, as well as in the nation was affected. As shown in Figure 2 the ADT in 1969 was approximately 15,600 vehicles. Through 1975, volumes increased at an average annual rate of 7.7%, to bring the 1975 ADT in excess of 24,000 vehicles.

It can be concluded from the data that the changes in traffic volume for the Hampton Roads Bridge-Tunnel were predictable and rather moderate prior to the removal of tolls. The traffic trend shown in Figure 2 indicates that the ADT for 1976 would have been approximately 26,000 vehicles had the tolls not been removed. However, the graph shows a sharp increase in the total volumes for 1976, even though the tolls were in effect for five months during that year. The 1976 ADT was 30,420, a 30.0% increase over the 1975 volume and a 22.3% increase over the 1976 ADT that would have been expected had the tolls not been lifted.

The traffic volumes have been monitored on a daily basis 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 Appendix C. Figure 3 summarizes that data and shows the variations in the ADT over the 12 months preceding and subsequent to the removal of tolls. The total number of vehicles crossing the facility during the before period was 9,075,299 as compared to 12,801,165 in the after period. The increase was 41.0%, or approximately 33.3% greater than the expected historical growth.

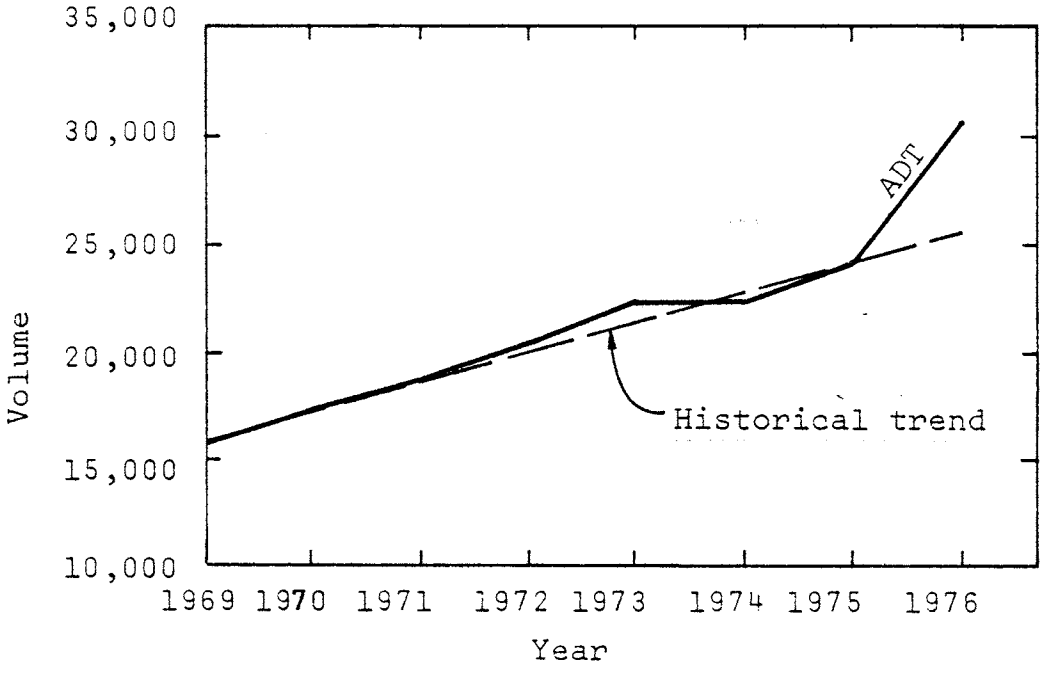

Figure 2. Average daily traffic volumes at Hampton Roads.

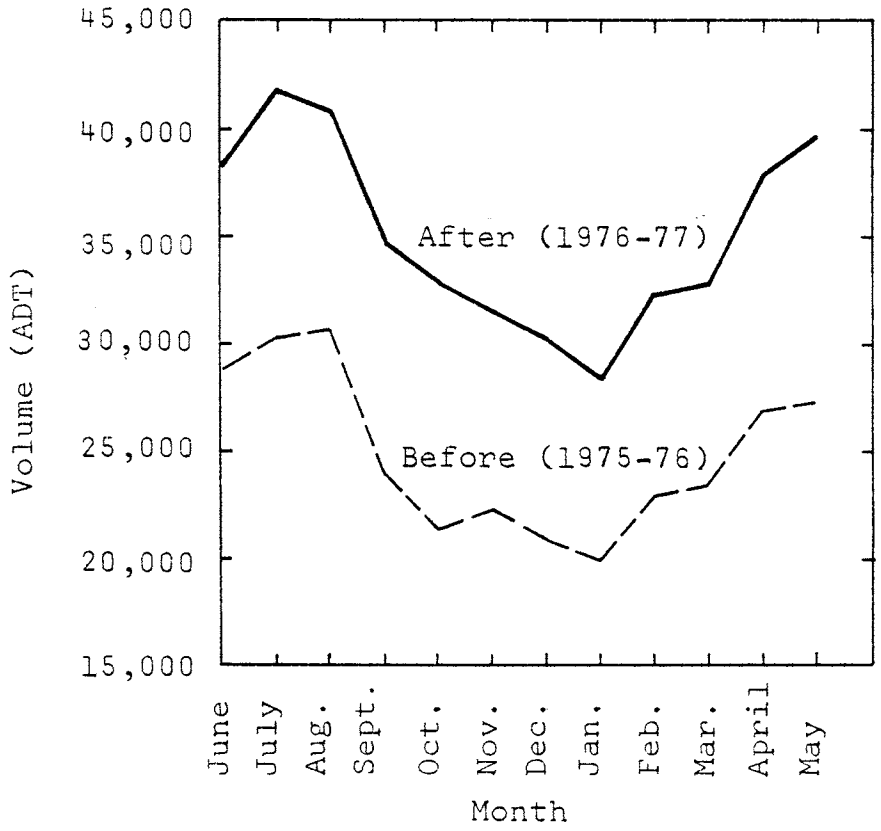

Figure 3. Monthly traffic volumes at Hampton Roads before and after removal of tolls.

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 from August through December. Quite apparently, after the tolls were removed an immediate and drastic increase occurred in travel across the harbor. Again referring to Figure 3, the curve for the after period indicates that the increase for the typically peak months of July and August was approximately 10,500 vehicles per day. The traffic growth for the typically low volume month, January, was about 8,500 vehicles per day.

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 upper graph shows how the 1971 ADT for the month of July compares with the 1976 ADT for the month of July, etc. The average rate of increase in the ADT for each of the months was a fairly moderate 7.0% during the period between 1971 and the removal of tolls in June 1976. The trends for the rates of increase for the three months were similar between 1971 through 1975; however, the similarity does not extend past the first of 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 31,000 vehicles; the actual ADT was 41,784 vehicles.

The above data indicate that after the tolls were lifted there was a drastic increase in the number of vehicles using the Hampton Roads Bridge-Tunnel. The greatest increase in traffic occurred during the first month after the tolls were lifted, and since that time only slight monthly volume increases, approximately equal to the historical growth, have been observed.

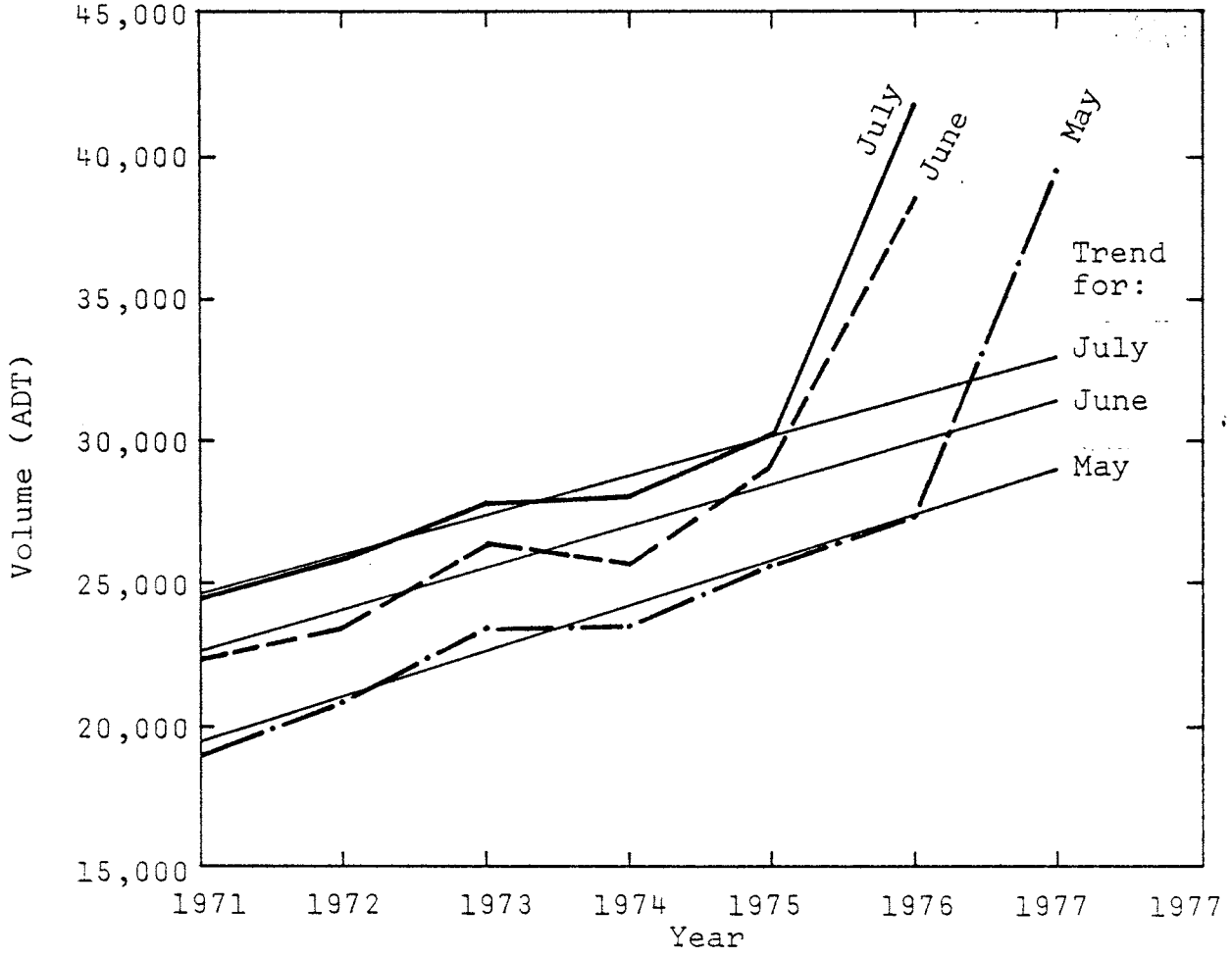

Figure 4. Monthly travel trends at Hampton Roads.

Changes in Traffic Composition

Traffic composition was important in this study for two reasons. First, it was used to detect changes, if any, in the types of vehicles crossing Hampton Roads after the tolls were removed. As previously mentioned, the tolls were considered as a barrier to trade within the region and data were required to determine if the truck traffic and therefore trade had changed. Second, the information was helpful to check the sampled population used in the questionnaire surveys against the general population using the facility.

After the tolls were removed, periodic manual classification counts were secured and the composition of traffic was recorded. This manual classification information is presented in Appendix D 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 86.5% of the ADT, they currently make up 76.5%. Pickups and vans have constituted approximately 12.0% of the total volume since the tolls were lifted; however, this increase may not be solely attributed to the removal of tolls because of the increasing popularity of the vehicles for recreational and commuter transportation. Furthermore, several vanpool programs have been initiated by individuals and private firms since June 1976, the date of the removal of tolls.

Table 5

Traffic Composition for Hampton Roads Bridge-Tunnel
(In Percentages)

	Type of Vehicle					
			Trucks			
Period	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other
1975	86.5	8.3	2.3	0.1	2.7	0.1
July 1976	78.4	13.0	3.3	0.9	3.4	1.0
August 1976	79.1	12.1	3.7	0.6	3.4	1.1
September 1976	78.2	11.9	4.2	0.6	4.3	0.8
October 1976	78.0	11.9	4.0	0.4	5.1	0.6
March 1977	77.4	12.9	3.7	0.6	4.6	0.8
May 1977	76.5	13.3	3.9	6.7	4.4	1.2

Table 5 shows that the percentages of trucks in the total volume, particularly the percentages of light 2-axle delivery and tractor-trailer trucks, have increased since the tolls were lifted. This finding seems to imply some type of generated economic activity as a result of the free crossing of the Bridge-Tunnel. This implication is consistent with the comments made by many of the respondents to the questionnaires. They noted that they were going to expand their businesses across the channel after the tolls were removed.

With respect to the types of vehicles sampled in the before questionnaire survey, the data showed that of the 2,008 vehicles involved, 81.7% were passenger cars, 8.3% were pickups and vans, 4.7% were 2-axle trucks, and about 4.0% were tractor-trailers. These statistics compare favorably with the before data (1975) shown in Table 5.

In the after survey, 91.8% of the respondents were traveling in passenger cars, 6.5% in pickups and vans, 1.1% in 2-axle delivery trucks, and approximately 0.1% in tractor-trailer trucks. These statistics do not compare with the actual volume counts obtained in October 1976 as well as those in the before survey. However, in the after survey license plate numbers were recorded and the questionnaires mailed to the owners of the vehicles who, in many cases, may not have been the drivers of the vehicles, particularly of the trucks, and company-owned and rental passenger cars on the day of the survey.

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. 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 only available information is a 1964 statistic of 2.40 persons per automobile crossing the Hampton Roads Bridge-Tunnel.[4] Dash and Vey[4] reported that this occupancy rate was much higher than the region-wide average, and thus indicated that the toll was a travel barrier. Manual counts were made periodically after the tolls were removed and the number of people riding in each vehicle was recorded.

The occupancy data gathered since the removal of the toll, plotted graphically and shown in Figure 5, indicate that occupancy rates declined until January 1977, when an upward trend began. Specifically, in July 1976, one month after the tolls were removed, the occupancy rate was 1.96; however, it had dropped to 1.38 in mid-January. From January the rate increased, and the counts taken in May 1977 revealed that an average of 1.52 persons were traveling in each vehicle. Further data on vehicle occupancy are given in Appendix E.

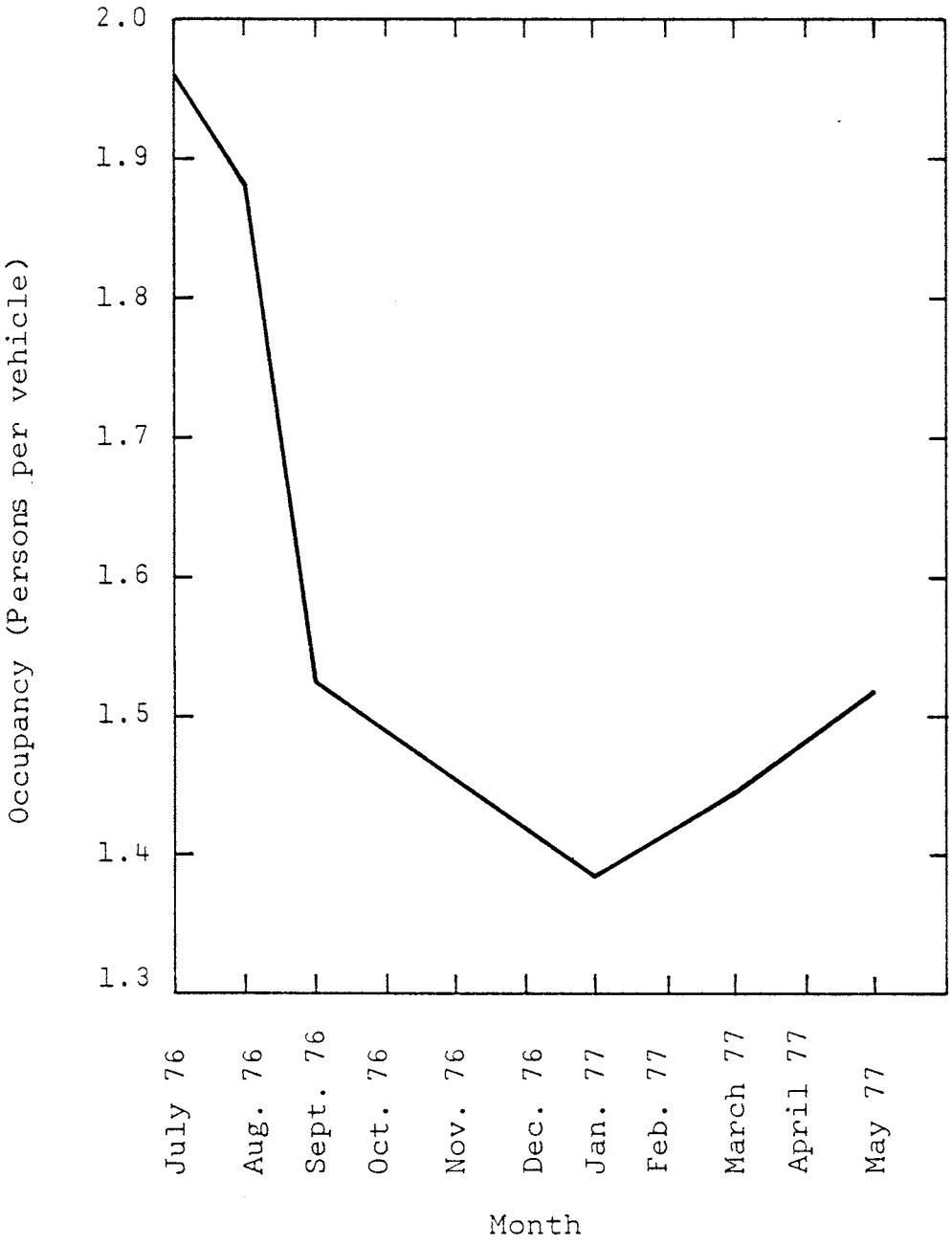

Figure 5. Vehicle occupancy rates after removal of tolls at Hampton Roads.

Without historical trends 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, July through September, under normal travel conditions. Therefore it appears that the removal of tolls probably has had a significant impact upon reducing the occupancy rate of the vehicles crossing Hampton Roads.

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, 12.8% indicated that they carpooled prior to the removal of tolls, while 10.7% said that they continued to use carpools to and from work after the tolls were lifted. The data show that while some motorists stopped riding in carpools after the tolls were lifted, others initiated carpools. Although the absolute number of respondents to the questions was relatively small, 28.0% of those who carpooled prior to removal of tolls indicated that they did not carpool afterwards, while 13.0% of those who did not formerly carpool entered a program. The changes in carpools were not statistically significant, therefore the removal of tolls does not appear to have had a major impact upon the carpooling habits of the motorists using the Bridge-Tunnel. Furthermore, it does not appear that there is a substantial number of carpoolers among motorists who make up the vast increase in travel since the tolls were removed. The propensity to carpool will be reviewed in greater detail in the latter section of the report on 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 1.90 and that for the youngest was 1.64; the 40-65 year age group had a rate of 1.62, and that for the 21-39 year group was 1.52.

The relationship between occupancy rate and income was nonlinear, as shown in Figure 6. The low income group, as expected, had the highest occupancy rate. The rate dropped for middle income groups and then rose for those respondents earning more than $30,000.

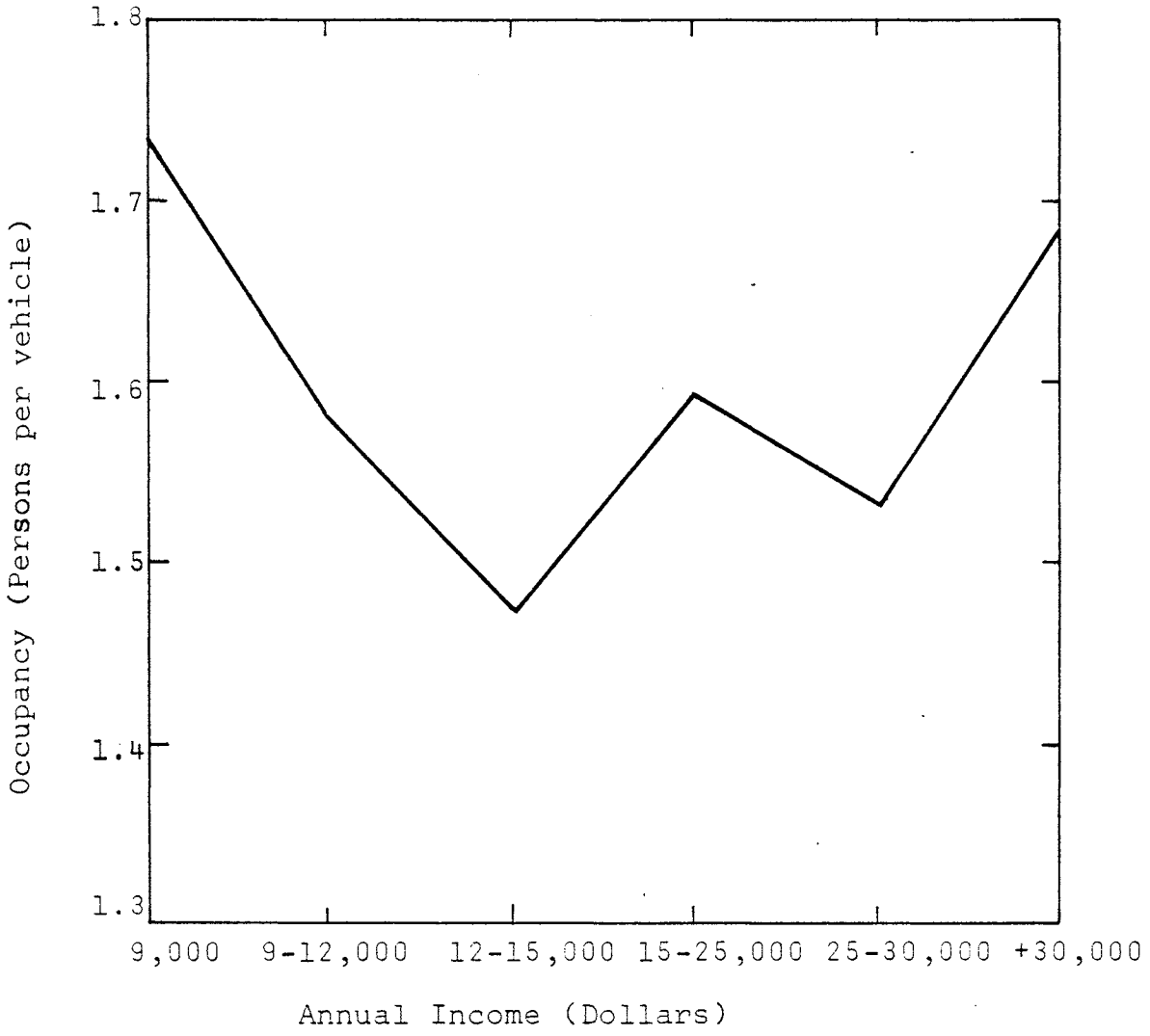

Figure 6. Vehicle occupancy rates and income in after period.

Occupation appeared to have a significant influence on the occupancy rate. From Table 6 it can be seen that students, business managers, and operators had the lowest mean occupancy rates, while homemakers 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 the other types of trips, particularly shopping. In fact, 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.

Table 8 shows the relationship between the occupancy rate and the frequency of the trips made across Hampton Roads. The data are consistent with those presented for trip purpose. The people (commuters) who travel most frequently across the Roads 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 the highest occupancy rate. The rate dropped for 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 work trips, while the trips made in the category designated "other" (recreational, visiting, etc.) were greater in travel time than the work trips.

Table 6

Vehicle Occupancy by Occupation, After Period

Occupation	Occupancy Rate
Professional	1.57
Business Manager	1.41
Clerical	1.53
Craftsman	1.66
Operator	1.43
Unskilled Laborer	1.85
Homemaker	2.06
Retired	1.99
Student	1.40

Table 7

Vehicle Occupancy by Trip Purpose, After Period

Trip Purpose	Occupancy Rate
Origin:	
Home	1.63
Work	1.41
Shopping	2.00
Other (Recreational, school, etc.)	1.71
Destination:	
Home	1.61
Work	1.32
Shopping	1.94
Other (Recreational, school, etc.)	1.75

Table 8

Vehicle Occupancy by Number of Crossings

Number of Crossings	Occupancy Rate
> 10 per week	1.38
4-6 per week	1.48
2 per week	1.53
1 per week	1.68
2 per month	1.93
< 6 per year	2.04

Table 9

Vehicle Occupancy by Trip Time, After Period

Trip Time in Minutes	Occupancy Rate
< 20	2.00
21 - 25	1.59
26 - 35	1.45
36 - 45	1.40
46 - 60	1.52
61 - 75	1.81
> 75	1.81

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 nonwork 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.

Removal of the tolls was hypothesized to have reduced the tendency of people to form carpools. An examination by trip purpose showed a small reduction in the number of respondents who participated in carpools, particularly for the work oriented trip. For shopping trips no significant change was recorded. This information is summarized in Table 12. A brief comment is in order concerning these results. Because of the rather slight reduction 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 tolls, but also of trip length, frequency, and time.

Table 10

Trip Purposes, Before Period
(Percentages in Parentehses)

Origin	Destination					
	Home	Work	School	Shopping	Other	Total
Home	24 (1.2)	480 (24.1)	37 (1.9)	28 (1.4)	258 (13.0)	827 (41.6)
Work	32.2 (16.2)	22.4 (11.3)	3 (0.2)	6 (0.3)	177 (8.9)	732 (36.9)
School	29 (1.6)	3 (0.1)	0 (0.0)	1 (0.0)	1 (0.0)	34 (1.7)
Shopping	20 (1.1)	3 (0.1)	0 (0.0)	1 (0.0)	0 (0.0)	24 (1.2)
Other	172 (8.7)	132 (6.6)	1 (0.0)	0 (0.0)	65 (3.3)	370 (18.6)
Total	567 (28.8)	842 (42.2)	41 (2.1)	36 (1.7)	501 (25.2)	1,987 (100.0)

Table 11

Trip Purposes, After Period
(Percentages in Parentheses)

Origin	Destination					
	Home	Work	School	Shopping	Other	Total
Home	30 (2.2)	234 (17.0)	84 (6.1)	48 (3.5)	225 (16.3)	621 (45.1)
Work	263 (19.1)	88 (6.4)	9 (0.7)	8 (0.6)	48 (3.4)	416 (30.2)
School	55 (4.0)	5 (0.5)	1 (0.0)	0 (0.0)	1 (0.0)	62 (4.5)
Shopping	25 (1.8)	4 (0.3)	0 (0.0)	3 (0.2)	3 (0.2)	35 (2.5)
Other	172 (12.6)	35 (2.5)	5 (0.4)	0 (0.0)	30 (2.2)	242 (17.7)
Total	545 (39.7)	366 (26.7)	99 (7.2)	59 (4.3)	307 (22.1)	1,376 (100.0)

Table 12

Percentage of Carpools by Trip Destination

Destination	Percentage of Carpool	
	Before	After
Home	15.2	13.9
Work	12.8	10.9
School	8.0	9.0
Shopping	5.1	5.1
Other	5.5	4.2

Changes in Travel Patterns

Since there was a high probability that the tolls were a barrier to travel across Hampton Roads, their removal was expected to 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 tolls.

Change in Frequency of Crossings

It has already been established that the removal of the tolls resulted in a drastic increase in the total volume of vehicles crossing the Bridge-Tunnel. 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 3.69. 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 "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.

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 2.4% while the after value was 5.0%. While both males and females made more trips after the tolls were lifted, females drastically increased their travel. Among the female respondents there was a 15.0% increase in the group making more than 10 crossings per week, while the males increased their percentage in this category by only 10.0%.

Table 13

Number of Crossings

Category	Before	After
> 10 per week	28.8	40.0
4 - 6 per week	11.4	16.1
2 per week	8.9	9.4
1 per week	7.7	8.9
2 per month	16.7	13.9
< 6 per year	26.5	11.7

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 demands for trips after the tolls were removed. This expectation was partially supported by the data in that among homemakers the percentage making at least 4 trips per week increased from 6.8% to 17.5%, and among the retired people the percentage making that number of trips more than doubled from 5.4% to 11.7%. The results of cross tabulations between the number of crossings and income, shown in Table 14, also reveals 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 Income in Percentages

Number of Crossings	Annual Income, Dollars											
	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	26.9	41.3	30.8	47.0	30.9	43.4	30.4	39.3	27.9	40.2	19.0	24.5
4 - 6 per week	7.0	10.5	8.8	14.2	9.0	18.0	13.5	18.1	10.7	10.7	13.3	17.0
2 per week	8.2	7.6	8.2	10.4	13.3	12.2	7.5	8.4	9.8	9.8	11.4	13.2
1 per week	7.0	8.7	6.6	6.0	11.2	7.9	4.6	7.5	9.8	13.1	13.3	14.5
2 per month	16.4	12.8	17.0	9.3	14.9	11.1	17.1	13.7	13.9	17.2	20.3	19.5
< 6 per year	32.7	18.6	28.0	12.6	19.7	5.8	25.8	12.0	27.9	8.2	22.2	11.3
No Response	1.8	0.5	0.5	0.5	1.1	1.6	1.2	1.0	0.0	0.8	0.6	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 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 49.8 minutes of travel time. After the tolls were lifted, the travel time averaged 49.3 minutes per trip. Similar results are revealed in Table 15, which shows the relationship between the number of crossings and length of trip.

Table 15

Trips by Average Trip Length

Number of Trips	Average Length, Minutes	
	Before	After
10 per week	41.1	40.0
4 per week	47.9	50.2
2 per week	52.1	52.6
1 per week	59.7	50.1
1 per month	65.3	60.9

It has already been shown that there was a large increase in the number of shopping and recreational trips after the tolls were removed; however, Table 16 shows that there were no significant differences in the lengths of trips made during the before and after periods.

Table 16

Trip Length by Destination

Destination	Average Length of Trips, Minutes	
	Before	After
Home	52	50
Work	46	45
School	47	46
Shopping	44	43
Other (recreational, visiting, etc.)	56	57

Changes in Origins and Destinations of Trips

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

The data show that the largest percentage of total trips originated in zones 15, 25, 3, and 13, respectively, during the before period. After the removal of tolls, most trips were generated in the same zones; however, there was a decrease in the percentage of trips generated west of the study area toward Richmond.

Of the trips generated south of the crossing and traveling in a northerly direction* prior to the removal of tolls, 61.2% were destined for zones 3, 4, 10, and 25. During the after period the same trips comprised 59.1% of the total trips. On the other hand, 78.0% and 76.2% of all the trips generated north of the crossing and traveling south during the before and after periods, respectively, were destined for zones 12, 13, 15, 16, and 17.

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.

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*Although Route 64 is designated as an east-west highway by the Virginia Department of Highways and Transportation, the Hampton Roads Bridge-Tunnel is actually north-south in direction. In this study the north-south designation was used because it was felt that it created less confusion for the motorists responding to the questionnaire surveys.

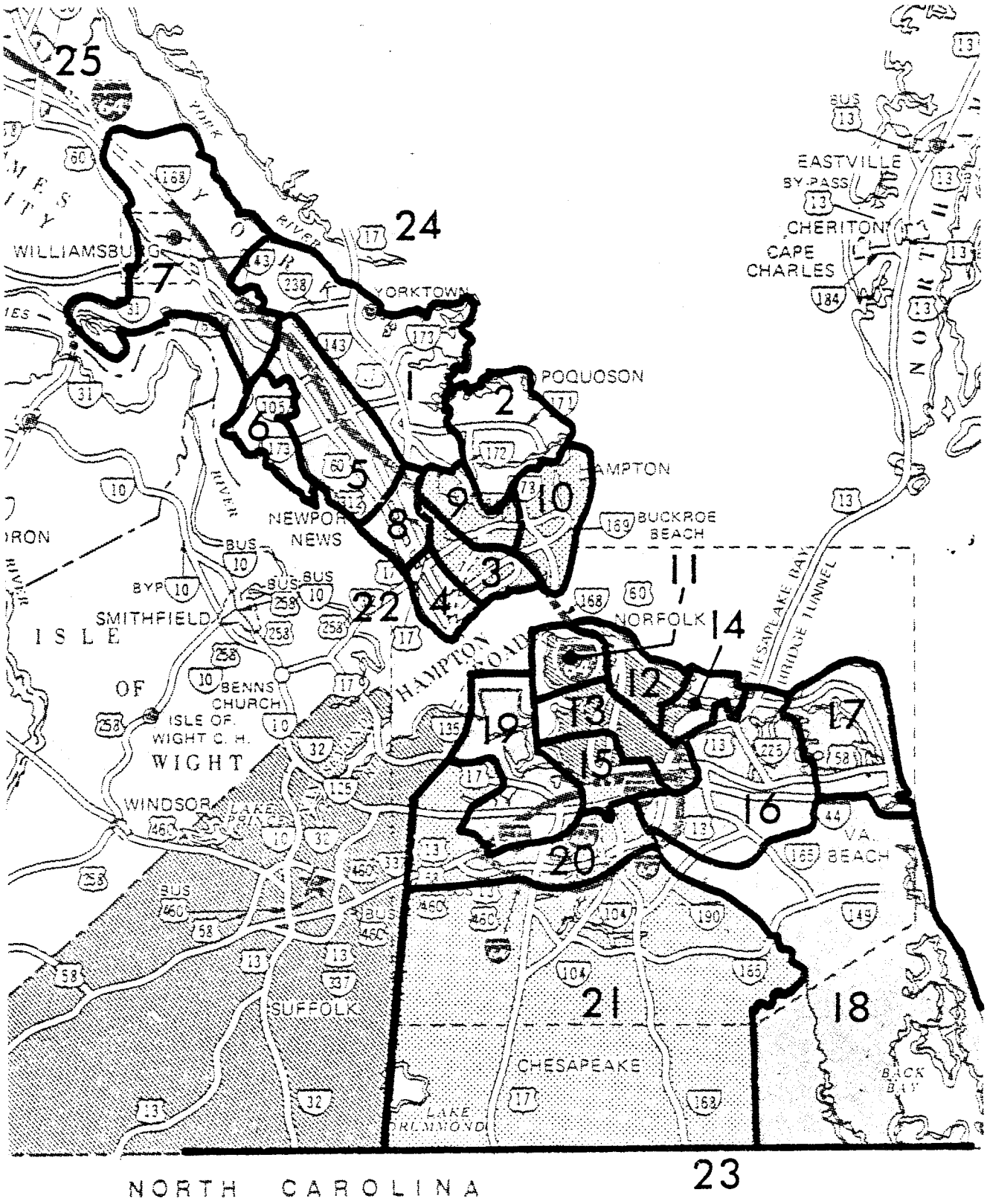

Figure 7. Traffic zones.

Table 17

Traffic Volumes by Zone of Origin and Destination

Zone	Origin				Destination			
	Volume		Relative Freq.		Volume		Relative Freq.	
	Before	After	Before	After	Before	After	Before	After
1	29	23	1.4	1.7	38	23	1.9	1.
2	45	30	2.2	2.2	49	29	2.4	2.
3	164	132	8.2	9.5	205	146	10.2	10.
4	135	88	6.7	6.4	147	79	7.3	5.
5	69	52	3.4	3.8	67	52	3.3	3.
6	11	4	.5	.3	14	4	.7	.
7	65	34	3.2	2.5	70	52	3.5	3.
8	67	45	3.3	3.3	58	51	2.9	3.
9	54	42	2.7	3.0	65	53	3.2	3.
10	104	87	5.2	6.3	123	61	6.1	4.
11	71	63	3.5	4.6	83	37	4.1	2.
12	100	107	5.0	7.7	111	99	5.5	7.
13	178	132	8.9	9.5	166	110	8.3	8.
14	21	12	1.0	.9	18	22	.9	1.
15	229	163	11.4	11.8	252	159	12.6	11.
16	144	91	7.2	6.6	124	92	6.2	6.
17	138	50	6.9	3.6	100	60	5.0	4.
18	49	31	2.4	2.2	45	40	2.2	2.
19	29	6	1.4	.4	8	20	.4	1.
20	33	19	1.6	1.4	26	17	1.3	1.
21	29	15	1.4	1.1	20	12	1.0	.
22	3	3	.1	.2	1	2	.0	.
23	18	11	.9	.8	11	12	.5	.
24	24	28	1.2	2.0	42	23	2.1	1.
25	197	116	9.8	8.4	158	128	7.9	9.
Total	2,006	1,384	100.0	100.0	2,001	1,383	100.0	100.

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, 3.2% 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 55.0% of those who had changed jobs made fewer than 6 trips per year across Hampton Roads in the before period. After changing jobs, 75.0% 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 2.8% 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 numbers of crossings, were tested for their influence on changes in residences. Cross tabulations showed that people who changed residences after the tolls were lifted likely were individuals earning $15,000 per year or less. Further, the data indicate that these individuals made very few trips across the Bridge-Tunnel prior to the removal of tolls. Specifically, 43.0% of those who changed residences made fewer than 6 trips per year across the facility. In the period after their move, 67.0% of this group made 10 or more crossings per week.

Information provided by the Penisula Apartment Council revealed a change in the housing vacancy rate in the Hampton area, thus indicating a change in the demand for housing on the Penisula. Since January 1976 the vacancy rate has decreased by 39.0%. However, the data did not indicate the extent to which the removal of tolls attributed to the decline in the vacancy rate.

CONCLUSIONS

The tolls on the Hampton Roads Bridge-Tunnel were a barrier which prevented many people from traveling across the channel. 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 under 21 years and over 65 years of age to travel across Hampton Roads. 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 making at least four trips per week has increased from 6.8% to 17.5%.

3. Income does not appear to be a factor in the changes that have occurred since the tolls were removed. The low income groups have not changed their demand for trips in a manner significantly different from that of higher income groups.

4. Traffic volume changes resulting from the removal of tolls have been quite pronounced. The total number of vehicles crossing the facility during a 12-month period prior to the removal of tolls was 9,075,299 as compared to 12,801,165 vehicles during the after period. The increase was 41%, or approximately 33.3% 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 there have been only slight monthly volume increases 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. Truck traffic appears to have increased, which might be taken as an indication that the removal of tolls has generated increases in economic activity.

7. After the tolls were removed the occupancy rate declined until January 1977, when an upward trend began. In July 1976 the rate was 1.96; by mid-January it had dropped to 1.38. In May 1977 the rate was 1.52 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 lowest and highest income groups have the greatest occupancy rates while the middle income group has the lowest 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. It is 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 3.69. In the after period the number has increased to an average of 5.2.

14. There have been no significant differences in the lengths of trips in the after period as compared to the before period.

15. The origins and destinations of the trips across Hampton Roads have not been significantly altered by the lifting of tolls.

16. Of the respondents to the study questionnaire, 3.2% have changed jobs or plan to change as a result of the removal of tolls.

17. The removal of the tolls has had some impact upon the places where people live. Of the respondents in the survey, 2.8% indicated that they had either changed residences or intended to change as a result of the lifting of tolls. Furthermore, changes in vacancy rates on the Hampton side of the channel indicate an increase in housing demand there since the tolls have been removed.

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 providing the 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 early drafts of the report; and the technicians and student helpers who assisted in the data collection.

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

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BEFORE STUDY QUESTIONNAIRE

DEPARTMENT OF HIGHWAYS & TRANSPORTATION
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COMMONWEALTH of VIRGINIA

HIGHWAY & TRANSPORTATION RESEARCH COUNCIL

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

BOX 3817 UNIVERSITY STATION
CHARLOTTESVILLE, VIRGINIA 22903

May 18, 1976

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 Hampton Roads Bridge-Tunnel 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.

A HIGHWAY IS AS SAFE AS THE USER MAKES IT

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 64 AT THE HAMPTON ROADS BRIDGE-TUNNEL TOLL PLAZA. YOU WERE TRAVELING TOWARD NORFOLK IN THE SOUTHBOUND 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 Bridge-Tunnel? 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

APPENDIX B

AFTER STUDY QUESTIONNAIRE

0373

COMMONWEALTH of VIRGINIA

HIGHWAY & TRANSPORTATION RESEARCH COUNCIL

BOX 3817 UNIVERSITY STATION
CHARLOTTESVILLE, VIRGINIA 22903

October 18, 1976

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 Hampton Roads Bridge Tunnel on October 18, 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 64 AT THE HAMPTON ROADS BRIDGE TUNNEL DURING THE MORNING OF OCTOBER 15, 1976 TRAVELING TOWARD HAMPTON IN THE NORTHBOUND 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
2. Pickup or Van
3. Two-Axle Truck
4. Three-Axle Truck
5. Tractor-Trailer
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.
2. 16-20 min.
3. 21-25 min.
4. 26-35 min.
5. 36-45 min.
6. 46-60 min.
7. 61-75 min.
8. more than 75 min.

V. How many persons rode with the driver on this trip? (circle one)
1. 0 riders
2. 1 rider
3. 2 riders
4. 3 riders
5. 4 riders
6. 5 riders
7. 6 riders
8. 7 riders
9. 8 riders
10. 9 or more riders

VI. A. About how often do you cross the Hampton Roads Bridge Tunnel? Include both directions; a round trip is 2 crossings. (circle one)
1. 10 or more crossings a week
2. 4-6 crossings a week
3. 2 crossings a week
4. 2 crossings every 2 weeks
5. 2 crossings a month
6. less than 6 a year

B. About how often did you cross the Hampton Roads Bridge Tunnel before the toll was removed? A round trip is 2 crossings. (circle one)
1. 10 or more crossings a week
2. 4-6 crossings a week
3. 2 crossings a week
4. 2 crossings every 2 weeks
5. 2 crossings a month
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
2. $9,000-$12,000
3. $12,001-$15,000
4. $15,001-$25,000
5. $25,001-$30,000
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

DAILY TRAFFIC VOLUMES
HAMPTON ROADS BRIDGE-TUNNEL

Date	1976	1975	Date	1976	1975	Date	1976	1975
6/1	33,029	28,930	7/1	42,302	29,601	8/1	49,999	33,918
6/2	33,029	28,930	7/2	44,662	30,157	8/2	39,101	32,109
6/3	32,417	22,259	7/3	39,412	35,876	8/3	38,666	32,478
6/4	39,867	23,134	7/4	39,984	30,095	8/4	37,377	30,870
6/5	43,679	24,240	7/5	42,879	27,913	8/5	41,500	28,316
6/6	48,536	29,698	7/6	38,892	32,881	8/6	44,942	29,315
6/7	27,687	27,518	7/7	39,102	33,005	8/7	43,992	29,327
6/8	30,971	29,652	7/8	39,183	28,013	8/8	42,477	33,222
6/9	36,132	25,400	7/9	41,319	29,420	8/9	30,948	32,022
6/10	34,619	24,757	7/10	39,360	30,006	8/10	38,065	32,718
6/11	37,476	25,300	7/11	45,565	33,027	8/11	39,645	30,219
6/12	40,526	25,758	7/12	38,076	27,700	8/12	39,163	28,368
6/13	37,698	32,954	7/13	36,268	27,047	8/13	47,819	29,315
6/14	37,947	32,022	7/14	37,990	27,597	8/14	45,757	29,327
6/15	38,172	33,635	7/15	39,880	26,919	8/15	45,705	33,222
6/16	43,052	30,350	7/16	47,878	28,397	8/16	38,847	32,992
6/17	35,598	26,857	7/17	45,148	28,099	8/17	38,321	32,461
6/18	43,809	27,815	7/18	45,320	33,485	8/18	39,814	30,632
6/19	39,073	28,196	7/19	39,164	33,643	8/19	40,854	28,737
6/20	39,877	33,106	7/20	37,935	34,902	8/20	46,132	30,385
6/21	32,664	30,865	7/21	39,019	31,138	8/21	41,848	30,434
6/22	33,266	31,969	7/22	40,722	28,159	8/22	43,470	32,577
6/23	34,031	28,960	7/23	46,406	28,914	8/23	38,190	30,978
6/24	37,203	26,251	7/24	46,760	29,200	8/24	37,329	29,527
6/25	52,636	27,584	7/25	48,782	32,243	8/25	38,463	28,558
6/26	43,833	28,002	7/26	39,743	31,987	8/26	37,369	27,290
6/27	47,502	34,214	7/27	38,856	31,345	8/27	42,625	27,910
6/28	36,561	32,872	7/28	40,159	29,979	8/28	43,549	29,112
6/29	34,164	34,132	7/29	41,568	27,623	8/29	41,524	34,113
6/30	35,474	32,541	7/30	45,548	28,486	8/30	37,082	31,218
			7/31	47,408	29,738	8/31	36,717	28,755
Total	1,140,528	867,901	Total	1,295,290	936,595	Total	1,267,690	950,445
Average	38,018	28,930	Average	41,784	30,213	Average	40,893	30,660

APPENDIX C (cont.)

Date	1976	1975	Date	1976	1975	Date	1976	1975
9/1	35,300	24,678	10/1	39,510	21,603	11/1	31,780	21,935
9/2	39,699	25,753	10/2	31,318	21,949	11/2	30,823	20,809
9/3	40,839	23,235	10/3	30,455	28,565	11/3	31,028	22,025
9/4	39,033	24,442	10/4	30,417	23,452	11/4	32,619	20,864
9/5	36,483	27,693	10/5	29,865	23,454	11/5	38,706	21,463
9/6	43,598	22,409	10/6	27,942	22,489	11/6	28,653	22,313
9/7	35,504	24,347	10/7	26,389	21,479	11/7	30,757	26,529
9/8	33,143	23,429	10/8	38,531	22,226	11/8	28,444	20,486
9/9	38,369	22,322	10/9	32,471	22,333	11/9	30,237	22,238
9/10	35,548	22,896	10/10	32,507	29,337	11/10	31,602	21,572
9/11	33,314	23,225	10/11	35,422	24,860	11/11	33,614	21,649
9/12	34,796	27,473	10/12	38,966	24,793	11/12	36,007	21,445
9/13	31,210	24,335	10/13	33,973	24,906	11/13	30,053	21,173
9/14	30,732	25,638	10/14	35,760	24,011	11/14	26,850	26,127
9/15	31,319	23,177	10/15	39,167	22,909	11/15	29,606	20,775
9/16	31,141	21,663	10/16	34,246	23,474	11/16	30,768	21,299
9/17	38,775	22,603	10/17	31,587	27,198	11/17	28,899	21,688
9/18	35,143	23,331	10/18	32,595	21,376	11/18	31,175	21,262
9/19	36,017	27,105	10/19	31,498	23,626	11/19	37,036	21,640
9/20	31,263	24,723	10/20	31,811	22,641	11/20	27,619	21,854
9/21	31,430	26,059	10/21	33,232	21,547	11/21	27,224	24,507
9/22	31,774	23,927	10/22	37,955	21,689	11/22	32,711	18,687
9/23	32,076	21,807	10/23	32,281	22,672	11/23	34,852	16,660
9/24	37,187	21,908	10/24	30,867	27,701	11/24	34,467	21,095
9/25	33,747	22,635	10/25	33,236	21,766	11/25	28,466	22,102
9/26	35,350	26,101	10/26	30,679	21,894	11/26	36,602	29,638
9/27	31,082	22,171	10/27	30,706	22,572	11/27	30,934	21,499
9/28	31,758	23,982	10/28	31,064	21,963	11/28	29,516	26,671
9/29	32,856	22,456	10/29	36,194	20,951	11/29	30,741	20,247
9/30	32,163	21,866	10/30	31,502	21,557	11/30	31,815	26,993
			10/31	27,429	25,014			
Total	1,040,649	717,389	Total	1,019,575	661,518	Total	943,604	667,245
Average	34,688	23,913	Average	32,890	21,339	Average	31,454	22,242

APPENDIX C (cont.)

Date	1976	1975	Date	1977	1976	Date	1977	1976
12/1	31,498	22,548	1/1	21,509	13,641	2/1	28,720	21,003
12/2	30,929	20,587	1/2	27,302	21,627	2/2	30,686	18,825
12/3	39,647	21,002	1/3	30,620	18,344	2/3	31,533	18,843
12/4	26,226	21,239	1/4	29,807	19,634	2/4	35,590	20,235
12/5	22,776	24,317	1/5	27,094	18,943	2/5	27,459	21,349
12/6	29,776	18,881	1/6	30,126	19,136	2/6	25,611	25,012
12/7	30,285	16,877	1/7	26,763	18,576	2/7	31,272	19,167
12/8	28,119	18,257	1/8	25,356	19,405	2/8	31,322	19,167
12/9	31,100	19,658	1/9	19,993	21,506	2/9	30,389	19,887
12/10	36,072	21,636	1/10	30,074	16,702	2/10	32,389	20,475
12/11	27,716	20,856	1/11	31,597	18,185	2/11	37,747	20,473
12/12	22,437	23,818	1/12	29,297	19,242	2/12	28,944	21,324
12/13	31,710	18,574	1/13	31,216	20,134	2/13	28,391	26,207
12/14	32,536	17,938	1/14	30,276	21,023	2/14	31,132	22,174
12/15	33,101	20,404	1/15	28,220	21,476	2/15	32,122	22,116
12/16	33,907	20,923	1/16	23,029	24,033	2/16	31,261	23,254
12/17	37,965	22,331	1/17	19,278	16,540	2/17	33,283	23,031
12/18	28,878	22,501	1/18	29,912	16,871	2/18	40,523	20,758
12/19	24,621	26,453	1/19	28,111	19,199	2/19	33,076	21,610
12/20	34,125	21,122	1/20	26,452	20,166	2/20	26,998	25,714
12/21	31,434	17,327	1/21	36,368	20,104	2/21	34,703	20,434
12/22	34,008	20,940	1/22	29,053	20,884	2/22	33,406	21,258
12/23	32,485	21,308	1/23	26,644	23,817	2/23	32,563	21,508
12/24	20,511	21,418	1/24	31,156	18,615	2/24	35,353	20,976
12/25	17,292	17,500	1/25	29,064	19,664	2/25	40,931	21,245
12/26	22,853	18,621	1/26	30,383	19,396	2/26	35,750	22,867
12/27	28,176	19,760	1/27	31,413	19,841	2/27	31,217	28,729
12/28	34,770	23,108	1/28	35,821	20,104	2/28	33,382	25,402
12/29	34,620	21,422	1/29	26,127	20,506			
12/30	37,591	22,088	1/30	23,628	24,646			
12/31	28,155	21,668	1/31	29,829	20,932			
Total	935,319	645,083	Total	875,518	612,892	Total	903,755	640,203
Average	30,172	20,809	Average	28,243	19,771	Average	32,277	22,864

APPENDIX C (cont.)

Date	1977	1976	Date	1977	1976	Date	1977	1976
3/1	31,409	21,603	4/1	41,713	23,570	5/1	40,619	25,029
3/2	31,752	21,788	4/2	34,282	28,569	5/2	35,507	25,612
3/3	33,746	21,929	4/3	32,750	24,045	5/3	34,871	26,010
3/4	38,359	22,715	4/4	33,258	25,444	5/4	36,196	23,883
3/5	31,633	27,840	4/5	33,474	24,780	5/5	36,459	24,753
3/6	27,956	22,142	4/6	37,479	22,901	5/6	43,582	25,193
3/7	33,431	24,434	4/7	37,521	24,752	5/7	36,907	30,395
3/8	33,210	20,874	4/8	46,779	24,878	5/8	40,512	28,231
3/9	32,362	19,193	4/9	36,000	28,934	5/9	36,592	27,971
3/10	32,223	21,198	4/10	37,320	25,986	5/10	35,142	26,744
3/11	37,314	22,309	4/11	40,985	24,975	5/11	36,234	24,488
3/12	31,245	26,611	4/12	37,641	25,467	5/12	37,332	24,608
3/13	29,304	20,844	4/13	36,385	23,749	5/13	45,488	25,286
3/14	33,744	22,639	4/14	37,859	25,114	5/14	41,110	31,238
3/15	32,565	24,707	4/15	45,184	28,694	5/15	43,366	28,153
3/16	29,555	21,517	4/16	40,472	34,143	5/16	36,914	27,345
3/17	29,340	22,340	4/17	39,734	30,822	5/17	36,023	26,576
3/18	33,145	23,512	4/18	35,185	31,490	5/18	38,578	24,108
3/19	31,603	26,983	4/19	34,667	31,815	5/19	36,714	24,899
3/20	29,539	24,968	4/20	36,471	26,951	5/20	43,260	25,876
3/21	31,363	22,553	4/21	36,869	26,617	5/21	41,838	31,286
3/22	32,342	25,214	4/22	43,874	27,276	5/22	39,627	30,384
3/23	32,863	24,684	4/23	37,914	32,122	5/23	36,002	29,514
3/24	34,501	23,538	4/24	35,236	29,455	5/24	36,426	27,362
3/25	40,915	23,457	4/25	34,951	25,371	5/25	36,593	25,125
3/26	33,225	28,413	4/26	35,304	25,226	5/26	39,227	25,524
3/27	32,686	22,937	4/27	35,731	22,894	5/27	51,830	26,388
3/28	33,564	23,722	4/28	36,309	23,439	5/28	47,587	35,485
3/29	33,285	23,959	4/29	45,457	24,353	5/29	43,891	31,977
3/30	34,259	21,917	4/30	38,538	30,612	5/30	43,460	28,262
3/31	35,901	23,110				5/31	40,076	30,329
Total	1,015,932	723,650	Total	1,135,342	804,444	Total	1,227,963	847,934
Average	32,772	23,344	Average	37,845	26,815	Average	39,612	27,353

APPENDIX D

CLASSIFICATION TRAFFIC VOLUMES
HAMPTON ROADS BRIDGE-TUNNEL

NORTHBOUND LANE

Hour	Cars & Vans	Pickups	2-Axle	3-Axle	TT	Other	Total
July 16, 1976, A.M.							
7:00 - 7:30	402	67	23	9	13	7	521
7:30 - 8:00	478	77	21	6	17	7	606
8:00 - 8:30	421	79	21	6	19	4	550
8:30 - 9:00	455	74	34	8	19	11	601
9:00 - 9:30	594	108	51	1	34	10	798
9:30 - 10:00	479	92	37	7	28	5	648
10:00 - 10:30	462	77	27	3	23	4	596
10:30 - 11:00	710	126	26	4	36	7	909
11:00 - 11:30	588	86	17	4	30	6	731
11:30 - 12:00	567	104	28	6	23	7	735
P.M.							
12:00 - 12:30	558	86	18	0	26	7	695
12:30 - 1:00	580	85	20	3	21	8	717
July 15, 1976, P.M.							
2:00 - 2:30	355	55	17	5	20	5	457
2:30 - 3:00	408	68	15	11	20	7	465
3:00 - 3:30	347	54	31	7	22	4	465
3:30 - 4:00	534	89	21	6	28	8	686
4:00 - 4:30	592	122	19	5	12	11	761
4:30 - 5:00	581	73	11	0	12	11	688
5:00 - 5:30	536	87	9	2	11	7	652
5:30 - 6:00	521	50	5	3	9	6	594
6:00 - 6:30	433	56	10	4	17	6	526
6:30 - 7:00	348	35	2	1	12	8	406
Subtotal	10,949	1,750	463	101	452	156	13,871
Percentage	79.0	12.6	3.4	0.7	3.2	1.1	100

APPENDIX D (cont.)

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
July 16, 1976, A.M.							
7:00 - 7:30	370	61	10	9	19	2	471
7:30 - 8:00	380	70	11	9	20	5	495
8:00 - 8:30	317	44	9	8	18	3	399
8:30 - 9:00	327	63	23	3	26	2	444
9:00 - 9:30	594	108	51	1	34	10	798
9:30 - 10:00	352	66	12	3	28	4	465
10:00 - 10:30	426	81	14	3	18	5	547
10:30 - 11:00	390	75	15	3	29	7	519
11:30 - 12:00	433	74	16	0	21	7	551
P.M.							
12:00 - 12:30	488	102	24	4	21	3	642
12:30 - 1:00	483	77	24	4	19	7	614
July 15, 1976, P.M.							
2:00 - 2:30	424	72	29	8	33	7	573
2:30 - 3:00	475	77	34	5	21	2	614
3:00 - 3:30	519	95	29	7	24	5	679
3:30 - 4:00	541	123	40	20	18	11	753
4:00 - 4:30	529	109	36	16	19	10	719
4:30 - 5:00	759	124	21	12	12	11	939
5:00 - 5:30	696	102	23	3	25	9	858
5:30 - 6:00	585	74	11	5	17	3	695
6:00 - 6:30	560	69	17	5	18	2	671
6:30 - 7:00	483	61	9	4	13	3	573
Subtotal	10,333	1,773	450	141	469	119	13,285
Percentage	77.8	13.3	3.4	1.1	3.5	0.9	100
Total	21,282	3,523	913	242	921	275	27,156
Percentage	78.4	13.0	3.3	0.9	3.4	1.0	100

APPENDIX D (cont.)

NORTHBOUND LANE

Hours	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
August 25, 1976, A.M.							
7:00 - 7:30	392	76	26	3	19	6	522
7:30 - 8:00	476	82	27	1	18	6	610
8:00 - 8:30	444	81	36	8	19	3	591
8:30 - 9:00	535	104	30	6	25	5	705
9:00 - 9:30	560	87	37	4	26	4	718
9:30 - 10:00	560	87	26	7	26	6	712
10:00 - 10:30	750	115	46	6	41	4	962
10:30 - 11:00	568	84	19	2	23	3	699
11:00 - 11:30	542	87	20	3	36	9	697
11:30 - 12:00	483	78	23	8	27	3	622
P.M.							
12:00 - 12:30	471	65	17	1	29	5	588
12:30 - 1:00	480	69	26	1	28	1	605
1:00 - 1:30	432	70	19	8	18	3	550
August 24, 1976, P.M.							
1:30 - 2:00	413	56	31	4	26	11	541
2:00 - 2:30	477	72	24	4	18	7	602
2:30 - 3:00	415	66	13	3	28	4	529
3:00 - 3:30	500	74	21	6	21	14	636
3:30 - 4:00	580	102	25	4	21	16	748
4:00 - 4:30	534	95	20	8	12	12	681
4:30 - 5:00	603	87	19	1	9	12	731
5:00 - 5:30	534	50	8	0	10	6	608
5:30 - 6:00	515	48	12	1	11	9	596
6:00 - 6:30	451	58	6	2	12	8	537
6:30 - 7:00	394	53	4	0	9	10	470
Subtotal	12,109	1,846	535	91	512	167	15,260
Percentage	79.4	12.1	3.5	0.6	3.3	1.1	100

APPENDIX C (cont.)

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
August 25, 1976, A. M.							
7:00 - 7:30	333	61	12	3	16	4	429
7:30 - 8:00	406	57	8	4	22	10	507
8:00 - 8:30	345	61	22	5	21	1	455
8:30 - 9:00	357	52	16	4	13	2	444
9:00 - 9:30	346	53	25	3	17	3	447
9:30 - 10:00	398	58	19	7	37	4	523
10:00 - 10:30	382	44	16	5	21	1	469
10:30 - 11:00	356	55	16	4	25	6	462
11:00 - 11:30	368	68	19	6	9	0	470
11:30 - 12:00	408	65	15	2	18	5	513
P.M.							
12:00 - 12:30	483	68	27	5	19	5	607
12:30 - 1:00	464	79	24	7	24	8	606
1:00 - 1:30	651	105	31	5	33	7	832
August 24, 1976, P.M.							
1:30 - 2:00	445	71	22	7	31	3	579
2:00 - 2:30	462	80	31	4	18	8	603
2:30 - 3:00	479	74	37	4	22	6	622
3:00 - 3:30	486	89	37	6	32	8	658
3:30 - 4:00	467	106	35	1	17	11	637
4:00 - 4:30	667	103	51	5	15	16	857
4:30 - 5:00	800	119	33	4	17	19	992
5:00 - 5:30	656	86	25	4	22	7	800
5:30 - 6:00	549	60	28	1	14	10	662
6:00 - 6:30	531	53	15	3	10	11	623
6:30 - 7:00	428	50	8	1	8	2	497
Subtotal	11,267	1,717	572	100	481	157	14,294
Percentage	78.8	12.0	4.0	0.7	3.4	1.1	100
Total	23,376	3,563	1,107	191	993	324	29,554
Percentage	79.1	12.1	3.7	0.6	3.4	1.1	100

APPENDIX D (cont.)

NORTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
September 21, 1976 A.M.							
7:00 - 7:30	381	70	27	1	15	7	501
7:30 - 8:00	443	74	40	2	13	2	574
8:00 - 8:30	383	56	27	3	20	2	491
8:30 - 9:00	393	73	36	2	19	5	528
9:00 - 9:30	410	76	32	3	37	2	560
9:30 - 10:00	402	72	27	4	48	2	555
10:00 - 10:30	386	58	29	3	28	1	505
10:30 - 11:00	400	70	26	5	25	2	528
11:00 - 11:30	389	51	29	3	31	1	504
11:30 - 12:00	323	45	10	4	23	3	408
P.M.							
12:00 - 12:30	296	55	16	5	21	3	396
12:30 - 1:00	395	56	15	5	27	7	505
1:00 - 1:30	310	50	19	1	22	2	404
1:30 - 2:00	326	71	14	5	27	5	448
2:00 - 2:30	344	58	13	4	18	6	443
2:30 - 3:00	333	48	12	3	21	6	423
3:00 - 3:30	465	65	22	2	30	4	588
3:30 - 4:00	468	103	16	0	16	6	609
4:00 - 4:30	498	74	20	7	13	11	623
4:30 - 5:00	550	68	16	4	20	2	660
5:00 - 5:30	501	67	5	2	7	1	583
5:30 - 6:00	435	40	7	2	14	7	505
6:00 - 6:30	327	33	5	2	8	3	378
6:30 - 7:00	279	53	9	0	8	3	352
Subtotal	9,437	1,486	472	72	511	93	12,071
Percentage	78.2	12.3	3.9	0.6	4.2	0.8	100

APPENDIX D (cont.)

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
September 21, 1976, A.M.							
7:00 - 7:30	551	74	13	5	33	7	683
7:30 - 8:00	440	60	14	0	15	2	531
8:00 - 8:30	396	36	16	3	26	1	478
8:30 - 9:00	406	50	24	5	21	0	506
9:00 - 9:30	309	42	22	3	30	5	411
9:30 - 10:00	333	57	15	1	38	3	447
10:00 - 10:30	331	45	20	1	27	3	427
10:30 - 11:00	307	51	18	1	27	9	413
11:00 - 11:30	294	56	16	2	24	1	393
11:30 - 12:00	298	47	29	3	25	8	410
P.M.							
12:00 - 12:30	312	49	25	3	23	4	416
12:30 - 1:00	334	59	25	2	17	3	440
1:00 - 1:30	319	55	20	4	19	2	419
1:30 - 2:00	344	48	38	4	24	3	461
2:00 - 2:30	411	71	30	5	29	1	547
2:30 - 3:00	400	87	32	5	20	5	549
3:00 - 3:30	444	89	40	0	33	2	608
3:30 - 4:00	496	89	46	1	15	3	650
4:00 - 4:30	591	91	28	6	20	4	740
4:30 - 5:00	677	116	37	3	24	12	869
5:00 - 5:30	577	60	20	1	18	8	684
5:30 - 6:00	457	57	19	4	8	2	547
6:00 - 6:30	471	49	15	1	19	3	558
6:30 - 7:00	370	28	11	1	16	2	428
Subtotal	9,868	1,466	573	64	551	93	12,615
Percentage	78.2	11.6	4.5	0.6	4.4	0.7	100
Total	19,305	3,952	1,045	136	1,062	186	24,686
Percentage	78.2	11.9	4.2	0.6	4.3	0.7	100

APPENDIX D (cont.)

NORTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
October 18, 1976, A.M.							
7:30 - 8:00	524	62	24	2	11	2	625
8:00 - 8:30	314	56	23	5	19	4	421
8:30 - 9:00	332	64	20	4	24	2	446
9:00 - 9:30	278	73	15	2	39	1	408
9:30 - 10:00	359	68	29	2	46	5	509
10:00 - 10:30	353	62	39	5	32	0	491
10:30 - 11:00	294	48	23	1	21	2	389
11:00 - 11:30	297	53	19	4	40	2	415
11:30 - 12:00	292	56	23	5	31	1	408
P.M.							
1:00 - 1:30	309	42	17	4	28	2	402
1:30 - 2:00	292	43	15	2	19	2	373
2:00 - 2:30	334	46	14	3	25	3	425
2:30 - 3:00	342	53	23	4	19	1	442
3:00 - 3:30	434	64	10	1	19	5	533
3:30 - 4:00	428	84	20	0	18	3	553
4:00 - 4:30	450	59	16	0	8	3	536
4:30 - 5:00	415	41	7	2	15	2	482
5:00 - 5:30	382	56	8	0	17	1	464
5:30 - 6:00	367	38	6	2	20	2	435
6:00 - 6:30	244	30	3	0	8	8	293
Subtotal	7,040	1,098	354	48	459	51	9,050
Percentage	77.8	12.1	3.9	0.5	5.1	0.6	100

APPENDIX D (cont.)

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
October 18, 1976, A.M.							
7:30 - 8:00	488	49	10	0	11	3	561
8:00 - 8:30	400	48	9	0	24	0	481
8:30 - 9:00	307	50	13	0	18	5	393
9:00 - 9:30	271	37	11	4	17	1	341
9:30 - 10:00	272	38	14	0	27	2	353
10:00 - 10:30	268	49	13	2	25	1	358
10:30 - 11:00	252	51	15	0	22	3	343
11:00 - 11:30	263	44	14	3	29	1	354
11:30 - 12:00	259	41	18	2	33	3	356
P.M.							
1:00 - 1:30	248	28	12	1	20	1	310
1:30 - 2:00	272	42	29	1	26	2	372
2:00 - 2:30	316	58	36	4	25	1	440
2:30 - 3:00	355	62	31	0	29	2	479
3:00 - 3:30	393	60	24	4	32	4	517
3:30 - 4:00	422	79	37	0	23	7	568
4:00 - 4:30	523	87	27	0	21	3	661
4:30 - 5:00	556	90	23	2	26	9	706
5:00 - 5:30	497	62	19	5	21	4	608
5:30 - 6:00	370	39	14	2	14	2	441
6:00 - 6:30	309	37	9	2	6	1	364
Subtotal	7,041	1,051	378	32	449	55	9,006
Percentage	78.2	11.7	4.2	0.3	5.0	0.6	100
Total	14,081	2,149	732	8.0	908	106	18,056
Percentage	78.0	11.9	4.0	0.4	5.1	0.6	100

APPENDIX D (cont.)

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
March 15, 1977, P.M.							
2:00 - 2:15	181	38	13	0	8	4	244
2:15 - 2:30	185	38	16	2	18	1	260
2:30 - 2:45	200	27	16	0	11	2	256
2:45 - 3:00	194	37	19	0	14	1	265
3:00 - 3:15	221	45	20	2	7	0	295
3:15 - 3:30	197	40	16	2	10	3	268
3:30 - 3:45	255	40	17	2	7	1	322
3:45 - 4:00	289	73	22	0	10	2	396
4:00 - 4:15	270	59	17	3	14	3	366
4:15 - 4:30	284	49	12	0	8	3	356
4:30 - 4:45	376	57	17	0	13	7	470
4:45 - 5:00	325	46	6	0	11	8	396
5:00 - 5:15	290	41	12	1	22	3	369
5:15 - 5:30	263	34	10	0	5	2	314
5:30 - 5:45	256	31	8	1	5	2	303
5:45 - 6:00	216	32	8	1	9	1	267
Subtotal	4,002	687	229	14	172	43	5,147
Percentage	77.8	13.3	4.5	0.3	3.3	0.8	100.0

APPENDIX D (cont.)

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
March 16, 1977, A. M.							
7:00 - 7:15	221	34	7	0	9	7	278
7:15 - 7:30	310	49	4	0	12	3	378
7:30 - 7:45	311	43	9	2	17	1	383
7:45 - 8:00	245	35	3	3	16	3	305
8:00 - 8:15	246	27	8	0	7	0	288
8:15 - 8:30	206	30	9	0	8	1	254
8:30 - 8:45	196	28	13	4	10	2	243
8:45 - 9:00	164	29	13	1	12	1	220
9:00 - 9:15	159	14	5	2	15	0	195
9:15 - 9:30	160	28	11	0	9	2	210
9:30 - 9:45	160	26	7	1	11	1	206
9:45 - 10:00	153	27	8	0	16	1	205
10:00 - 10:15	163	34	11	1	11	1	221
10:15 - 10:30	169	20	9	1	19	0	218
10:30 - 10:45	138	27	11	1	17	0	194
10:45 - 11:00	142	32	7	3	17	1	202
11:00 - 11:15	156	24	12	2	15	0	209
11:15 - 11:30	153	29	6	0	8	3	199
11:30 - 11:45	191	29	7	0	17	1	245
11:45 - 12:00	156	23	13	0	23	0	215
Subtotal	3,799	588	173	21	259	28	4,868
Percentage	78.0	12.1	3.6	0.4	5.3	0.6	100

NORTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
March 15, 1977, P.M.							
2:00 - 2:14	174	30	5	4	11	1	225
2:15 - 2:30	179	28	9	4	14	1	235
2:30 - 2:45	162	30	10	2	18	5	227
2:45 - 3:00	238	33	8	3	10	2	294
3:00 - 3:15	238	35	16	0	11	7	307
3:15 - 3:30	246	42	9	2	17	8	324
3:30 - 3:45	243	53	9	1	18	5	329
3:45 - 4:00	304	56	5	0	12	1	378
4:00 - 4:15	261	52	10	3	7	3	336
4:15 - 4:30	271	45	10	1	10	4	341
4:30 - 4:45	293	44	6	1	9	3	356
4:45 - 5:00	283	38	4	1	8	6	340
5:00 - 5:15	313	49	10	4	9	3	388
5:15 - 5:30	214	25	4	3	5	4	255
5:30 - 5:45	250	31	3	3	9	2	298
5:45 - 6:00	197	31	3	1	10	1	243
Subtotal	3,866	622	121	33	178	56	4,876
Percentage	79.3	12.8	2.5	0.7	3.7	1.1	100

APPENDIX D (cont.)

NORTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
March 16, 1977, A.M.							
7:00 - 7:15	204	41	8	4	3	3	263
7:15 - 7:30	193	31	13	1	11	5	254
7:30 - 7:45	222	40	17	0	7	0	286
7:45 - 8:00	265	42	12	0	12	2	333
8:00 - 8:15	181	26	11	3	6	0	227
8:15 - 8:30	172	30	21	1	12	1	237
8:30 - 8:45	192	43	14	2	22	2	275
8:45 - 9:00	195	47	14	1	16	0	273
9:00 - 9:15	183	32	22	2	21	1	261
9:15 - 9:30	178	38	18	1	14	0	249
9:30 - 9:45	189	39	17	3	21	2	271
9:45 - 10:00	192	38	13	2	23	2	270
10:00 - 10:15	155	24	12	0	13	1	205
10:15 - 10:30	172	26	12	4	17	4	235
10:30 - 10:45	172	29	9	2	17	0	229
10:45 - 11:00	175	27	12	1	17	1	233
11:00 - 11:15	176	34	8	2	20	1	241
11:15 - 11:30	181	24	16	4	21	1	247
11:30 - 11:45	177	18	15	0	13	2	225
11:45 - 12:00	153	30	13	1	11	2	210
Subtotal	3,727	659	277	34	297	30	5,024
Percentage	74.2	13.1	5.5	0.7	5.9	0.6	100
Total	15,394	2,556	800	102	906	157	19,915
Percentage	77.3	12.8	4.0	0.5	4.6	0.8	100

APPENDIX D (cont.)

NORTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
May 17, 1977, A.M.							
7:00 - 7:15	221	38	14	1	10	2	286
7:15 - 7:30	231	43	11	6	8	4	303
7:30 - 7:45	257	53	17	2	6	5	340
7:45 - 8:00	249	29	15	2	9	0	304
8:00 - 8:15	194	30	25	3	12	4	268
8:15 - 8:30	169	33	16	1	12	7	238
8:30 - 8:45	172	40	23	0	11	1	247
8:45 - 9:00	197	40	20	2	18	1	278
9:00 - 9:15	194	34	14	1	17	2	262
9:15 - 9:30	234	53	20	0	14	2	323
9:30 - 9:45	230	30	14	2	17	3	296
9:45 - 10:00	202	42	17	1	15	3	280
10:15 - 10:30	196	31	10	2	15	2	256
10:30 - 10:45	174	36	10	2	17	1	240
10:45 - 11:00	165	17	10	1	12	0	205
11:00 - 11:15	184	34	13	6	17	3	257
11:15 - 11:30	195	28	11	1	21	6	262
May 16, 1977, P.M.							
2:00 - 2:15	178	37	9	0	15	8	247
2:15 - 2:30	219	34	7	2	19	2	283
2:30 - 2:45	216	24	8	7	17	7	279
2:45 - 3:00	193	36	8	2	14	3	256
3:00 - 3:15	229	40	10	1	12	9	301
3:15 - 3:30	264	42	7	0	12	3	328
3:30 - 3:45	282	41	7	1	20	3	354
4:00 - 4:15	283	52	11	1	12	3	362
4:15 - 4:30	315	56	7	2	11	8	399
4:30 - 4:45	334	39	8	0	17	6	404
4:45 - 5:00	305	39	8	3	5	6	366
5:00 - 5:15	276	37	3	0	8	4	328
5:15 - 5:30	282	43	1	1	5	4	336
Subtotal	6,840	1,131	354	53	398	112	8,888
Percentage	77.1	12.8	3.9	0.6	4.4	1.2	100

APPENDIX D (Cont.)

SOUTHBOUND LANE

Hour	Cars	Pickups & Vans	2-Axle	3-Axle	TT	Other	Total
May 17, 1977, A.M.							
7:00 - 7:15	221	43	4	1	17	0	286
7:15 - 7:30	271	47	7	1	5	6	337
7:30 - 7:45	304	34	9	2	13	5	367
7:45 - 8:00	218	32	12	6	10	7	285
8:00 - 8:15	212	25	5	2	13	0	257
8:15 - 8:30	181	29	9	8	16	0	243
8:30 - 8:45	196	19	6	3	12	10	246
8:45 - 9:00	196	25	6	3	18	1	249
9:00 - 9:15	178	38	9	2	14	2	243
9:15 - 9:30	173	26	7	1	11	2	220
9:30 - 9:45	173	25	11	4	13	3	229
9:45 - 10:00	167	26	12	4	9	0	218
10:45 - 11:00	146	34	9	2	20	3	214
11:00 - 11:15	168	23	12	1	8	3	215
11:15 - 11:30	177	47	14	3	13	3	257
May 16, 1977, P.M.							
2:00 - 2:15	215	31	15	5	24	4	294
2:15 - 2:30	195	42	11	1	10	2	261
2:30 - 2:45	203	36	10	3	13	7	272
2:45 - 3:00	168	71	15	2	8	2	266
3:00 - 3:15	242	43	14	3	10	2	314
3:15 - 3:30	189	51	16	3	10	5	274
3:30 - 3:45	220	59	21	1	16	2	319
3:45 - 4:00	280	66	18	1	10	10	385
4:00 - 4:15	287	53	11	3	8	2	364
4:45 - 5:00	303	57	6	0	7	8	381
5:00 - 5:15	294	43	7	0	9	7	360
5:15 - 5:30	253	40	8	0	13	5	319
Subtotal	5,830	1,065	284	65	330	101	7,675
Percentage	76.0	13.9	3.7	0.8	4.3	1.3	100
Total	12,670	2,196	638	118	728	213	16,563
Percentage	76.5	13.2	3.9	0.7	4.4	1.3	100

APPENDIX E

OCCUPANCY VOLUMES
HAMPTON ROADS BRIDGE-TUNNEL

NORTHBOUND LANE

Hour	Vehicles With the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
July 16, 1976, A.M.								
7:05 - 7:20	162	57	10	11	5	3	247	1.57
7:35 - 7:50	191	59	19	13	7	12	301	1.74
8:05 - 8:20	142	63	36	21	6	12	280	2.01
8:35 - 8:50	142	71	27	27	14	15	296	2.14
9:05 - 9:20	159	111	38	38	10	13	369	2.10
9:35 - 9:50	132	106	40	33	14	14	339	2.21
10:05 - 10:20	131	87	37	32	17	9	313	2.19
10:35 - 10:50			BREAK					
11:05 - 11:20	138	98	38	26	14	15	329	2.16
11:35 - 11:50	162	101	35	31	12	12	353	2.05
12:05 - 12:20	131	78	25	33	14	6	287	2.09
12:35 - 12:50	152	117	34	26	15	16	360	2.12
Subtotal	1,642	948	339	291	127	127	3,474	2.05
July 15, 1976, P.M.								
2:05 - 2:20	118	93	31	20	4	10	276	2.02
2:35 - 2:50	123	103	21	11	6	8	272	1.89
3:05 - 3:20	134	89	32	30	7	12	304	2.09
3:35 - 3:50	144	103	34	21	5	9	316	1.95
4:05 - 4:20	161	114	33	27	7	9	351	1.95
4:35 - 4:50	165	76	30	25	7	4	307	1.84
5:35 - 5:50	161	77	29	24	13	8	312	1.96
6:05 - 6:20	138	50	30	25	4	6	253	1.91
6:35 - 6:50	101	60	22	14	6	7	210	1.98
Subtotal	1,245	765	262	197	59	73	2,601	1.95
Total	2,887	1,713	601	488	186	200	6,075	2.01

APPENDIX E (cont.)

SOUTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
July 16, 1976, A.M.								
7:05 - 7:20	140	34	6	4	3	0	187	1.37
7:35 - 7:50	161	33	9	4	1	1	209	1.34
8:05 - 8:20	142	41	8	4	7	0	202	1.48
8:35 - 8:50	124	40	16	9	4	3	196	1.66
9:10 - 9:25	112	58	18	12	5	3	208	1.79
9:35 - 9:50	90	60	19	16	10	4	199	2.04
10:05 - 10:20	88	58	26	16	6	11	205	2.16
11:05 - 11:20	85	64	33	15	14	9	220	2.25
11:35 - 11:50	70	67	37	20	5	6	205	2.22
12:05 - 12:20	92	72	24	30	8	7	233	2.19
12:35 - 12:50	104	92	21	22	6	6	251	2.01
Subtotal	1,208	619	217	152	69	50	2,315	1.88
July 15, 1976, P.M.								
2:05 - 2:20	96	90	17	16	2	2	223	1.99
2:35 - 2:50	106	66	17	21	5	3	218	1.91
3:05 - 3:20	133	100	31	10	0	1	275	1.72
3:35 - 3:50	145	67	25	17	2	1	257	1.70
4:05 - 4:20	121	65	23	12	4	6	231	1.84
4:35 - 4:50	128	79	34	18	9	8	276	2.04
5:35 - 5:50	136	74	27	16	12	6	271	1.94
6:05 - 6:20	108	61	31	15	15	20	250	2.31
6:35 - 6:50	66	55	25	22	8	7	183	2.30
Subtotal	1,039	657	230	147	57	54	2,184	1.94
Southbound Total	2,247	1,276	447	299	126	104	4,499	1.91
Northbound Total	2,887	1,713	601	488	186	200	6,075	2.01
Total Both Directions	5,134	2,989	1,048	787	312	304	10,574	1.96

APPENDIX E (cont.)

NORTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
August 25, 1976 A.M.								
7:15 - 7:30	172	41	10	4	2	3	232	1.41
7:35 - 7:50	172	42	18	10	3	2	247	1.53
8:10 - 8:25	192	63	25	15	8	6	309	1.71
8:48 - 8:58	122	53	22	15	9	10	231	1.99
9:13 - 9:28	160	116	32	32	17	17	374	2.15
9:40 - 9:55	141	91	34	34	19	12	331	2.20
10:05 - 10:15	137	101	46	32	7	18	341	2.19
10:35 - 10:45	90	72	25	23	15	9	234	2.26
11:10 - 11:20	88	67	23	17	12	9	216	2.19
11:40 - 11:50	76	82	26	19	11	12	226	2.30
Subtotal	1,350	728	261	201	103	98	2,741	2.00
August 24, 1976, P.M.								
1:30 - 1:45	130	75	31	14	7	4	261	1.87
2:05 - 2:20	118	57	27	26	6	7	241	2.03
2:30 - 2:45	120	88	26	10	11	5	260	1.92
3:18 - 3:30	114	76	22	17	8	1	238	1.87
4:00 - 4:15	179	106	37	15	6	8	351	1.82
4:40 - 5:00	206	92	37	18	11	2	366	1.75
5:05 - 5:15	130	63	19	10	2	2	226	1.66
5:48 - 6:00	105	61	23	8	3	1	201	1.74
6:00 - 6:15	139	83	25	24	8	6	285	1.94
6:30 - 6:45	104	67	24	18	8	7	228	2.04
Subtotal	1,345	768	271	160	70	43	2,657	1.86
Northbound Total	2,695	1,496	532	361	173	141	5,398	1.93

APPENDIX E (cont.)

SOUTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
August 25, 1976, A.M.								
7:00 - 7:15	165	33	10	3	3	0	214	1.32
7:35 - 7:50	202	33	19	6	3	3	266	1.44
8:05 - 8:20	163	45	7	1	3	3	222	1.40
8:35 - 8:50	146	51	10	6	0	3	216	1.48
9:05 - 9:20	130	50	16	18	5	2	221	1.75
9:40 - 9:55	120	66	33	26	12	4	261	2.06
10:18 - 10:28	71	54	17	9	3	1	155	1.85
10:58 - 11:08	74	35	17	11	3	2	142	1.87
11:25 - 11:40	114	53	28	18	23	9	245	2.22
Subtotal	1,185	420	157	98	55	27	1,942	1.71
August 24, 1976, P.M.								
1:35 - 1:50	128	90	32	14	5	3	272	1.89
2:05 - 2:20	135	80	27	23	10	6	281	1.97
2:50 - 3:00	88	56	24	12	4	5	189	1.95
3:00 - 3:15	149	96	29	22	12	6	314	1.95
3:50 - 4:00	122	63	15	18	7	3	228	1.83
4:10 - 4:25	244	113	38	19	16	15	445	1.86
4:40 - 4:55	251	131	44	37	12	12	487	1.90
5:15 - 5:25	144	56	26	14	4	8	252	1.82
5:40 - 5:55	169	84	31	15	4	5	308	1.75
6:10 - 6:25	116	102	28	23	4	13	286	2.08
6:30 - 6:50	114	74	25	22	5	5	245	1.95
Subtotal	1,660	945	319	219	83	81	3,307	1.90
Southbound Total	2,845	1,365	476	317	138	108	5,249	1.83
Northbound Total	2,695	1,496	532	361	173	141	5,398	1.93
Total Both Directions	5,540	2,861	1,008	678	311	249	10,647	1.88

APPENDIX E (cont.)

NORTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
Sept. 21, 1976, A.M.								
7:00 - 7:15	191	34	10	6	5	1	247	1.39
7:30 - 7:45	225	48	16	2	1	1	293	1.32
8:00 - 8:15	201	56	9	3	2	1	272	1.35
8:30 - 8:45	159	60	10	2	0	2	233	1.41
9:00 - 9:15	172	74	14	10	1	0	271	1.50
9:30 - 9:45	149	94	18	7	3	0	271	1.60
10:00 - 10:15	139	87	17	9	1	0	253	1.60
10:30 - 10:45	130	82	19	8	3	0	242	1.64
11:15 - 11:30	144	71	14	6	1	3	239	1.57
11:35 - 11:50	117	63	13	7	3	2	205	1.64
P.M.								
12:00 - 12:15	98	78	10	5	0	1	192	1.61
1:15 - 1:30	111	81	15	5	1	0	213	1.61
1:35 - 1:50	160	73	6	7	1	1	248	1.46
2:00 - 2:15	133	59	8	4	0	2	206	1.47
2:30 - 2:45	125	56	7	8	1	1	198	1.52
3:00 - 3:15	142	69	13	8	3	6	241	1.67
3:30 - 3:45	176	78	14	9	1	3	281	1.54
4:00 - 4:15	176	71	11	5	2	4	269	1.50
4:30 - 4:45	208	77	16	8	3	0	312	1.46
5:00 - 5:15	200	86	16	8	4	1	315	1.52
5:30 - 5:40	117	39	9	7	1	0	173	1.47
6:00 - 6:15	104	52	14	11	1	7	189	1.80
6:30 - 6:45	106	47	16	7	2	3	181	1.68
Subtotal	3,483	1,535	295	152	40	39	5,544	1.53

APPENDIX E (cont.)

SOUTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
7:00 - 7:20	308	72	10	4	1	1	396	1.28
7:25 - 7:45	335	85	19	8	5	2	454	1.39
7:50 - 8:10	246	69	14	6	4	0	339	1.39
8:15 - 8:35	221	72	22	5	0	1	321	1.42
8:40 - 9:00	221	76	16	7	2	4	326	1.48
9:25 - 9:45	182	81	16	4	4	2	289	1.52
9:50 - 10:10	194	82	5	4	0	1	286	1.40
10:15 - 10:35	191	80	13	7	3	5	299	1.55
10:40 - 11:00	162	89	8	4	2	0	265	1.47
11:20 - 11:40	156	71	17	6	0	4	254	1.56
11:45 - 12:05	160	81	15	4	1	0	261	1.50
P.M.								
12:10 - 12:30	173	83	10	3	2	2	273	1.48
12:35 - 12:50	122	56	18	5	1	0	202	1.55
1:15 - 1:35	172	98	19	5	1	0	295	1.52
1:40 - 2:00	179	98	25	9	3	1	315	1.61
2:05 - 2:25	231	104	16	10	0	3	364	1.50
2:30 - 2:50	222	101	14	13	1	3	354	1.53
3:00 - 3:20	244	99	18	14	7	6	388	1.60
3:25 - 3:45	253	109	30	13	3	3	411	1.57
3:50 - 4:10	268	142	30	12	3	6	461	1.61
4:15 - 4:35	296	143	37	16	4	10	506	1.65
4:55 - 5:15	290	112	32	8	4	4	449	1.52
5:25 - 5:45	227	94	21	20	4	2	368	1.60
6:00 - 6:15	160	63	12	11	3	0	249	1.53
6:25 - 6:45	192	78	30	10	2	0	312	1.56
Subtotal Southbound	5,405	2,238	467	208	60	60	8,438	1.51
Subtotal Northbound	3,483	1,535	295	152	40	39	5,544	1.53
Total Both Directions	8,888	3,773	762	360	100	99	13,982	1.52

APPENDIX E (cont.)

NORTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
January 14, 1977, A.M.								
7:00 - 7:15	170	41	10	5	1	2	229	1.39
7:15 - 7:30	194	37	5	2	0	1	239	1.24
7:30 - 7:45	237	44	5	8	1	1	296	1.29
7:45 - 8:00	227	49	6	1	0	2	285	1.26
8:00 - 8:15	171	48	9	5	1	1	235	1.38
8:15 - 8:30	178	29	9	0	0	2	218	1.26
8:30 - 8:45	188	47	9	2	0	0	246	1.29
8:45 - 9:00	160	37	6	2	2	1	208	1.33
Subtotal	1,525	332	59	25	5	10	1,956	1.30
January 13, 1977, P.M.								
2:00 - 2:15	127	42	14	4	0	1	188	1.46
2:15 - 2:30	140	50	13	3	0	3	209	1.48
2:30 - 2:45	154	66	7	1	0	0	228	1.36
2:45 - 3:00	168	56	14	2	0	0	240	1.38
3:00 - 3:15	169	74	14	7	3	3	270	1.56
3:15 - 3:30	156	51	20	5	1	0	233	1.47
3:30 - 3:45	196	62	14	9	0	1	282	1.43
3:45 - 4:00	219	74	8	6	0	1	308	1.37
4:00 - 4:15	177	66	16	7	0	2	268	1.48
4:15 - 4:30	199	75	11	3	3	1	292	1.42
4:30 - 4:45	202	62	14	8	2	1	289	1.44
4:45 - 5:00	216	63	9	2	1	2	293	1.38
5:00 - 5:15	174	49	9	4	2	0	238	1.37
Subtotal	2,297	790	163	61	12	15	3,338	1.43
Total	3,823	1,122	222	86	17	25	5,294	1.37

APPENDIX E (cont.)

SOUTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occ pan Rat
	1	2	3	4	5	>5		
January 14, 1977, A.M.								
7:00 - 7:15	163	40	4	3	0	0	210	1.2
7:15 - 7:30	195	45	11	5	0	1	257	1.3
7:30 - 7:45	209	43	13	1	0	0	266	1.2
7:45 - 8:00	196	31	6	1	2	0	236	1.2
8:00 - 8:15	179	43	9	1	0	0	232	1.2
8:15 - 8:30	95	22	8	3	1	1	130	1.4
8:30 - 8:45	107	28	3	2	1	0	141	1.3
8:45 - 9:00	75	22	-	-	1	1	99	1.3
Subtotal	1,219	274	54	16	5	3	1,571	1.3
January 13, 1977, P.M.								
2:00 - 2:15	147	64	14	1	1	1	228	1.4
2:15 - 2:30	147	44	28	3	0	0	222	1.4
2:30 - 2:45	143	61	18	6	0	1	229	1.4
2:45 - 3:00	148	51	8	2	0	0	209	1.3
3:00 - 3:15	198	70	15	5	4	0	293	1.4
3:15 - 3:30	201	70	13	5	3	5	297	1.5
3:30 - 3:45	206	65	30	1	2	1	305	1.4
3:45 - 4:00	235	84	21	7	4	3	354	1.5
4:00 - 4:15	225	98	15	7	3	1	349	1.4
4:15 - 4:30	242	82	15	8	10	1	358	1.5
4:30 - 4:45	222	85	26	13	4	7	357	1.6
4:45 - 5:00	227	87	26	15	7	3	365	1.6
5:00 - 5:15	265	78	23	11	3	4	384	1.4
Subtotal	2,606	939	252	84	41	27	3,949	1.5
Southbound Total	3,825	1,213	306	100	46	30	5,520	1.4
Northbound Total	3,823	1,122	222	86	17	25	5,294	1.37
Total Both Directions	7,648	2,335	528	186	63	55	10,814	1.39

APPENDIX E (cont.)

NORTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
March 16, 1977, A.M.								
7:00 - 7:10	131	32	10	7	3	2	185	1.51
7:35 - 7:45	171	25	10	2	1	2	211	1.31
8:10 - 8:20	113	32	6	3	1	0	155	1.37
8:45 - 8:55	121	43	4	1	1	2	172	1.40
10:50 - 11:00	98	44	7	2	0	1	152	1.45
11:20 - 4:30	110	38	13	2	0	1	164	1.46
11:50 - 12:00	82	40	9	3	1	0	135	1.52
Subtotal	826	254	59	20	7	8	1,174	1.42
March 15, 1977, P.M.								
2:05 - 2:15	90	37	8	3	1	1	140	1.51
2:35 - 2:45	102	38	10	5	1	2	158	1.55
3:05 - 3:15	129	31	19	5	2	2	188	1.54
3:35 - 3:45	151	49	16	4	0	0	220	1.42
4:20 - 4:30	151	52	14	3	1	3	224	1.48
4:50 - 5:00	150	50	10	1	2	2	215	1.42
5:20 - 5:30	152	35	12	6	0	1	206	1.40
Subtotal	925	292	89	27	7	11	1,351	1.47
Total	1,751	546	148	47	14	19	2,525	1.45

APPENDIX E (cont.)

SOUTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
March 16, 1977, A.M.								
7:15 - 7:25	172	41	17	9	0	1	240	1.41
7:50 - 8:00	151	23	7	2	0	0	183	1.23
8:30 - 8:40	135	33	10	3	1	1	183	1.39
9:00 - 9:10	98	21	9	3	0	0	131	1.37
10:35 - 10:45	92	28	5	4	0	0	129	1.39
11:05 - 11:15	89	29	9	2	1	0	130	1.44
11:35 - 11:45	103	45	10	4	0	0	162	1.48
Subtotal	840	220	67	27	2	2	1,158	1.39
March 15, 1977, P.M.								
2:20 - 2:30	120	44	9	5	4	0	182	1.51
2:50 - 3:00	119	56	10	2	1	0	188	1.46
3:20 - 3:30	131	41	13	4	0	1	190	1.44
4:00 - 4:10	141	55	16	5	1	1	219	1.51
4:35 - 4:45	187	75	30	10	1	3	306	1.60
5:05 - 5:15	183	62	11	5	0	1	262	1.40
5:35 - 5:45	132	49	9	4	1	0	195	1.42
Subtotal	1,013	382	98	35	8	6	1,542	1.48
Southbound Total	1,853	602	165	62	10	8	2,700	1.44
Northbound Total	1,751	546	148	47	14	19	2,525	1.45
Total Both Directions	3,604	1,148	313	109	24	27	5,225	1.45

APPENDIX E (cont.)

NORTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occupancy Rate
	1	2	3	4	5	>5		
May 17, 1977, A.M.								
7:00 - 7:15	210	57	9	8	2	0	286	1.37
7:15 - 7:30	232	43	17	3	0	0	295	1.29
7:30 - 7:45	248	52	15	8	2	5	330	1.42
7:45 - 8:00	246	47	7	2	0	0	302	1.22
8:00 - 8:15	196	52	11	2	0	4	265	1.38
8:15 - 8:30	168	43	13	2	1	7	234	1.49
8:30 - 8:45	161	60	13	2	0	1	237	1.41
8:45 - 9:00	199	55	13	4	2	4	277	1.44
9:00 - 9:15	181	54	11	9	1	1	257	1.44
9:15 - 9:30	207	73	9	13	4	9	315	1.61
9:30 - 9:45	188	80	9	9	4	3	293	1.53
9:45 - 10:00	161	87	11	10	2	4	275	1.61
10:00 - 10:15	187	72	14	13	2	2	290	1.54
10:15 - 10:30	163	65	13	6	1	1	249	1.47
10:30 - 10:45	134	75	16	4	3	2	234	1.60
10:45 - 11:00	123	61	15	6	0	0	205	1.53
11:00 - 11:15	163	68	11	7	5	3	257	1.57
11:15 - 11:30	161	79	15	3	1	1	260	1.49
Subtotal	3,328	1,123	222	111	30	47	4,861	1.46
May 16, 1977, P.M.								
2:00 - 2:15	143	81	14	4	1	4	247	1.59
2:15 - 2:30	159	77	11	9	2	6	264	1.62
2:30 - 2:45	152	75	25	9	1	3	267	1.66
2:45 - 3:00	146	81	24	10	0	2	263	1.64
3:00 - 3:15	157	102	28	11	1	4	303	1.71
3:15 - 3:30	193	99	17	9	1	1	320	1.53
3:30 - 3:45	202	96	26	11	1	3	339	1.59
3:45 - 4:00	214	89	24	5	0	0	332	1.46
4:00 - 4:15	217	113	22	15	3	2	372	1.60
4:15 - 4:30	243	121	20	8	1	4	397	1.53
4:30 - 4:45	233	109	19	11	1	2	375	1.52
4:45 - 5:00	229	92	27	6	2	3	359	1.52
5:00 - 5:15	203	87	17	10	3	1	321	1.52
5:15 - 5:30	231	75	12	6	4	1	329	1.42
Subtotal	2,722	1,297	288	124	21	36	4,488	1.56
Total	6,050	2,420	510	235	51	83	9,349	1.51

APPENDIX E (cont.)

SOUTHBOUND LANE

Hour	Vehicles with the Following Number of Occupants						Total Vehicles	Occ par Rat
	1	2	3	4	5	>5		
May 17, 1977, A.M.								
7:00 - 7:15	234	38	11	2	0	1	286	1.2
7:15 - 7:30	240	49	12	5	4	2	312	1.3
7:30 - 7:45	263	60	11	3	0	0	337	1.2
7:45 - 8:00	209	33	7	5	2	3	259	1.3
8:00 - 8:15	190	38	12	2	3	0	245	1.3
8:15 - 8:30	168	50	10	5	2	1	236	1.4
8:30 - 8:45	123	38	13	6	2	0	182	1.4
8:45 - 9:00	167	45	16	10	1	1	240	1.4
9:00 - 9:15	185	52	8	6	2	3	256	1.4
9:15 - 9:30	124	55	11	6	0	0	196	1.4
9:30 - 9:45	142	58	11	2	0	4	217	1.4
9:45 - 10:00	127	53	15	9	3	1	208	1.6
10:00 - 10:15	131	80	14	5	1	4	235	1.6
10:15 - 10:30	146	73	16	3	4	2	244	1.5
10:30 - 10:45	132	79	19	11	3	0	244	1.6
10:45 - 11:00	122	61	19	5	3	2	202	1.6
11:00 - 11:15	119	62	17	5	3	6	212	1.7
11:15 - 11:30	129	72	12	2	1	1	217	1.5
Subtotal	2,951	986	234	92	34	31	4,328	1.4
May 16, 1977, P.M.								
2:00 - 2:30	141	69	15	3	2	2	232	1.5
2:15 - 2:30	107	47	12	6	2	1	175	1.5
2:30 - 2:45	131	56	13	2	4	0	206	1.5
2:45 - 3:00	107	62	14	8	2	2	195	1.6
3:00 - 3:15	145	67	15	10	3	2	242	1.6
3:15 - 3:30	137	56	8	9	2	2	214	1.5
3:30 - 3:45	158	60	21	12	2	0	253	1.5
3:45 - 4:00	168	75	13	12	0	5	273	1.5
4:00 - 4:15	169	83	14	6	5	0	277	1.5
4:15 - 4:30	183	84	20	3	3	3	296	1.5
4:30 - 4:45	264	102	31	30	6	7	440	1.7
4:45 - 5:00	175	88	30	11	1	4	309	1.6
5:00 - 5:15	183	74	26	10	0	1	294	1.5
5:15 - 5:30	179	76	10	7	2	3	277	1.4
Subtotal	2,247	999	242	129	34	32	3,683	1.5
Southbound Total	5,198	1,985	476	221	68	63	8,011	1.5
Northbound Total	6,050	2,420	510	235	51	83	9,349	1.5
Total Both Directions	11,248	4,405	986	456	119	146	17,360	1.5

APPENDIX F

TRIP TABLES – BEFORE PERIOD

Origin Zone	Destination Zone													Total
Zones	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	
1.	3 10.3	3 10.3	4 13.8	1 3.4	6 20.7	5 17.2	3 10.3	2 6.9	0 0	2 6.9	0 0	0 0	0 0	29 3.0
2.	3 6.7	5 11.1	10 22.2	2 4.4	9 20.0	7 15.6	2 4.4	4 8.9	0 0	2 4.4	1 2.2	0 0	0 0	45 4.7
3.	7 4.3	15 9.1	37 22.6	6 3.7	39 23.8	26 15.9	13 7.9	8 4.9	0 0	6 3.7	3 1.8	1 .6	2 1.2	163 17.0
4.	6 4.5	18 13.4	26 19.4	1 .7	32 23.9	18 13.4	14 10.4	9 6.7	0 0	5 3.7	4 3.0	0 0	1 .7	134 13.9
5.	13 19.1	7 10.3	13 19.1	2 2.9	23 33.8	5 7.4	3 4.4	0 0	0 0	2 2.9	0 0	0 0	0 0	68 7.1
6.	0 0	3 27.3	1 9.1	0 0	1 9.1	2 18.2	2 18.2	0 0	0 0	2 18.2	0 0	0 0	0 0	11 1.1
7.	1 1.5	9 13.8	9 13.8	0 0	18 27.7	9 13.8	7 10.8	5 7.7	1 1.5	2 3.1	2 3.1	0 0	2 3.1	65 6.7
8.	11 16.4	8 11.9	10 14.9	0 0	19 28.4	8 11.9	4 6.0	3 4.5	0 0	0 0	2 3.0	0 0	2 3.0	67 7.0
9.	7 13.0	8 14.8	10 18.5	2 3.7	12 22.2	7 13.0	4 7.4	1 1.9	0 0	0 0	1 1.9	0 0	2 3.7	54 5.6
10.	15 14.4	12 11.5	17 16.3	3 2.9	35 33.7	8 7.7	5 4.8	2 1.9	1 1.0	3 2.9	3 2.9	0 0	0 0	104 10.8
22.	0 0	0 0	0 0	0 0	1 50.0	0 0	1 50.0	0 0	0 0	0 0	0 0	0 0	0 0	2 .2
24.	2 8.3	3 12.5	3 12.5	0 0	6 25.0	4 16.7	3 12.5	1 4.2	1 4.2	1 4.2	0 0	0 0	0 0	24 2.5
25.	14 7.1	20 10.2	26 13.3	1 .5	50 25.5	25 12.8	38 19.4	10 5.1	5 2.6	1 .5	4 2.0	0 0	2 1.0	196 20.4
Total	82 8.5	111 11.5	166 17.2	18 1.9	251 26.1	124 12.9	99 10.3	45 4.7	8 .8	26 2.7	20 2.1	1 .1	11 1.1	962 100.0

APPENDIX F (cont.)

TRIP TABLES — BEFORE PERIOD

Zones	Destination Zone												
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	24.	25.	Total
11.	4 5.6	3 4.2	12 16.9	7 9.9	4 5.6	1 1.4	1 1.4	4 5.6	11 15.5	15 21.1	4 5.6	5 7.0	71 6.9
12.	7 7.1	4 4.0	15 15.2	18 18.2	7 7.1	4 4.0	4 4.0	7 7.1	9 9.1	10 10.1	2 2.0	12 12.1	99 9.6
13.	10 5.7	8 4.5	34 19.3	29 16.5	11 6.3	2 1.1	7 4.0	12 6.8	10 5.7	22 12.5	5 2.8	25 14.2	175 17.0
14.	2 9.5	2 9.5	5 23.8	1 4.8	3 14.3	0 0	3 14.3	1 4.8	0 0	1 4.8	1 4.8	2 9.5	21 2.0
15.	3 1.3	9 3.9	51 22.3	36 15.7	18 7.9	0 0	12 5.2	18 7.9	16 7.0	34 14.8	8 3.5	24 10.5	229 22.1
16.	2 1.4	8 5.6	34 23.8	25 17.5	6 4.2	1 .7	16 11.2	3 2.1	7 4.9	8 5.6	5 3.5	28 19.6	143 13.8
17.	8 5.9	7 5.1	21 15.4	17 12.5	6 4.4	3 2.2	14 10.3	6 4.4	3 2.2	12 8.8	6 4.4	33 24.3	136 13.1
18.	1 2.0	6 12.2	10 20.4	4 8.2	6 12.2	0 0	6 12.2	2 4.1	3 6.1	4 8.2	3 6.1	4 8.2	49 4.7
19.	0 0	0 0	9 31.0	2 6.9	1 3.4	1 3.4	2 6.9	1 3.4	0 0	7 24.1	2 6.9	4 13.8	29 2.8
20.	1 3.0	0 0	3 9.1	5 15.2	2 6.1	2 6.1	3 9.1	1 3.0	3 9.1	5 15.2	2 6.1	6 18.2	33 3.2
21.	0 0	2 6.9	9 31.0	3 10.3	1 3.4	0 0	1 3.4	2 6.9	1 3.4	5 17.2	0 0	5 17.2	29 2.8
22.	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 100.0	0 0	1 .1
23.	0 0	0 0	2 11.1	0 0	1 5.6	0 0	1 5.6	0 0	2 11.1	0 0	3 16.7	9 50.0	18 1.7
Total	38 3.7	49 4.7	205 19.8	147 14.2	66 6.4	14 1.4	70 6.8	57 5.5	65 6.3	123 11.9	42 4.1	157 15.2	1,033 100.0

Origin Zone

APPENDIX F (cont.)

TRIP TABLES — AFTER PERIOD

Zones	Destination Zone													
	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	Total
1.	0 0	2 8.7	7 30.4	3 13.0	5 21.7	3 13.0	1 4.3	2 8.7	0 0	0 0	0 0	0 0	0 0	23 3.4
2.	1 3.3	7 23.3	1 3.3	1 3.3	5 16.7	8 26.7	1 3.3	4 13.3	1 3.3	0 0	1 3.3	0 0	0 0	30 4.4
3.	7 5.3	21 15.9	22 16.7	2 1.5	34 25.8	19 14.4	4 3.0	8 6.1	8 6.1	2 1.5	5 3.8	0 0	0 0	132 19.4
4.	7 8.0	19 21.6	10 11.4	2 2.3	17 19.3	9 10.2	12 13.6	8 9.1	1 1.1	2 2.3	1 1.1	0 0	0 0	88 12.9
5.	3 5.8	1 1.9	15 28.8	5 9.6	18 34.6	1 1.9	4 7.7	1 1.9	0 0	2 3.8	0 0	0 0	2 3.8	52 7.6
6.	0 0	0 0	0 0	1 25.0	1 25.0	1 25.0	0 0	0 0	0 0	1 25.0	0 0	0 0	0 0	4 .6
7.	0 0	5 14.7	7 20.6	1 2.9	5 14.7	6 17.6	5 14.7	1 2.9	2 5.9	1 2.9	1 2.9	0 0	0 0	34 5.0
8.	2 4.4	5 11.1	7 15.6	1 2.2	16 35.6	8 17.8	4 8.9	1 2.2	1 2.2	0 0	0 0	0 0	0 0	45 6.6
9.	5 11.9	8 19.0	8 19.0	1 2.4	9 21.4	6 14.3	2 4.8	1 2.4	1 2.4	0 0	1 2.4	0 0	0 0	42 6.2
10.	8 9.2	14 16.1	15 17.2	1 1.1	32 36.8	7 8.0	1 1.1	2 2.3	2 2.3	2 2.3	1 1.1	0 0	2 2.3	87 12.8
22.	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 50.0	1 50.0	0 0	0 0	0 0	0 0	2 .3
24.	0 0	4 14.3	7 25.0	2 7.1	1 3.6	5 17.9	2 7.1	5 17.9	0 0	1 3.6	0 0	0 0	1 3.6	28 4.1
25.	4 3.5	13 11.3	11 9.6	2 1.7	16 13.9	19 16.5	24 20.9	6 5.2	3 2.6	6 5.2	2 1.7	2 1.7	7 6.1	115 16.9
Total	37 5.4	99 14.5	110 16.1	22 3.2	159 23.3	92 13.5	60 8.8	40 5.9	20 2.9	17 2.5	12 1.8	2 .3	12 1.8	682 100.0

Origin Zone

TRIP TABLES — AFTER PERIOD

Origin Zone	Destination Zone												
Zones	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	24.	25.	Total
11.	2 3.2	1 1.6	11 17.5	9 14.3	8 12.7	0 0	2 3.2	6 9.5	8 12.7	11 17.5	2 3.2	3 4.8	63 9.0
12.	2 1.9	4 3.8	26 24.5	20 18.9	4 3.8	1 .9	5 4.7	8 7.5	10 9.4	5 4.7	4 3.8	17 16.0	106 15.1
13.	9 6.8	3 2.3	31 23.5	9 6.8	12 9.1	0 0	11 8.3	13 9.8	9 6.8	9 6.8	2 1.5	24 18.2	132 18.8
14.	0 0	2 16.7	2 16.7	2 16.7	1 8.3	1 8.3	1 8.3	0 0	0 0	1 8.3	1 8.3	1 8.3	12 1.7
15.	7 4.3	9 5.5	34 20.9	20 12.3	18 11.0	1 .6	10 6.1	11 6.7	11 6.7	23 14.1	4 2.5	15 9.2	163 23.3
16.	1 1.1	7 7.7	18 19.8	3 3.3	2 2.2	0 0	12 13.2	5 5.5	9 9.9	8 8.8	5 5.5	21 23.1	91 13.0
17.	0 0	3 6.0	10 20.0	5 10.0	3 6.0	0 0	3 6.0	1 2.0	3 6.0	1 2.0	4 8.0	17 34.0	50 7.1
18.	1 3.2	0 0	4 12.9	6 19.4	1 3.2	1 3.2	5 16.1	4 12.9	1 3.2	1 3.2	0 0	7 22.6	31 4.4
19.	0 0	0 0	1 16.7	1 16.7	0 0	0 0	1 16.7	1 16.7	1 16.7	1 16.7	0 0	0 0	6 .9
20.	1 5.3	0 0	3 15.8	1 5.3	2 10.5	0 0	1 5.3	1 5.3	0 0	0 0	0 0	10 52.6	19 2.7
21.	0 0	0 0	6 40.0	2 13.3	1 6.7	0 0	1 6.7	0 0	1 6.7	1 6.7	0 0	3 20.0	15 2.1
22.	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 100.0	0 0	0 0	0 0	0 0	1 .1
23.	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 9.1	10 90.9	11 1.6
Total	23 3.3	29 4.1	146 20.8	78 11.3	52 7.4	4 .6	52 7.4	51 7.3	53 7.6	61 8.7	23 3.3	128 18.3	700 100.0