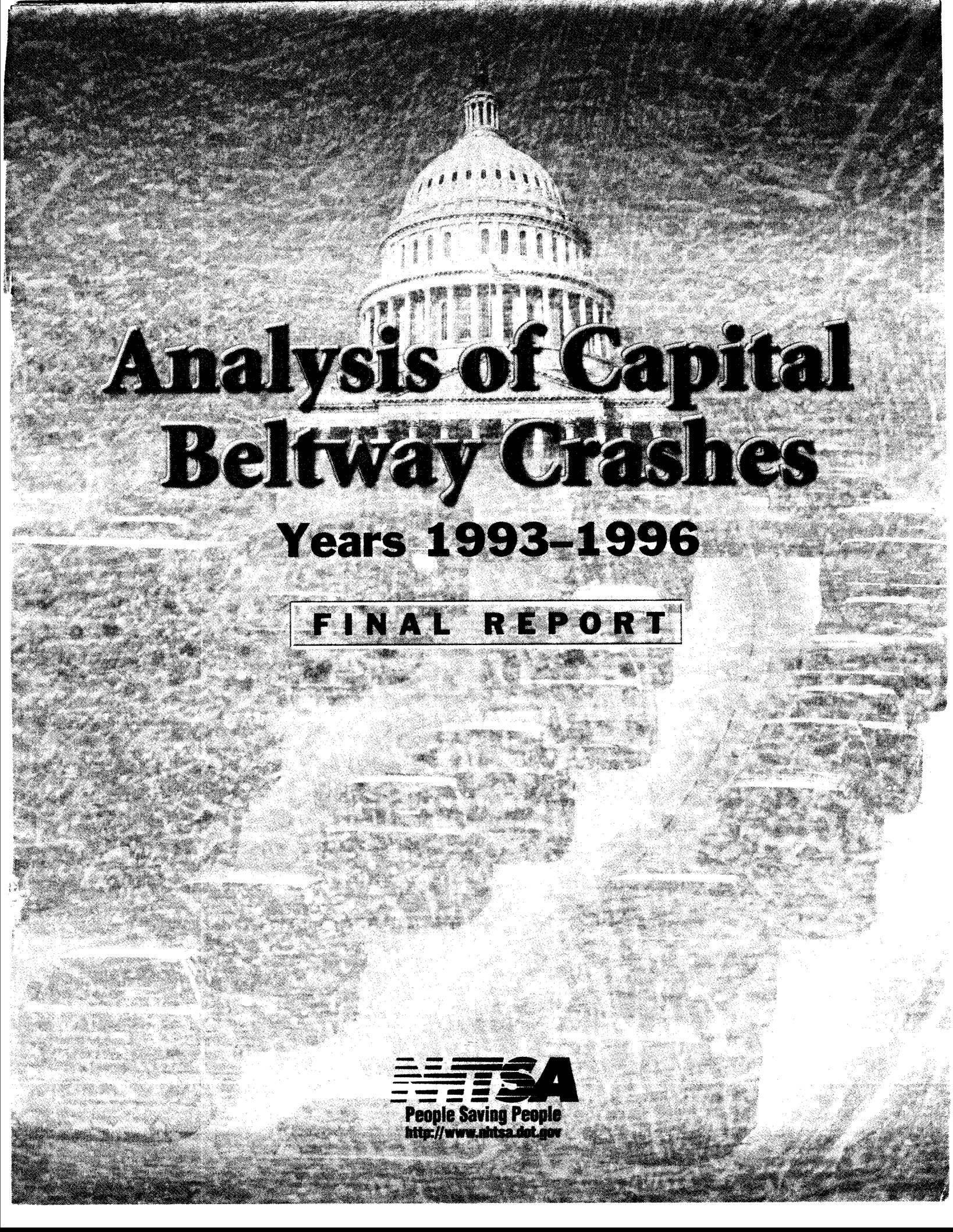

Analysis of Capital Beltway Crashes

Years 1993–1996

FINAL REPORT

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Dr. Linda Cosgrove served as the NHTSA Contracting Officer's Technical Representative for the study.

16. Abstract

The sixty-four mile interstate highway system encircling Washington, D.C. is known as the Capital Beltway. Hard-copy crash reports for all crash events occurring on the Capital Beltway during the period 1993 through 1996 (N=9,403) were provided by Maryland and Virginia. From 1993 to 1996 total crashes decreased per million vehicle miles traveled (from .45 to .43); injury/fatal crashes decreased (from .19 to .18); alcohol related crashes decreased as a proportion of total crashes (from 8.1 percent to 6.8 percent) and fatal crashes dropped by nearly half (from 17 to 9). Crash type distribution remained relatively consistent over time. Three major crash types accounted for 78 percent of all crashes. The most common type of crash was *stop/slowing* (36 percent of all crashes). Congestion was typically a factor in these crashes. *Ran off road* was second (24.3 percent) and sideswipe/cutoff was third (17.8 percent). Tractor-trailers remained relatively consistent as a proportion of total vehicles in crashes. The number of crash involved straight trucks increased.

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I. Introduction

The Capital Beltway Safety Team (CBST) was formed in January 1994 with the intent to better understand and address safety problems on the Capital Beltway. Since the group's inception, the CBST has strived to identify needs and implement measures that promote a safer driving environment for Beltway motorists.

Technical support for the CBST has been provided by, among others, the Federal Highway Administration and the National Highway Traffic Safety Administration (NHTSA). The present report is part of a series of reports that provides technical support by NHTSA through the Preusser Research Group, Inc. (PRG). This work was performed under Contract Number DTNH22-97-D-05018 between NHTSA and PRG.

II. Background

The sixty-four mile interstate highway system encircling Washington, D.C. is known as the Capital Beltway. The Capital Beltway is characterized as an over-utilized roadway system. Many segments are inadequate for the volume of traffic they carry. At times, congestion is the norm. Although capacity improvements have been made, the number of vehicles using this roadway continues to rise.

In 1994, Preusser Research Group (PRG) obtained Capital Beltway crash report data for a twelve month period, October 1992 through September 1993. PRG analyzed the data and provided the CBST with an identification of driver and vehicle behavior associated with crashes on the Beltway (Preusser et al., 1994). In 1995, crash report data for the period October 1993 through December 1994 were obtained. Using data for calendar years 1993 and 1994, PRG again provided the CBST with a crash analysis (Solomon et al., 1996). In both studies, crash type analysis was the primary technique used to explain how and why crashes had occurred.

More recent Beltway crash data, for years 1995 and 1996, have since been obtained. These data, aggregated with the prior data, are used to examine trends in crashes that occurred over the four year period 1993 through 1996. Special attention is given to examining crashes by crash type and vehicle miles traveled.

III. Method

Previously, the states of Maryland and Virginia had provided hard-copy crash reports for all crash events occurring on the Capital Beltway during 1993 and 1994 (N = 4,447). For the current study, Maryland and Virginia provided additional crash reports for all crash events occurring on the Capital Beltway during 1995 and 1996. Each report was assigned a case number for tracking purposes. The reports were then screened for usability. A usable crash report documents an event that included one or more vehicles involved in a collision. This event must have occurred on, or originated from: the mainlines of travel; ramps leading to and away from the Beltway; or collector distributor lanes. Reports not meeting these criteria were removed. All non-Beltway crash reports were removed. Several Maryland reports detailed a non-collision vehicle fire. These were excluded. Finally, duplicate copies of crash reports were removed. After unusable reports were removed, 5,447 crash reports were left, 3,376 from Maryland and 2,071 from Virginia. Reports detailing crashes on ramps leading to and away from Beltway mainlines of travel came mostly from Virginia. Although reports pertaining to crashes on ramps were coded and keypunched, they were not included in the general analysis of Beltway crashes. Therefore, the total number of analyzed reports (N = 4,956) is lower than the number coded and keypunched. Assigning crash codes to these reports was the next step.

Crash Coding

Crash type analysis is a technique that uses established crash type definitions to identify pre-crash characteristics leading to a crash occurrence. The focus is on driver behavior and vehicle movement just prior to a crash event. Numerous studies have used crash type analysis to learn how and why crashes occur. Crash type analysis was developed by Snyder and Knoblauch (1971) and used to study pedestrian crashes (Knoblauch, 1977). The technique has since been applied to the study of bicycle crashes (Cross and Fisher, 1977), motorcycle crashes (Preusser et al., 1995), urban crashes (Retting et al., 1995) and more recently fatal crashes between large trucks and passenger cars (Braver et al., 1996).

The crash type definitions used in this study were developed for classification of crash reports used in the initial CBST study (Preusser et al., 1995). The development of the definitions was an iterative process whereby reports were read and grouped by identifiable defining characteristics. Subsequent groups were formed as appropriate. Crash type codes were then assigned. Crash type definitions used are shown in Table 1.

Using the above pre-defined definitions, the 1995 and 1996 crash reports were coded. Crash type codes were then keypunched with other coded crash report information to form a data set. This newest data set was then combined with the 1993 - 1994 data set to form a single 1993 - 1996 data set usable for computer analysis (N=9,403).

Vehicle Miles Traveled

Vehicle miles traveled (VMT) figures for 1993, 1994 and 1995 were obtained from the U.S. Department of Transportation Computer Center. VMT is given by interstate roadway number and by state and county. VMT for I-495 and I-95 in the Maryland and Virginia counties containing the Beltway were totaled by year. Figures for 1996 were not available at the time of this study. Measured percentage differences between 1993 and 1994 and between 1994 and 1995 were averaged and used to estimate Beltway VMT for 1996. In this document, VMT should be interpreted as annual. VMT is given as million vehicle miles traveled (MVMT). A determination of change in the rate of total crashes and injury/fatal crashes on the Beltway was made using MVMT.

Average Number of Crashes per Tenth Mile

The average number of crashes per tenth mile was determined by counting all crashes within a one-mile range surrounding each tenth mile. The number of crashes for a particular tenth mile was added to the number occurring within the five tenths "upstream" and four tenths "downstream." The total was divided by ten. This method of looking at the distribution of crashes across Beltway mile points serves two purposes. First, officers do not always record crashes at their exact locations but in near proximity (i.e., in whole miles). Second, using a one-mile "moving" average clearly "smoothes" the overall distribution, making trends easier to discern.

The average number of crashes per tenth mile was calculated using data for combined years 1993 and 1994, then again using combined data for years 1995 and 1996. The 1995/1996 averages were then normalized to account for change in VMT since 1993/1994. The difference in average number of crashes per tenth mile between each two-year period was then calculated.

Statistical Significance

Variables of interest are shown by year in Appendices A, B and C. Level of significance is indicated for each.

Table 1. Crash Type Definitions

Major Types

Stop/Slowing One vehicle slows or stops on the roadway and is rear-ended by some other vehicle. Typically, the first vehicle slows or stops in response to congestion. The trailing vehicle does not slow down in time, thus rear-ending the first vehicle.

Ran Off Road A vehicle leaves the road and strikes some object, or overturns, at the roadside, on the shoulder, or at another point off the main travel lanes. Vehicles may leave the roadway for a variety of reasons including loss of control and being forced off the road by some other vehicle.

Sideswipe/Cutoff A vehicle is struck in the side by some other vehicle that is changing lanes. This crash group includes lane changes that were "forced" by traffic congestion ahead. Most often, one car (or light truck, van or motorcycle) sideswipes another car. Second most common is a tractor-trailer sideswiping a car.

Other and Less Frequent Types

Lost Control in Road A vehicle spins, slides or overturns out of control on the main travel lanes. (Similar to "Ran Off Road" except that the first harmful event occurs on the main travel-lanes.)

Run Down One vehicle, traveling straight ahead, is run down from behind by a faster moving vehicle.

Ramp Related Collision between one or more vehicles on the main line and one or more vehicles in the acceleration or deceleration lane(s).

Disabled Vehicle in Road A vehicle becomes disabled, stops on the main line, and is s truck by some other vehicle on the main line. (This type does not include disabled vehicles on the shoulder or median.)

Obstacle in Motion A vehicle is struck by some debris in motion on the main line.

Obstacle in Road A vehicle strikes stationary debris on the main line.

Driver Black-Out Driver loses control of the vehicle because of some medical problem.

Other/Unknown A variety of other circumstances (includes police and highway department activity.)

IV. Results

Crashes Over Time

The number of reported crashes increased each successive year from 1993 through 1996 (Table 2). Vehicle miles traveled also increased each of these years. The crash rate per MVMT remained consistent from 1993 through 1995 (.45) followed by a decrease in 1996 (to .43). The rate of injury/fatal crashes per MVMT was identical from 1993 through 1995 (.19) followed by a decrease in 1996 (to .18).

In Maryland, the number of reported crashes in 1993 equaled 1,323. By 1994, a relatively small decrease occurred (to 1,301). Between 1994 and 1995, the number increased by 26.7 percent (to 1,649). The number remained nearly identical in 1996 (1,640). Over the four year period, crash rates per MVMT went from .45 in 1993 to its lowest in 1994 (.43), highest in 1995 (.50) and dropped to .46 in 1996. The rate of injury/fatal crashes was highest in 1993 (.22). By 1996, the injury/fatal crash rate was .20.

The number of reported crashes in Virginia increased 14.5 percent from 1993 (850) to 1994 (973). The number decreased by 18.5 percent in 1995 (to 793), then increased 10.2 percent for the year 1996 (874). Per MVMT, crash rates increased from 1993 (.44) to 1994 (.47), but then decreased in 1995 (to .37), followed by a relatively small increase in 1996 (to .38). Injury/fatal crashes on a MVMT basis were identical for years 1993, 1995 and 1996 (.15). The rate in 1994 equaled .17.

Table 2. Total Crashes and Injury/Fatal Crashes per Million Vehicle Miles Traveled (MVMT) by State and Year

	Year			
	1993	*1994*	*1995*	*1996*
Beltway				
MVMT	4,872.0	5,091.7	5,484.4	5,825.2*
Total Crashes	2,173	2,274	2,442	2,514
Per MVMT	.45	.45	.45	.43
Injury/Fatal Crashes	949	947	1,021	1,048
Per MVMT	.19	.19	.19	.18
Maryland				
MVMT	2,929.6	3,009.1	3,317.0	3,535.6*
Total Crashes	1,323	1,301	1,649	1,640
Per MVMT	.45	.43	.50	.46
Injury/Fatal Crashes	655	589	703	714
Per MVMT	.22	.20	.21	.20
Virginia				
MVMT	1,942.8	2,082.6	2,167.3	2,289.6*
Total Crashes	850	973	793	874
Per MVMT	.44	.47	.37	.38
Injury/Fatal Crashes	294	358	318	334
Per MVMT	.15	.17	.15	.15

* estimated

The number of injury/fatal crashes per route has shifted over time (Figure 1). In Maryland, the number of injury/fatal crashes on I-495 decreased by 36.6 percent from 1993 to 1996 while I-95 injury/fatal crashes increased by 42.4 percent. During the same time period, injury/fatal crashes in Virginia increased by 39.2 percent on I-495 and decreased by 27.3 percent on I-95.

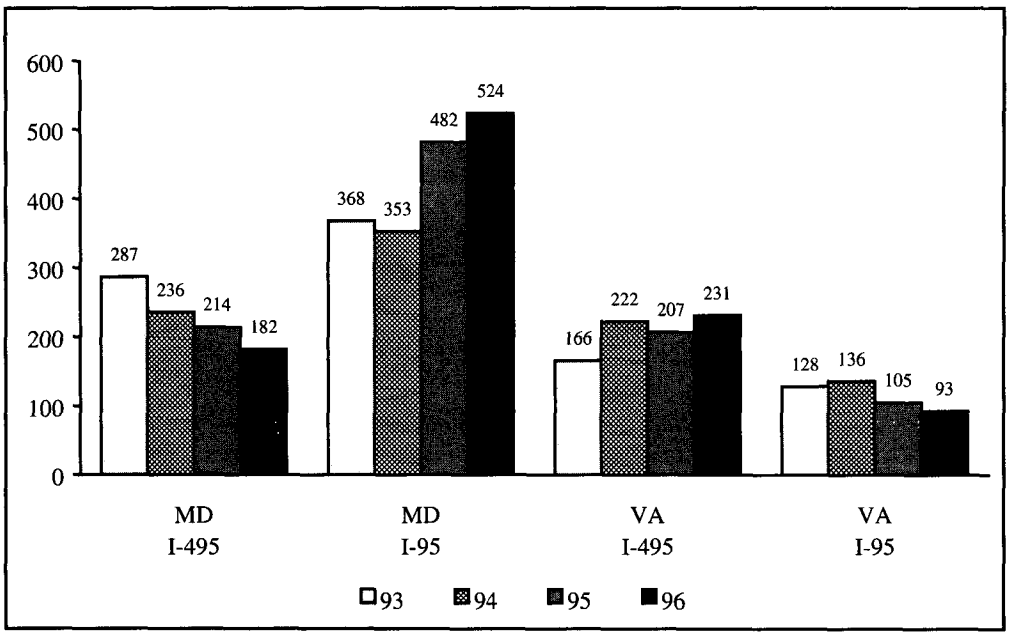

Fig. 1. Number of Injury/Fatal Crashes per State, Route and Year

Crash Types

Overall, the distribution of crashes by crash type remained relatively consistent over time. The three most frequently occurring crash type categories, *stop/slowing*, *ran off road* and *sideswipe/cutoff*, accounted for 7,335 crashes (Table 3). This equals 78.0 percent of the total crashes. The remaining 2,068 crashes (22.0 percent) were distributed in less frequent categories. Two less frequent categories contained over half of these crashes, *lost control in road* (6.7 percent) and *run down* (5.3 percent). Per state, the distribution also has remained relatively consistent (Table 4).

Stop/Slowing (3,381 crashes; 36.0 percent)

Beltway crashes were most frequently coded *stop/slowing*. In this category, the lead vehicle slowed, stopped or was beginning to accelerate from a stopped position in a main travel lane and was struck by a second vehicle coming from behind. In most cases, the crash report had enough information to assign a sub-group of *stop/slowing*. Five sub-groups were assigned: *congestion related*; *lead vehicle swerve*; *follow vehicle swerve*; *not congestion related*; and *unknown*.

Typically, *stop/slowing crashes* were *congestion related* (2,756). Reports indicated that a lead vehicle slowed or stopped due to congestion and a following vehicle, coming from behind, in the same travel lane, did not reduce speed quickly enough to avoid a rear-end collision.

Two variations of *stop/slowing* crashes that were typically congestion related were *lead vehicle swerve* (113) and *follow vehicle swerve* (118). In *lead vehicle swerve*, a vehicle changed lanes in front of a second vehicle, then slowed down immediately. In *follow vehicle swerve*, a vehicle changed lanes, coming in behind a vehicle that had already slowed or stopped. These two sub-groups usually involved

maneuvers where a swerving vehicle attempted to avoid a *stop/slowing* crash in one lane, only to become involved in a crash in an adjacent lane.

Table 3. Distribution of Crashes by Type and Year

	Year					
Crash Type	*1993*	*1994*	*1995*	*1996*	*Total*	*Percent*
Stop/Slowing	*804*	*807*	*843*	*927*	*3,381*	*36.0%*
Congestion	625	684	683	764	2,756	29.3%
Lead Vehicle Swerve	28	29	28	28	113	1.2%
Follow Vehicle Swerve	39	24	31	24	118	1.3%
Not Congestion	57	47	77	63	244	2.6%
Unknown	55	23	24	48	150	1.6%
Ran Off Road	*513*	*528*	*631*	*610*	*2,282*	*24.3%*
Sideswipe/Cutoff	*362*	*447*	*422*	*441*	*1,672*	*17.8%*
Car > Car	178	185	203	202	768	8.2%
TrT > Car	81	105	112	101	399	4.2%
Car > TrT	49	50	48	61	208	2.2%
Other/Unknown	54	107	59	77	297	3.2%
Other Less Frequent	*494*	*492*	*546*	*536*	*2,068*	*22.0%*
Lost Control in Road	145	157	157	169	628	6.7%
Run Down	116	134	134	110	494	5.3%
Ramp Related	62	54	58	57	231	2.5%
Obstacle in Motion	42	32	29	32	135	1.4%
Obstacle in Road	28	24	31	43	126	1.3%
Disabled Vehicle in Road	39	16	24	16	95	1.0%
Driver Black Out	8	3	2	4	17	0.1%
Other/Unknown	54	72	111	105	342	3.6%
Total	*2,173*	*2,274*	*2,442*	*2,514*	*9,403*	*100.0%*

Table 4. Percent Distribution of Crashes by Major Crash Type, State, and Year

	Maryland				*Virginia*			
Major Crash Type	*1993*	*1994*	*1995*	*1996*	*1993*	*1994*	*1995*	*1996*
Stop/Slowing	32.7	29.7	30.4	31.9	43.6	43.3	43.1	46.2
Ran Off Road	27.1	27.3	28.3	26.5	18.2	17.8	20.7	20.1
Sideswipe/Cutoff	15.3	18.2	17.2	18.4	18.7	21.6	17.5	16.0
Other Less Frequent	24.9	24.8	24.1	23.3	19.4	17.4	18.7	17.6

Fewer crashes could not be associated with traffic congestion and were sub-grouped *not congestion related* (244). These crashes included situations where the lead vehicle slowed because of: mechanical problems; debris on the roadway; some other obstruction; or an illegal stop or turn.

Some crashes (150), for various reasons, could not be sub-grouped and were coded *unknown.*

Ran Off Road (2,282; 24.3 percent)

Ran off road was the second most frequently occurring crash type. In this situation, a vehicle left the main travel lanes and overturned or struck some off-road object. Unlike *stop/slowing*, these events were not typically congestion related and usually involved a single vehicle.

Sideswipe/Cutoff (1,672; 17.8 percent)

Sideswipe/cutoff was the third most frequently occurring crash type. This group of crashes involved a vehicle changing lanes into another vehicle. They differed from *lead vehicle swerve* and *follow vehicle swerve* crashes in that the crash occurred during the lane change and not immediately thereafter. Reports indicated that congestion was often a factor in *sideswipe/cutoff* crashes and that lane change maneuvers were often in response to slower moving traffic ahead. In some cases, the maneuver was made while attempting to exit the Beltway, and in a few cases, the maneuver was made by an inattentive driver.

Four sub-groups were assigned to *sideswipe/cutoff.* The sub-groups were used to identify each type of vehicle involved and indicated which vehicle was the striker. The sub-groups include *light vehicles crashing into light vehicles* (768); *tractor-trailers crashing into light vehicles* (399); *light vehicles crashing into tractor-trailers* (208); and *other/unknown* (297). Crashes involving straight trucks were included in *other/unknown.*

Other and Less Frequent Types

Lost Control in Road (628; 6.7 percent)

This less frequent crash type is similar to *ran off road.* The difference is that the harmful event occurred on a main travel lane. A vehicle in a *lost control in road* crash first lost control on the main travel lanes then experienced a harmful event on the main travel lanes. These crashes were typically multiple vehicle events.

Run Down (494; 5.3 percent)

In these crashes, a lead vehicle traveling at a constant rate of speed was literally "run down" from behind by a faster moving vehicle. These crashes were most often caused by inattentive drivers who were speeding or going too fast for roadway conditions.

Ramp Related (231; 2.5 percent)

Crashes coded *ramp related* involved a vehicle on an acceleration or deceleration lane attempting to move onto or off of the Beltway. A crash event qualified as *ramp related* when the first harmful event occurred during the merge action. Some of these crashes had characteristics of a *sideswipe/cutoff* crash or a *stop/slowing* crash but were distinguished from these two other crash types by the physical location on the ramp.

Obstacle in Motion (135; 1.4 percent)

In these crashes, debris moving along or across the road struck, or was struck by a vehicle in transit. The severity of these crashes appeared dependent upon the size of the obstacle in motion. Typical obstacles included tires or tire parts, rocks and other loose materials falling from trucks.

Obstacle in Road (126; 1.3 percent)

This crash type is similar to *obstacle in motion,* except that the debris struck was resting in the roadway.

Disabled Vehicle in Road (95; 1.0 percent)

In these crashes, one vehicle struck a second that had become disabled on the main travel lanes.

Driver Black Out (17; 0.1 percent)

This crash type covered specific medical conditions, such as a heart attack or seizure. This type does not include drivers who fell asleep or who were intoxicated.

Other/Unknown (342; 3.6 percent)

This crash type included situations where the dynamics of the crash could not be determined. Also included in this category were situations related to police and/or highway department activity.

Crash Type Characteristics

Beltway crash reports include information describing pertinent crash characteristics. Examination of selected characteristics provided evidence for when and under what conditions crashes occurred. Characteristics were examined by year, 1993 through 1996. Most of the characteristics displayed relatively little or no change over time. The sections below focus on whether or not change occurred, patterns of crash characteristics and crash type distribution among these characteristics.

Time of Day

Level of traffic can influence when crashes will occur. Beltway traffic is heaviest during weekday rush hour periods and, to a less extent, the daylight time in between. On the Beltway, more traffic often means more congestion. A crash type like *stop/slowing*, more times than not, involves traffic congestion. Therefore, this type of crash is more likely to happen when traffic congestion is present. Traffic congestion has less influence on the other crash types, and therefore, these types are spread more evenly across hours of the day.

The distribution of crashes by hour remained relatively unchanged between 1993 and 1996. Across all years, crashes occurred most often during the afternoon rush hours 3:00 p.m. to 6:59 p.m. (28.3 percent). The 5 p.m. hour had the greatest frequency of crashes (8.7 percent). A relatively large number of crashes occurred during the morning rush hours, 6:00 a.m. to 9:59 a.m. (21.6 percent). Combined, the two rush hour periods contained nearly one-half of the Beltway crashes (49.9 percent).

Ran off road was the most evenly distributed crash type. These crashes occurred at all hours. Less frequent crash types also occurred at all hours of the day but with small increases around the rush hour periods. *Sideswipe/cutoff* was present primarily during daytime and early evening hours. *Stop/slowing* was less likely to occur in early a.m. hours and late p.m. hours. Instead, these crashes occurred most often during rush hour periods. Rush hour periods were dominated by *stop/slowing*. Between 6:00 a.m. and 9:59 a.m., 44.2 percent of crashes were *stop/slowing* and between 3:00 p.m. to 6:59 p.m., 54.3 percent. In comparison, *stop/slowing* makes up 36.0 percent of total crashes.

Day of Week

Virtually no change occurred in the distribution of crashes by day of week. Across all years, the number of crashes increased on successive weekdays, Monday (13.5 percent), Tuesday (14.5 percent) and Wednesday (15.3 percent). The percentage of crashes on Thursdays (15.0 percent) was only -.3 of a percentage point less than on Wednesday. More crashes occurred on Friday (19.3 percent) than on any other day. Fewer crashes occurred on weekend days: Saturday (12.4 percent) and Sunday (9.6 percent).

Twice as many *stop/slowing* crashes occurred on a weekday than on a Saturday or a Sunday. Overall, 85.7 percent of *stop/slowing* crashes occurred on the five weekdays. *Ran off road* crashes occurred more on a weekend day than any other crash type. Over one-third (35.2 percent) occurred on weekend days. In comparison, only 14.1 percent of *stop/slowing*, 21.0 percent of *sideswipe/cutoff* and 24.0 percent of the combined *other less frequent* types occurred on Saturday and Sunday. *Ran off road* crashes accounted for 41.0 percent of weekend crashes. In comparison, they account for only 24.3 percent of total crashes.

Month of Year

The distribution of crashes by month remained relatively even across all months. Crash type distribution also was relatively even across all months.

Weather Conditions

The distribution of crashes by weather condition remained relatively consistent over time. Most crashes occurred in clear weather (78.5 percent). Some (19.8 percent) occurred during rain or snow, and few (1.3 percent) were reported in fog.

Road Surface Condition

Road surface condition on which crashes occurred remained mostly consistent. Most crashes were on dry roads (71.1 percent), some were on wet roads (23.6 percent), and a small percentage were on snowy (2.5 percent) or icy roads (2.3 percent). Icy conditions in calendar year 1994 (5.2 percent) were more frequent than in other years. Icy roads contributed to 1.4 percent of crashes in 1993 and 1.3 percent in 1995 and 1996.

Weather and road surface conditions were likely contributing factors in some of the Beltway crashes. The percentage of *ran off road* (27.4 percent) and *lost control in road* (44.5 percent) crashes that occurred in the rain or snow was much higher than the percentage of *stop/slowing* (16.5 percent) and *sideswipe/cutoff* (13.2 percent) crashes. Likewise, *ran off road* (38.7 percent) and *lost control in road* (57.8 percent) occurred on wet, snowy or icy pavement more than *stop/slowing* (23.9 percent) and *sideswipe/cutoff* (19.5 percent).

Alcohol in Crashes

The total number of alcohol and drug related crashes across 1993 through 1996 was 663, 7.1 percent of the total crashes (Table 5). Over the four-year period, alcohol related crashes were proportionally highest in 1993 and lowest in 1994. In 1995, the number of alcohol related crashes surpassed the 1993 total but did not surpass as a proportion of the total crashes. In 1996, the number and proportion decreased again but did not decrease below 1994 levels.

Table 5. Number and Percent of Alcohol and Drug Related Crashes per MVMT by Year

	Year				
	1993	*1994*	*1995*	*1996*	*Total*
Total Crashes	2,173	2,274	2,442	2,514	9,403
Number Unrelated	1,998	2,139	2,260	2,343	8,740
Number Related	175	135	182	171	663
Percent Related	*8.1*	*5.9*	*7.5*	*6.8*	*7.1*

Alcohol related crashes occurred most on Saturday (21.7 percent) followed by Sunday and Friday (18.1 percent). They occurred less Monday through Thursday (9 percent to 13.6 percent).

Alcohol or drug use was present in four of the 55 fatal crashes (7.3 percent). The percentage of injury/fatal crashes that was alcohol related equaled 8.9 percent in 1993, 6.2 percent in 1994, 8.7 percent in 1995 and 8.7 percent in 1996. The percentage of injury/fatal crashes that was alcohol related (8.2 percent) was slightly higher than the average percentage (7.1 percent) for total crashes.

Passenger vehicle drivers were reportedly under the influence of alcohol or drugs or some combination at a rate of 4.8 percent. In comparison, 1.5 percent of tractor-trailer and straight truck drivers were reportedly using alcohol or drugs. There was a high percentage of "unknown alcohol use" in driver data. Use was either not reported or unknown for 12.3 percent of the passenger vehicle drivers, 11.9 percent of the tractor-trailer drivers and 9.3 percent of the straight truck drivers.

Alcohol related crashes were distributed differently than non-alcohol related crashes among crash types (Table 6). The difference appeared each year, 1993 through 1996. Alcohol related crashes were distributed mostly in *ran off road* (42.9 percent) whereas a much lower percent of non-alcohol related crashes were *ran off road* (22.9 percent). Alcohol related crashes also were less often *stop/slowing* (14.4 percent) than non-related crashes (37.6 percent). Both related and non-related crashes were relatively the same in their distribution for *sideswipe/cutoff.*

Table 6. Percent Distribution of Alcohol Related Crashes by Crash Type

	Crash Type				
	Stop/ Slowing	*Sideswipe/ Cutoff*	*Ran Off Road*	*Other*	*Total*
Alcohol Related	14.4	16.4	42.9	26.3	*100.0*
Not Related	37.6	17.9	22.9	21.7	*100.0*
Total Crashes	36.0	17.8	24.3	22.0	*100.0*

Fatal Crashes

Between 1993 and 1996 fatal crashes decreased in number each succeeding year. The total number of fatal crashes in 1996 was nine, nearly half the total in 1993 (Figure 2).

Fatal crashes occurred more often on Maryland Beltway portions. From 1993 to 1996, 42 (76.4 percent) of the fatal crashes occurred in Maryland and 13 (23.6 percent) in Virginia. Fatal crashes in Maryland occurred more often on I-95 (33) than on I-495 (9). Of the 13 fatal crashes in Virginia, six occurred on I-495 and seven on I-95.

Crash reports indicated that less than half (45.5 percent) of the fatal crashes occurred during daylight hours and that most occurred on Saturday and Sunday (40.0 percent). The three weekdays at the beginning of the workweek, Monday (12.7 percent), Tuesday (14.5 percent) and Wednesday (16.4 percent), contained a combined 43.6 percent of the fatal crashes. Thursday (7.3 percent) and Friday (9.1 percent) contained the least.

From 1993 to 1996, only once were there more than 3 fatal crashes in one calendar month. Seven fatal crashes occurred in July 1993. Fatal crashes occurred least often in January (1.8 percent) and most often in July (20.0 percent), December (12.7 percent) and June (10.9 percent).

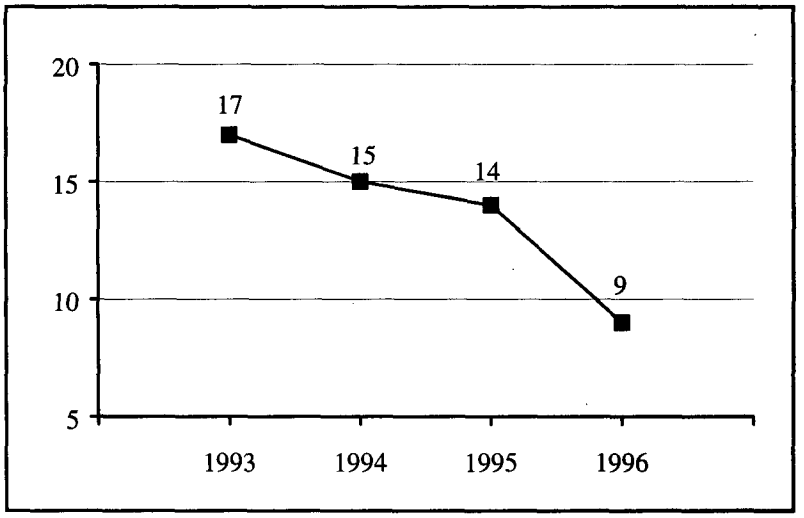

Fig. 2. Number of Fatal Crashes by Year

Crash typing fatal crash reports found that 23 of 55 (41.8 percent) exhibited *ran off road* characteristics (Figure 3). In comparison, only 24.3 percent of total crashes were categorized *ran off road.* Only a small percentage of fatal crashes were *stop/slowing* (14.5 percent) and fewer were *sideswipe/cutoff* (7.3 percent), whereas overall crashes occupied a much larger percentage (36.0 and 17.8 percent). Over one-third (36.4 percent) of the fatal crashes were classified *other.*

Fatal crashes were more likely to occur in clear weather (89.1 percent) and on dry roads (83.6 percent). Only four (7.3 percent) involved alcohol or drugs. Eleven (20.0 percent) involved at least one tractor-trailer. Nine (16.4 percent) involved at least one straight truck. The number of fatal crashes involving no trucks was 35 (63.6 percent). Nine (16.3 percent) involved at least one pedestrians.

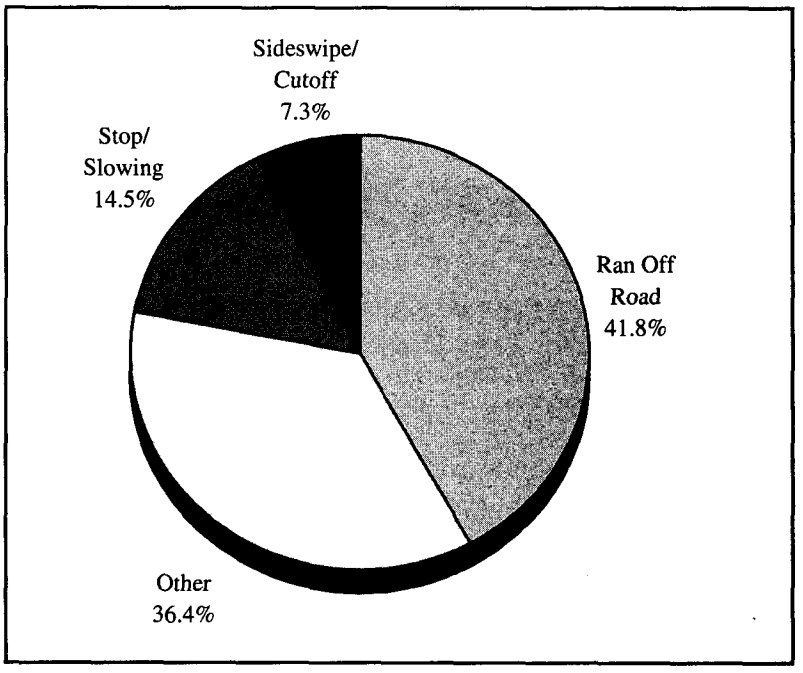

Fig. 3. Percent of Fatal Crashes by Crash Type

Passenger Vehicle Drivers

The number of passenger vehicle crashes increased 14.0 percent from 1993 to 1996. The increase was distributed across all age categories (Figure 4). Driver age groups that grew over ten percent

included ages 31 through 40 (+29.0 percent), under 21 (+22.7 percent), over 70 (+21.7 percent) and 41 through 50 (+16.1 percent).

No age group decreased in number, although some had only small increases. Drivers age 21 through 30 only had a +2.3 percent increase in number. Drivers in this age group proportionately dominated all drivers in crashes. They accounted for 33.3 percent of drivers in crashes across all years. In each successive year, though, the proportion of drivers in this age group dropped. In 1993, the group contained 35.4 percent of drivers but in 1996 just 31.8 percent. The age group chronologically following, 31 through 40, grew each year. In 1993, these drivers were 22.7 percent of drivers in crashes. In 1996, they were 25.7 percent.

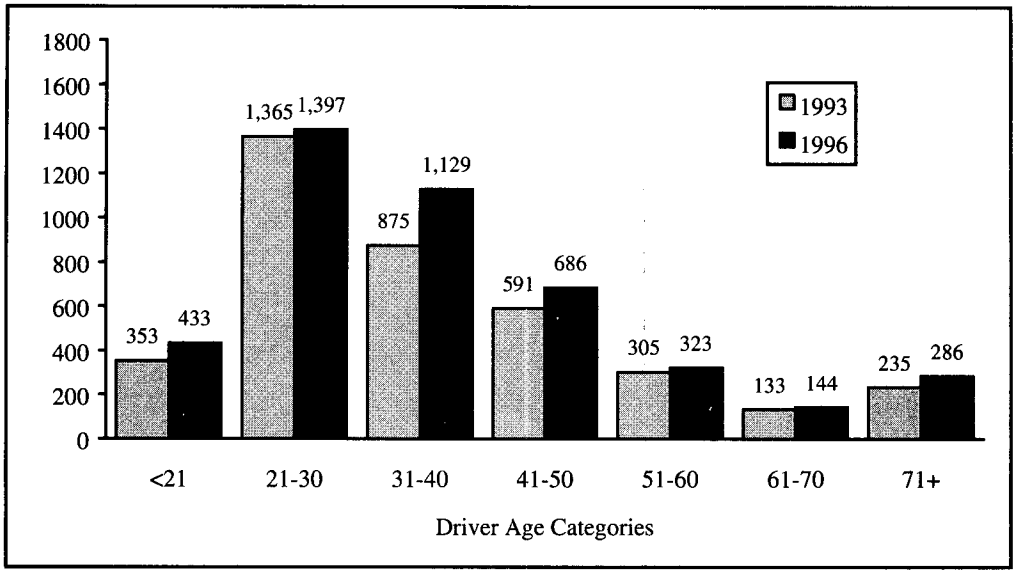

Fig. 4. Number of Passenger Vehicle Drivers in Crashes by Age Categories, 1993 Versus 1996

Over time, the distribution of drivers by age and crash type remained relatively consistent. As driver age increased towards age 70, *ran off road* appeared less (Table 7). Nearly one of every five drivers under age 21 (20.9 percent) was involved in *ran off road* crashes. In comparison, close to one of every ten drivers aged 51 through 60 (10.8 percent) or 61 through 70 (10.3 percent) was involved in *ran off road* crashes. As driver age increased towards age 60, *stop/slowing* and *sideswipe/cutoff* appeared more often. The increase, although subtle, is constant. The proportion of each age group that was *less frequent/other* was relatively even through age 70 and slightly higher for drivers older than 70.

Drivers over 70 showed many fewer *stop/slowing* crashes than younger drivers. One possible explanation is that they drive much less frequently during rush hours.

Table 7. Percent Distribution of Passenger Vehicle Drivers by Age and Crash Type

	Age Group							
Major Crash Type	*<21*	*21-30*	*31-40*	*41-50*	*51-60*	*61-70*	*71+*	*Avg.*
Stop/Slowing	45.0	45.4	48.5	48.8	52.1	51.6	31.5	46.5
Sideswipe/Cutoff	13.8	15.3	15.6	18.3	18.5	18.4	28.5	16.9
Ran Off Road	20.9	18.2	14.5	12.0	10.8	10.3	13.8	15.5
Less Frequent/Other	20.3	21.1	21.4	21.0	18.5	19.7	26.3	21.1

Gender of driver was reported only in the Maryland crash reports. Data pertaining to drivers with known gender revealed that 64.5 percent were male and 35.5 percent were female. Crash type distributions for males and females were nearly identical.

Across all years, 55.7 percent of passenger vehicle drivers who crashed on the Beltway were living over ten miles away (Table 8); fewer drivers (27.2 percent) were living ten miles or less outside of the Beltway; even fewer were living inside the loop (17.1 percent). Drivers residing inside the Beltway or within three miles began to decrease after 1994 through 1996. This may suggest that over time fewer residents from these locations were using the Beltway or that more drivers were residing further out.

Table 8. Percent of Passenger Vehicle Drivers in Crashes by Residence and Year

	Year				
Driver Residence	*1993*	*1994*	*1995*	*1996*	*Avg.*
Inside the Beltway	17.9	17.4	16.8	16.4	17.1
Outside up to 3 Miles	13.8	13.6	13.0	13.1	13.4
>3 to 10 Miles Away	13.1	13.4	14.7	14.1	13.8
Other MD/VA	36.4	34.3	39.3	38.5	37.1
Non MD/VA/DC	12.1	12.5	10.4	12.1	11.8
Unknown	6.7	8.8	5.8	5.9	6.8

Trucks in Crashes

Comparisons between truck and non-truck vehicles required creation of two additional data sets. One included only truck vehicle information. The other included only non-truck vehicle information. The data sets contained driver level information for every vehicle in a Beltway crash. Therefore, if more than one truck type was involved in any single crash event, information regarding all of the involved truck types could be analyzed.

The number of tractor-trailers in crashes fluctuated over time (Table 9). By 1996, the total number was 399. This was a 17.0 percent increase compared to the total in 1993 (341). Non-trucks increased 14.2 percent over the same time period. The percent of total vehicles in crashes that were tractor-trailers stayed relatively consistent across the years. They never made up less than 7.4 percent of vehicles in crashes and never more than 8.9 percent.

Table 9. Number and Percent of Truck Types by Year

	Year				
Vehicle Type	*1993*	*1994*	*1995*	*1996*	*Total*
Tractors	341	421	359	399	1,520
%	*7.7*	*8.9*	*7.4*	*7.8*	*7.9*
Straight Trucks	226	320	313	343	1,202
%	*5.1*	*6.8*	*6.4*	*6.7*	*6.3*
Total Trucks	567	741	672	742	2,722
%	*12.8*	*15.7*	*13.8*	*14.4*	*14.2*
Non-Trucks	3,858	3,968	4,208	4,402	16,436
%	*87.2*	*84.3*	*86.2*	*85.6*	*85.8*
Total	4,425	4,709	4,880	5,144	19,158

The total number of straight trucks in crashes in 1994 (320) was 41.6 percent higher than the total number in 1993 (226). By 1996, the number had grown to 343. The percentage of total vehicles in crashes that were straight trucks increased +1.7 percentage points from 1993 (5.1 percent) to 1994 (6.8 percent) and remained nearly that in 1996 (6.7 percent).

The distribution of crash types for tractor-trailers differs from that of straight trucks and non-truck vehicles (Table 10). The straight truck distribution more closely resembles the non-truck distribution than the tractor-trailer distribution. Relatively little variation occurred in vehicle type distribution by crash type over time.

Across the years, *stop/slowing* was most predominant for non-truck (46.4 percent) and straight truck (38.6 percent) vehicles. Compared to these vehicle types, tractor-trailers were less than half as likely in *stop/slowing* crashes (18.2 percent).

Sideswipe/cutoff was most predominant for tractor-trailers (46.1 percent). Tractor-trailers were in this category at over twice the rate of straight trucks (20.7 percent) and nearly three times that of non-truck vehicles (16.9 percent). Of tractor-trailers in *sideswipe/cutoff*, 54.5 percent were identified as a tractor-trailer moving into a lane already occupied by a passenger vehicle and 29.0 percent were identified as a passenger vehicle moving into a lane already occupied by a tractor-trailer. Other and unknown sub-types of *sideswipe/cutoff* accounted for 16.5 percent.

Non-truck vehicles were in *ran off road* crashes 15.5 percent of the time. Truck vehicles were less likely to be in *ran off road* crashes. Tractor-trailers were least likely. Straight trucks more closely resembled non-truck vehicles though they still were less likely.

Table 10. Percent of Vehicle Type by Crash Type and Year

	Year				
Crash Type	*1993*	*1994*	*1995*	*1996*	*Avg.*
Tractor-trailer					
Stop/Slowing	20.8	18.5	15.0	18.3	18.2
Sideswipe/Cutoff	44.6	46.1	47.9	45.9	46.1
Ran Off Road	8.5	7.4	7.8	8.0	7.9
Less Frequent/Other	26.1	28.0	29.2	27.8	27.8
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Straight Truck					
Stop/Slowing	43.4	33.4	41.5	36.2	38.6
Sideswipe/Cutoff	21.7	21.3	17.6	22.2	20.7
Ran Off Road	12.8	15.0	12.1	14.9	13.7
Less Frequent/Other	22.1	30.3	28.8	26.8	27.0
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Non-Trucks					
Stop/Slowing	46.8	46.4	44.8	47.8	46.4
Sideswipe/Cutoff	15.9	18.0	16.8	16.7	16.9
Ran Off Road	15.0	14.9	16.5	15.6	15.5
Less Frequent/Other	22.3	20.6	21.9	19.9	21.2
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Other less frequent types of crashes contained a higher proportion of tractor-trailers and straight trucks than non-truck vehicles. Among these types, *lost control in road* and *run down* collected the most trucks. *Lost control in road* contained 8.4 percent of tractor-trailers and 7.9 percent of straight trucks. *Run down* contained 6.4 percent of tractor-trailers 6.9 percent of straight trucks.

Tractor-trailers and straight trucks were more often involved in multiple three and four vehicle crashes in 1995 and 1996 as compared with earlier years (Figure 5). Average number of vehicles per crash for non-trucks has remained nearly unchanged. Straight trucks show the most increase. From 1993 to 1996 the average number of vehicles per crash involving a straight truck, increased by +.19 vehicles. As of 1996, crashes involving a straight truck averaged 2.42 vehicles.

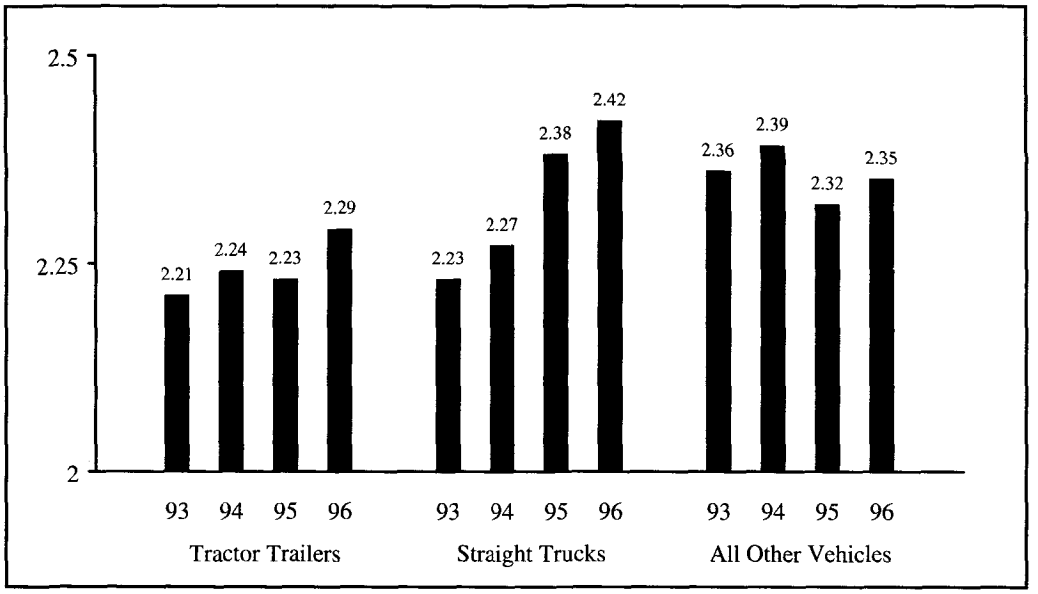

Fig. 5. Mean Number of Vehicles per Crash by Vehicle Type and Year

The distribution of truck crashes by day of week showed relatively no change over time. For all years, trucks were in crashes mostly on weekdays and less often on weekend days. Tractor-trailers were in weekday crashes 86.6 percent of the time and straight trucks 85.4 percent. For both truck types, Sunday had the least crashes followed by Saturday.

The frequency of straight trucks in crashes increased as weekdays progressed, Monday (16.0 percent) through Friday (18.4 percent). Tractor-trailers had a slight mid-week drop in the frequency of crashes on Thursday (15.2 percent); otherwise, crash frequency increased as days progressed, Monday (16.4 percent) through Friday (21.1 percent).

Straight truck crashes were spread more evenly than tractor-trailer crashes across the daytime hours. This is probably because straight trucks run more during daytime business hours. On the other hand, bigger trucks are more likely to be running at all hours of the day and night. This may explain why more tractor-trailers (16.6 percent) crashed in the late evening hours, 8 p.m. up to midnight, compared to straight trucks (7.7 percent). Both truck types had more crashes during evening and morning rush hours and hours around noon.

Residence of truck drivers in crashes has remained relatively unchanged over time (Table 11). Tractor-trailer drivers usually drive long distances, and therefore, they are far away from home. Straight truck drivers normally make day trips. Most tractor-trailer drivers were from residences outside of Maryland, Virginia or DC (53 percent). A majority of straight truck drivers were living more than ten miles beyond the Beltway (49.8 percent) though still in Maryland or Virginia. Only 11.5 percent of straight truck drivers lived outside of either state or DC. Thirty-three percent of straight truck drivers lived inside or no further than ten miles from the Beltway, while only 6.3 percent of tractor-trailer drivers lived within this area.

Table 11. Percent Distribution of Truck Drivers by Truck Type, Residence and Year

	Tractor-trailer					*Straight Trucks*				
Residence	*1993*	*1994*	*1995*	*1996*	*Avg.*	*1993*	*1994*	*1995*	*1996*	*Avg.*
Inside the Beltway	1.8	3.3	1.9	1.3	2.1	12.8	15.0	10.5	8.7	11.8
Outside up to 3 Miles	.9	1.0	2.5	2.0	1.6	6.6	9.1	7.3	9.9	8.2
>3 to 10 Miles Away	1.8	2.6	3.3	2.5	2.6	16.4	9.4	11.8	14.6	12.9
Other MD/VA	29.9	28.3	34.3	31.1	30.9	50.0	47.5	52.1	49.6	49.8
Non MD/VA/DC	54.8	52.5	50.1	54.6	53.0	10.2	11.9	12.5	11.4	11.5
Unknown	10.9	12.4	7.8	8.5	9.9	4.0	7.2	5.8	5.8	5.7

Crash Location

For each tenth of a mile along the Beltway, the average number of crashes occurring within one-half mile in either direction was calculated. This was done using data for combined years 1993 and 1994, then again using combined data for years 1995 and 1996. The difference between each two year period was calculated. Differences were plotted and are shown in Figures 6 through 9. Positive numbers show more crashes in 1995 and 1996. The total number of crashes (1993 through 1996) per tenth mile by inner loop (Table 12) and outer loop follow (Table 13).

Figure 6 represents the entire Maryland Inner Loop. It shows, in general, that crashes decreased on I-495 and increased on I-95. The decrease on I-495 is most evident from around mile point nine up to its approach to I-95. Some small increases are shown within the roadway's first nine miles. On I-95, the crash increase appears to be spread across the entire roadway, with crash decreases limited to only a few short locations.

Maryland's Outer Loop is shown in Figure 7. Like Figure 6, Figure 7 shows that all across I-95 crashes increased and that crashes lessened over I-495. In comparison, both figures show more massive increases occurred over a relatively long distance in the vicinity of mile point seven to thirteen on I-95. Both figures also show that within the few miles leading to and from the Woodrow Wilson Bridge crashes increased at most locations.

Fewer crashes occurred in Virginia than in Maryland. Therefore, average number differences are more likely to be less massive. Comparisons between Figures 6 and 7 and Figures 8 and 9 should be made with caution because the distance represented on the *x* axes differ.

Virginia's Inner Loop, shown in Figure 8, shows that crashes decreased over nearly the entirety of I-95. The most massive decrease was near mile point 174 and continued beyond mile point 172. On I-495, increases were more prevalent than decreases. Increases stand out in three vicinities. The most massive increase was between mile points six and nine. The second was between mile points nine and eleven and the third was around mile point five.

The Outer Loop in Virginia is shown in Figure 9. Crash increases are obvious on the I-495 portion. A noticeable increase in crash frequency, is shown from around mile point fourteen up to around mile point seven. Then, near mile point six, the beginning of a relatively large decrease is shown. The decrease stretches nearly to mile point three. Other noticeable decreases are shown near mile points two through one of I-495, and surrounding mile point 173 on I-95. Overall, crashes decreased on this portion of I-95.

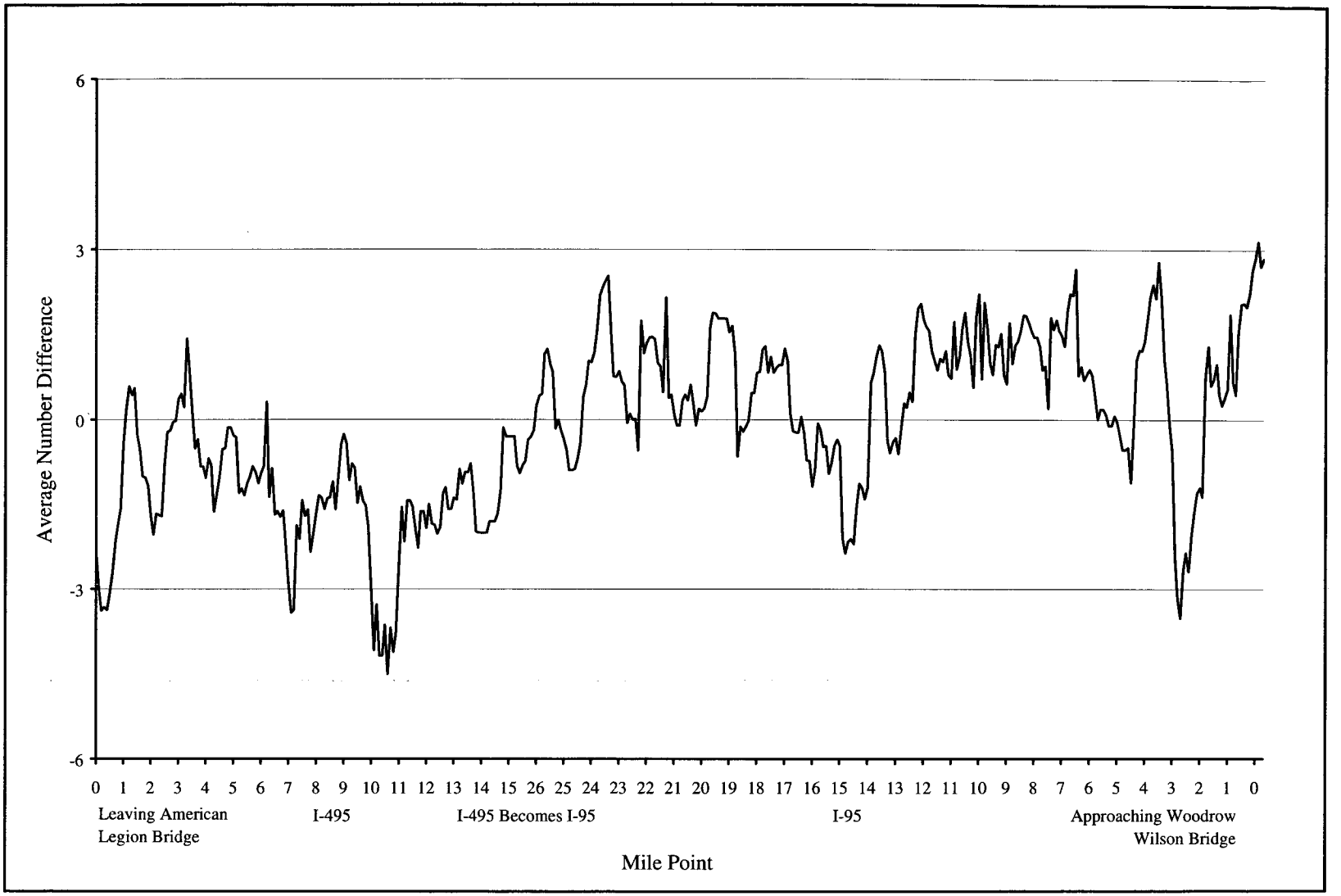

Fig. 6. Maryland Inner Loop; Difference in Average Number of Crashes, 1993-1994 Versus 1995-1996

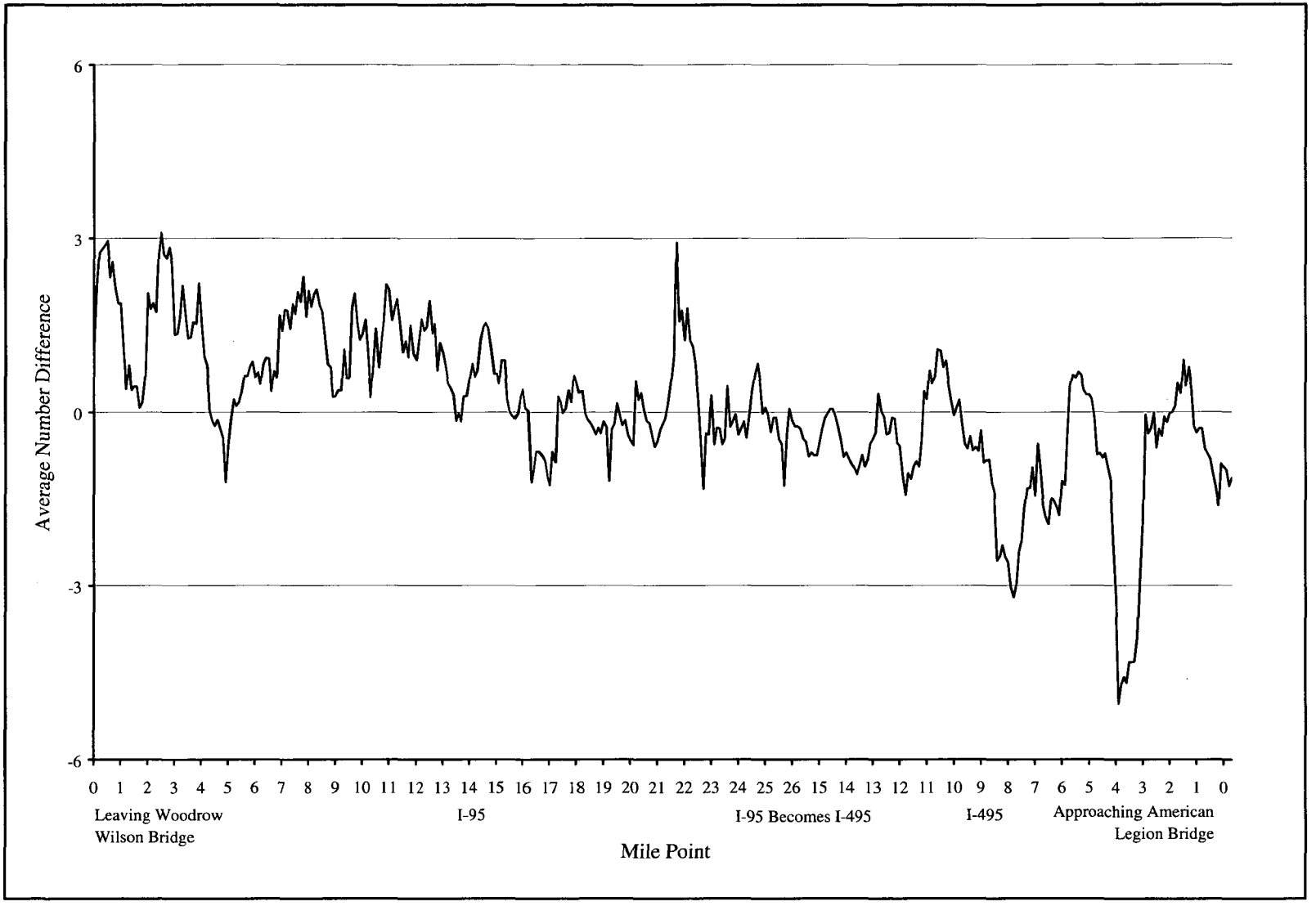

Fig. 7. Maryland Outer Loop; Difference in Average Number of Crashes, 1993-1994 Versus 1995-1996

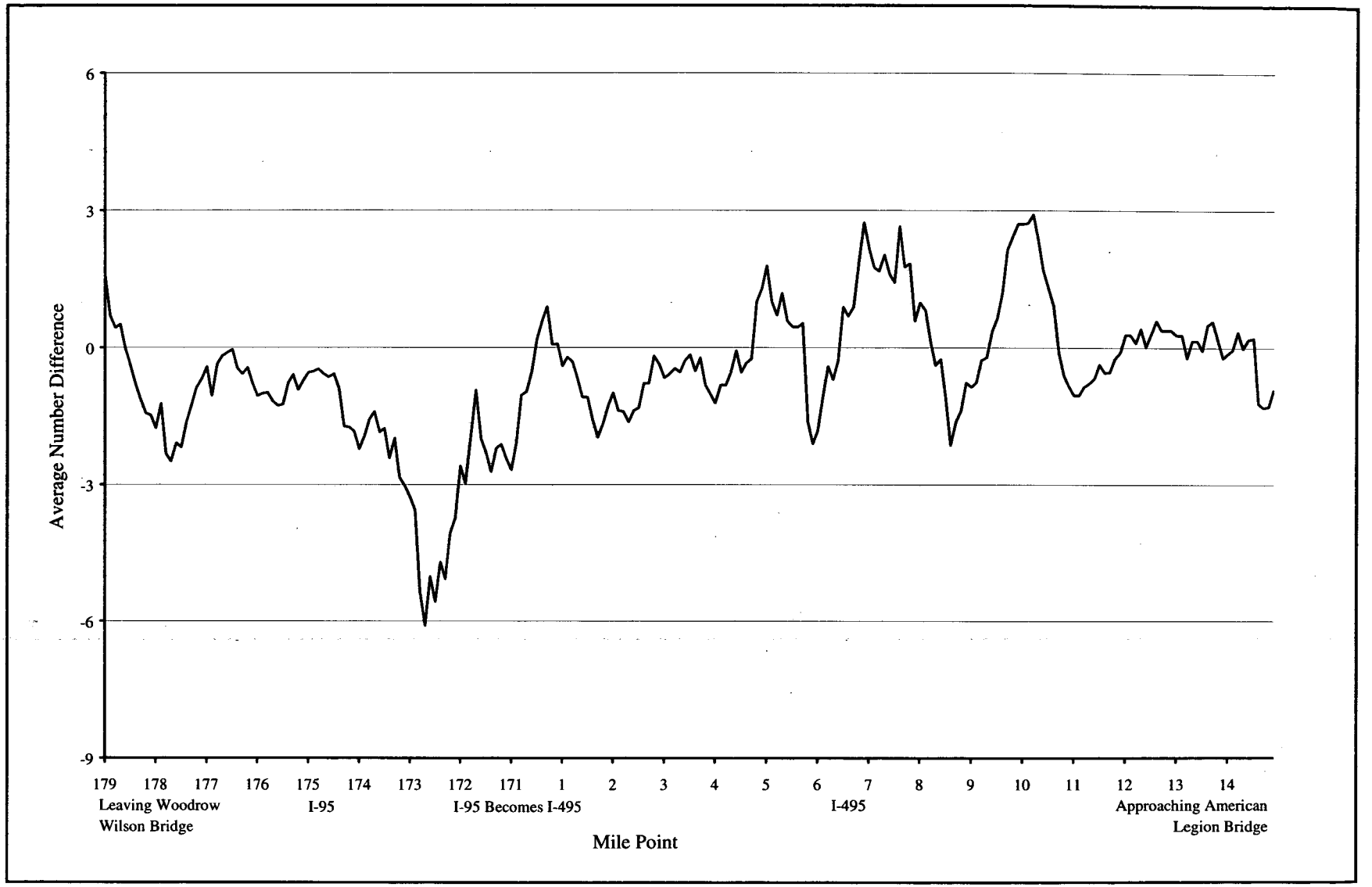

Fig. 8. Virginia Inner Loop; Difference in Average Number of Crashes, 1993-1994 Versus 1995-1996

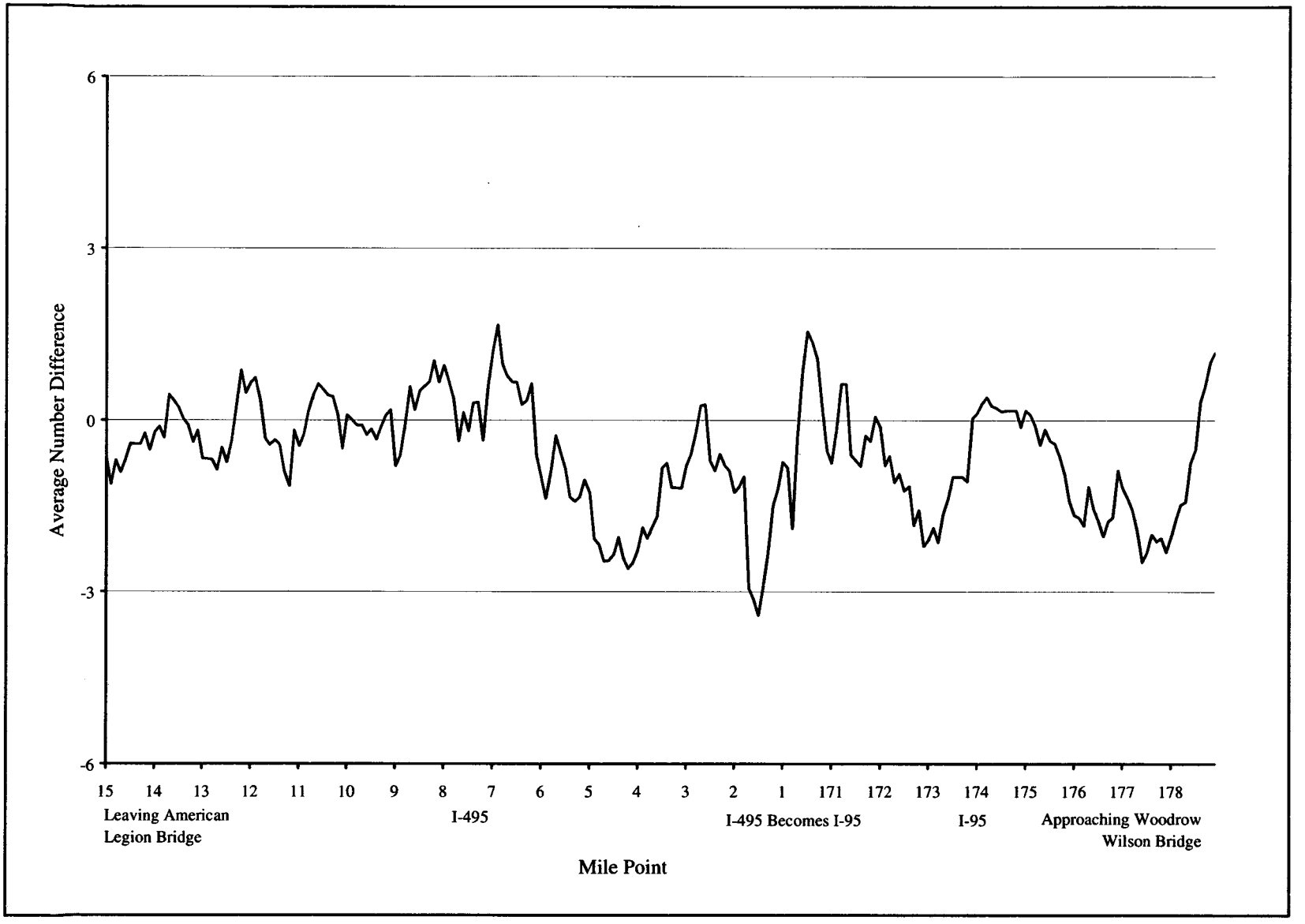

Fig. 9. Virginia Outer Loop; Difference in Average Number of Crashes, 1993-1994 Versus 1995-1996

Table 12. Total Number of Beltway Inner Loop Crashes by Tenth Mile, 1993-1996

Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.
Maryland I-495		5.6	25	11.3	1	25.4	18	19.7	11	14.0	1	8.3	16	2.6	16	175.7	4	0.3	2	6.0	17	11.7	1
0.0	6	5.7	3	11.4	0	25.3	8	19.6	53	13.9	1	8.2	9	2.5	20	175.6	8	0.4	1	6.1	8	11.8	0
0.1	6	5.8	6	11.5	11	25.2	35	19.5	5	13.8	4	8.1	3	2.4	10	175.5	3	0.5	12	6.2	10	11.9	0
0.2	5	5.9	7	11.6	2	25.1	13	19.4	3	13.7	1	8.0	1	2.3	5	175.4	7	0.6	0	6.3	11	12.0	11
0.3	14	6.0	0	11.7	2	25.0	13	19.3	1	13.6	2	7.9	2	2.2	9	175.3	2	0.7	0	6.4	15	12.1	2
0.4	19	6.1	3	11.8	4	24.9	17	19.2	1	13.5	5	7.8	6	2.1	3	175.2	2	0.8	1	6.5	12	12.2	3
0.5	12	6.2	1	11.9	10	24.8	4	19.1	2	13.4	1	7.7	1	2.0	11	175.1	6	0.9	2	6.6	6	12.3	2
0.6	9	6.3	2	12.0	18	24.7	5	19.0	0	13.3	8	7.6	8	1.9	9	175.0	7	1.0	19	6.7	12	12.4	2
0.7	4	6.4	3	12.1	2	24.6	1	18.9	2	13.2	23	7.5	11	1.8	52	174.9	1	1.1	2	6.8	6	12.5	5
0.8	5	6.5	17	12.2	0	24.5	0	18.8	7	13.1	5	7.4	35	1.7	72	174.8	4	1.2	2	6.9	7	12.6	3
0.9	8	6.6	19	12.3	1	24.4	5	18.7	3	13.0	1	7.3	30	1.6	16	174.7	0	1.3	4	7.0	13	12.7	2
1.0	4	6.7	50	12.4	3	24.3	7	18.6	22	12.9	4	7.2	13	1.5	10	174.6	7	1.4	4	7.1	15	12.8	5
1.1	20	6.8	17	12.5	5	24.2	10	18.5	11	12.8	3	7.1	7	1.4	7	174.5	3	1.5	0	7.2	8	12.9	4
1.2	2	6.9	8	12.6	25	24.1	7	18.4	2	12.7	6	7.0	1	1.3	8	174.4	3	1.6	8	7.3	15	13.0	11
1.3	4	7.0	3	12.7	4	24.0	7	18.3	2	12.6	5	6.9	1	1.2	7	174.3	0	1.7	0	7.4	8	13.1	2
1.4	9	7.1	4	12.8	2	23.9	4	18.2	0	12.5	2	6.8	6	1.1	1	174.2	2	1.8	4	7.5	26	13.2	6
1.5	1	7.2	7	12.9	0	23.8	6	18.1	14	12.4	4	6.7	8	1.0	2	174.1	4	1.9	2	7.6	18	13.3	2
1.6	3	7.3	13	13.0	3	23.7	5	18.0	0	12.3	4	6.6	3	0.9	2	174.0	12	2.0	12	7.7	8	13.4	7
1.7	2	7.4	12	13.1	1	23.6	8	17.9	6	12.2	13	6.5	0	0.8	3	173.9	2	2.1	6	7.8	19	13.5	11
1.8	2	7.5	8	13.2	11	23.5	6	17.8	3	12.1	6	6.4	4	0.7	5	173.8	1	2.2	3	7.9	12	13.6	3
1.9	18	7.6	6	13.3	1	23.4	4	17.7	1	12.0	4	6.3	0	0.6	7	173.7	3	2.3	6	8.0	22	13.7	10
2.0	5	7.7	3	13.4	1	23.3	6	17.6	12	11.9	3	6.2	2	0.5	46	173.6	1	2.4	10	8.1	12	13.8	15
2.1	5	7.8	14	13.5	0	23.2	18	17.5	10	11.8	8	6.1	0	0.4	17	173.5	15	2.5	12	8.2	4	13.9	11
2.2	4	7.9	3	13.6	0	23.1	28	17.4	3	11.7	3	6.0	0	0.3	6	173.4	5	2.6	23	8.3	3	14.0	13
2.3	9	8.0	4	13.7	3	23.0	9	17.3	1	11.6	1	5.9	2	0.2	2	173.3	1	2.7	17	8.4	9	14.1	6
2.4	41	8.1	10	13.8	0	22.9	3	17.2	1	11.5	0	5.8	7	0.1	8	173.2	4	2.8	20	8.5	2	14.2	7
2.5	15	8.2	18	13.9	0	22.8	4	17.1	6	11.4	0	5.7	8	0.0	11	173.1	3	2.9	2	8.6	3	14.3	7
2.6	10	8.3	49	14.0	5	22.7	2	17.0	0	11.3	2	5.6	7	**Virginia I-95**		173.0	12	3.0	6	8.7	3	14.4	7
2.7	4	8.4	19	14.1	4	22.6	9	16.9	5	11.2	6	5.5	2	178.6	0	172.9	4	3.1	2	8.8	2	14.5	1
2.8	4	8.5	12	14.2	20	22.5	10	16.8	9	11.1	6	5.4	4	178.5	0	172.8	11	3.2	6	8.9	3	14.6	1
2.9	14	8.6	10	14.3	3	22.4	5	16.7	12	11.0	12	5.3	1	178.4	0	172.7	4	3.3	9	9.0	2	14.7	0
3.0	3	8.7	5	14.4	1	22.3	4	16.6	34	10.9	13	5.2	2	178.3	0	172.6	13	3.4	1	9.1	2		
3.1	3	8.8	5	14.5	0	22.2	33	16.5	14	10.8	45	5.1	0	178.2	1	172.5	18	3.5	7	9.2	1		
3.2	6	8.9	1	14.6	0	22.1	22	16.4	3	10.7	17	5.0	2	178.1	0	172.4	21	3.6	1	9.3	6		
3.3	0	9.0	3	14.7	1	22.0	11	16.3	2	10.6	10	4.9	5	178.0	5	172.3	12	3.7	6	9.4	6		
3.4	5	9.1	6	14.8	0	21.9	5	16.2	2	10.5	10	4.8	0	177.9	3	172.2	12	3.8	6	9.5	15		
3.5	7	9.2	5	14.9	0	21.8	3	16.1	7	10.4	3	4.7	3	177.8	4	172.1	4	3.9	3	9.6	11		
3.6	7	9.3	6	15.0	0	21.7	0	16.0	2	10.3	9	4.6	7	177.7	0	172.0	43	4.0	10	9.7	4		
3.7	40	9.4	3	15.1	0	21.6	0	15.9	2	10.2	1	4.5	11	177.6	4	171.9	15	4.1	2	9.8	8		
3.8	17	9.5	3	15.2	0	21.5	1	15.8	8	10.1	4	4.4	29	177.5	31	171.8	26	4.2	10	9.9	15		
3.9	3	9.6	4	15.3	1	21.4	0	15.7	0	10.0	26	4.3	18	177.4	5	171.7	4	4.3	5	10.0	11		
4.0	15	9.7	2	15.4	1	21.3	1	15.6	7	9.9	7	4.2	16	177.3	6	171.6	8	4.4	3	10.1	3		
4.1	5	9.8	4	15.5	0	21.2	5	15.5	0	9.8	13	4.1	2	177.2	13	171.5	18	4.5	10	10.2	1		
4.2	9	9.9	9	15.6	0	21.1	4	15.4	1	9.7	11	4.0	4	177.1	13	171.4	11	4.6	6	10.3	0		
4.3	0	10.0	9	**Maryland I-95**		21.0	18	15.3	5	9.6	9	3.9	7	177.0	27	171.3	3	4.7	3	10.4	6		
4.4	7	10.1	5	26.6	8	20.9	1	15.2	2	9.5	1	3.8	11	176.9	1	171.2	8	4.8	2	10.5	5		
4.5	0	10.2	4	26.5	3	20.8	3	15.1	2	9.4	5	3.7	3	176.8	0	171.1	6	4.9	4	10.6	4		
4.6	1	10.3	8	26.4	4	20.7	0	15.0	1	9.3	0	3.6	3	176.7	1	171.0	27	5.0	15	10.7	6		
4.7	2	10.4	14	26.3	1	20.6	5	14.9	5	9.2	7	3.5	4	176.6	2	170.9	5	5.1	7	10.8	4		
4.8	3	10.5	53	26.2	10	20.5	0	14.8	45	9.1	13	3.4	0	176.5	0	170.8	22	5.2	5	10.9	4		
4.9	2	10.6	12	26.1	7	20.4	1	14.7	12	9.0	7	3.3	11	176.4	1	170.7	7	5.3	5	11.0	14		
5.0	3	10.7	11	26.0	13	20.3	2	14.6	5	8.9	1	3.2	8	176.3	4	170.6	3	5.4	6	11.1	17		
5.1	3	10.8	4	25.9	8	20.2	1	14.5	7	8.8	6	3.1	3	176.2	3	170.5	11	5.5	13	11.2	3		
5.2	0	10.9	0	25.8	2	20.1	2	14.4	0	8.7	5	3.0	9	176.1	1	**Virginia I-495**		5.6	14	11.3	0		
5.3	0	11.0	7	25.7	9	20.0	0	14.3	12	8.6	2	2.9	10	176.0	9	0.0	1	5.7	14	11.4	8		
5.4	3	11.1	4	25.6	1	19.9	9	14.2	5	8.5	6	2.8	56	175.9	1	0.1	6	5.8	4	11.5	12		
5.5	4	11.2	10	25.5	4	19.8	10	14.1	1	8.4	5	2.7	14	175.8	3	0.2	5	5.9	11	11.6	1		

Table 13. Total Number of Beltway Outer Loop Crashes by Tenth Mile, 1993-1996

Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.	Location	No.
Maryland I-95		5.6	4	11.3	6	17.0	0	22.7	3	14.0	3	8.3	43	2.6	8	11.8	3	6.1	9	0.4	3	175.6	13
0.0	10	5.7	4	11.4	0	17.1	3	22.8	5	13.9	1	8.2	8	2.5	2	11.7	6	6.0	17	0.3	9	175.7	6
0.1	3	5.8	5	11.5	1	17.2	3	22.9	3	13.8	1	8.1	11	2.4	26	11.6	7	5.9	7	0.2	6	175.8	7
0.2	6	5.9	2	11.6	2	17.3	1	23.0	27	13.7	2	8.0	3	2.3	12	11.5	20	5.8	6	0.1	12	175.9	6
0.3	2	6.0	3	11.7	2	17.4	2	23.1	12	13.6	0	7.9	2	2.2	7	11.4	7	5.7	4	0.0	1	176.0	37
0.4	5	6.1	0	11.8	0	17.5	6	23.2	9	13.5	2	7.8	12	2.1	4	11.3	10	5.6	16	**Virginia I-95**		176.1	7
0.5	43	6.2	4	11.9	2	17.6	9	23.3	6	13.4	2	7.7	1	2.0	1	11.2	9	5.5	4	170.5	10	176.2	6
0.6	5	6.3	1	12.0	7	17.7	1	23.4	5	13.3	3	7.6	3	1.9	9	11.1	8	5.4	7	170.6	1	176.3	20
0.7	5	6.4	2	12.1	3	17.8	4	23.5	3	13.2	11	7.5	7	1.8	2	11.0	13	5.3	2	170.7	0	176.4	6
0.8	5	6.5	2	12.2	9	17.9	5	23.6	3	13.1	1	7.4	7	1.7	1	10.9	7	5.2	4	170.8	7	176.5	16
0.9	3	6.6	6	12.3	9	18.0	3	23.7	5	13.0	2	7.3	9	1.6	4	10.8	6	5.1	4	170.9	0	176.6	4
1.0	5	6.7	10	12.4	3	18.1	13	23.8	4	12.9	2	7.2	8	1.5	2	10.7	3	5.0	11	171.0	20	176.7	7
1.1	6	6.8	2	12.5	5	18.2	5	23.9	2	12.8	7	7.1	2	1.4	6	10.6	2	4.9	6	171.1	2	176.8	8
1.2	1	6.9	4	12.6	6	18.3	4	24.0	1	12.7	6	7.0	3	1.3	4	10.5	1	4.8	7	171.2	4	176.9	9
1.3	1	7.0	3	12.7	4	18.4	3	24.1	4	12.6	19	6.9	14	1.2	2	10.4	7	4.7	5	171.3	2	177.0	38
1.4	5	7.1	6	12.8	5	18.5	6	24.2	10	12.5	3	6.8	12	1.1	6	10.3	3	4.6	7	171.4	1	177.1	21
1.5	6	7.2	7	12.9	5	18.6	20	24.3	1	12.4	5	6.7	43	1.0	11	10.2	5	4.5	11	171.5	4	177.2	17
1.6	6	7.3	24	13.0	7	18.7	5	24.4	1	12.3	1	6.6	25	0.9	3	10.1	4	4.4	6	171.6	2	177.3	13
1.7	16	7.4	16	13.1	7	18.8	3	24.5	0	12.2	3	6.5	2	0.8	3	10.0	12	4.3	14	171.7	1	177.4	6
1.8	13	7.5	4	13.2	17	18.9	0	24.6	0	12.1	3	6.4	1	0.7	1	9.9	11	4.2	14	171.8	9	177.5	27
1.9	8	7.6	8	13.3	8	19.0	0	24.7	4	12.0	24	6.3	1	0.6	11	9.8	7	4.1	5	171.9	1	177.6	6
2.0	5	7.7	0	13.4	3	19.1	3	24.8	2	11.9	6	6.2	3	0.5	10	9.7	6	4.0	12	172.0	12	177.7	0
2.1	4	7.8	9	13.5	0	19.2	0	24.9	7	11.8	5	6.1	3	0.4	14	9.6	8	3.9	2	172.1	2	177.8	2
2.2	2	7.9	0	13.6	1	19.3	5	25.0	6	11.7	4	6.0	1	0.3	12	9.5	10	3.8	2	172.2	7	177.9	1
2.3	6	8.0	3	13.7	1	19.4	1	25.1	17	11.6	1	5.9	1	0.2	6	9.4	11	3.7	2	172.3	4	178.0	0
2.4	15	8.1	4	13.8	10	19.5	5	25.2	49	11.5	4	5.8	2	0.1	11	9.3	3	3.6	1	172.4	13	178.1	0
2.5	5	8.2	12	13.9	2	19.6	50	25.3	12	11.4	1	5.7	4	0.0	2	9.2	0	3.5	5	172.5	8	178.2	1
2.6	5	8.3	14	14.0	0	19.7	13	25.4	15	11.3	2	5.6	13	**Virginia I-495**		9.1	3	3.4	3	172.6	5	178.3	3
2.7	10	8.4	4	14.1	1	19.8	4	25.5	5	11.2	11	5.5	2	14.7	0	9.0	10	3.3	6	172.7	2	178.4	0
2.8	20	8.5	3	14.2	7	19.9	4	25.6	3	11.1	4	5.4	5	14.6	0	8.9	3	3.2	6	172.8	3	178.5	0
2.9	8	8.6	4	14.3	6	20.0	2	25.7	9	11.0	10	5.3	0	14.5	2	8.8	4	3.1	7	172.9	2	178.6	0
3.0	3	8.7	1	14.4	0	20.1	1	25.8	2	10.9	2	5.2	0	14.4	6	8.7	2	3.0	8	173.0	11		
3.1	1	8.8	8	14.5	5	20.2	1	25.9	7	10.8	9	5.1	2	14.3	10	8.6	2	2.9	8	173.1	1		
3.2	2	8.9	3	14.6	7	20.3	0	26.0	20	10.7	8	5.0	0	14.2	5	8.5	4	2.8	9	173.2	1		
3.3	5	9.0	5	14.7	15	20.4	2	26.1	11	10.6	14	4.9	1	14.1	2	8.4	10	2.7	9	173.3	3		
3.4	1	9.1	11	14.8	31	20.5	2	26.2	12	10.5	35	4.8	1	14.0	12	8.3	7	2.6	15	173.4	8		
3.5	1	9.2	7	14.9	11	20.6	7	26.3	0	10.4	3	4.7	2	13.9	3	8.2	6	2.5	7	173.5	9		
3.6	6	9.3	4	15.0	5	20.7	3	26.4	2	10.3	3	4.6	5	13.8	3	8.1	9	2.4	5	173.6	3		
3.7	12	9.4	2	15.1	0	20.8	1	26.5	6	10.2	1	4.5	0	13.7	4	8.0	25	2.3	6	173.7	2		
3.8	4	9.5	2	15.2	1	20.9	5	26.6	3	10.1	1	4.4	4	13.6	2	7.9	9	2.2	4	173.8	3		
3.9	3	9.6	4	15.3	3	21.0	19	**Maryland I-495**		10.0	11	4.3	1	13.5	2	7.8	28	2.1	9	173.9	1		
4.0	1	9.7	9	15.4	0	21.1	7	15.6	0	9.9	17	4.2	13	13.4	7	7.7	7	2.0	15	174.0	22		
4.1	4	9.8	11	15.5	1	21.2	5	15.5	0	9.8	4	4.1	6	13.3	3	7.6	9	1.9	2	174.1	2		
4.2	6	9.9	5	15.6	3	21.3	2	15.4	0	9.7	5	4.0	18	13.2	4	7.5	12	1.8	11	174.2	3		
4.3	15	10.0	21	15.7	0	21.4	1	15.3	0	9.6	2	3.9	16	13.1	4	7.4	4	1.7	3	174.3	0		
4.4	15	10.1	1	15.8	2	21.5	2	15.2	0	9.5	3	3.8	37	13.0	20	7.3	8	1.6	14	174.4	4		
4.5	9	10.2	1	15.9	0	21.6	4	15.1	0	9.4	2	3.7	29	12.9	4	7.2	3	1.5	9	174.5	2		
4.6	2	10.3	3	16.0	0	21.7	2	15.0	0	9.3	8	3.6	9	12.8	16	7.1	8	1.4	2	174.6	11		
4.7	1	10.4	1	16.1	8	21.8	4	14.9	0	9.2	7	3.5	1	12.7	4	7.0	13	1.3	2	174.7	0		
4.8	0	10.5	7	16.2	2	21.9	5	14.8	0	9.1	4	3.4	4	12.6	3	6.9	4	1.2	5	174.8	3		
4.9	2	10.6	8	16.3	2	22.0	13	14.7	1	9.0	1	3.3	1	12.5	7	6.8	4	1.1	15	174.9	1		
5.0	0	10.7	9	16.4	10	22.1	23	14.6	1	8.9	1	3.2	4	12.4	3	6.7	4	1.0	54	175.0	12		
5.1	0	10.8	28	16.5	8	22.2	28	14.5	1	8.8	6	3.1	2	12.3	6	6.6	5	0.9	2	175.1	12		
5.2	0	10.9	10	16.6	26	22.3	2	14.4	0	8.7	1	3.0	0	12.2	4	6.5	7	0.8	6	175.2	0		
5.3	0	11.0	7	16.7	18	22.4	8	14.3	3	8.6	9	2.9	7	12.1	8	6.4	10	0.7	2	175.3	2		
5.4	3	11.1	4	16.8	5	22.5	19	14.2	25	8.5	7	2.8	4	12.0	16	6.3	6	0.6	8	175.4	11		
5.5	1	11.2	7	16.9	3	22.6	4	14.1	4	8.4	9	2.7	2	11.9	2	6.2	10	0.5	24	175.5	14		

V. Discussion

The number of Beltway crashes continues to rise. This is not surprising because the number of vehicle miles traveled also increases each passing year. Despite the increase, there are encouraging signs that safety has improved for the Beltway. From 1993 through 1996, crashes per vehicle miles traveled decreased. And, there was a decrease in the percentage of these crashes that were alcohol related. Most encouraging is the downward trend in fatalities. In just four years, the number of fatalities has reduced by nearly half.

The frequency of crashes by location has changed over time. In Maryland, crashes increased on I-95 and decreased on I-495. In Virginia, crashes increased on I-495 and decreased on I-95. In general, change occurred over relatively long segments on these routes.

The crash type distribution remained relatively consistent over time. Three major crash types accounted for 78.0 percent of crashes. *Stop/slowing* was most common. This crash type is directly related to congestion on the Beltway. Its occurrence dominated all other types during rush hour periods, when congestion is heaviest. *Ran off road* was second most common. This type is less congestion related and happens across all hours and in all driving environments. Fatal crashes were most likely in this type. *Ran off road*, more so than others, happened during wet and icy conditions. A higher percentage of young drivers and drivers using alcohol were in *ran off road* crashes. *Sideswipe/cutoff* crashes involve more than one vehicle and are rare when traffic is minimal. These crashes are density-related to the extent that a certain amount of traffic is necessary for them to occur.

By 1996, tractor-trailers in crashes had increased in number although they remained relatively consistent as a proportion of total vehicles in crashes. Straight trucks increased in number and in proportion of total vehicles in crashes. The average number of vehicles involved in crashes with trucks has been increasing, particularly for straight trucks. As of 1996, crashes with a straight truck on average involved more vehicles than those without.

Crash type remained relatively consistent for truck vehicles. Tractor-trailers were most likely in *sideswipe/cutoff* crashes and more often the vehicle that made a lane change. They were less often *stop/slowing* and even less *ran off road.* Straight trucks more closely resembled passenger vehicles in their crash type distribution.

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Appendix A:
General Crosstabs Combined States

Crash Type Categories by Year

Crash Type	Year 1993 (93)	1994 (94)	1995 (95)	1996 (96)	Row Total
1 Stop/Slowing	804	807	843	927	3381
	23.8	23.9	24.9	27.4	36.0
	37.0	35.5	34.5	36.9	
3 Sideswipe/Cutoff	362	447	422	441	1672
	21.7	26.7	25.2	26.4	17.8
	16.7	19.7	17.3	17.5	
4 Ran Off Road	513	528	631	610	2282
	22.5	23.1	27.7	26.7	24.3
	23.6	23.2	25.8	24.3	
5 Other	494	492	546	536	2068
	23.9	23.8	26.4	25.9	22.0
	22.7	21.6	22.4	21.3	
Column Total	2173	2274	2442	2514	9403
	23.1	24.2	26.0	26.7	100.0

Chi-Square	Value	DF	Significance
Pearson	14.49259	9	.10585
Likelihood Ratio	14.35416	9	.11027
Mantel-Haenszel test for linear association	.00129	1	.97134

Minimum Expected Frequency - 386.393 Number of Missing Observations: 0

Injury Severity by Year

SEVERITY	YEAR 1993 (93)	1994 (94)	1995 (95)	1996 (96)	Row Total
1 Fatal	17	15	14	9	55
	30.9	27.3	25.5	16.4	.6
	.8	.7	.6	.4	
2 Injury	932	932	1007	1039	3910
	23.8	23.8	25.8	26.6	41.6
	42.9	41.0	41.2	41.3	
3 Property Damage	1154	1193	1326	1375	5048
	22.9	23.6	26.3	27.2	53.7
	53.1	52.5	54.3	54.7	
9 Unknown	70	134	95	91	390
	17.9	34.4	24.4	23.3	4.1
	3.2	5.9	3.9	3.6	
Column Total	2173	2274	2442	2514	9403
	23.1	24.2	26.0	26.7	100.0

Chi-Square	Value	DF	Significance
Pearson	29.76887	9	.00048
Likelihood Ratio	28.48960	9	.00079
Mantel-Haenszel test for linear association	.00131	1	.97112

Minimum Expected Frequency - 12.710 Number of Missing Observations: 0

General Crosstabs Combined States

Any Alcohol in Crash by Year

ANY ALCOHOL	YEAR 1993 (93)	1994 (94)	1995 (95)	1996 (96)	Row Total
1 No Alcohol/Drugs	1998	2139	2260	2343	8740
	22.9	24.5	25.9	26.8	92.9
	91.9	94.1	92.5	93.2	
2 Alcohol	168	128	173	165	634
	26.5	20.2	27.3	26.0	6.7
	7.7	5.6	7.1	6.6	
3 Drugs	7	7	9	5	28
	25.0	25.0	32.1	17.9	.3
	.3	.3	.4	.2	
4 Alcohol and Drugs				1	1
				100.0	.0
				.0	
Column Total	2173	2274	2442	2514	9403
	23.1	24.2	26.0	26.7	100.0

Chi-Square	Value	DF	Significance
Pearson	12.50214	9	.18646
Likelihood Ratio	12.58205	9	.18245
Mantel-Haenszel test for linear association	.73664	1	.39074

Minimum Expected Frequency - .231

Cells with Expected Frequency < 5 - 4 OF 16 (25.0%) Number of Missing Observations: 0

Passenger Car Driver Residence by Year

RESIDENCE	YEAR 1993 (93)	1994 (94)	1995 (95)	1996 (96)	Row Total
1.00 Inside Beltway	690	689	706	720	2805
	24.6	24.6	25.2	25.7	17.1
	17.9	17.4	16.8	16.4	
2.00 Outside to 3 Miles	533	541	547	576	2197
	24.3	24.6	24.9	26.2	13.4
	13.8	13.6	13.0	13.1	
3.00 >3 to 10 Miles Out	504	530	620	618	2272
	22.2	23.3	27.3	27.2	13.8
	13.1	13.4	14.7	14.1	
4.00 Other MD,VA,DC	1405	1360	1653	1692	6110
	23.0	22.3	27.1	27.7	37.2
	36.4	34.3	39.3	38.5	
5.00 Non MD,VA,DC	465	497	437	533	1932
	24.1	25.7	22.6	27.6	11.8
	12.1	12.5	10.4	12.1	
9.00 Unknown	260	347	243	259	1109
	23.4	31.3	21.9	23.4	6.8
	6.7	8.8	5.8	5.9	
Column Total	3857	3964	4206	4398	16425
	23.5	24.1	25.6	26.8	100.0

Chi-Square	Value	DF	Significance
Pearson	69.82400	15	.00000
Likelihood Ratio	68.65699	15	.00000
Mantel-Haenszel test for linear association	.96942	1	.32482

Minimum Expected Frequency - 260.421 Number of Missing Observations: 11

Straight Truck Driver Residence by Year

Count / Row Pct / Col Pct	YEAR 1993	1994	1995	1996	Row Total
RESIDENCE					
1 Inside Beltway	29	48	33	30	140
	20.7	34.3	23.6	21.4	11.6
	12.8	15.0	10.5	8.7	
2 Outside to 3 Miles	15	29	23	34	101
	14.9	28.7	22.8	33.7	8.4
	6.6	9.1	7.3	9.9	
3 >3 to 10 Miles Out	37	30	37	50	154
	24.0	19.5	24.0	32.5	12.8
	16.4	9.4	11.8	14.6	
4 Other MD, VA, DC	113	152	163	170	598
	18.9	25.4	27.3	28.4	49.8
	50.0	47.5	52.1	49.6	
5 Outside MD, VA, DC	23	38	39	39	139
	16.5	27.3	28.1	28.1	11.6
	10.2	11.9	12.5	11.4	
9 Unknown	9	23	18	20	70
	12.9	32.9	25.7	28.6	5.8
	4.0	7.2	5.8	5.8	
Column Total	226	320	313	343	1202
	18.8	26.6	26.0	28.5	100.0

Chi-Square	Value	DF	Significance
Pearson	18.41858	15	.24130
Likelihood Ratio	18.62469	15	.23125
Mantel-Haenszel test for linear association	1.47805	1	.22408

Minimum Expected Frequency - 13.161 Number of Missing Observations: 0

Straight Truck Driver Residence by Year

Count / Row Pct / Col Pct	YEAR 1993	1994	1995	1996	Row Total
RESIDENCE					
1 Inside Beltway	6	14	7	5	32
	18.8	43.8	21.9	15.6	2.1
	1.8	3.3	1.9	1.3	
2 Outside to 3 Miles	3	4	9	8	24
	12.5	16.7	37.5	33.3	1.6
	.9	1.0	2.5	2.0	
3 >3 to 10 Miles Out	6	11	12	10	39
	15.4	28.2	30.8	25.6	2.6
	1.8	2.6	3.3	2.5	
4 Other MD, VA, DC	102	119	123	124	468
	21.8	25.4	26.3	26.5	30.8
	29.9	28.3	34.3	31.1	
5 Outside MD, VA, DC	187	221	180	218	806
	23.2	27.4	22.3	27.0	53.0
	54.8	52.5	50.1	54.6	
9 Unknown	37	52	28	34	151
	24.5	34.4	18.5	22.5	9.9
	10.9	12.4	7.8	8.5	
Column Total	341	421	359	399	1520
	22.4	27.7	23.6	26.3	100.0

Chi-Square	Value	DF	Significance
Pearson	19.41151	15	.19569
Likelihood Ratio	19.25519	15	.20240
Mantel-Haenszel test for	3.07149	1	.07968

Minimum Expected Frequency - 5.384 Number of Missing Observations: 0

Weather by Year

WEATHER	Count / Row Pct / Col Pct	YEAR 1993	1994	1995	1996	Row Total
1 Clear		1697	1807	1942	1933	7379
		23.0	24.5	26.3	26.2	78.5
		78.1	79.5	79.5	76.9	
2 Rain		369	321	394	466	1550
		23.8	20.7	25.4	30.1	16.5
		17.0	14.1	16.1	18.5	
3 Snow		54	101	75	80	310
		17.4	32.6	24.2	25.8	3.3
		2.5	4.4	3.1	3.2	
4 Fog		43	33	21	29	126
		34.1	26.2	16.7	23.0	1.3
		2.0	1.5	.9	1.2	
5 Other		2	1	4		7
		28.6	14.3	57.1		.1
		.1	.0	.2		
9 Unknown		8	11	6	6	31
		20.8	29.2	25.0	25.0	.4
		.3	.5	.2	.2	
	Column Total	2173	2274	2442	2514	9403
		23.1	24.2	26.0	26.7	100.0

Chi-Square	Value	DF	Significance
Pearson	54.89035	18	.00001
Likelihood Ratio	58.14795	18	.00000
Mantel-Haenszel test for linear association	5.52255	1	.01877

Minimum Expected Frequency - 1.618

Cells with Expected Frequency < 5 - 8 OF 28 (28.6%) Number of Missing Observations: 0

Weather on Road by Year

ROAD WEATHER	YEAR 1993	1994	1995	1996	Row Total
1 Dry	1543	1622	1779	1745	6689
	23.1	24.2	26.6	26.1	71.1
	71.0	71.3	72.9	69.4	
2 Wet	551	471	566	633	2221
	24.8	21.2	25.5	28.5	23.6
	25.4	20.7	23.2	25.2	
3 Snowy	44	50	56	86	236
	18.6	21.2	23.7	36.4	2.5
	2.0	2.2	2.3	3.4	
4 Icy	30	118	32	32	212
	14.2	55.7	15.1	15.1	2.3
	1.4	5.2	1.3	1.3	
5 Other		5	2	2	9
		55.6	22.2	22.2	.1
		.2	.1	.1	
9 Unknown	5	8	7	16	36
	13.9	22.2	19.4	44.4	.4
	.2	.4	.3	.6	
Column Total	2173	2274	2442	2514	9403
	23.1	24.2	26.0	26.7	100.0

Chi-Square	Value	DF	Significance
Pearson	154.13576	15	.00000
Likelihood Ratio	135.74337	15	.00000
Mantel-Haenszel test for linear association	.95598	1	.32820

Minimum Expected Frequency - 2.080
Cells with Expected Frequency < 5 - 4 OF 24 (16.7%) Number of Missing Observations: 0

Month by Year

MONTH	Count / Row Pct / Col Pct	YEAR 1993 (93)	1994 (94)	1995 (95)	1996 (96)	Row Total
1		157	201	205	197	760
Jan		20.7	26.4	27.0	25.9	8.1
		7.2	8.8	8.4	7.8	
2		137	193	141	186	657
Feb		20.9	29.4	21.5	28.3	7.0
		6.3	8.5	5.8	7.4	
3		195	205	177	216	793
March		24.6	25.9	22.3	27.2	8.4
		9.0	9.0	7.3	8.6	
4		184	179	193	177	733
April		25.1	24.4	26.3	24.1	7.8
		8.5	7.9	7.9	7.0	
5		178	201	218	227	824
May		21.6	24.4	26.5	27.5	8.8
		8.2	8.8	8.9	9.0	
6		172	181	205	238	796
June		21.6	22.7	25.8	29.9	8.5
		7.9	8.0	8.4	9.5	
7		171	163	182	183	699
July		24.5	23.3	26.0	26.2	7.4
		7.9	7.2	7.5	7.3	
8		211	181	221	212	825
Aug		25.6	21.9	26.8	25.7	8.8
		9.7	8.0	9.1	8.4	
9		183	182	181	230	776
Sept		23.6	23.5	23.3	29.6	8.3
		8.4	8.0	7.4	9.1	
10		214	148	242	234	838
Oct		25.5	17.7	28.9	27.9	8.9
		9.8	6.5	9.9	9.3	
11		206	222	222	192	842
Nov		24.5	26.4	26.4	22.8	9.0
		9.5	9.8	9.1	7.6	
12		159	196	254	221	830
Dec		19.2	23.6	30.6	26.6	8.8
		7.3	8.6	10.4	8.8	
99		6	22		1	29
Unknown		20.7	75.9		3.4	.3
		.3	1.0		.0	
	Column Total	2173 / 23.1	2274 / 24.2	2441 / 26.0	2514 / 26.7	9402 / 100.0

Chi-Square	Value	DF	Significance
Pearson	128.58043	36	.00000
Likelihood Ratio	129.50455	36	.00000
Mantel-Haenszel test for linear association	6.41719	1	.01130

Minimum Expected Frequency - 6.703 Number of Missing Observations: 1

Day of Week by Year

DAY OF WEEK	YEAR 1993	1994	1995	1996	Row Total
1 Sunday	203	189	274	234	900
	22.6	21.0	30.4	26.0	9.6
	9.3	8.3	11.2	9.3	
2 Monday	281	326	330	334	1271
	22.1	25.6	26.0	26.3	13.5
	12.9	14.3	13.5	13.3	
3 Tuesday	281	353	354	375	1363
	20.6	25.9	26.0	27.5	14.5
	12.9	15.5	14.5	14.9	
4 Wednesday	326	340	367	409	1442
	22.6	23.6	25.5	28.4	15.3
	15.0	15.0	15.0	16.3	
5 Thursday	322	364	343	380	1409
	22.9	25.8	24.3	27.0	15.0
	14.8	16.0	14.0	15.1	
6 Friday	468	430	425	492	1815
	25.8	23.7	23.4	27.1	19.3
	21.5	18.9	17.4	19.6	
7 Saturday	285	249	348	288	1170
	24.4	21.3	29.7	24.6	12.4
	13.1	10.9	14.3	11.5	
9 Unknown	7	23	1	2	33
	21.2	69.7	3.0	6.1	.4
	.3	1.0	.0	.1	
Column Total	2173 23.1	2274 24.2	2442 26.0	2514 26.7	9403 100.0

Chi-Square	Value	DF	Significance
Pearson	87.45158	21	.00000
Likelihood Ratio	84.17494	21	.00000
Mantel-Haenszel test for linear association	5.71257	1	.01684

Minimum Expected Frequency - 7.626 Number of Missing Observations: 0

Hour of Day by Year

HOUR	Count / Row Pct / Col Pct	YEAR 1993 (93)	1994 (94)	1995 (95)	1996 (96)	Row Total
0		53	44	65	55	214
Mid-12:59am		24.8	20.6	29.9	24.8	2.3
		2.4	1.9	2.6	2.2	
1		41	38	53	46	178
		23.0	21.3	29.8	25.8	1.9
		1.9	1.7	2.2	1.8	
2		49	54	51	57	211
		23.2	25.6	24.2	27.0	2.2
		2.3	2.4	2.1	2.3	
3		28	37	50	49	164
		17.1	22.6	30.5	29.9	1.7
		1.3	1.6	2.0	2.0	
4		30	38	30	34	132
		22.7	28.8	22.7	25.8	1.4
		1.4	1.7	1.2	1.4	
5		36	41	47	48	172
		20.9	23.8	27.3	27.9	1.8
		1.7	1.8	1.9	1.9	
6		83	88	87	96	354
		23.4	24.9	24.6	27.1	3.8
		3.8	3.9	3.6	3.8	
7		112	105	137	159	513
		21.8	20.5	26.7	31.0	5.5
		5.2	4.6	5.6	6.3	
8		158	160	168	171	657
		24.0	24.4	25.6	26.0	7.0
		7.3	7.0	6.9	6.8	
9		110	126	123	140	499
		22.0	25.3	24.6	28.1	5.3
		5.1	5.5	5.0	5.6	
10		68	107	116	96	387
		17.6	27.6	30.0	24.8	4.1
		3.1	4.7	4.8	3.8	
11		85	97	96	104	382
		22.3	25.4	25.1	27.2	4.1
		3.9	4.3	3.9	4.1	
12		102	87	87	130	406
Noon-12:59pm		25.1	21.4	21.4	32.0	4.3
		4.7	3.8	3.6	5.2	
13		84	106	113	121	424
		19.8	25.0	26.7	28.5	4.5
		3.9	4.7	4.6	4.8	
14		95	117	116	102	430
		22.1	27.2	27.0	23.7	4.6
		4.4	5.1	4.8	4.1	
15		124	132	160	153	569
		21.8	23.2	28.1	26.9	6.1
		5.7	5.8	6.6	6.1	
16		148	159	141	156	604
		24.5	26.3	23.3	25.8	6.4
		6.8	7.0	5.8	6.2	
17		201	199	201	217	818
		24.6	24.3	24.6	26.5	8.7
		9.3	8.8	8.2	8.6	

General Crosstabs Combined States

18	152	169	167	177	665
	22.9	25.4	25.1	26.6	7.1
	7.0	7.4	6.8	7.0	
19	119	105	104	113	441
	27.0	23.8	23.6	25.6	4.7
	5.5	4.6	4.3	4.5	
20	58	47	64	57	226
	25.7	20.8	28.3	25.2	2.4
	2.7	2.1	2.6	2.3	
21	69	65	92	74	300
	23.0	21.7	30.7	24.7	3.2
	3.2	2.9	3.8	2.9	
22	82	64	86	76	308
	26.6	20.8	27.9	24.7	3.3
	3.8	2.8	3.5	3.0	
23	73	62	84	78	297
	24.6	20.9	28.3	26.3	3.2
	3.4	2.7	3.4	3.1	
99	12	27	3	3	45
Unknown	26.7	60.0	6.7	6.7	.5
	.6	1.2	.1	.1	
Column	2172	2274	2441	2512	9399
Total	23.1	24.2	26.0	26.7	100.0

Chi-Square	Value	DF	Significance
Pearson	111.27928	75	.00416
Likelihood Ratio	111.15003	75	.00426
Mantel-Haenszel test for linear association	16.18605	1	.00006

Minimum Expected Frequency - .693
Cells with Expected Frequency < 5 - 4 OF 104 (3.8%) Number of Missing Observations: 4

Appendix B:
General Crosstabs Maryland

General Crosstabs Maryland

Crash Type Categories by Year

Crash Type	YEAR 1993	1994	1995	1996	Row Total
1 Stop/Slowing	433	386	501	523	1843
	23.5	20.9	27.2	28.4	31.2
	32.7	29.7	30.4	31.9	
3 Sideswipe/Cutoff	203	237	283	301	1024
	19.8	23.1	27.6	29.4	17.3
	15.3	18.2	17.2	18.4	
4 Ran Off Road	358	355	467	434	1614
	22.2	22.0	28.9	26.9	27.3
	27.1	27.3	28.3	26.5	
5 Other	329	323	398	382	1432
	23.0	22.6	27.8	26.7	24.2
	24.9	24.8	24.1	23.3	
Column Total	1323	1301	1649	1640	5913
	22.4	22.0	27.9	27.7	100.0

Chi-Square	Value	DF	Significance
Pearson	9.28694	9	.41122
Likelihood Ratio	9.37685	9	.40324
Mantel-Haenszel test for linear association	.25517	1	.61346

Minimum Expected Frequency - 225.304 Number of Missing Observations: 0

Injury Severity by Year

SEVERITY	YEAR 1993	1994	1995	1996	Row Total
1 Fatal	12	10	12	8	42
	28.6	23.8	28.6	19.0	.7
	.9	.8	.7	.5	
2 Injury	643	579	691	706	2619
	24.6	22.1	26.4	27.0	44.3
	48.6	44.5	41.9	43.0	
3 Property Damage	598	580	851	835	2864
	20.9	20.3	29.7	29.2	48.4
	45.2	44.6	51.6	50.9	
9 Unknown	70	132	95	91	388
	18.0	34.0	24.5	23.5	6.6
	5.3	10.1	5.8	5.5	
Column Total	1323	1301	1649	1640	5913
	22.4	22.0	27.9	27.7	100.0

Chi-Square	Value	DF	Significance
Pearson	55.44738	9	.00000
Likelihood Ratio	52.24118	9	.00000
Mantel-Haenszel test for linear association	.02188	1	.88241

Minimum Expected Frequency - 9.241 Number of Missing Observations: 0

Any Alcohol in Crash by Year

ANY ALCOHOL	YEAR 1993	1994	1995	1996	Row Total
1 No Alcohol/Drugs	1197	1216	1517	1530	5460
	21.9	22.3	27.8	28.0	92.3
	90.5	93.5	92.0	93.3	
2 Alcohol	119	78	123	104	424
	28.1	18.4	29.0	24.5	7.2
	9.0	6.0	7.5	6.3	
3 Drugs	7	7	9	5	28
	25.0	25.0	32.1	17.9	.5
	.5	.5	.5	.3	
4 Alcohol and Drugs				1	1
				100.0	.0
				.1	
Column Total	1323	1301	1649	1640	5913
	22.4	22.0	27.9	27.7	100.0

Chi-Square	Value	DF	Significance
Pearson	15.24057	9	.08454
Likelihood Ratio	15.07777	9	.08882
Mantel-Haenszel test for linear association	4.40463	1	.03584

Minimum Expected Frequency - .220
Cells with Expected Frequency < 5 - 4 OF 16 (25.0%) Number of Missing Observations: 0

Weather by Year

WEATHER	YEAR 1993	1994	1995	1996	Row Total
1 Clear	998	995	1268	1251	4512
	22.1	22.1	28.1	27.7	76.3
	75.4	76.5	76.9	76.3	
2 Rain	278	226	310	319	1133
	24.5	19.9	27.4	28.2	19.2
	21.0	17.4	18.8	19.5	
3 Snow	27	64	50	56	197
	13.7	32.5	25.4	28.4	3.3
	2.0	4.9	3.0	3.4	
4 Fog	13	8	12	9	42
	31.0	19.0	28.6	21.4	.7
	1.0	.6	.7	.5	
5 Other	2	1	4		7
	28.6	14.3	57.1		.1
	.2	.1	.2		
9 *Unknown*	5	7	5	5	22
	22.7	31.8	22.7	22.7	.4
	.4	.5	.3	.3	
Column Total	1323	1301	1649	1640	5913
	22.4	22.0	27.9	27.7	100.0

Chi-Square	Value	DF	Significance
Pearson	29.80716	15	.01264
Likelihood Ratio	30.89410	15	.00908
Mantel-Haenszel test for linear association	.71257	1	.39859

Minimum Expected Frequency - 1.540
Cells with Expected Frequency < 5 - 6 OF 24 (25.0%) Number of Missing Observations: 0

Weather on Road by Year

WEATHER ON ROAD		1993	1994	1995	1996	Row Total
Dry	1	885	886	1132	1109	4012
		22.1	22.1	28.2	27.6	67.9
		66.9	68.1	68.6	67.6	
Wet	2	403	322	451	431	1607
		25.1	20.0	28.1	26.8	27.2
		30.5	24.8	27.3	26.3	
Snowy	3	18	33	42	58	151
		11.9	21.9	27.8	38.4	2.6
		1.4	2.5	2.5	3.5	
Icy	4	13	54	17	26	110
		11.8	49.1	15.5	23.6	1.9
		1.0	4.2	1.0	1.6	
Other	5		2	1	2	5
			40.0	20.0	40.0	.1
			.2	.1	.1	
Unknown	9	4	4	6	14	28
		14.3	14.3	21.4	50.0	.5
		.3	.3	.4	.9	
Column Total		1323	1301	1649	1640	5913
		22.4	22.0	27.9	27.7	100.0

Chi-Square	Value	DF	Significance
Pearson	80.67681	15	.00000
Likelihood Ratio	74.43961	15	.00000
Mantel-Haenszel test for linear association	2.15368	1	.14223

Minimum Expected Frequency - 1.100

Cells with Expected Frequency < 5 - 4 OF 24 (16.7%) Number of Missing Observations: 0

Month by Year

MONTH	Count / Row Pct / Col Pct	1993	1994	1995	1996	Row Total
		YEAR				
1		93	110	143	135	481
Jan		19.3	22.9	29.7	28.1	8.1
		7.0	8.5	8.7	8.2	
2		80	127	93	119	419
Feb		19.1	30.3	22.2	28.4	7.1
		6.0	9.8	5.6	7.3	
3		122	120	115	142	499
March		24.4	24.0	23.0	28.5	8.4
		9.2	9.2	7.0	8.7	
4		117	115	133	125	490
April		23.9	23.5	27.1	25.5	8.3
		8.8	8.8	8.1	7.6	
5		106	126	153	154	539
May		19.7	23.4	28.4	28.6	9.1
		8.0	9.7	9.3	9.4	
6		95	92	120	150	457
June		20.8	20.1	26.3	32.8	7.7
		7.2	7.1	7.3	9.1	
7		90	73	126	116	405
July		22.2	18.0	31.1	28.6	6.8
		6.8	5.6	7.6	7.1	
8		131	95	156	146	528
Aug		24.8	18.0	29.5	27.7	8.9
		9.9	7.3	9.5	8.9	
9		119	108	124	137	488
Sept		24.4	22.1	25.4	28.1	8.3
		9.0	8.3	7.5	8.4	
10		136	76	169	149	530
Oct		25.7	14.3	31.9	28.1	9.0
		10.3	5.8	10.2	9.1	
11		143	124	159	120	546
Nov		26.2	22.7	29.1	22.0	9.2
		10.8	9.5	9.6	7.3	
12		85	113	158	146	502
Dec		16.9	22.5	31.5	29.1	8.5
		6.4	8.7	9.6	8.9	
99		6	22		1	29
Unknown		20.7	75.9		3.4	.5
		.5	1.7		.1	
	Column Total	1323	1301	1649	1640	5913
		22.4	22.0	27.9	27.7	100.0

Chi-Square	Value	DF	Significance
Pearson	143.79822	36	.00000
Likelihood Ratio	142.79409	36	.00000
Mantel-Haenszel test for linear association	10.76001	1	.00104

Minimum Expected Frequency - 6.381 Number of Missing Observations: 0

Day of Week by Year

DAY OF WEEK	YEAR 1993	1994	1995	1996	Row Total
1 Sunday	126	120	208	175	629
	20.0	19.1	33.1	27.8	10.6
	9.5	9.2	12.6	10.7	
2 Monday	170	168	219	203	760
	22.4	22.1	28.8	26.7	12.9
	12.8	12.9	13.3	12.4	
3 Tuesday	163	194	228	238	823
	19.8	23.6	27.7	28.9	13.9
	12.3	14.9	13.8	14.5	
4 Wednesday	185	197	255	272	909
	20.4	21.7	28.1	29.9	15.4
	14.0	15.1	15.5	16.6	
5 Thursday	201	215	226	249	891
	22.6	24.1	25.4	27.9	15.1
	15.2	16.5	13.7	15.2	
6 Friday	294	232	282	307	1115
	26.4	20.8	25.3	27.5	18.9
	22.2	17.8	17.1	18.7	
7 Saturday	178	152	231	195	756
	23.5	20.1	30.6	25.8	12.8
	13.5	11.7	14.0	11.9	
9 Unknown	6	23		1	30
	20.0	76.7		3.3	.5
	.5	1.8		.1	
Column Total	1323	1301	1649	1640	5913
	22.4	22.0	27.9	27.7	100.0

Chi-Square	Value	DF	Significance
Pearson	93.18694	21	.00000
Likelihood Ratio	88.98457	21	.00000
Mantel-Haenszel test for linear association	9.44531	1	.00212

Minimum Expected Frequency - 6.601 Number of Missing Observations: 0

Hour of Day by Year

HOUR	YEAR 1993	1994	1995	1996	Row Total
0	32	31	48	43	151
Mid-12:59am	21.2	20.5	31.1	27.2	2.6
	2.4	2.4	2.9	2.6	
1	28	29	42	38	137
	20.4	21.2	30.7	27.7	2.3
	2.1	2.2	2.5	2.3	
2	32	37	35	42	146
	21.9	25.3	24.0	28.8	2.5
	2.4	2.8	2.1	2.6	
3	23	29	40	40	132
	17.4	22.0	30.3	30.3	2.2
	1.7	2.2	2.4	2.4	
4	25	22	22	25	94
	26.6	23.4	23.4	26.6	1.6
	1.9	1.7	1.3	1.5	
5	30	27	40	32	129
	23.3	20.9	31.0	24.8	2.2
	2.3	2.1	2.4	2.0	
6	56	58	63	64	241
	23.2	24.1	26.1	26.6	4.1
	4.2	4.5	3.8	3.9	
7	64	62	87	95	308
	20.8	20.1	28.2	30.8	5.2
	4.8	4.8	5.3	5.8	
8	86	89	108	90	373
	23.1	23.9	29.0	24.1	6.3
	6.5	6.8	6.5	5.5	
9	61	68	90	81	300
	20.3	22.7	30.0	27.0	5.1
	4.6	5.2	5.5	4.9	
10	47	55	84	70	256
	18.4	21.5	32.8	27.3	4.3
	3.6	4.2	5.1	4.3	
11	48	52	70	77	247
	19.4	21.1	28.3	31.2	4.2
	3.6	4.0	4.2	4.7	
12	71	50	52	90	263
Noon-12:59pm	27.0	19.0	19.8	34.2	4.4
	5.4	3.8	3.2	5.5	
13	42	60	73	80	255
	16.5	23.5	28.6	31.4	4.3
	3.2	4.6	4.4	4.9	
14	58	57	71	58	244
	23.8	23.4	29.1	23.8	4.1
	4.4	4.4	4.3	3.5	
15	77	85	109	99	370
	20.8	23.0	29.5	26.8	6.3
	5.8	6.5	6.6	6.0	
16	73	85	87	96	341
	21.4	24.9	25.5	28.2	5.8
	5.5	6.5	5.3	5.9	
17	108	102	120	130	460
	23.5	22.2	26.1	28.3	7.8
	8.2	7.8	7.3	7.9	

General Crosstabs Maryland

18	81	76	106	112	375
	21.6	20.3	28.3	29.9	6.3
	6.1	5.8	6.4	6.8	
19	68	58	75	73	274
	24.8	21.2	27.4	26.6	4.6
	5.1	4.5	4.5	4.5	
20	41	25	48	38	152
	27.0	16.4	31.6	25.0	2.6
	3.1	1.9	2.9	2.3	
21	48	36	61	53	198
	24.2	18.2	30.8	26.8	3.3
	3.6	2.8	3.7	3.2	
22	60	42	57	53	212
	28.3	19.8	26.9	25.0	3.6
	4.5	3.2	3.5	3.2	
23	52	39	58	58	207
	25.1	18.8	28.0	28.0	3.5
	3.9	3.0	3.5	3.5	
99	12	27	3	3	45
Unknown	26.7	60.0	6.7	6.7	.8
	.9	2.1	.2	.2	
Column	1323	1301	1649	1640	5913
Total	22.4	22.0	27.9	27.7	100.0

Chi-Square	Value	DF	Significance
Pearson	108.40152	75	.00703
Likelihood Ratio	106.91947	75	.00913
Mantel-Haenszel test for linear association	15.04603	1	.00011

Minimum Expected Frequency - .660
Cells with Expected Frequency < 5 - 4 OF 104 (3.8%) Number of Missing Observations: 0

Appendix C:
General Crosstabs Virginia

General Crosstabs Virginia

Major Crash Type Categories by Year

CRASH TYPE	YEAR 1993 (93)	1994 (94)	1995 (95)	1996 (96)	Row Total
1 Stop/Slowing	371	421	342	404	1538
	24.1	27.4	22.2	26.3	44.1
	43.6	43.3	43.1	46.2	
3 Sideswipe/Cutoff	159	210	139	140	648
	24.5	32.4	21.5	21.6	18.6
	18.7	21.6	17.5	16.0	
4 Ran Off Road	155	173	164	176	668
	23.2	25.9	24.6	26.3	19.1
	18.2	17.8	20.7	20.1	
5 Other	165	169	148	154	636
	25.9	26.6	23.3	24.2	18.2
	19.4	17.4	18.7	17.6	
Column Total	850	973	793	874	3490
	24.4	27.9	22.7	25.0	100.0

Chi-Square	Value	DF	Significance
Pearson	13.59877	9	.13733
Likelihood Ratio	13.49630	9	.14141
Mantel-Haenszel test for linear association	.37449	1	.54057

Minimum Expected Frequency - 144.512 Number of Missing Observations: 0

Injury Severity by Year

SEVERITY	YEAR 1993 (93)	1994 (94)	1995 (95)	1996 (96)	Row Total
1 Fatal	5	5	2	1	13
	38.5	38.5	15.4	7.7	.4
	.6	.5	.3	.1	
2 Injury	289	353	316	333	1291
	22.4	27.3	24.5	25.8	37.0
	34.0	36.3	39.8	38.1	
3 Property Damage	556	613	475	540	2184
	25.5	28.1	21.7	24.7	62.6
	65.4	63.0	59.9	61.8	
9 Unknown		2			2
		100.0			.1
		.2			
Column Total	850	973	793	874	3490
	24.4	27.9	22.7	25.0	100.0

Chi-Square	Value	DF	Significance
Pearson	14.97491	9	.09163
Likelihood Ratio	15.33125	9	.08223
Mantel-Haenszel test for linear association	3.00135	1	.08320

Minimum Expected Frequency - .454
Cells with Expected Frequency < 5 - 8 OF 16 (50.0%) Number of Missing Observations: 0

Any Alcohol in Crash by Year

ANY ALCOHOL	YEAR 1993	1994	1995	1996	Row Total
1 No Alcohol/Drugs	801	923	743	813	3280
	24.4	28.1	22.7	24.8	94.0
	94.2	94.9	93.7	93.0	
2 Alcohol	49	50	50	61	210
	23.3	23.8	23.8	29.0	6.0
	5.8	5.1	6.3	7.0	
Column Total	850	973	793	874	3490
	24.4	27.9	22.7	25.0	100.0

Chi-Square	Value	DF	Significance
Pearson	2.97072	3	.39616
Likelihood Ratio	2.96955	3	.39634
Mantel-Haenszel test for linear association	1.84787	1	.17403

Minimum Expected Frequency - 47.716 Number of Missing Observations: 0

Weather by Year

WEATHER	YEAR 1993	1994	1995	1996	Row Total
1 Clear	699	812	674	682	2867
	24.4	28.3	23.5	23.8	82.1
	82.2	83.5	85.0	78.0	
2 Rain	91	95	84	147	417
	21.8	22.8	20.1	35.3	11.9
	10.7	9.8	10.6	16.8	
3 Snow	27	37	25	24	113
	23.9	32.7	22.1	21.2	3.2
	3.2	3.8	3.2	2.7	
4 Fog	30	25	9	20	84
	35.7	29.8	10.7	23.8	2.4
	3.5	2.6	1.1	2.3	
9 Unknown	3	4	1	1	9
	42.9	57.1	50.0	50.0	.3
	.4	.4	.1	.1	
Column Total	850	973	793	874	3490
	24.4	27.9	22.7	25.0	100.0

Chi-Square	Value	DF	Significance
Pearson	46.59824	15	.00004
Likelihood Ratio	49.14628	15	.00002
Mantel-Haenszel test for linear association	4.37174	1	.03654

Minimum Expected Frequency - .454
Cells with Expected Frequency < 5 - 8 OF 24 (33.3%) Number of Missing Observations: 0

Weather on Road by Year

WEATHER ON ROAD	YEAR 1993	1994	1995	1996	Row Total
1 Dry	658	736	647	636	2677
	24.6	27.5	24.2	23.8	76.7
	77.4	75.6	81.6	72.8	
2 Wet	148	149	115	202	614
	24.1	24.3	18.7	32.9	17.6
	17.4	15.3	14.5	23.1	
3 Snowy	26	17	14	28	85
	30.6	20.0	16.5	32.9	2.4
	3.1	1.7	1.8	3.2	
4 Icy	17	64	15	6	102
	16.7	62.7	14.7	5.9	2.9
	2.0	6.6	1.9	.7	
5 Other		3	1		4
		75.0	25.0		.1
		.3	.1		
9 Unknown	1	4	1	2	8
	12.5	50.0	12.5	25.0	.2
	.1	.4	.1	.2	
Column Total	850	973	793	874	3490
	24.4	27.9	22.7	25.0	100.0

Chi-Square	Value	DF	Significance
Pearson	105.77849	15	.00000
Likelihood Ratio	101.43745	15	.00000
Mantel-Haenszel test for linear association	.68967	1	.40628

Minimum Expected Frequency - .909

Cells with Expected Frequency < 5 - 8 OF 24 (33.3%) Number of Missing Observations: 0

Month by Year

MONTH	Count / Row Pct / Col Pct	1993	1994	1995	1996	Row Total
1 Jan		64	91	62	62	279
		22.9	32.6	22.2	22.2	8.0
		7.5	9.4	7.8	7.1	
2 Feb		57	66	48	67	238
		23.9	27.7	20.2	28.2	6.8
		6.7	6.8	6.1	7.7	
3 March		73	86	62	74	294
		24.8	28.9	21.1	25.2	8.4
		8.6	8.7	7.8	8.5	
4 April		67	64	60	52	243
		27.6	26.3	24.7	21.4	7.0
		7.9	6.6	7.6	5.9	
5 May		72	75	65	73	285
		25.3	26.3	22.8	25.6	8.2
		8.5	7.7	8.2	8.4	
6 June		77	89	85	88	339
		22.7	26.3	25.1	26.0	9.7
		9.1	9.1	10.7	10.1	
7 July		81	90	56	67	294
		27.6	30.6	19.0	22.8	8.4
		9.5	9.2	7.1	7.7	
8 Aug		80	86	65	66	297
		26.9	29.0	21.9	22.2	8.5
		9.4	8.8	8.2	7.6	
9 Sept		64	74	57	93	288
		22.2	25.7	19.8	32.3	8.3
		7.5	7.6	7.2	10.6	
10 Oct		78	72	73	85	308
		25.3	23.4	23.7	27.6	8.8
		9.2	7.4	9.2	9.7	
11 Nov		63	98	63	72	296
		21.3	33.1	21.3	24.3	8.5
		7.4	10.1	8.0	8.2	
12 Dec		74	83	96	75	328
		22.6	25.3	29.3	22.9	9.4
		8.7	8.5	12.1	8.6	
	Column Total	850	973	792	874	3489
		24.4	27.9	22.7	25.1	100.0

Chi-Square	Value	DF	Significance
Pearson	40.65087	33	.16898
Likelihood Ratio	39.72931	33	.19523
Mantel-Haenszel test for linear association	1.32482	1	.24973

Minimum Expected Frequency - 54.026 Number of Missing Observations: 1

Day of Week by Year

DAY OF WEEK		YEAR 1993 (93)	1994 (94)	1995 (95)	1996 (96)	Row Total
Sunday	1	77	69	66	59	271
		28.4	25.5	24.4	21.8	7.8
		9.1	7.1	8.3	6.8	
Monday	2	111	158	111	131	511
		21.7	30.9	21.7	25.6	14.6
		13.1	16.2	14.0	15.0	
Tuesday	3	118	159	126	137	540
		21.9	29.4	23.3	25.4	15.5
		13.9	16.3	15.9	15.7	
Wednesday	4	141	143	112	137	533
		26.5	26.8	21.0	25.7	15.3
		16.6	14.7	14.1	15.7	
Thursday	5	121	149	117	131	518
		23.4	28.8	22.6	25.3	14.8
		14.2	15.3	14.8	15.0	
Friday	6	174	198	143	185	700
		24.9	28.3	20.4	26.4	20.1
		20.5	20.3	18.0	21.2	
Saturday	7	107	97	117	93	414
		25.8	23.4	28.3	22.5	11.9
		12.6	10.0	14.8	10.6	
Unknown	9	1		1	1	3
		33.3		33.3	33.3	.1
		.1		.1	.1	
Column Total		850	973	793	874	3490
		24.4	27.9	22.7	25.0	100.0

Chi-Square	Value	DF	Significance
Pearson	25.06871	21	.24420
Likelihood Ratio	25.71690	21	.21745
Mantel-Haenszel test for linear association	.02536	1	.87347

Minimum Expected Frequency - .682

Cells with Expected Frequency < 5 - 4 OF 32 (12.5%) Number of Missing Observations: 0

Hour of Day by Year

HOUR	YEAR 1993	1994	1995	1996	Row Total
0	21	13	17	12	63
Mid-12:59am	33.3	20.6	27.0	19.0	1.8
	2.5	1.3	2.1	1.4	
1	13	9	11	8	41
	31.7	22.0	26.8	19.5	1.2
	1.5	.9	1.4	.9	
2	17	17	16	15	65
	26.2	26.2	24.6	23.1	1.9
	2.0	1.7	2.0	1.7	
3	5	8	10	9	32
	15.6	25.0	31.3	28.1	.9
	.6	.8	1.3	1.0	
4	5	16	8	9	38
	13.2	42.1	21.1	23.7	1.1
	.6	1.6	1.0	1.0	
5	6	14	7	16	43
	14.0	32.6	16.3	37.2	1.2
	.7	1.4	.9	1.8	
6	27	30	24	32	113
	23.9	26.5	21.2	28.3	3.2
	3.2	3.1	3.0	3.7	
7	48	43	50	64	205
	23.4	21.0	24.4	31.2	5.9
	5.7	4.4	6.3	7.3	
8	72	71	60	81	284
	25.4	25.0	21.1	28.5	8.1
	8.5	7.3	7.6	9.3	
9	49	58	33	59	199
	24.6	29.1	16.6	29.6	5.7
	5.8	6.0	4.2	6.8	
10	21	52	32	26	131
	16.0	39.7	24.4	19.8	3.8
	2.5	5.3	4.0	3.0	
11	37	45	26	27	135
	27.4	33.3	19.3	20.0	3.9
	4.4	4.6	3.3	3.1	
12	31	37	35	40	143
Noon-12:59pm	21.7	25.9	24.5	28.0	4.1
	3.7	3.8	4.4	4.6	
13	42	46	40	41	169
	24.9	27.2	23.7	24.3	4.8
	4.9	4.7	5.1	4.7	
14	37	60	45	44	186
	19.9	32.3	24.2	23.7	5.3
	4.4	6.2	5.7	5.0	
15	47	47	51	54	199
	23.6	23.6	25.6	27.1	5.7
	5.5	4.8	6.4	6.2	
16	75	74	54	60	263
	28.5	28.1	20.5	22.8	7.5
	8.8	7.6	6.8	6.9	

General Crosstabs Virginia

17	93	97	81	87	358
	26.0	27.1	22.6	24.3	10.3
	11.0	10.0	10.2	10.0	
18	71	93	61	65	290
	24.5	32.1	21.0	22.4	8.3
	8.4	9.6	7.7	7.5	
19	51	47	29	40	167
	30.5	28.1	17.4	24.0	4.8
	6.0	4.8	3.7	4.6	
20	17	22	16	19	74
	23.0	29.7	21.6	25.7	2.1
	2.0	2.3	2.0	2.2	
21	21	29	31	21	102
	20.6	28.4	30.4	20.6	2.9
	2.5	3.0	3.9	2.4	
22	22	22	29	23	96
	22.9	22.9	30.2	24.0	2.8
	2.6	2.3	3.7	2.6	
23	21	23	26	20	90
	23.3	25.6	28.9	22.2	2.6
	2.5	2.4	3.3	2.3	
Column	849	973	792	872	3486
Total	24.4	27.9	22.7	25.0	100.0

Chi-Square	Value	DF	Significance
Pearson	79.07983	69	.19061
Likelihood Ratio	78.87317	69	.19501
Mantel-Haenszel test for linear association	1.68850	1	.19380

Minimum Expected Frequency - 7.270 Number of Missing Observations: 4

DOT HS 808 852
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National Highway Traffic Safety Administration