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CRASH DATA SAFETY FACTORS EVALUATION

FINAL REPORT

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Gavin Gray (gagray@pa.gov), Chief, Highway Safety Section, served as the project technical advisor. Robert Ranieri, Crash Information Systems and Analysis Manager, supplied the data used for the project. Heather Heslop (hheslop@pa.gov) was the research project manager.

16. Abstract

The purpose of this project was to identify annual trends and contributory factors of crashes involving mature drivers, vulnerable road users, fatal and injury crashes involving guiderail, and collisions resulting from vehicle failures. Three years of data, covering the years 2014 through 2016, were used in the analysis. Based on data in the present study, mature drivers appear to have issues during wet weather or in wet roadway surface conditions, at night and at intersections. In line with national trends, the majority of pedestrian crashes in Pennsylvania occurred mostly in urban areas, at night, during rainfall events, and at intersections involving careless turns. The majority of bicycle crashes occurred in urban areas, at night, during rainfall events, and when the collision involved a bicyclist or motor vehicle failure to obey a traffic control device. In crashes involving a motorcyclist, speeding- and alcohol-related collisions with fixed objects were prominent, as were collisions on horizontal curves at night. In the present study, crashes involving horse-driven buggies were overrepresented at night and involved careless turning and rear-end collisions. Guiderail crashes were overrepresented on rural roads, horizontal curves, and wet pavement surfaces. Finally, the most common vehicle failure crashes were associated with tire, brake systems, and steering, which is consistent with national statistics.

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EXECUTIVE SUMMARY

The purpose of this project was to identify annual trends and contributory factors of crashes involving mature drivers, vulnerable road users, fatal and injury crashes involving guiderail, and collisions resulting from vehicle failures. Mature drivers were those defined as crashes involving drivers aged 65 and older, as well as drivers aged 75 and older. Vulnerable road users included pedestrians, bicyclists, motorcyclists, and non-motorized horse-driven buggies. Efforts were undertaken to identify when mature drivers or vulnerable road users were at-fault in a crash.

Three years of electronic crash and roadway inventory data, covering the years 2014 through 2016, were used to investigate the trends among the four crash types of interest, as well as the contributory factors associated with all four crash types. The annual number of total crashes and each crash type of interest were determined using the crash data. The frequency of total and serious injury crashes increased during the analysis period; however, the number of fatal crashes declined over this same period. Statistical comparisons between the crash type of interest and a baseline or comparison crash type were made to determine if certain contributory factors were overrepresented in the crash type of interest.

Crashes involving mature drivers increased during the analysis period. Drivers aged 65 and older represented approximately 15.5 percent of total crashes in 2014, 15.7 percent of total crashes in 2015, and 16.3 percent of total crashes in 2016, while drivers aged 75 and older represented approximately 6.2 percent of total crashes in 2014, 6.2 percent of total crashes in 2015, and 6.4 percent of total crashes in 2016. National studies suggest that mature drivers are more likely to be involved in crashes at intersections, including driveways or alleys. Further, mature drivers are more likely to be involved in crashes during daylight, and in crashes involving a failure to yield to conflicting traffic. Based on data in the present study, crashes involving mature drivers occurred less often during inclement weather conditions or inclement roadway surface conditions, which suggest that mature drivers might travel less frequently when roadway or weather conditions are not ideal. However, among crashes that occur during inclement weather or during wet roadway conditions, mature driver crashes were overrepresented in crashes that occurred during rain or on wet roadways. Nighttime visibility may also be an issue for mature drivers, as mature driver crashes were overrepresented during dusk and at night at locations with street lights. Additionally, mature drivers were also overrepresented in crashes at intersections, including at driveways and in parking lots, which is consistent with national crash trends. In these crashes, mature drivers often midjudge the speed or turning path of conflicting drivers. Finally, mature drivers who were at-fault were overrepresented in crashes at stop-controlled intersections during the analysis period. This is likely the result of issues associated with judging the gap in conflicting traffic.

The number of crashes involving vulnerable road users increased during the analysis period. This crash type represented approximately 7.1, 6.8, and 6.9 percent of total crashes in 2014, 2015, and 2016, respectively. National crash statistics found that fatal crashes involving pedestrians often occur in urban areas, at non-intersection locations, and during non-

daylight hours. More than one-third of pedestrians killed in a crash were found to be under the influence of alcohol. In line with national trends, the majority of pedestrian crashes in Pennsylvania occurred mostly in urban areas. This was expected because non-motorized users are more prevalent in urban areas. Pedestrian crashes in Pennsylvania were also overrepresented at night and during rainfall events, which suggests that visibility is an issue. Overrepresentation was also observed for improper or careless turns at intersections when pedestrians were not at-fault, which suggests that motor vehicle drivers might also have visibility problems and not see pedestrians at intersections during these non-ideal conditions.

With regard to bicyclists, national statistics indicate that fatal crashes involving bicyclists occur frequently at intersections. Among the contributory factors, the most common among national statistics are a failure to yield to right of way; limited visibility (dark clothing or no lighting); failure to obey traffic control devices; operating under the influence of alcohol, drugs, or medication; and improper crossing of roadway or intersection. In the present study, the majority of bicycle crashes occurred in urban areas, which is consistent with national trends. This was expected because non-motorized users are more prevalent in urban areas. Among the bicycle crashes in Pennsylvania, there was overrepresentation at night and during rainfall events, which suggests that visibility is an issue. Failure to obey traffic control devices was a contributory factor in several bicycle crashes, particularly when the bicyclist was at-fault, which is also consistent with national crash statistics involving bicyclists.

National crash statistics indicate that motorcyclists are more likely to be involved in collisions with fixed objects, and motorcycle crashes are likely to involve speeding and alcohol relative to crashes involving other vehicle types. In Pennsylvania, crashes involving motorcyclists generally occurred on curves at night. Wet roadway conditions and driving under in the influence of alcohol were other factors that were overrepresented in crashes involving motorcyclists.

Little national data are available related to the frequency or severity of crashes involving horse-driven buggies. In the present study, crashes involving horse-driven buggies were overrepresented at night and involved careless turning and rear-end collisions. This suggests that buggies may not be adequately visible to motor vehicle drivers at night, and that the speed differential between horse-driven buggies and motor vehicles contributes to rear-end collisions.

Fatal and injury guiderail crashes increased throughout the analysis period and represented 0.2 percent of total crashes in 2014 to 0.3 percent of total crashes in 2016. Among national crash statistics, collisions with guiderail represented 2.8 percent of the total fatal crashes in the United States. in 2015. A rollover occurred in 19 percent of the crashes. In the present study, guiderail crashes were overrepresented on rural roads and horizontal curves, and multi-vehicle guiderail crashes were overrepresented on wet pavement surfaces at night. This suggests that drivers fail to adequately adjust their travel speeds along horizontal curves of two-lane rural highways. Improved delineation (e.g., signs and pavement markings) may reduce these crash types. Further, fatal and injury collisions involving

guiderail were more likely when drivers were operating their vehicle under the influence of alcohol or were otherwise impaired. DUI checkpoints on rural highways may mitigate this crash type.

About 2 percent of crashes in the United States are attributed to vehicle failures. In Pennsylvania, about 2.3 percent of total crashes were attributed to vehicle failures. National statistics indicated that vehicle failure-related crashes are most frequently caused by tires (43 percent), brakes (25 percent), and steering/ suspension/ transmission/ engine (10.5 percent) breakdowns. In the present study, the most common vehicle failure crashes were associated with tire, brake systems, and steering, which is consistent with national statistics. An increased focus on these systems during annual inspections may help to mitigate these failures and reduce this crash type.

PROJECT PURPOSE AND OBJECTIVES

Fatalities resulting from traffic crashes in Pennsylvania during the most recent five years ranged from a low of 1,089 in 2016 to a high of 1,310 in 2012. During this same time period, injuries resulting from traffic crashes ranged from a low of 79,758 in 2014 to a high of 87,839 in 2011. More than 120,000 traffic crashes were reported annually during this same five-year period, suggesting that many incidents result in property-damage only. These crash statistics represent a significant cost to society. In order to effectively apply federal funding to manage safety programs in the Commonwealth, the Pennsylvania Department of Transportation (PennDOT) seeks information about the contributory factors associated with traffic crashes.

The purpose of this project was to identify annual trends and contributory factors of four specific crash types. The crash types are defined as follows:

1. *Older or mature drivers*: This crash type involves drivers aged 65 and older, as well as drivers aged 75 and older.
2. *Vulnerable road users*: This crash type primarily includes pedestrians, bicyclists, and motorcyclists, but also includes non-motorized horse-driven buggies.
3. *Guiderail fatal and serious injury crashes*: This crash type includes those that involve vehicles colliding with guiderail along the outside (right-side) of the traveled way or along the inside (median) of a divided highway.
4. *Motor vehicle failures*: This crash type involves collisions that result from a motor vehicle failure (e.g., brake failure, tire eruption, etc.).

Research Tasks

This project was completed in two phases. The first phase of the project involved compiling the most recent three years of crash data on roadways in Pennsylvania in order to identify the four crash types of interest for the study. The sample of crash data included all crashes

included in PennDOT's crash reporting system data files. Roadway inventory, traffic volume, and other site-specific data were then appended to the crash data in order to identify the range of factors contributing to the four crash types of interest.

The purpose of the second phase of work was to undertake a comprehensive analysis of the crash data files compiled during the first phase. This included efforts to summarize the total number of crashes for the four crash types included in the study. The contributory factors identified in the electronic data files were summarized in tabular form (e.g., location of crashes, time of day, etc.). Additionally, for each of the four crash types identified above, proportions or frequencies of the crash types of interest were compared to a reference group to determine if there was overrepresentation of the particular crash type of interest. For example, the proportion of rear-end crashes at signalized intersections involving at-fault mature drivers over the age of 65 years was compared to the proportion of rear-end crashes not involving mature drivers at signalized intersections.

The primary outcome of the analysis was to identify possible causal factors associated with the four crash types of interest, and to determine if these factors were overrepresented relative to the baseline or comparison category. The results of the statistical tests will be used to identify the locations or circumstances that may be considered when developing crash mitigation strategies for the four crash types of interest.

Organization of the Report

This report is organized into four subsequent sections. The first section reviews the data request and the codes that were used to identify the four crash types included in the analysis. The second section provides the results of the detailed data analyses. In this section, the data are summarized in tabular form, and the statistical tests that were used to perform the comparisons between the crash types of interest and the reference group are shown. The third section provides a discussion of the results, including comparisons to national trends for the four crash types included in the present study. The fourth section is a summary of the main findings from the project.

DATA REQUEST AND CRASH TYPE IDENTIFICATION

Three data sources were requested for the present study. A description of each is summarized below:

- *Crash Data:* All crashes occurring on roadways for the years 2014 through 2016 (inclusive) were included in this request. Among the PennDOT crash data files were information related to the event, vehicles, and occupants involved in the crash. All of the different data tables included a unique crash record number so that the event, vehicle, and occupant information could be linked. Additionally, the crash data

included where the event occurred along PennDOT's linear referencing system, so that the crash data could be appended to the roadway inventory data.

- *Roadway Inventory Data:* Three years of roadway inventory data (2014 through 2016, inclusive) were also requested in order to identify roadway characteristics associated with each crash event. This file included information about the linear referencing system (in order to append crash data to the files), traffic volume, cross-section elements, posted speed limit, and roadside hardware details.
- *Driver License Data:* The distribution of driver licenses by vehicle class category and age for the years 2014 to 2016 (inclusive) was provided in order to develop an exposure measure for the mature driver and motorcyclist crash types included in the analysis. For example, these data were used to compute statistics such as the number of crashes involving mature drivers as a function of the number of mature licensed drivers in Pennsylvania.

The following steps were taken to identify the four crash types considered in the analysis:

Mature Drivers

The mature driver crash analysis involved screening the data to identify crashes involving drivers who were 65 years of age and older, as well as drivers aged 75 and older. This involved using the DRIVER_COUNT_65_74 variable flag and the DRIVER_COUNT_75PLUS variable flag located in the crash database. A new variable, DRIVER_COUNT_65PLUS, was created to capture all mature drivers aged 65 and older. This provided the list of all crashes that involved a mature driver (either aged 65 and older or 75 and older).

In addition to the age flag, efforts were undertaken to determine if the mature driver was at-fault in the crash, or if the mature driver was involved in the crash, but not at-fault. This was done to identify situations in which mature drivers might have difficulty or confusion that might lead to a crash. The process to identify such crashes for drivers aged 65 and older required joining the crash report numbers (CRNs) from the crash database with the person database. For each CRN, records with the same value of PRIME_FACTOR_UNIT (from crash table) and UNIT_NUM (from person table) provided the list of all passengers in the at-fault vehicle. The PERSON_TYPE = 1 code was used to identify the driver of the at-fault vehicle and the AGE >= 65 (or AGE >= 75) was used to determine if the mature driver was at-fault. The crashes were further screened to only consider those with PRIME_FACTOR_TYPE = D, which represented crashes caused by a driver error (compared to environment or vehicle-related reasons).

In order to confirm that these methods accurately identified mature drivers that were at-fault or not at-fault in the crash using the electronic databases, a random sample of 40 crashes involving mature drivers were sampled and reviewed using PennDOT's online crash reporting tool. This tool provides a narrative summary of the crash from the perspective of the investigating police officer who responded to the crash scene. The narrative summaries confirmed that mature drivers were at-fault in all of the 40 crashes identified. A random

sample of 20 crashes involving mature drivers who were not deemed at-fault in the crash also confirmed that the electronic codes were consistent with the narrative summaries of the crash event.

Vulnerable Road Users

The vulnerable road user crash analysis involved screening the data to identify crashes involving motorcycles, bicycles, pedestrians, and horse-driven buggies. This involved using the MOTORCYCLE_COUNT variable, the BICYCLE_COUNT variable, and the PED_COUNT variable located in the crash database for motorcycle, bicycle, and pedestrian crashes, respectively. To identify crashes involving non-motorized horse-driven buggies, the VEH_TYPE code in the vehicle database was used. A VEH_TYPE = 22 for any CRN represented a crash involving a non-motorized horse-driven buggy. New variables MOTORCYCLE_FLAG, BICYCLE_FLAG, PED_FLAG, and HORSEBUGGY_FLAG were created for each CRN, indicating if a crash was associated with a certain type of vulnerable road user. Separate datasets for each of the four vulnerable road user crash types were then extracted using the newly created flag variables.

In addition, the at-fault vehicle or unit in each crash was determined using the VEH_TYPE or UNIT_TYPE variables in the vehicle database. This process required joining the crash database with the vehicle database based on CRN values. For each CRN, records with the same value of PRIME_FACTOR_UNIT (from crash table) and UNIT_NUM (from vehicle table) provided the at-fault vehicle information in the crash. Values of VEH_TYPE and UNIT_TYPE variables involved in this step included VEH_TYPE = 2 (motorcycle), VEH_TYPE = 20 (unicycle, bicycle, or tricycle), VEH_TYPE = 21 (other pedalcycle), UNIT_TYPE = 31 (pedestrian), and VEH_TYPE = 22 (horse and buggy). Single-unit motorcycle crashes were identified using the TOTAL_UNITS variable in the crash table. Note that, as with mature driver crashes, only crashes with PRIME_FACTOR_TYPE = D were included in the analysis.

Guiderail-related Fatal and Serious Injury Crashes

The guiderail crash analysis involved screening the data to identify motor vehicle crashes that involved a vehicle hitting a guiderail or guiderail end, resulting in a fatality or serious injury among motor vehicle occupants. To identify these crashes, the crash database was first joined with the flag database based on CRNs. Then, a new dataset was created based on the values of variables HIT_GDRAIL, HIT_GDRAIL_END, and FATAL_OR_MAJ_INJ. The resulting crashes had a value of FATAL_OR_MAJ_INJ = 1 and either HIT_GDRAIL = 1 or HIT_GDRAIL_END = 1.

Within the new dataset, the crashes were further split into single-vehicle and multi-vehicle crashes. Crashes with VEHICLE_COUNT = 1 were identified as single-vehicle crashes and the rest were considered multi-vehicle crashes. Within the single-vehicle crashes, 5 records involved pedestrians and 4 records involved phantom vehicles. A manual check of the

PennDOT Crash Reporting System confirmed that no motor vehicle occupant was killed or seriously injured in the crashes involving pedestrians, so these were removed from the analysis database. Phantom vehicle crashes were crashes in which the driver claimed another vehicle caused the crash. Since there was no solid evidence for the existence of a phantom vehicle, single-vehicle guiderail crashes involving phantom vehicles were kept in the single-vehicle category. Again, only crashes with PRIME_FACTOR_TYPE = D were included in the final analysis database.

Motor Vehicle Failures

Several selection criteria were considered to identify crashes involving motor vehicle failures. The VEHICLE_FAILURE flag in the flag database and the VEH_FAILURE1 code in the vehicle database were both considered to identify this crash type. However, both were found to provide an unusually large number of motor vehicle failure crashes. A manual check of these CRNs using the PennDOT Crash Reporting System revealed that neither of these two fields served as a good indicator of crashes caused by vehicle failures, since many times these codes were used to indicate a motor vehicle failure that occurred as a result of a crash (i.e., the crash caused the motor vehicle failure and the motor vehicle failure did not cause the crash). Finally, the PRIME_FACTOR_TYPE = V code in the crash database was used to identify crashes that occurred as a consequence of motor vehicle failures.

Summary Statistics

The annual number of total crashes and each crash type of interest were determined using the crash data. Table 1 provides a summary of these data. The data shown in Table 1 indicate that total crashes have increased during the analysis period; however, the number of fatal crashes has declined over this same period. Serious injury crashes appear to have increased during this time, but this is likely due to changes in how serious injury crashes were codified by investigating officers in 2016.

Crashes involving mature drivers increased during the analysis period. Drivers aged 65 and older represent approximately 15.5 percent of total crashes in 2014, 15.7 percent of total crashes in 2015, and 16.3 percent of total crashes in 2016, while drivers aged 75 and older represent approximately 6.2 percent of total crashes in 2014, 6.2 percent of total crashes in 2015, and 6.4 percent of total crashes in 2016.

Crashes involving vulnerable road users increased during the analysis period. This crash type represents approximately 7.1, 6.8, and 6.9 percent of total crashes in 2014, 2015, and 2016, respectively. Fatal and serious injury crashes involving guiderail increased during the analysis period. These crashes represented 7.3 percent of the total fatal and serious injury crashes in 2014, 7.7 percent of the total fatal and serious injury crashes in 2015, and 7.2 percent of the total fatal and serious injury crashes in 2016.

Fatal and serious injury guiderail crashes increased throughout the analysis period, and represented 0.2 percent of total crashes in 2014 to 0.3 percent of total crashes 2016. A significant increase in this crash type was observed between 2015 and 2016.

Vehicle failure crashes also increased during the analysis period. These crashes represented 2.3 percent of the total crashes in 2014, 2.3 percent of the total crashes in 2015, and 2.4 percent of the total crashes in 2016. All of the vehicle failure types increased during the analysis period. The most significant increase occurred between 2015 and 2016.

Table 1. Summary of Total Crashes and Four Crash Types.

Crash Type	Year						Total	%
	2014	%	2015	%	2016	%		
Total Crashes	**121,541**	-	**127,401**	-	**129,395**	-	**378,337**	-
Fatal Crashes	**1,107**	0.91%	**1,102**	0.86%	**1,089**	0.84%	**3,298**	0.87%
Serious Injury Crashes	**2,575**	2.12%	**2,578**	2.02%	**3,681**	2.84%	**8,834**	2.33%
Mature Drivers								
≥ 65 yr	**18,837**	15.50%	**19,979**	15.68%	**21,122**	16.32%	**59,938**	15.84%
Driver related	**17,167**	91.13%	**18,258**	91.39%	**19,345**	91.59%	**54,770**	91.38%
Mature driver at fault	***10,617***	*61.85%*	***11,373***	*62.29%*	***12,046***	*62.27%*	***34,036***	*62.14%*
Mature driver not at fault	***6,550***	*38.15%*	***6,885***	*37.71%*	***7,299***	*37.73%*	***20,734***	*37.86%*
≥ 75 yr	**7,526**	6.19%	**7,915**	6.21%	**8,239**	6.37%	**23,680**	6.26%
Driver related	**7,010**	93.14%	**7,369**	93.10%	**7,705**	93.52%	**22,084**	93.26%
Mature driver at fault	***4,810***	*68.62%*	***5,120***	*69.48%*	***5,322***	*69.07%*	***15,252***	*69.06%*
Mature driver not at fault	***2,200***	*31.38%*	***2,249***	*30.52%*	***2,383***	*30.93%*	***6,832***	*30.94%*
Vulnerable Road Users	**8,625**	7.10%	**8,711**	6.84%	**8,977**	6.94%	**26,313**	6.95%
Pedestrian	**4,011**	46.50%	**4,009**	46.02%	**4,201**	46.80%	**12,221**	46.4%
Driver related	**3,212**	80.08%	**3,543**	88.38%	**3,973**	94.57%	**10,728**	87.78%
Ped at fault	***1,542***	*48.01%*	***1,582***	*44.65%*	***1,742***	*43.85%*	***4,866***	*45.36%*
Ped not at fault	***1,670***	*51.99%*	***1,961***	*55.35%*	***2,231***	*56.15%*	***5,862***	*54.64%*
Bicyclist	**1,316**	15.26%	**1,277**	14.66%	**1,305**	14.54%	**3,898**	14.81%
Driver related	**1,069**	81.23%	**1,108**	86.77%	**1,179**	90.34%	**3,356**	86.10%
Bicycle at fault	***669***	*62.58%*	***645***	*58.21%*	***681***	*57.76%*	***1,995***	*59.45%*
Bicycle not at fault	***400***	*37.42%*	***463***	*41.79%*	***498***	*42.24%*	***1,361***	*40.55%*
Motorcyclist	**3,307**	38.34%	**3,442**	39.51%	**3,467**	38.62%	**10,216**	38.82%
Driver related	**2,739**	82.82%	**2,923**	84.92%	**2,895**	83.50%	**8,557**	83.76%
Single motorcycle	***1,091***	*39.83%*	***1,104***	*37.77%*	***1,121***	*38.72%*	***3,316***	*38.75%*
Multi unit, motorcycle at fault	***728***	*26.58%*	***761***	*26.03%*	***744***	*25.70%*	***2,233***	*26.10%*
Multi unit, motorcycle not at fault	***920***	*33.59%*	***1,058***	*36.20%*	***1,030***	*35.58%*	***3,008***	*35.15%*
Horse-driven Buggy	**65**	0.75%	**61**	0.70%	**67**	0.75%	**193**	0.73%
Driver related	**56**	86.15%	**54**	88.52%	**54**	80.60%	**165**	85.49%
Horse buggy at fault	***21***	*37.50%*	***14***	*25.93%*	***15***	*27.78%*	***50***	*30.30%*
Horse buggy not at fault	***35***	*62.50%*	***40***	*74.07%*	***39***	*72.22%*	***114***	*69.09%*
Guiderail	**267**	0.22%	**283**	0.22%	**343**	0.27%	**893**	0.24%
Driver related	***245***	*91.76%*	***257***	*90.81%*	***314***	*91.55%*	***816***	*91.38%*
Single vehicle	***158***	*64.49%*	***173***	*67.32%*	***210***	*66.88%*	***541***	*66.30%*
Multi vehicle	***87***	*35.51%*	***84***	*32.68%*	***104***	*33.12%*	***275***	*33.70%*
Vehicle Failures	**2,795**	2.30%	**2,981**	2.34%	**3,037**	2.35%	**8,813**	2.33%
Tire	**615**	22.00%	**665**	22.31%	**707**	23.28%	**1,987**	22.55%
Brake	**710**	25.40%	**759**	25.46%	**723**	23.81%	**2,192**	24.87%
Steering	**328**	11.74%	**360**	12.08%	**357**	11.76%	**1,045**	11.86%
Power Train	**249**	8.91%	**266**	8.92%	**265**	8.73%	**780**	8.85%
Wheels	**247**	8.84%	**255**	8.55%	**289**	9.52%	**791**	8.98%
Suspension	**94**	3.36%	**89**	2.99%	**86**	2.83%	**269**	3.05%

Table 2 shows crash rates for several driver and vehicle types, which are provided as the number of crashes per 100 licensed drivers in Pennsylvania of that type. For each category and year, the first number represents the crash rate considering only crashes involving licensed PA drivers, while the second number in parentheses considers all crashes. When considering the entire sample of mature drivers, the crash rate per 100 licensed drivers is underrepresented relative to the crash rate per 100 licensed drivers for all drivers in Pennsylvania. The lower crash rate for mature drivers is likely attributable to the lower mileage or trip frequency that they travel relative to other drivers. Motorcycle crashes are

also underrepresented compared to other crashes, perhaps also due to the lower mileage or trip frequency.

Table 2. Crash Rate Per 100 Licensed Drivers in Pennsylvania.

Driver Category	Year		
	2014	2015	2016
All Drivers	1.26 (1.36)	1.32 (1.42)	1.33 (1.44)
Drivers Aged 65 to 74	0.95 (1.01)	0.98 (1.05)	1.02 (1.09)
Driver Aged 75 or Older	0.94 (0.98)	0.98 (1.03)	1.02 (1.07)
Motorcyclists	0.34 (0.38)	0.36 (0.38)	0.36 (0.39)
Drivers Aged 19 or Younger	5.51 (5.77)	5.88 (6.19)	5.46 (5.77)

Table 3 provides crash rates per 1 billion vehicle miles traveled (VMT) in Pennsylvania for all fatal or serious injury crashes, fatal or serious injury crashes involving guiderails and non-guiderail fatal or serious injury crashes involving a fixed object. All crashes are included since VMT could not be estimated for only licensed PA drivers. Note that the crash rate increased significantly between 2015 and 2016, due to the increase in fatal or serious injury crashes that were reported. In general, fatal or serious injury guiderail crashes have a lower crash rate than fatal or serious injury crashes involving a fixed object that was not a guiderail.

Table 3. Crash Rate Per 1 Billion Vehicle Miles Traveled in Pennsylvania.

	Year		
	2014	2015	2016
All fatal or serious injury crashes on state-owned roadways	32.65	31.86	41.21
Guiderail fatal or serious injury crashes on state-owned roadways	8.85	8.83	10.58
Hit-fixed-object fatal or serious injury crashes on state-owned roadways	13.79	13.22	16.14

ANALYSIS RESULTS

This section of the report describes the analyses that were completed to evaluate the contributory factors associated with the four crash types. The first section describes the general statistical analysis methodology that was used to identify statistically significant differences between characteristics of each crash type and a reference group. The next four subsections describe the analysis for each of the four crash types considered. For each crash type, the entire analysis process is described first. Then a tabular summary of the results is provided. This is followed by a discussion related to the statistical analysis that was performed to compare each crash type to a reference group.

Statistical Methodology

For each of the four crash types of interest, the proportion of these crashes that share the same geometric, environmental, or other characteristics was computed. These proportions indicate the conditions under which these crash types occurred. Additionally, the proportion of crashes of a particular type (i.e., mature driver crashes, guiderail fatal and serious injury crashes, or vulnerable road users) sharing a set of characteristics were compared to the proportion of crashes from a reference group to see if there was overrepresentation in the group being considered. In cases where differences existed between the proportion of crashes reported from the group being considered (P_C) and the proportion of crashes reported from the reference group (P_R), a statistical z-test of proportions was performed to determine if the difference was statistically different from zero. Cases that were not statistically significant likely represent random differences that might occur due to the fact that crashes are random events, whereas statistically significant differences might represent the presence of a larger trend or issue.

The null and alternative hypotheses for the test are:

- Null Hypothesis (H_0): There is no difference between the two sample proportions, or H_0: $P_C - P_R = 0$
- Alternative Hypothesis (H_A): There is a difference between the two sample proportions, H_A: $P_C - P_R \neq 0$.

The Z-statistic used to determine the statistical difference between the two proportions is as follows:

$$Z = \frac{P_C - P_R}{\sqrt{P(1-P)\left(\frac{1}{n_C} + \frac{1}{n_R}\right)}}$$

where P_C and P_R are the sample proportions of the group being considered and the reference group, respectively, and n_C and n_R are sample sizes for the corresponding proportions being considered. P is the combined proportion in both samples, computed as follows:

$$P = \frac{x_C + x_R}{n_C + n_R}$$

where x_C and x_R are the number of positive observations in each sample, respectively.

The computed Z-statistic is associated with a p-value. A p-value of 0.05 or less results in a failure to accept (reject) the null hypothesis and conclude that the difference observed is a statistically significant difference at the 95 percent confidence level.

Mature Drivers

Appendix A provides four tables containing the crash characteristics for mature drivers. Table 4 provides the characteristics for at-fault mature drivers aged 65 and older and Table 5 provides the characteristics for at-fault mature drivers aged 75 and older. Table 6 and Table 7 provide the characteristics for mature drivers aged 65 and older and 75 and older, respectively, who were deemed not at-fault in the reported crash. In all cases, the reference group that was used to compare the mature driver crashes is the set of crashes not involving any drivers aged 65 and older.

Each of the tables is organized as follows. The first column represents the category that describes a specific crash characteristic. The indentation and justification of numerical values show the level of detail for each category. The descriptions that are not indented refer to primary categories that are a subset of the total reported crashes; these numerical values are left-justified. The descriptions indented once are secondary categories that are a subset of the primary category. The associated numerical values are center-justified and the text is also italicized. Descriptions indented twice are tertiary categories that are presented as subsets of the preceding secondary category. The associated numerical values are right-justified and these cells are shaded.

Each of the remaining columns is described as follows:

- The second column provides the count of mature driver crashes within each category.
- The third column provides the proportion of mature driver crashes that is represented by the category. For primary categories, this is presented as a proportion of all mature driver-related crashes, whereas for secondary and tertiary categories, this is presented as a proportion of the associated primary or secondary category, respectively.
- The fourth column represents the total number of crashes from the reference group that falls within this category. For mature driver-related crashes, the reference group refers to all non-mature driver-related crashes.
- The fifth column provides the proportion of crashes from the reference group that falls within this category. As with the second column, this is presented as a proportion of all mature driver-related crashes, whereas for secondary and tertiary categories, this is presented as a proportion of the associated primary or secondary category, respectively.
- The sixth column provides the difference in proportion between the mature driver-related crashes and the reference group crashes for each category. Positive values represent cases in which the mature driver crash category is overrepresented relative to the reference category.

Furthermore, a red color is used to differentiate rows with a positive difference in proportions between the mature driver group and the reference group that are statistically significant as obtained from the z-test of proportions. Bold text is used to identify rows for which this difference is also practically significant, as identified by the research team. Rows

with bold and red font, therefore, suggest characteristics that are overrepresented within each set of mature driver crashes.

The subsequent discussion focuses on crash types or categories that are overrepresented among mature drivers. Findings from Table 4, which compares drivers aged 65 and older who were deemed at-fault in a crash to all crashes not involving mature drivers, indicate the following:

- Approximately 52.7 percent of crashes involving at-fault mature drivers occur on local roadways, while approximately 45.8 percent of crashes involve drivers less than 65 years old. Similarly, mature drivers who were deemed at-fault were involved in approximately 76.0 percent of crashes on state-owned roadways, while the proportion of drivers who were less than 65 years old comprised 72.4 percent of crashes on state-owned roadways.
- Crashes involving mature drivers generally occur less often during inclement weather (11.8 percent) or inclement roadway (16.6 percent) conditions than crashes not involving mature drivers (18.2 percent and 24.8 percent, respectively). This could suggest that mature drivers travel less often when roadway or weather conditions are not ideal.
- Among crashes occurring during inclement weather conditions, approximately 72.8 percent of crashes involving at-fault mature drivers aged 65 and older occur in the rain. In contrast, approximately 62.9 percent of crashes during inclement weather conditions involve rain for drivers less than 65 years old. This same disparity was observed when crashes were codified as occurring in inclement road conditions. Mature drivers who were deemed at-fault were overrepresented in wet road conditions (78.1 percent for mature drivers versus 66.9 percent for non-mature drivers).
- Among crashes occurring at night, approximately 52.7 percent involved at-fault mature drivers at locations with street lights. Among the reference group, only 50.5 percent occurred at night with street lights. Approximately 8.8 percent of at-fault mature driver crashes occurred during dusk, while only 4.9 percent of non-mature driver crashes occurred during dusk. This may suggest that mature drivers are challenged to adapt to changing light conditions (dark adaptation between lighted and unlighted areas).
- When considering crashes that occur with inclement road conditions at night, approximately 48.1 percent involve mature at-fault drivers on local roads, while 41.4 percent involve non-mature drivers on local roads. A similar disparity was found among crashes occurring on state-owned roads with inclement road conditions at night – at-fault mature drivers are overrepresented in these types of crashes when compared to non-mature drivers.
- For the location type category in Table 4, mature drivers aged 65 and older who were deemed at-fault were overrepresented in reported crashes near driveways and parking lots when compared to non-mature drivers. In this case, mature drivers fail to provide the necessary clearance (i.e., misjudge speed or turning path) to the conflicting vehicle (16.6 percent for mature drivers versus 12.4 percent for non-mature drivers).

- For the collision type category in Table 4, at-fault mature drivers are overrepresented in angle collisions (45.3 percent) relative to non-mature drivers (26.8 percent). Stop-controlled intersections appear to be the location that is most prominent among the angle collision type, and the most overrepresented contributory factor for at-fault mature drivers is related to clearance, which involves misjudging the speed or turning pathway of a conflicting vehicle.
- Among the prime factors coded in crashes involving at-fault mature drivers, there are several actions that appear overrepresented when comparing mature drivers to non-mature drivers. These include the following: (1) making an improper or careless turn (16.6 percent), (2) proceeding without clearance after a stop (13.8 percent), (3) running a stop sign (3.9 percent), (4) running a red light (5.6%), and (5) making an improper entrance to a highway (2.9%). When making improper or careless turns, at-fault mature drivers are overrepresented in this collision type at midblock locations, at locations with no traffic control device, and at t-intersections. This suggests judgment errors or confusion at locations that do not have clear lane-use controls and that conflicting traffic may confuse older drivers. When proceeding without clearance after a stop, at-fault mature drivers are overrepresented in crashes at stop-controlled intersections, which again suggests issues with judgment errors or lack of clear traffic control. With regard to running stop signs, mature at-fault drivers are overrepresented at four-way stop-controlled intersections, although the difference relative to all non-mature drivers is not considerable (72.0 percent for mature drivers versus 70.4 percent for non-mature drivers).
- Mature at-fault drivers aged 65 and older are cited as aggressive drivers in 65.4 percent of reported crashes, while aggressive driving is cited in 60.5 percent of non-mature driver crashes. Relative to non-mature drivers, the most common locations in which at-fault mature drivers exhibit this behavior were at intersections and parking lot and driveway locations. This finding supports the other driver behavior findings at intersections, which suggests that mature drivers make improper or careless maneuvers at locations with conflicting vehicle traffic.

Table 5 compares the crash characteristics for at-fault mature drivers aged 75 and older to crashes not involving mature drivers (less than 65 years old). A summary of the findings is provided below:

- Approximately 55.3 percent of crashes involving at-fault mature drivers occur on local roadways, while approximately 45.8 percent of crashes involve drivers less than 65 years old.
- Crashes involving mature drivers generally occur less often during inclement weather (10.7 percent) or inclement roadway (15.2 percent) conditions than crashes not involving mature drivers (18.2 percent and 24.8 percent, respectively). This could suggest that mature drivers travel less often when roadway or weather conditions are not ideal.
- Among crashes occurring during inclement weather conditions, approximately 76.0 percent of crashes involving at-fault mature drivers aged 75 and older occur in the rain. In contrast, approximately 62.9 percent of crashes during inclement weather conditions involve rain for drivers less than 65 years old. This same disparity was

observed when crashes were codified as occurring during inclement road conditions. Mature drivers who were deemed at-fault were overrepresented in wet road conditions (81.7 percent for mature drivers versus 66.9 percent for non-mature drivers).

- Among crashes occurring at night, approximately 53.6 percent involved at-fault mature drivers at locations with street lights. Among the reference group, only 50.5 percent occurred at night with street lights. Approximately 9.5 percent of at-fault mature driver crashes occurred during dusk, while only 4.9 percent of non-mature driver crashes occurred during dusk. This may suggest that mature drivers are challenged to adapt to changing light conditions (dark adaptation between lighted and unlighted areas).
- When considering crashes that occur with inclement road conditions, crashes involving at-fault mature drivers were more likely to occur on local or state-owned roads than other crashes. With respect to those crashes occurring during both inclement road conditions and at night, mature drivers are overrepresented on local roads.
- For the location type category in Table 5, mature drivers aged 75 and older who were deemed at-fault were overrepresented in reported crashes near driveways and parking lots when compared to non-mature drivers. In this case, mature drivers fail to provide the necessary clearance (i.e., misjudge speed or turning path) of the conflicting vehicle (16.5 percent for mature drivers versus 12.4 percent for non-mature drivers).
- For the collision type category in Table 5, at-fault mature drivers are overrepresented in angle collisions (48.7 percent) relative to non-mature drivers (26.8 percent). Stop-controlled intersections appear to be the location that is most prominent among the angle collision type, and the most overrepresented contributory factor for at-fault mature drivers is related to clearance, which involves misjudging the speed or turning pathway of a conflicting vehicle.
- Among the prime factors coded in crashes involving at-fault mature drivers, there are several actions that appear overrepresented when comparing mature drivers to non-mature drivers. These include the following: (1) making an improper or careless turn (18.3 percent), (2) proceeding without clearance after a stop (15.0 percent), (3) running a stop sign (4.5 percent), (4) running a red light (5.4%), and (5) making an improper entrance to a highway (3.5%). When making improper or careless turns, at-fault mature drivers are overrepresented in this collision type at midblock locations, at locations with no traffic control device, and at t-intersections. This suggests judgment errors or confusion at locations that do not have clear lane-use controls and that conflicting traffic may confuse older drivers. When proceeding without clearance after a stop, at-fault mature drivers are overrepresented in crashes at stop-controlled intersections, which again suggests issues with judgment errors or lack of clear traffic control.
- Mature at-fault drivers aged 75 and older are cited as aggressive drivers in 66.0 percent of reported crashes, while aggressive driving is cited in 60.5 percent of non-mature driver crashes. Relative to non-mature drivers, the most common locations in which at-fault mature drivers exhibit this behavior were intersections and parking

lot and driveway locations. This finding supports the other driver behavior findings at intersections, which suggests that mature drivers make improper or careless maneuvers at locations with conflicting vehicle traffic.

Table 6 and Table 7 show the crash characteristics for mature drivers aged 65 and older and aged 75 and older, respectively, when the mature driver was not deemed at-fault by the investigating police officer. As expected, the findings are similar to the at-fault analyses described for at-fault mature drivers. Major differences between the at-fault and not-at-fault analyses are described below:

- Among the collision types, at-fault mature drivers were overrepresented in angle collisions. Mature drivers that were deemed not at-fault were also overrepresented for this collision type (44.8 percent for non at-fault drivers aged 65 and older versus 26.8 percent for drivers less than 65 years old in Table 6; 50.1 percent for non at-fault drivers aged 75 and older versus 26.8 percent for drivers less than 65 years old in Table 7). Rear-end collisions were also overrepresented in crashes involving not- at-fault mature drivers. Among the mature drivers aged 65 and older who were not at-fault, 40.3 percent of crashes were rear-end, while only 24.2 percent of crashes in the reference group were rear-end. Among the mature drivers aged 75 and older who were not at-fault in a crash, 35.6 percent were coded as rear-end collisions.
- Among the prime contributory factors involving mature drivers who were not at-fault in the crash, approximately 12.9 percent were coded as distracted driving for drivers 65 and older, and 12.2 percent were coded as distracted driving for drivers 75 and older. The reference group found that only 10.0 percent of drivers were distracted.
- Tailgating was also a factor cited more frequently in crashes involving mature drivers not at-fault in a reportable crash.
- Crashes involving an improper or careless turn were overrepresented at midblock locations and at traffic signals when not-at-fault mature drivers were considered relative to a reference group.

Vulnerable Road Users

The analysis of vulnerable road users is split into four subsections representing the different types of vulnerable road users that exist: pedestrians, bicyclists, motorcyclists, and non-motorized, horse-driven buggies.

Pedestrians

Appendix B provides two tables containing the crash characteristics for crashes involving pedestrians. Table 8 provides the characteristics for crashes involving pedestrians in which the pedestrian was at-fault, and Table 9 provides the characteristics for crashes involving pedestrians in which the pedestrian was not at-fault. In both cases, the reference group that

was used to compare the pedestrian crashes is the set of crashes not involving any vulnerable road users. Each of the tables is organized the same as for the mature driver crashes.

Table 8 shows the crash characteristics or contributory factors in crashes involving pedestrians in which the pedestrian was determined to be at-fault. The reference group includes the proportion of crashes not involving vulnerable road users. The findings from this comparison are provided below:

- At-fault pedestrian crashes are overrepresented on local roads (65.5 percent) when compared to crashes involving less vulnerable road users (45.7 percent).
- At-fault pedestrian crashes are overrepresented in urban locations (81.9 percent) when compared to crashes involving other road users in urban locations (41.0 percent).
- Approximately 73.9 percent of at-fault pedestrian crashes occurring during inclement weather are reported during a rainfall event, while only 61.2 percent of inclement weather-related crashes involving other road users occur during a rainfall event. Similarly, at-fault pedestrian crashes are overrepresented at locations with wet roadway surfaces when compared to crashes involving less vulnerable road users.
- Approximately 41.4 percent of at-fault pedestrian crashes occur in non-daylight periods, while only 35.2 percent of crashes involving less vulnerable road users occur during non-daylight periods. The majority of at-fault pedestrian crashes occurring in non-daylight periods occur in urban areas (78.2 percent) at locations with street lights. While a low proportion of at-fault pedestrian crashes occur in suburban or rural areas (21.8 percent), locations that are dark with no street lighting experience a high proportion of at-fault pedestrian crashes relative to crashes not involving vulnerable road users.
- Among the crashes occurring at intersections, at-fault pedestrian crashes (53.1 percent) are overrepresented at signalized intersections when compared to crashes at intersections involving less vulnerable road users (39.6 percent).
- At-fault pedestrian crashes are overrepresented at mid-block locations (64.9 percent) when compared to mid-block crashes involving less vulnerable road users (60.2 percent). At the mid-block locations, at-fault pedestrian crashes are overrepresented at night at locations with street lights when compared to similar crash types involving less vulnerable road users.

Table 9 shows the crash characteristics or contributory factors in crashes involving pedestrians in which the pedestrian was determined not to be at-fault. The reference group includes the proportion of crashes not involving vulnerable road users. Many of the findings are consistent with the at-fault pedestrian crash analysis (i.e., nighttime, inclement weather conditions and at signalized intersections), although there are some differences, which are summarized below:

- When pedestrians were not considered at-fault in vulnerable road user crashes, the most overrepresented driver actions were improper or careless turns at intersections (35.7 percent).

- Similarly, when pedestrians were not considered at-fault in mid-block vulnerable road user crashes, careless or illegal backing (6.3 percent) or careless parking (6.1 percent) actions were overrepresented relative to similar crashes involving less vulnerable road users (0.5 percent). This could suggest that motor vehicle drivers fail to see or properly yield to a pedestrian.

Bicyclists

Appendix C provides two tables containing the crash characteristics for crashes involving bicyclists. Table 10 provides the characteristics for crashes involving bicyclists in which the bicyclist was at-fault, and Table 11 provides the characteristics for crashes involving bicyclists in which the bicyclist was not at-fault. In both cases, the reference group that was used to compare the bicycle crashes is the set of crashes not involving any vulnerable road users. Each of the tables is organized the same as for the mature driver crashes.

Table 10 shows the crash characteristics or contributory factors in crashes involving bicyclists in which the bicyclist was determined to be at-fault. The reference group includes the proportion of crashes not involving vulnerable road users. The findings from this comparison are provided below:

- At-fault bicyclist crashes are overrepresented on local roads (81.2 percent) when compared to crashes involving less vulnerable road users (45.7 percent).
- At-fault bicyclist crashes are overrepresented in urban locations (77.7 percent) when compared to crashes involving other road users in urban locations (41.0 percent).
- Approximately 85.5 percent of at-fault bicyclist crashes occurring during inclement weather are reported during a rainfall event, while only 61.2 percent of inclement weather-related crashes involving other road users occur during a rainfall event. Similarly, at-fault bicyclist crashes are overrepresented at locations with wet roadway surfaces when compared to crashes involving less vulnerable road users.
- Among the crashes occurring at intersections, at-fault bicyclist crashes (67.3 percent) are overrepresented at intersections when compared to crashes at intersections involving less vulnerable road users (39.8 percent). The most prominent crash type at intersections is angle crashes involving at-fault bicyclists (86.9 percent). Only 55.9 percent of angle crashes at intersections involve less vulnerable road users. At-fault bicyclist crashes are also overrepresented at stop-controlled intersections, compared to other intersection types.
- Among the crashes occurring at intersections involving at-fault bicyclists, the most overrepresented action was running a stop sign (16.2 percent), running a red light (12.9 percent), driving the wrong way on a one-way street or on the wrong side of the road (12.8 percent), and making an improper entrance to the roadway (6.2 percent).

Table 11 shows the crash characteristics or contributory factors in crashes involving bicyclists in which the bicyclist was determined not to be at-fault. The reference group includes the proportion of crashes not involving vulnerable road users. Many of the findings

are consistent with the at-fault bicyclist crash analysis; however, the bicyclist actions were not overrepresented in this crash type.

Motorcyclists

Appendix D provides three tables containing the crash characteristics for crashes involving motorcycles. Table 12 provides the characteristics for single-vehicle motorcycle crashes, Table 13 provides the characteristics for multi-vehicle crashes involving motorcycles in which the motorcycle was at-fault, and Table 14 provides the characteristics for multi-vehicle crashes involving motorcycles in which the motorcycle was not at-fault. In all three cases, the reference group that was used to compare the motorcycle crashes is the set of crashes not involving any vulnerable road users. Each of the tables is organized the same as for the mature driver crashes.

Table 12 shows the crash characteristics associated with single-vehicle motorcycle crashes. The reference group was crashes involving all road users that were not considered vulnerable users in the present study. A summary of the findings from the comparison are described below:

- Single-vehicle motorcycle crashes are overrepresented (53.5 percent) on curved roadways when compared to crashes on curved roadways involving less vulnerable road users (18.8 percent). Among these crashes, 45.9 percent are non-collisions (e.g., rider loses control of motorcycle and slides across roadway) involving motorcyclists. In the reference group, only 4.5 percent of crashes involving a less vulnerable road user were codified as non-collisions.
- Among the single-vehicle motorcyclist crashes occurring on curved roadway sections, the most overrepresented action was over- or under-compensation of the curve (25.8 percent). Speeding and driver inexperience were also overrepresented among single-vehicle motorcycle crashes.
- Among crashes occurring during inclement weather conditions, single-vehicle motorcycle crashes were overrepresented during rainfall events (78.9 percent) relative to crashes involving less vulnerable road users (61.2 percent).
- Among crashes occurring on an inclement roadway surface, single-vehicle motorcycle crashes were overrepresented when the road surface was covered with sand or mud (21.1 percent) when compared to similar crash contributory factors involving less vulnerable road users (0.9 percent).
- Single-vehicle motorcycle crashes were overrepresented in crashes along curves at night (16.8 percent) when compared to the same crash type involving less vulnerable road users (8.3 percent).
- Single-vehicle motorcycle crashes were overrepresented in crashes along curves when the driver was speeding or driving too fast for conditions (19.7 percent) relative to the same crash type involving less vulnerable road users (8.2 percent).
- Single-vehicle motorcycle crashes were overrepresented in hit-fixed-object crashes (43.3 percent) when compared to the same crash type involving less vulnerable road

users (30.9 percent). The most prominent contributory factor in single-vehicle motorcycle crashes with fixed objects was speeding.
- Driving under the influence of alcohol was cited as a contributory factor in 17.9 percent of single-vehicle motorcycle crashes, which was significantly higher than the same crash cause for less vulnerable road users (8.4 percent).

Table 13 compares multi-vehicle crashes involving at-fault motorcyclists to a reference group of road users that were not included in the vulnerable road users group included in the present study. The major findings from this comparison are summarized below:

- At-fault motorcycle crashes involving multiple vehicles are overrepresented on local roads (48.7 percent) when compared to crashes involving less vulnerable road users (45.7 percent).
- Among the multi-vehicle crashes involving an at-fault motorcyclist on curved roadway sections, sideswipe collisions were overrepresented relative to similar crash types among the reference group of crashes involving less vulnerable road users. The primary contributory factors that were identified in multi-vehicle motorcycle crashes were over- or undercompensation at the curve (19.7 percent), driving on the wrong side of the road (8.5 percent), and speeding (8.5 percent).
- Traveling on wet roadway surfaces or during rainfall events were contributory factors that were overrepresented in multi-vehicle motorcycle crashes during inclement weather or inclement roadway surface crashes relative to similar crash types not involving vulnerable road users.
- Multi-vehicle motorcycle crashes were overrepresented at intersections (42.8 percent) relative to intersection crashes not involving vulnerable road users (39.8 percent). The most overrepresented contributory factors at intersections involving at-fault motorcyclists were careless passing or lane changing (11.2 percent) and speeding (8.5 percent).
- Multi-vehicle motorcycle crashes were overrepresented near driveways and parking lots (9.3 percent) relative to the reference group (5.0 percent) of less vulnerable road users.
- Multi-vehicle motorcycle crashes involving an at-fault motorcyclist under the influence of alcohol most often result in fatalities and major injuries (17.1 percent and 29.4 percent, respectively) relative to the same crash type involving less vulnerable road users.

Table 14 compares multi-vehicle crashes involving not-at-fault motorcyclists to a reference group of road users that were not included in the vulnerable road users group in the present study. The findings from this analysis were very similar to the at-fault motorcyclist analysis described above. A few differences, however, were identified, which are described below:

- Not-at-fault motorcycle crashes involving multiple vehicles are overrepresented on local roads (53.9 percent) when compared to crashes involving less vulnerable road users (45.7 percent).
- On curved roadway sections, multi-vehicle crashes involving motorcyclists in which the motorcyclist was not at-fault involved a high proportion of improper or careless

turn maneuvers (24.3 percent) relative to the same crash scenario involving less vulnerable road users (3.2 percent). Similarly, driving on the wrong side of the road was a contributory factor overrepresented in multi-vehicle crashes involving motorcycles (11.9 percent) when compared to the reference group (2.2 percent).

- Multi-vehicle crashes at intersections involving not-at-fault motorcyclists were overrepresented (58.4 percent) relative to the intersection crashes involving the reference group (39.8 percent). Among the contributory factors, improper turns and proceeding without clearance were the most prominent factors.

Non-motorized, horse-driven buggies

Appendix E provides two tables containing the crash characteristics for crashes involving horse-driven buggies. Table 15 provides the characteristics for crashes involving horse-driven buggies in which the horse-driven buggy was at-fault, and Table 16 provides the characteristics for crashes involving horse-driven buggies in which the horse-driven buggy was not at-fault. In both cases, the reference group that was used to compare the horse-driven buggy crashes is the set of crashes not involving any vulnerable road users. Each of the tables is organized the same as for the mature driver crashes.

Table 15 compares the characteristics associated with horse-driven buggy crashes in which the buggies were at-fault to crashes involving less vulnerable road users. Horse-driven buggy crashes were rare events among the sample. While several of the mathematical comparisons were statistically significant, it is possible that a small sample size may influence the results. A summary of the major findings from the horse-driven buggy analysis is provided below:

- Horse-driven buggy crashes are overrepresented on local roads (66.0 percent) when compared to crashes involving less vulnerable road users (45.7 percent).
- Horse-driven buggy crashes are overrepresented at night at locations with no street lights.
- Careless turning by the horse-driven buggy is a contributory factor that is overrepresented when compared to careless driving crashes among less vulnerable road users.
- For crashes occurring at intersections, horse-driven buggy crashes were overrepresented at stop-controlled intersections (56.0 percent) compared to crashes involving less vulnerable road users (31.7 percent).
- Nearly all crashes involving horse-driven buggies occurred on the roadway (96.0 percent) while only 63.8 percent of all crashes involving less vulnerable road users occurred on the roadway.

Table 16 compares the characteristics associated with horse-driven buggy crashes in which the buggies were not at-fault to crashes involving less vulnerable road users. Horse-driven buggy crashes were rare events among the sample. While several of the mathematical comparisons were statistically significant, it is possible that a small sample size may influence the results. A summary of the major findings from the horse-driven buggy not-at-fault analysis is provided below:

- Nearly all horse-driven buggy crashes occurred on state roadways (90.4 percent) when compared to crashes on state roads involving less vulnerable road users (73.9 percent).
- Among the mid-block crashes involving horse-driven buggy crashes, many involved rear-end crashes (68.3 percent). When compared to the reference group, only 28.3 percent of mid-block crashes involved less vulnerable road users (28.3 percent).
- Crashes involving at-fault horse-driven buggies were mainly classified as rear-end collisions (65.8 percent), which represents a significantly larger proportion than the reference group (25.9 percent are rear-end collisions).
- Nearly all at-fault horse-driven buggy crashes occurred on the roadway (94.7 percent), while the reference group crashes occurred less frequently on the roadway (63.8 percent).

Fatal and Serious Injury Crashes with Guiderail

Appendix F provides four tables containing crash characteristics for fatal and serious injury crashes (hereafter referred to as just fatal and injury crashes) involving guiderails. Table 17 and Table 18 provide the crash characteristics for single-vehicle fatal or injury crashes involving guiderails. The former uses the group of single-vehicle non-fatal or injury crashes involving guiderails as a reference group while the latter uses the group of single-vehicle fatal or injury crashes at other (non-guiderail) fixed objects as the reference group. Table 19 and Table 20 provide the crash characteristics for multi-vehicle fatal or injury crashes involving guiderails. The former uses the group of multi-vehicle non-fatal or injury crashes involving guiderails as a reference group while the latter uses the group of multi-vehicle fatal or injury crashes at other (non-guiderail) fixed objects as the reference group.

Table 17 compares the crash characteristics of single-vehicle fatal and injury crashes with guiderail to single-vehicle non-fatal or major injury crashes involving guiderail. A summary of the major findings from this comparison is described below:

- Single-vehicle fatal and injury crashes involving guiderail are overrepresented in rural areas (71.9 percent) when compared to single-vehicle property damage only (PDO) and less severe crashes involving guiderail in rural areas (60.2 percent).
- Single-vehicle fatal and injury crashes involving guiderail are overrepresented on curved roadways (55.1 percent) when compared to single-vehicle PDO and less severe crashes involving guiderail on curved roadways (45.5 percent).
- When considering the combination of curved roadways in rural areas, single-vehicle fatal and injury crashes involving guiderail are significantly overrepresented (75.5 percent) relative to similar crash types with a less severe outcome (61.0 percent).
- When considering the prime factor associated with guiderail crashes, speeding (6.7 percent) on curved roadways (69.4 percent of speeding-related crashes) appears to be overrepresented in fatal and injury crashes involving guiderail when compared to similar prime factors for PDO and less severe crashes involving guiderail.

- When considering speeding as the prime factor in single-vehicle fatal and injury crashes with guiderail, a curved roadway (69.4 percent) appears overrepresented to the reference group (56.6 percent). At nighttime, speeding on a curved roadway is overrepresented (60.0 percent) relative to the reference group (50.2 percent).
- When considering driving too fast for conditions as the prime factor in fatal and injury crashes involving guiderail, events on curved roadways (70.0 percent) are overrepresented relative to the reference group (52.7 percent).
- When considering driving too fast for conditions as the prime factor, and then hitting the guiderail as the first harmful event, overturning as the most harmful event is overrepresented (35.2 percent) in fatal and injury crashes involving guiderail, relative to the reference group (7.3 percent).
- Among the single-vehicle fatal and injury crashes involving guiderail, approximately 22.9 percent involve a driver affected by physical condition, which is a higher proportion than the reference group (16.9 percent). Among these crashes, impaired drivers are overrepresented (59.7 percent) relative to the reference group (50.5 percent).
- Among the speeding-related crashes involving a single-vehicle fatal or injury crash with guiderail, events occurring on a curved roadway are overrepresented (66.8 percent) relative to the reference group (53.4 percent).
- Among the aggressive driving-related crashes involving a single-vehicle fatal or injury crash with guiderail, events occurring on a curved roadway are overrepresented (63.4 percent) relative to the reference group (50.2 percent).

In Table 18, single-vehicle fatal and injury crashes involving guiderail are compared to single-vehicle fatal and injury crashes involving other fixed objects. Many of the findings are the same as when the previous reference group was used. A few key differences are described below:

- Single-vehicle fatal and injury crashes with guiderail occur in higher proportions on Interstate roadways (16.6 percent) when compared to the reference group (4.9 percent). Similarly, fatal and injury crashes with guiderail occur in higher proportion on state roadways (87.1 percent) when compared to the reference group (72.6 percent).
- Single-vehicle fatal and injury crashes with guiderail occur in higher proportions in rural areas (71.9 percent) when compared to the reference group (68.1 percent). Similarly, fatal and injury crashes with guiderail occur in higher proportion on curved roadways (55.1 percent) when compared to the reference group (49.3 percent).

Table 19 compares the crash characteristics of multi-vehicle fatal and injury crashes with guiderail to multi-vehicle non-fatal or serious injury crashes involving guiderail. A summary of the major findings from this comparison is described below:

- Multi-vehicle fatal and injury crashes involving guiderail are overrepresented in rural areas (66.5 percent) when compared to multi-vehicle PDO or less severe crashes involving guiderail in rural areas (51.4 percent).

- Multi-vehicle fatal and injury crashes involving guiderail are overrepresented on curved roadways (38.2 percent) when compared to multi-vehicle PDO or less severe crashes involving guiderail on curved roadways (23.2 percent).
- When considering the combination of curved roadways in rural areas, multi-vehicle fatal and injury crashes involving guiderail are significantly overrepresented (76.2 percent) relative to similar crash types with a less severe outcome (55.4 percent).
- When considering the combination of wet roads at night, multi-vehicle fatal and injury crashes involving guiderail are significantly overrepresented (62.8 percent) relative to similar crash types with a less severe outcome (33.8 percent).
- Multi-vehicle fatal and injury crashes involving guiderail appear to be overrepresented when one vehicle in the crash is traveling on the wrong side of the roadway (13.8 percent) when compared to the reference group of similar crash types with less severe outcomes (2.8 percent).
- When considering driving too fast for conditions as the prime factor in multi-vehicle fatal and injury crashes involving guiderail, events on curved roadways are overrepresented (54.4 percent) relative to the reference group (33.5 percent).
- When considering driving too fast for conditions as the prime factor, and then hitting the guiderail as the first harmful event, overturning as the most harmful event is overrepresented (35.2 percent) in fatal and injury crashes involving guiderail, relative to the reference group (7.3 percent).
- Among the multi-vehicle fatal and injury crashes involving guiderail, approximately 12.4 percent involve a driver affected by physical condition, which is a higher proportion than the reference group (7.2 percent).
- Among the speeding-related crashes involving a multi-vehicle fatal or injury crash with guiderail, events occurring on a curved roadway are overrepresented (47.4 percent) relative to the reference group (31.0 percent). Similarly, speeding-related crashes involving multi-vehicle fatal and injury crashes at night are overrepresented (37.9 percent) relative to the reference group (30.4 percent).

In Table 20, multi-vehicle fatal and injury crashes involving guiderail are compared to multi-vehicle fatal and injury crashes involving other fixed objects. A summary of the major findings are described below:

- Multi-vehicle fatal and injury crashes with guiderail occur in higher proportions on Interstate roadways (23.3 percent) when compared to the reference group (12.1 percent). Similarly, fatal and injury crashes with guiderail occur in higher proportion on state roadways (92.0 percent) when compared to the reference group (73.0 percent).
- Multi-vehicle fatal and injury crashes with guiderail occur in higher proportions in rural areas (66.5 percent) when compared to the reference group (54.0 percent).

Motor Vehicle Failures

Table 21 in Appendix G shows the characteristics for motor vehicle failure crashes. No reference group is used for this crash type due to its uniqueness. The major findings from this assessment are described below:

- Approximately 22.5 percent of the 8,813 vehicle failures between 2014 and 2016 involved tires. Among these, the most frequent characteristics associated with tire failures were that they occurred at night (30.6 percent), were on curved roadways (26.3 percent), or involved inclement weather (25.3 percent).
- Approximately 24.9 percent of the 8,813 vehicle failures between 2014 and 2016 involved brakes. Among these, the most frequent characteristics associated with brake system failures were that they occurred at intersections (45.5 percent) or occurred at night (20.5 percent).
- Approximately 11.9 percent of the 8,813 vehicle failures between 2014 and 2016 involved steering. Among these, the most frequent characteristics associated with steering system failures were that they occurred at night (34.1 percent) or occurred on curved roadways (22.6 percent).
- Approximately 3.1 percent of the 8,813 vehicle failures between 2014 and 2016 involved the vehicle suspension. Approximately 30.9 percent of crashes associated with vehicle suspension failures occurred at night, while approximately 19.7 percent occurred on curved roadways.
- Approximately 8.9 percent of the 8,813 vehicle failures between 2014 and 2016 involved the vehicle power train. Among these crashes, 25.4 percent occurred at night while 20.9 percent occurred at intersections.
- Approximately 9.0 percent of the 8,813 vehicle failures between 2014 and 2016 involved the vehicle wheels. Among these crashes, approximately 31.1 percent occurred at night and 16.7 percent occurred on curved roadways.

DISCUSSION

This section of the report compares the safety trends for the four crash types in the present study to national trends for the same four crash types.

Mature Drivers

Generally across the United States, the number of mature drivers aged 65 and older increased by 29 percent between 2006 and 2015, with a 33 percent increase in the number of older licensed drivers during this same period (NHTSA 2017a). The number of total licensed drivers in the United States only increased 8 percent during that same time period (NHTSA 2017a). Due to the decreased physical and mental fitness that accompanies aging, it is expected that studies investigating the contributing characteristics of crashes involving mature drivers will provide meaningful insights about the possible measures that may be

considered to mitigate crashes involving these drivers. Mature drivers typically experience reduced physical skills, such as strength, flexibility, and range of motion, as well as cognitive skills, such as memory and processing speed, and visual functions (Potts et al. 2004). These deteriorations can result in more crashes with increased rates of injury severities and fatalities.

For all crashes in the United States, drivers aged 65 and older were found at-fault in between 45 and 68 percent of crashes involving mature drivers – the proportion of at-fault drivers increased as aged increased. For fatal crashes, drivers aged 65 and older were at-fault in between 52 and 73 percent of crashes involving mature drivers. This proportion also increased as driver age increased (Potts et al. 2004). Mature drivers were involved in a greater percentage of angle crashes when compared to all driving ages in angle crashes; 45 percent of crashes for all ages were angle crashes, while 50 to 64 percent of crashes involving older drivers were angle collisions (Stutts et al. 2009). Mature drivers were also 3 to 13 percent more likely to be involved in crashes at intersections; 1 to 6 percent more likely to be involved in crashes at stop-controlled intersections; and 1 to 6 percent more likely to be involved in crashes at driveways or alleys (Stutts et al. 2009).

Nationally, when compared to the overall driving population, the occurrence of crashes involving mature drivers differed for certain environmental characteristics. Most crashes involving mature drivers occurred during no adverse weather conditions. Approximately 85 percent of mature driver crashes occurred during no adverse conditions, while 79 percent of crashes for all drivers occurred during no adverse conditions (Stutts et al. 2009). Additionally, older drivers were 6 to 17 percent more likely to be involved in crashes between 10 a.m. and 2 p.m. than the total population, and were 12 to 30 percent more likely to be involved in crashes during daylight (Stutts et al. 2009). Alcohol or drugs and speeding were also less likely to be contributing factors in crashes for mature drivers, while failure to yield was more likely to be a mature driver contributing factor in crashes (Stutts et al. 2009).

In the present study, mature drivers aged 65 and older were found to be involved in 15.8 percent of crashes and mature drivers aged 75 and older were found to be involved in 6.3 percent of crashes. These mature drivers were at-fault in 62.1 percent of crashes (69.1 percent for the older group). This seems to be consistent with the higher side of the national trends. In Pennsylvania, crashes involving mature drivers occurred less often during inclement weather conditions or inclement roadway surface conditions, which suggests that mature drivers might travel less frequently when roadway or weather conditions are not ideal. However, among crashes that occur during inclement weather or roadway conditions, mature driver crashes were overrepresented in crashes that occurred during rain or on wet roadways. Nighttime visibility may also be an issue for mature drivers, as mature driver crashes were overrepresented during dusk and at night at locations with street lights. A temporal analysis revealed that the frequency of crashes involving mature drivers peaks during October, November and December, which might suggest visibility issues related to foliage. Additionally, mature drivers are also overrepresented in crashes at intersections, including at driveways and in parking lots. In these crashes, mature drivers often midjudge the speed or turning path of conflicting drivers. Finally, mature drivers who were at-fault are overrepresented in crashes at stop-controlled intersections. This is likely the results of

issues associated with judging the gap in conflicting traffic. Issues related to confusion and difficulty judging gaps at intersections were verified through an examination of a sample of crash reports for crashes involving mature drivers.

Vulnerable Road Users

Pedestrians

Pedestrians are defined as any person involved in a crash that is on foot, walking, running, jogging, hiking, sitting, or lying down. It is estimated that about 85 percent of non-fatal pedestrian crashes occur in urban areas (Zegeer and Stutts, 2004). The proportion of pedestrian fatalities in total traffic fatalities has increased from 11 percent to 15 percent during the period from 2006 to 2015. The National Highway Traffic Safety Administration (NHTSA) summarized the Fatality Analysis Reporting System (FARS) 2015 data and found that 76 percent of pedestrian fatalities occurred in urban areas; 72 percent at non-intersection locations; and 77 percent during non-daylight periods. Alcohol was found to be highly related to pedestrian fatalities. Over one-third of pedestrians killed in a crash were estimated to have blood-alcohol contents of 0.8 g/dL or higher.

Bicyclists

While a national goal was to increase the number of bicycle trips and decrease the number of fatal and injury bicycle crashes (Radborn et al. 2008), increased bicycle ridership could result in an adverse effect on safety. Fatal crashes involving bicycles accounted for 2.3 percent of the total fatal crashes, and bicycle injury crashes accounted for 1.9 percent of the total injury crashes in the United States in 2015 (NHTSA 2017c). When considering injury types, 3.9 percent of all incapacitating injury crashes in 2015 involved a bicycle, and 3.2 percent of all non-incapacitating injury crashes in 2015 involved a bicyclist (NHTSA 2017d). While there was a 10 percent decrease in injury crashes involving a bicyclist between 2014 and 2015, there was a 12.2 percent increase in fatal bicycle crashes during that same time period (NHTSA 2017c).

Nationally, bicycle fatalities involving alcohol accounted for 12.3 percent of all bicycle fatalities, compared to 29 percent of all crashes involving alcohol in 2015 (NHTSA 2017d). When comparing location type, 27.0 percent of bicycle fatal crashes occurred at an intersection, while 57.1 percent of bicycle injury crashes occurred at an intersection (NHTSA 2017d). Injury crashes involving bicycles were 30.1 percent more likely to occur at intersections than fatal crashes, which were more likely to occur at non-intersections.

When reviewing the contributory factors associated with fatal bicyclist crashes, the top five related factors by percentage were as follows: (1) failure to yield to right of way – 25 percent, (2) not visible (dark clothing, no lighting, etc.) – 11.7 percent, (3) failure to obey traffic signs, signals, or officer – 9.9 percent, (4) under the influence of alcohol, drugs, or medication – 7.1 percent, and (5) improper crossing of roadway or intersection – 6.0 percent (NHTSA 2017d).

Motorcycles

According to NHTSA, motorcycles include two- or three-wheeled motorcycles, off-road motorcycles, mopeds, scooters, mini bikes, and pocket bikes. The fatality and injury rates for motorcycle crashes have decreased based on registered vehicle or per vehicle mile-traveled between 2006 and 2015 (NHTSA 2017).

In comparison to other vehicle types, motorcycle crashes are more likely to be involved in hitting fixed objects. According to 2015 FARS data, 24 percent of fatal motorcycle crashes involved hitting fixed objects. In addition, motorcycle crashes have higher percentages involving speeding and alcohol use than other vehicle types. Over 40 percent of single-unit motorcycle fatal crashes involve driving under the influence, which is consistent with findings by Shaheed et al. (2014).

Summary of study findings related to vulnerable road users

In the present study, 3.2 percent of all crashes involved pedestrians, 1.0 percent of all crashes involved bicyclists, and 2.7 percent of all crashes involved motorcyclists. In line with national trends, the majority of pedestrian and bicycle crashes occurred mostly in urban areas. This was expected because non-motorized users are more prevalent in urban areas. Among the pedestrian and bicycle crashes, there was overrepresentation at night and during rainfall events, which suggests that visibility is an issue. Concerning pedestrian crashes, a closer examination revealed that approximately 47 percent of pedestrians involved in crashes at night were wearing dark clothing, compared to only about 25 percent of pedestrians involved in crashes during the day. Although approximately 40 percent of pedestrians involved in crashes (both day and night) had "unknown" clothing, this finding may provide further evidence that pedestrian visibility at night may be an issue. Concerning bicycle crashes, the research team examined the use of bicycle headlights and rear reflectors during daytime and nighttime crashes. Although both headlights and rear reflectors were observed more in nighttime crashes, the vast majority of the records indicated unknown use for either device (over 52 percent for headlights and 60 percent for rear reflectors). Thus, further conclusions could not be drawn.

Overrepresentation was also observed for improper or careless turns at intersections when pedestrians were not at-fault, which suggests that motor vehicle drivers might also have visibility problems and not see pedestrians at intersections during these non-ideal conditions. The research team examined vehicle types involved in these crashes, but found no large differences between the vehicle types involved in pedestrian crashes involving improper or careless turning compared to the overall population of vehicles involved in all crashes during the analysis period. Failure to obey traffic control devices was a contributory factor in several bicycle crashes, particularly when the bicyclist was at-fault. Crashes involving motorcyclists generally occurred on curves at night. Wet roadway conditions and driving under in the influence of alcohol were other factors that were overrepresented in

crashes involving motorcyclists. Finally, crashes involving horse-driven buggies were overrepresented at night and involved careless turning and rear-end crashes. This suggests that buggies may not be adequately visible to motor vehicle drivers at night, and that the speed differential between horse-driven buggies and motor vehicles contribute to rear-end collisions.

Fatal and Serious Injury Crashes at Guiderails

The intended purpose of guiderail is to contain or redirect vehicles that run-off-the-road. In 2015, there were 909 fatal crashes involving guiderail (either guiderail end or guiderail face) as the first harmful event, which resulted in 2.8 percent of the total fatal crashes in the United States (NHTSA 2017b). Of the 2015 fatal guiderail crashes, a rollover occurred in 19 percent of the crashes (Insurance Institute for Highway Safety Highway Loss Data Institute 2017). Using 2014 data, 1.7 percent of injury crashes occurred where guiderail was the first harmful event (Insurance Information Institute 2017). However, these percentages were a slight decrease from 2008 guiderail statistics. In 2008, 3.1 percent of fatal crashes and 1.9 percent of injury crashes involved guiderail as the first harmful event (Insurance Information Institute 2017).

In the present study, guiderail crashes were overrepresented on rural roads and horizontal curves, and multi-vehicle guiderail crashes were overrepresented on wet pavement surfaces at night. This suggests that drivers fail to adequately adjust their travel speeds along horizontal curves of two-lane rural highways. The research team examined the age and surface type of the pavements involved in these crashes and the distributions were generally consistent with pavement surfaces on all state-owned roadways. A slight overrepresentation of fatal or injury guiderail crashes was observed on newer bituminous pavements (i.e., at most 5 years old) and a slight underrepresentation was observed on older bituminous pavements (i.e., greater than 10 years old). Improved delineation (e.g., signs and pavement markings) may reduce these crash types. Further, fatal and injury collisions involving guiderail are more likely when drivers are traveling under the influence of alcohol or if drivers were otherwise impaired. This finding was verified through examination of the individual crash reports. DUI checkpoints on rural highways may mitigate this crash type. Speeding was also found to be a contributing factor for this crash type. An examination of distracted driving-related fatal or serious injury crashes at guiderails did not reveal any specific trends with regard to the types of distractions causing these crashes.

Vehicle Failures

About 2 percent of crashes in the United States are attributed to vehicles. The National Motor Vehicle Crash Causation Survey (NHTSA 2008) conducted on-scene data collection for light vehicle crashes between 2005 and 2007. According to the dataset, vehicle failure-related crashes are most frequently caused by tires (43 percent), brakes (25 percent), and steering/ suspension/ transmission/ engine (10.5 percent). In the present study, the most common

vehicle failure crashes were associated with tire, brake systems, and steering, which is consistent with national statistics. An increased focus on these systems during annual inspections may help to mitigate these failures and reduce this crash type. The research team also examined the distribution of these vehicle failures across the state and noticed higher rates of vehicle failure crashes (in terms of vehicle failure crashes per lane-mile of state-owned roadway) in the urban areas located in the southwest, southeast and northeast regions of Pennsylvania.

CONCLUSIONS

The purpose of this project was to identify annual trends and contributory factors involving mature drivers; vulnerable road users; fatal and injury crashes with guiderail; and collisions resulting from vehicle failures. When an adequate sample of crashes was available to compare the crash type of interest to a reference group, statistical tests were performed to determine if the difference in proportions between the two groups was statistically significant. The findings from this research effort are summarized below:

Mature Drivers

- Crashes involving mature drivers occurred less often during inclement roadway or weather conditions. This suggests that mature drivers might travel less frequently when roadway conditions are not ideal.
- Among crashes that occur during inclement weather or roadway conditions, mature drivers were overrepresented in crashes during periods of rain or on wet roadways.
- Nighttime visibility may also be an issue for mature drivers, as mature driver crashes were overrepresented during dusk and at night at locations with street lights.
- Mature drivers were overrepresented in crashes at intersections, including at driveways and in parking lots, which is consistent with national crash trends. In these crashes, mature drivers often midjudge the speed or turning path of conflicting drivers.
- Mature drivers who were at-fault were overrepresented in crashes at stop-controlled intersections during the analysis period. This is likely the result of issues associated with judging the gap in conflicting traffic and is consistent with the issues observed at driveways and parking lots.

Vulnerable Road Users

- The majority of pedestrian crashes in Pennsylvania occurred mostly in urban areas. This was expected because non-motorized users are more prevalent in urban areas.
- Pedestrian crashes in Pennsylvania were overrepresented at night and during rainfall events, which suggests that pedestrian visibility is an issue.
- Pedestrian crashes were overrepresented in collisions involving improper or careless turns at intersections when pedestrians were not at-fault, which further suggests that

pedestrian visibility is an issue. It appears that motor vehicle drivers may have a difficult time seeing pedestrians at intersections during these non-ideal conditions.

- The majority of bicycle crashes in Pennsylvania occurred in urban areas, which is consistent with national trends. This was expected because non-motorized users are more prevalent in urban areas.
- Bicycle crashes were overrepresented at night and during rainfall events, which suggests that bicycle visibility is an issue.
- Failure to obey traffic control devices was a contributory factor in several bicycle crashes, particularly when the bicyclist was at-fault, which is also consistent with national crash statistics involving bicyclists. Stronger enforcement at these locations may help reduce crashes involving bicyclists.

- Crashes involving motorcyclists generally occurred on curves at night.
- Wet roadway conditions and driving under the influence of alcohol were other factors that were overrepresented in crashes involving motorcyclists.

- Crashes involving horse-driven buggies were overrepresented at night and involved careless turning and rear-end collisions. This suggests that buggies may not be adequately visible to motor vehicle drivers at night, and that the speed differential between horse-driven buggies and motor vehicles contributes to rear-end collisions.

Fatal and Injury Crashes involving Guiderail

- Guiderail crashes were overrepresented on rural roads and horizontal curves, and multi-vehicle guiderail crashes were overrepresented on wet pavement surfaces at night. This suggests that drivers fail to adequately adjust their travel speeds along horizontal curves of two-lane rural highways. Improved delineation (e.g., signs and pavement markings) may reduce these crash types.
- Fatal and injury collisions involving guiderail were more likely when drivers were operating their vehicle under the influence of alcohol or drivers were otherwise impaired. DUI checkpoints on rural highways may mitigate this crash type.

Vehicle Failure Crashes

- The most common vehicle failure crashes were associated with tire, brake systems, and steering, which is consistent with national statistics. An increased focus on these systems during annual inspections may help to mitigate these failures and reduce this crash type.

REFERENCES

Federal Highway Administration (2014). Guardrail 101. Washington, DC.

Insurance Information Institute (2017). Facts + Statistics: Highway Safety. New York, NY.

Insurance Institute for Highway Safety Highway Loss Data Institute (2017). Roadway and environment: Collisions with fixed objects and animals. Arlington, VA.

National Center for Statistics and Analysis. (2017). Motorcycles: 2015 data (Updated, Traffic Safety Facts. Report No. DOT HS 812 353). Washington, DC: National Highway Traffic Safety Administration.

National Highway Traffic Safety Administration (2017b). Fatality Analysis Reporting System (FARS) Encyclopedia. Washington, DC.

National Highway Traffic Safety Administration (2017a). Traffic Safety Facts 2015 Data: Older Population. Washington, DC.

National Highway Traffic Safety Administration (2017c). Traffic Safety Facts 2015 Data: Older Population. Washington, DC.

National Highway Traffic Safety Administration (2017d). Traffic Safety Facts 2015: A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System. Washington, DC.

National Highway Traffic Safety Administration (2008). *National Motor Vehicle Crash Causation Survey: Report to Congress.* National Highway Traffic Safety Administration Technical Report DOT HS 811 059, Washington, DC.

Potts, I., S. Garets, T. Smith, R. Pfefer, T.R. Neuman, K.L. Slack, and J. Nichols (2008). *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan, Volume 22: A Guide for Addressing Collisions Involving Motorcycles.* National Cooperative Highway Research Program (NCHRP) Report 500, Transportation Research Board, Washington, DC.

Potts, I., J. Stutts, R. Pfefer, T.R. Neuman, K.L. Slack, and K.K. Hardy (2004). *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan, Volume 9: A Guide for Reducing Collisions Involving Older Drivers*. National Cooperative Highway Research Program (NCHRP) Report 500, Transportation Research Board, Washington, DC.

Radborn, C., D.J. Torbic, D.K. Gilmore, L.J. Thomas, J.M. Hutton, R. Pfefer, T.R. Neuman, K.L. Slack, V. Bond, and K.K. Hardy (2008). *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan, Volume 18: A Guide for Reducing Collisions Involving Bicycles.* National Cooperative Highway Research Program (NCHRP) Report 500, Transportation Research Board, Washington, DC.

Shaheed, M.S., and K. Gkritza (2014). A latent class analysis of single-vehicle motorcycle crash severity outcomes. *Analytic Methods in Accident Research*, Vol. 2, 30-38.

Stutts, J., C. Martell, and L. Staplin (2009). *Identifying Behaviors and Situations Associated With Increased Crash Risk for Older Drivers*. National Highway Traffic Safety Administration (NHTSA), Washington, DC.

Zeeger, C., and Stutts, J. (2004). *A Guide for Reducing Collisions Involving Pedestrians*. National Cooperative Highway Research Program Report 500, Transportation Research Board, Washington, D.C.

APPENDIX A

Table 4. Crash Characteristics for at-fault Mature Drivers Aged 65 and Over.

Category	# Crashes 65+ drivers at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Total	**34036**	-	**271545**	-	-
Interstate	1367	4.0%	22120	8.1%	-4.1%
Local road	**17952**	**52.7%**	**124496**	**45.8%**	**6.9%**
Curved road	4064	11.9%	54734	20.2%	-8.3%
Rural	14041	41.3%	110046	40.5%	0.8%
Turnpike	308	0.9%	4691	1.7%	-0.8%
State road	**25871**	**76.0%**	**196480**	**72.4%**	**3.6%**
State road, 2 lane, no divisor, rural, non-intersection	4377	12.9%	37341	13.8%	-0.9%
Inclement weather	4009	11.8%	49343	18.2%	-6.4%
Rain	**2919**	**72.8%**	**31052**	**62.9%**	**9.9%**
Sleet (hail)	46	1.1%	1113	2.3%	-1.2%
Snow	847	21.1%	14587	29.6%	-8.5%
Fog	116	2.9%	1425	2.9%	0.0%
Rain and fog	72	1.8%	975	2.0%	-0.2%
Sleet and fog	9	0.2%	191	0.4%	-0.2%
Dark illumination	5943	17.5%	103832	38.2%	-20.7%
Dark (no street lights)	1972	33.2%	40623	39.1%	-5.9%
Dark (street lights)	**3132**	**52.7%**	**52452**	**50.5%**	**2.2%**
Dusk	**524**	**8.8%**	**5122**	**4.9%**	**3.9%**
Dawn	236	4.0%	4277	4.1%	-0.1%
Dark – unknown roadway lighting	79	1.3%	1358	1.3%	0.0%
Inclement road condition	5656	16.6%	67437	24.8%	-8.2%
Wet	***4415***	***78.1%***	***45110***	***66.9%***	***11.2%***
Snow covered	*576*	*10.2%*	*10224*	*15.2%*	*-5.0%*
Slush	*243*	*4.3%*	*3988*	*5.9%*	*-1.6%*
Ice	*137*	*2.4%*	*2695*	*4.0%*	*-1.6%*
Ice patches	*243*	*4.3%*	*4730*	*7.0%*	*-2.7%*
Water standing or moving	*42*	*0.7%*	*690*	*1.0%*	*-0.3%*
Wet road	4415	13.0%	45110	16.6%	-3.6%
Dark (no street lights)	*395*	*8.9%*	*7556*	*16.8%*	*-7.9%*
Dark (street lights)	*633*	*14.3%*	*9686*	*21.5%*	*-7.2%*
Dusk	*88*	*2.0%*	*1103*	*2.4%*	*-0.4%*
Dawn	*46*	*1.0%*	*932*	*2.1%*	*-1.1%*
Dark (unknown roadway lighting)	*16*	*0.4%*	*266*	*0.6%*	*-0.2%*
Snow/slush road	819	2.4%	14212	5.2%	-2.8%
Dark (no street lights)	*104*	*12.7%*	*3274*	*23.0%*	*-10.3%*
Dark (street lights)	*66*	*8.1%*	*1801*	*12.7%*	*-4.6%*
Dusk	*9*	*1.1%*	*249*	*1.8%*	*-0.7%*
Dawn	*8*	*1.0%*	*286*	*2.0%*	*-1.0%*
Dark (unknown roadway lighting)	*3*	*0.4%*	*61*	*0.4%*	*0.0%*
Icy road	380	1.1%	7425	2.7%	-1.6%
Dark (no street lights)	*67*	*17.6%*	*2161*	*29.1%*	*-11.5%*

Category	# Crashes 65+ drivers at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Dark (street lights)	*35*	*9.2%*	*1132*	*15.2%*	*-6.0%*
Dusk	*4*	*1.1%*	*100*	*1.3%*	*-0.2%*
Dawn	*12*	*3.2%*	*284*	*3.8%*	*-0.6%*
Dark (unknown roadway lighting)	*1*	*0.3%*	*43*	*0.6%*	*-0.3%*
Inclement road condition	5656	16.6%	67437	24.8%	-8.2%
Dark illumination	*1496*	*26.4%*	*29202*	*43.3%*	*-16.9%*
Interstate	90	6.0%	2759	9.4%	-3.4%
Local Road	**720**	**48.1%**	**12092**	**41.4%**	**6.7%**
Curved road	276	18.4%	8893	30.5%	-12.1%
Turnpike	23	1.5%	589	2.0%	-0.5%
Rural	639	42.7%	13908	47.6%	-4.9%
State Road	**1112**	**74.3%**	**20838**	**71.4%**	**2.9%**
Curved road	*1016*	*18.0%*	*20774*	*30.8%*	*-12.8%*
Local road	***2826***	***50.0%***	***27443***	***40.7%***	***9.3%***
Interstate	*258*	*4.6%*	*6168*	*9.1%*	*-4.5%*
Turnpike	*79*	*1.4%*	*1756*	*2.6%*	*-1.2%*
Rural	*2552*	*45.1%*	*33025*	*49.0%*	*-3.9%*
State Road	***4283***	***75.7%***	***48893***	***72.5%***	***3.2%***
Dark illumination	5943	17.5%	103832	38.2%	-20.7%
Curved road	*877*	*14.8%*	*25132*	*24.2%*	*-9.4%*
Local road	***2942***	***49.5%***	***47023***	***45.3%***	***4.2%***
Interstate	*325*	*5.5%*	*8827*	*8.5%*	*-3.0%*
Turnpike	*67*	*1.1%*	*1586*	*1.5%*	*-0.4%*
Rural	*2394*	*40.3%*	*43204*	*41.6%*	*-1.3%*
State road	***4497***	***75.7%***	***72723***	***70.0%***	***5.7%***
Location type					
Ramp	868	2.6%	8652	3.2%	-0.6%
Bridge	285	0.8%	3561	1.3%	-0.5%
Driveway or parking lot	**2899**	**8.5%**	**12144**	**4.5%**	**4.0%**
No TCD controls	*2024*	*69.8%*	*8830*	*72.7%*	*-2.9%*
No clearance	***481***	***16.6%***	***1506***	***12.4%***	***4.2%***
Collision type					
Non collision	421	1.2%	7230	2.7%	-1.5%
Rear-end	6935	20.4%	65844	24.2%	-3.8%
Head-on	1570	4.6%	9589	3.5%	1.1%
Angle	**15413**	**45.3%**	**72772**	**26.8%**	**18.5%**
Intersection	***11603***	***75.3%***	***53474***	***73.5%***	***1.8%***
Stop-controlled intersection	**5700**	**49.1%**	**22506**	**42.1%**	**7.0%**
Signalized intersection	4325	37.3%	23429	43.8%	-6.5%
Other intersection	1578	13.6%	7539	14.1%	-0.5%
Dark illumination (incl. dusk and dawn)	*2099*	*13.6%*	*21764*	*29.9%*	*-16.3%*
Inclement weather	*1574*	*10.2%*	*10436*	*14.3%*	*-4.1%*
Inclement road condition	*2261*	*14.7%*	*14222*	*19.5%*	*-4.8%*
Driveway or parking lot	***2047***	***13.3%***	***7838***	***10.8%***	***2.5%***
No clearance	***4574***	***29.7%***	***15568***	***21.4%***	***8.3%***
No traffic control device	*4586*	*29.8%*	*23853*	*32.8%*	*-3.0%*
Sideswipe (same dir.)	1546	4.5%	13768	5.1%	-0.6%
Sideswipe (opposite dir.)	782	2.3%	5553	2.0%	0.3%

Category	# Crashes 65+ drivers at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Hit fixed object	6502	19.1%	89656	33.0%	-13.9%
Hit pedestrian	682	2.0%	5672	2.1%	-0.1%
Prime factor					
D1 Driver was distracted	2910	8.5%	27273	10.0%	-1.5%
D4 Making illegal U-turn	183	0.5%	1098	0.4%	0.1%
D5 Making improper or careless turn	**5666**	**16.6%**	**23980**	**8.8%**	**7.8%**
Intersection	*4036*	*71.2%*	*17863*	*74.5%*	*-3.3%*
Signalized intersection	2213	54.8%	10457	58.5%	-3.7%
Other intersection	**1099**	**27.2%**	**4431**	**24.8%**	**2.4%**
Stop-controlled intersection	**724**	**17.9%**	**2975**	**16.7%**	**1.2%**
No traffic control device	***2465***	***43.5%***	***9560***	***39.9%***	***3.6%***
Midblock	***1630***	***28.8%***	***6117***	***25.5%***	***3.3%***
Four way intersection	*2261*	*39.9%*	*10400*	*43.4%*	*-3.5%*
Traffic signal	1713	75.8%	7981	76.7%	-0.9%
Stop sign	220	9.7%	982	9.4%	0.3%
"T" intersection	***1566***	***27.6%***	***6214***	***25.9%***	***1.7%***
No traffic control device	667	42.6%	2560	41.2%	1.4%
Traffic signal	407	26.0%	1786	28.7%	-2.7%
Stop sign	470	30.0%	1795	28.9%	1.1%
"Y" intersection	*112*	*2.0%*	*522*	*2.2%*	*-0.2%*
Multi-leg intersection	*51*	*0.9%*	*453*	*1.9%*	*-1.0%*
Ramp	*27*	*0.5%*	*160*	*0.7%*	*-0.2%*
Single vehicle	*234*	*4.1%*	*1620*	*6.8%*	*-2.7%*
Angle Collision type	***4424***	***78.1%***	***17535***	***73.1%***	***5.0%***
Driveway or parking lot	***924***	***16.3%***	***3348***	***14.0%***	***2.3%***
Dark illumination (incl. dusk and dawn)	*944*	*16.7%*	*7959*	*33.2%*	*-16.5%*
Inclement weather	*539*	*9.5%*	*2893*	*12.1%*	*-2.6%*
Inclement road condition	*754*	*13.3%*	*3927*	*16.4%*	*-3.1%*
No clearance	*168*	*3.0%*	*592*	*2.5%*	*0.5%*
D6 Turning from wrong lane	129	0.4%	933	0.3%	0.1%
D7 Proceeding w/o clearance after stop	**4696**	**13.8%**	**16505**	**6.1%**	**7.7%**
Intersection	*4144*	*88.2%*	*14589*	*88.4%*	*-0.2%*
Other intersection	279	6.7%	1111	7.6%	-0.9%
Signalized intersection	198	4.8%	843	5.8%	-1.0%
Stop-controlled intersection	**3667**	**88.5%**	**12635**	**86.6%**	**1.9%**
Four way intersection	*2602*	*55.4%*	*9200*	*55.7%*	*-0.3%*
No traffic control device	120	4.6%	514	5.6%	-1.0%
Traffic signal	104	4.0%	487	5.3%	-1.3%
Stop sign	**2320**	**89.2%**	**7974**	**86.7%**	**2.5%**
"T" intersection	*1327*	*28.3%*	*4546*	*27.5%*	*0.8%*
No traffic control device	123	9.3%	396	8.7%	0.6%
Traffic signal	29	2.2%	113	2.5%	-0.3%
Stop sign	1166	87.9%	3999	88.0%	-0.1%
"Y" intersection	*120*	*2.6%*	*405*	*2.5%*	*0.1%*
Angle Collision type	***4256***	***90.6%***	***14431***	***87.4%***	***3.2%***
Driveway or parking lot	***421***	***9.0%***	***1256***	***7.6%***	***1.4%***
Dark illumination (incl. dusk and dawn)	*571*	*12.2%*	*3476*	*21.1%*	*-8.9%*
Inclement weather	*478*	*10.2%*	*2043*	*12.4%*	*-2.2%*

Category	# Crashes 65+ drivers at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Inclement road condition	*687*	*14.6%*	*2867*	*17.4%*	*-2.8%*
D8 Running stop sign	**1319**	**3.9%**	**5952**	**2.2%**	**1.7%**
Four way intersection	*950*	*72.0%*	*4192*	*70.4%*	*1.6%*
T" intersection	*272*	*20.6%*	*1333*	*22.4%*	*-1.8%*
D9 Running red light	**1919**	**5.6%**	**10096**	**3.7%**	**1.9%**
Dark	*202*	*10.5%*	*2950*	*29.2%*	*-18.7%*
Inclement road condition	*277*	*14.4%*	*1722*	*17.1%*	*-2.7%*
D10 Failure to respond to TCD	505	1.5%	2854	1.1%	0.4%
D11 Tailgating	1080	3.2%	11745	4.3%	-1.1%
D12 Sudden slowing or stopping	317	0.9%	3104	1.1%	-0.2%
D14 Careless passing or lane change	1027	3.0%	9573	3.5%	-0.5%
D17 Careless or illegal backing on roadway	229	0.7%	1288	0.5%	0.2%
D18 Driving on wrong side of roadway	536	1.6%	3835	1.4%	0.2%
D19 Making improper entrance to highway	**992**	**2.9%**	**3560**	**1.3%**	**1.6%**
Dark	*85*	*8.6%*	*641*	*18.0%*	*-9.4%*
Inclement road condition	*139*	*14.0%*	*612*	*17.2%*	*-3.2%*
No traffic control device	*723*	*72.9%*	*2627*	*73.8%*	*-0.9%*
D21 Careless parking or unparking	209	0.6%	871	0.3%	0.3%
D22 Over or under compensation at curve	604	1.8%	6667	2.5%	-0.7%
D23 Speeding	151	0.4%	5437	2.0%	-1.6%
D24 Driving too fast for conditions	3041	8.9%	56189	20.7%	-11.8%
D25 Failure to maintain proper speed	352	1.0%	3738	1.4%	-0.4%
D92 Affected by physical condition	2758	8.1%	25660	9.4%	-1.3%
D98 Other improper driving actions	3778	11.1%	28594	10.5%	0.6%
D99 Unknown	1363	4.0%	15467	5.7%	-1.7%
Fatigue/asleep	736	2.2%	6817	2.5%	-0.3%
Aggressive driving	**22262**	**65.4%**	**164306**	**60.5%**	**4.9%**
Intersection	***14110***	***63.4%***	***73643***	***44.8%***	***18.6%***
Signalized intersection	***5345***	***24.0%***	***29600***	***18.0%***	***6.0%***
Stop controlled intersection	***6154***	***27.6%***	***25469***	***15.5%***	***12.1%***
Dark illumination	*3028*	*13.6%*	*51578*	*31.4%*	*-17.8%*
Inclement road condition	*4133*	*18.6%*	*51028*	*31.1%*	*-12.5%*
Inclement weather	*2999*	*13.5%*	*38388*	*23.4%*	*-9.9%*
Parking lot/driveway	*2268*	*10.2%*	*8994*	*5.5%*	*4.7%*
Tailgating	1377	4.0%	14716	5.4%	-1.4%
No clearance	**5060**	**14.9%**	**17701**	**6.5%**	**8.4%**
Dark illumination	*504*	*10.0%*	*3223*	*18.2%*	*-8.2%*
Inclement road condition	*733*	*14.5%*	*3068*	*17.3%*	*-2.8%*
Inclement weather	*512*	*10.1%*	*2187*	*12.4%*	*-2.3%*
Intersection	*4413*	*87.2%*	*15393*	*87.0%*	*0.2%*
Other intersection	*309*	*6.1%*	*1240*	*7.0%*	*-0.9%*
Signalized intersection	*280*	*5.5%*	*1120*	*6.3%*	*-0.8%*
Stop-controlled intersection	***3824***	***75.6%***	***13033***	***73.6%***	***2.0%***

Category	# Crashes 65+ drivers at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Parking lot/driveway	***481***	***9.5%***	***1506***	***8.5%***	***1.0%***
Curve driver error	841	2.5%	12668	4.7%	-2.2%
Impaired driver	1197	3.5%	35312	13.0%	-9.5%

Table 5. Crash Characteristics for at-fault Mature Drivers Aged 75 and Over.

Category	# Crashes 75+ drivers at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Total	**15252**	**-**	**271545**	**-**	**-**
Interstate	436	2.9%	22120	8.1%	-5.2%
Local road	**8434**	**55.3%**	**124496**	**45.8%**	**9.5%**
Curved road	1581	10.4%	54734	20.2%	-9.8%
Rural	6208	40.7%	110046	40.5%	0.2%
Turnpike	86	0.6%	4691	1.7%	-1.1%
State road	**11535**	**75.6%**	**196480**	**72.4%**	**3.2%**
State road, 2 lane, no divisor, rural, non-intersection	1829	12.0%	37341	13.8%	-1.8%
Inclement weather	1631	10.7%	49343	18.2%	-7.5%
Rain	**1240**	**76.0%**	**31052**	**62.9%**	**13.1%**
Sleet (hail)	15	0.9%	1113	2.3%	-1.4%
Snow	295	18.1%	14587	29.6%	-11.5%
Fog	48	2.9%	1425	2.9%	0.0%
Rain and fog	31	1.9%	975	2.0%	-0.1%
Sleet and fog	2	0.1%	191	0.4%	-0.3%
Dark illumination	2202	14.4%	103832	38.2%	-23.8%
Dark (no street lights)	702	31.9%	40623	39.1%	-7.2%
Dark (street lights)	**1181**	**53.6%**	**52452**	**50.5%**	**3.1%**
Dusk	**210**	**9.5%**	**5122**	**4.9%**	**4.6%**
Dawn	76	3.5%	4277	4.1%	-0.6%
Dark – unknown roadway lighting	33	1.5%	1358	1.3%	0.2%
Inclement road condition	2317	15.2%	67437	24.8%	-9.6%
Wet	***1894***	***81.7%***	***45110***	***66.9%***	***14.8%***
Snow covered	*187*	*8.1%*	*10224*	*15.2%*	*-7.1%*
Slush	*89*	*3.8%*	*3988*	*5.9%*	*-2.1%*
Ice	*44*	*1.9%*	*2695*	*4.0%*	*-2.1%*
Ice patches	*84*	*3.6%*	*4730*	*7.0%*	*-3.4%*
Water standing or moving	*19*	*0.8%*	*690*	*1.0%*	*-0.2%*
Wet road	1894	12.4%	45110	16.6%	-4.2%
Dark (no street lights)	*140*	*7.4%*	*7556*	*16.8%*	*-9.4%*
Dark (street lights)	*245*	*12.9%*	*9686*	*21.5%*	*-8.6%*
Dusk	*30*	*1.6%*	*1103*	*2.4%*	*-0.8%*
Dawn	*17*	*0.9%*	*932*	*2.1%*	*-1.2%*
Dark (unknown roadway lighting)	*6*	*0.3%*	*266*	*0.6%*	*-0.3%*
Snow/slush road	276	1.8%	14212	5.2%	-3.4%
Dark (no street lights)	*29*	*10.5%*	*3274*	*23.0%*	*-12.5%*
Dark (street lights)	*16*	*5.8%*	*1801*	*12.7%*	*-6.9%*
Dusk	*3*	*1.1%*	*249*	*1.8%*	*-0.7%*
Dawn	*0*	*0.0%*	*286*	*2.0%*	*-2.0%*
Dark (unknown roadway lighting)	*1*	*0.4%*	*61*	*0.4%*	*0.0%*
Icy road	128	0.8%	7425	2.7%	-1.9%
Dark (no street lights)	*15*	*11.7%*	*2161*	*29.1%*	*-17.4%*

Category	# Crashes 75+ drivers at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Dark (street lights)	*13*	*10.2%*	*1132*	*15.2%*	*-5.0%*
Dusk	*1*	*0.8%*	*100*	*1.3%*	*-0.5%*
Dawn	*2*	*1.6%*	*284*	*3.8%*	*-2.2%*
Dark (unknown roadway lighting)	*1*	*0.8%*	*43*	*0.6%*	*0.2%*
Inclement road condition	2317	15.2%	67437	24.8%	-9.6%
Dark illumination	*522*	*22.5%*	*29202*	*43.3%*	*-20.8%*
Interstate	19	3.6%	2759	9.4%	-5.8%
Local Road	**261**	**50.0%**	**12092**	**41.4%**	**8.6%**
Curved road	85	16.3%	8893	30.5%	-14.2%
Turnpike	3	0.6%	589	2.0%	-1.4%
Rural	203	38.9%	13908	47.6%	-8.7%
State Road	383	73.4%	20838	71.4%	2.0%
Curved road	*345*	*14.9%*	*20774*	*30.8%*	*-15.9%*
Local road	***1242***	***53.6%***	***27443***	***40.7%***	***12.9%***
Interstate	*69*	*3.0%*	*6168*	*9.1%*	*-6.1%*
Turnpike	*21*	*0.9%*	*1756*	*2.6%*	*-1.7%*
Rural	*961*	*41.5%*	*33025*	*49.0%*	*-7.5%*
State Road	***1734***	***74.8%***	***48893***	***72.5%***	***2.3%***
Dark illumination	2202	14.4%	103832	38.2%	-23.8%
Curved road	*279*	*12.7%*	*25132*	*24.2%*	*-11.5%*
Local road	***1152***	***52.3%***	***47023***	***45.3%***	***7.0%***
Interstate	*82*	*3.7%*	*8827*	*8.5%*	*-4.8%*
Turnpike	*16*	*0.7%*	*1586*	*1.5%*	*-0.8%*
Rural	*851*	*38.6%*	*43204*	*41.6%*	*-3.0%*
State road	***1648***	***74.8%***	***72723***	***70.0%***	***4.8%***
Location type					
Ramp	310	2.0%	8652	3.2%	-1.2%
Bridge	113	0.7%	3561	1.3%	-0.6%
Driveway or parking lot	**1452**	**9.5%**	**12144**	**4.5%**	**5.0%**
No TCD controls	*1014*	*69.8%*	*8830*	*72.7%*	*-2.9%*
No clearance	***239***	***16.5%***	***1506***	***12.4%***	***4.1%***
Collision type					
Non collision	107	0.7%	7230	2.7%	-2.0%
Rear-end	2918	19.1%	65844	24.2%	-5.1%
Head-on	741	4.9%	9589	3.5%	1.4%
Angle	**7422**	**48.7%**	**72772**	**26.8%**	**21.9%**
Intersection	*5563*	*75.0%*	*53474*	*73.5%*	*1.5%*
Stop-controlled intersection	**2823**	**50.7%**	**22506**	**42.1%**	**8.6%**
Signalized intersection	1975	35.5%	23429	43.8%	-8.3%
Other intersection	765	13.8%	7539	14.1%	-0.3%
Dark illumination (incl. dusk and dawn)	*794*	*10.7%*	*21764*	*29.9%*	*-19.2%*
Inclement weather	*689*	*9.3%*	*10436*	*14.3%*	*-5.0%*
Inclement road condition	*1013*	*13.6%*	*14222*	*19.5%*	*-5.9%*
Driveway or parking lot	***1023***	***13.8%***	***7838***	***10.8%***	***3.0%***
No clearance	***2263***	***30.5%***	***15568***	***21.4%***	***9.1%***
No traffic control device	*2209*	*29.8%*	*23853*	*32.8%*	*-3.0%*
Sideswipe (same dir.)	688	4.5%	13768	5.1%	-0.6%
Sideswipe (opposite dir.)	352	2.3%	5553	2.0%	0.3%

Category	# Crashes 75+ drivers at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Hit fixed object	2634	17.3%	89656	33.0%	-15.7%
Hit pedestrian	301	2.0%	5672	2.1%	-0.1%
Prime factor					
D1 Driver was distracted	1174	7.7%	27273	10.0%	-2.3%
D4 Making illegal U-turn	77	0.5%	1098	0.4%	0.1%
D5 Making improper or careless turn	**2796**	**18.3%**	**23980**	**8.8%**	**9.5%**
Intersection	*2002*	*71.6%*	*17863*	*74.5%*	*-2.9%*
Signalized intersection	1089	54.4%	10457	58.5%	-4.1%
Other intersection	**562**	**28.1%**	**4431**	**24.8%**	**3.3%**
Stop-controlled intersection	351	17.5%	2975	16.7%	0.8%
No traffic control device	***1222***	***43.7%***	***9560***	***39.9%***	***3.8%***
Midblock	***794***	***28.4%***	***6117***	***25.5%***	***2.9%***
Four way intersection	*1097*	*39.2%*	*10400*	*43.4%*	*-4.2%*
Traffic signal	840	76.6%	7981	76.7%	-0.1%
Stop sign	94	8.6%	982	9.4%	-0.8%
"T" intersection	***812***	***29.0%***	***6214***	***25.9%***	***3.1%***
No traffic control device	354	43.6%	2560	41.2%	2.4%
Traffic signal	208	25.6%	1786	28.7%	-3.1%
Stop sign	239	29.4%	1795	28.9%	0.5%
"Y" intersection	*51*	*1.8%*	*522*	*2.2%*	*-0.4%*
Multi-leg intersection	*24*	*0.9%*	*453*	*1.9%*	*-1.0%*
Ramp	*64*	*2.3%*	*160*	*0.7%*	*1.6%*
Single vehicle	*120*	*4.3%*	*1620*	*6.8%*	*-2.5%*
Angle Collision type	***2208***	***79.0%***	***17535***	***73.1%***	***5.9%***
Driveway or parking lot	***449***	***16.1%***	***3348***	***14.0%***	***2.1%***
Dark illumination (incl. dusk and dawn)	*382*	*13.7%*	*7959*	*33.2%*	*-19.5%*
Inclement weather	*265*	*9.5%*	*2893*	*12.1%*	*-2.6%*
Inclement road condition	*374*	*13.4%*	*3927*	*16.4%*	*-3.0%*
No clearance	*82*	*2.9%*	*592*	*2.5%*	*0.4%*
D6 Turning from wrong lane	48	0.3%	933	0.3%	0.0%
D7 Proceeding w/o clearance after stop	**2291**	**15.0%**	**16505**	**6.1%**	**8.9%**
Intersection	*2002*	*87.4%*	*14589*	*88.4%*	*-1.0%*
Other intersection	120	6.0%	1111	7.6%	-1.6%
Signalized intersection	96	4.8%	843	5.8%	-1.0%
Stop-controlled intersection	**1786**	**89.2%**	**12635**	**86.6%**	**2.6%**
Four way intersection	*1268*	*55.3%*	*9200*	*55.7%*	*-0.4%*
No traffic control device	54	4.3%	514	5.6%	-1.3%
Traffic signal	52	4.1%	487	5.3%	-1.2%
Stop sign	**1135**	**89.5%**	**7974**	**86.7%**	**2.8%**
"T" intersection	*642*	*28.0%*	*4546*	*27.5%*	*0.5%*
No traffic control device	53	8.3%	396	8.7%	-0.4%
Traffic signal	12	1.9%	113	2.5%	-0.6%
Stop sign	570	88.8%	3999	88.0%	0.8%
"Y" intersection	*55*	*2.4%*	*405*	*2.5%*	*-0.1%*
Angle Collision type	***2109***	***92.1%***	***14431***	***87.4%***	***4.7%***
Driveway or parking lot	***217***	***9.5%***	***1256***	***7.6%***	***1.9%***
Dark illumination (incl. dusk and dawn)	*227*	*9.9%*	*3476*	*21.1%*	*-11.2%*
Inclement weather	*214*	*9.3%*	*2043*	*12.4%*	*-3.1%*

Category	# Crashes 75+ drivers at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Inclement road condition	*323*	*14.1%*	*2867*	*17.4%*	*-3.3%*
D8 Running stop sign	**686**	**4.5%**	**5952**	**2.2%**	**2.3%**
Four way intersection	*490*	*71.4%*	*4192*	*70.4%*	*1.0%*
"T" intersection	*151*	*22.0%*	*1333*	*22.4%*	*-0.4%*
D9 Running red light	**831**	**5.4%**	**10096**	**3.7%**	**1.7%**
Dark	*67*	*8.1%*	*2950*	*29.2%*	*-21.1%*
Inclement road condition	*102*	*12.3%*	*1722*	*17.1%*	*-4.8%*
D10 Failure to respond to TCD	230	1.5%	2854	1.1%	0.4%
D11 Tailgating	410	2.7%	11745	4.3%	-1.6%
D12 Sudden slowing or stopping	123	0.8%	3104	1.1%	-0.3%
D14 Careless passing or lane change	393	2.6%	9573	3.5%	-0.9%
D17 Careless or illegal backing on roadway	100	0.7%	1288	0.5%	0.2%
D18 Driving on wrong side of roadway	262	1.7%	3835	1.4%	0.3%
D19 Making improper entrance to highway	**528**	**3.5%**	**3560**	**1.3%**	**2.2%**
Dark	*33*	*6.3%*	*641*	*18.0%*	*-11.7%*
Inclement road condition	*59*	*11.2%*	*612*	*17.2%*	*-6.0%*
No traffic control device	*389*	*73.7%*	*2627*	*73.8%*	*-0.1%*
D21 Careless parking or unparking	109	0.7%	871	0.3%	0.4%
D22 Over or under compensation at curve	254	1.7%	6667	2.5%	-0.8%
D23 Speeding	48	0.3%	5437	2.0%	-1.7%
D24 Driving too fast for conditions	1068	7.0%	56189	20.7%	-13.7%
D25 Failure to maintain proper speed	158	1.0%	3738	1.4%	-0.4%
D92 Affected by physical condition	1160	7.6%	25660	9.4%	-1.8%
D98 Other improper driving actions	1799	11.8%	28594	10.5%	1.3%
D99 Unknown	606	4.0%	15467	5.7%	-1.7%
Fatigue/asleep	311	2.0%	6817	2.5%	-0.5%
Aggressive driving	**10061**	**66.0%**	**164306**	**60.5%**	**5.5%**
Intersection	***6630***	***65.9%***	***73643***	***44.8%***	***21.1%***
Signalized intersection	***2425***	***24.1%***	***29600***	***18.0%***	***6.1%***
Stop controlled intersection	***3023***	***30.0%***	***25469***	***15.5%***	***14.5%***
Dark illumination	*1094*	*10.9%*	*51578*	*31.4%*	*-20.5%*
Inclement road condition	*1652*	*16.4%*	*51028*	*31.1%*	*-14.7%*
Inclement weather	*1165*	*11.6%*	*38388*	*23.4%*	*-11.8%*
Parking lot/driveway	*1118*	*11.1%*	*8994*	*5.5%*	*5.6%*
Tailgating	529	3.5%	14716	5.4%	-1.9%
No clearance	**2466**	**16.2%**	**17701**	**6.5%**	**9.7%**
Dark illumination	*197*	*8.0%*	*3223*	*18.2%*	*-10.2%*
Inclement road condition	*344*	*13.9%*	*3068*	*17.3%*	*-3.4%*
Inclement weather	*228*	*9.2%*	*2187*	*12.4%*	*-3.2%*
Intersection	*2137*	*86.7%*	*15393*	*87.0%*	*-0.3%*
Other intersection	*135*	*5.5%*	*1240*	*7.0%*	*-1.5%*
Signalized intersection	*135*	*5.5%*	*1120*	*6.3%*	*-0.8%*
Stop-controlled intersection	***1867***	***75.7%***	***13033***	***73.6%***	***2.1%***

Category	# Crashes 75+ drivers at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Parking lot/driveway	***239***	***9.7%***	***1506***	***8.5%***	***1.2%***
Curve driver error	330	2.2%	12668	4.7%	-2.5%
Impaired driver	258	1.7%	35312	13.0%	-11.3%

Table 6. Crash Characteristics for not at-fault Mature Drivers Aged 65 and Over.

Category	# Crashes 65+ drivers not at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Total	**20734**	-	**271545**	-	-
Interstate	1284	6.2%	22120	8.1%	-2.0%
Local road	**10240**	**49.4%**	**124496**	**45.8%**	**3.5%**
Curved road	1645	7.9%	54734	20.2%	-12.2%
Rural	7239	34.9%	110046	40.5%	-5.6%
Turnpike	189	0.9%	4691	1.7%	-0.8%
State road	**16655**	**80.3%**	**196480**	**72.4%**	**8.0%**
State road, 2 lane, no divisor, rural, non-intersection	**6391**	**30.8%**	**37341**	**13.8%**	**17.1%**
Inclement weather	2504	12.1%	49343	18.2%	-6.1%
Rain	**1900**	**75.9%**	**31052**	**62.9%**	**12.9%**
Sleet (hail)	28	1.1%	1113	2.3%	-1.1%
Snow	486	19.4%	14587	29.6%	-10.2%
Fog	47	1.9%	1425	2.9%	-1.0%
Rain and fog	38	1.5%	975	2.0%	-0.5%
Sleet and fog	5	0.2%	191	0.4%	-0.2%
Dark illumination	3329	16.1%	103832	38.2%	-22.2%
Dark (no street lights)	897	26.9%	40623	39.1%	-12.2%
Dark (street lights)	**1890**	**56.8%**	**52452**	**50.5%**	**6.3%**
Dusk	**360**	**10.8%**	**5122**	**4.9%**	**5.9%**
Dawn	144	4.3%	4277	4.1%	0.2%
Dark – unknown roadway lighting	38	1.1%	1358	1.3%	-0.2%
Inclement road condition	3489	16.8%	67437	24.8%	-8.0%
Wet	***2819***	***80.8%***	***45110***	***66.9%***	***13.9%***
Snow covered	*329*	*9.4%*	*10224*	*15.2%*	*-5.7%*
Slush	*114*	*3.3%*	*3988*	*5.9%*	*-2.6%*
Ice	*75*	*2.1%*	*2695*	*4.0%*	*-1.8%*
Ice patches	*132*	*3.8%*	*4730*	*7.0%*	*-3.2%*
Water standing or moving	*20*	*0.6%*	*690*	*1.0%*	*-0.4%*
Wet road	2819	13.6%	45110	16.6%	-3.0%
Dark (no street lights)	*164*	*5.8%*	*7556*	*16.8%*	*-10.9%*
Dark (street lights)	*383*	*13.6%*	*9686*	*21.5%*	*-7.9%*
Dusk	*67*	*2.4%*	*1103*	*2.4%*	*-0.1%*
Dawn	*35*	*1.2%*	*932*	*2.1%*	*-0.8%*
Dark (unknown roadway lighting)	*10*	*0.4%*	*266*	*0.6%*	*-0.2%*
Snow/slush road	443	2.1%	14212	5.2%	-3.1%
Dark (no street lights)	*35*	*7.9%*	*3274*	*23.0%*	*-15.1%*
Dark (street lights)	*39*	*8.8%*	*1801*	*12.7%*	*-3.9%*
Dusk	*12*	*2.7%*	*249*	*1.8%*	*1.0%*
Dawn	*5*	*1.1%*	*286*	*2.0%*	*-0.9%*
Dark (unknown roadway lighting)	*0*	*0.0%*	*61*	*0.4%*	*-0.4%*
Icy road	207	1.0%	7425	2.7%	-1.7%
Dark (no street lights)	*20*	*9.7%*	*2161*	*29.1%*	*-19.4%*

Category	# Crashes 65+ drivers not at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Dark (street lights)	*32*	*15.5%*	*1132*	*15.2%*	*0.2%*
Dusk	*3*	*1.4%*	*100*	*1.3%*	*0.1%*
Dawn	*4*	*1.9%*	*284*	*3.8%*	*-1.9%*
Dark (unknown roadway lighting)	*0*	*0.0%*	*43*	*0.6%*	*-0.6%*
Inclement road condition	3489	16.8%	67437	24.8%	-8.0%
Dark illumination	*813*	*23.3%*	*29202*	*43.3%*	*-20.0%*
Interstate	59	7.3%	2759	9.4%	-2.2%
Local Road	**374**	**46.0%**	**12092**	**41.4%**	**4.6%**
Curved road	97	11.9%	8893	30.5%	-18.5%
Turnpike	12	1.5%	589	2.0%	-0.5%
Rural	289	35.5%	13908	47.6%	-12.1%
State Road	**662**	**81.4%**	**20838**	**71.4%**	**10.1%**
Curved road	*491*	*14.1%*	*20774*	*30.8%*	*-16.7%*
Local road	***1725***	***49.4%***	***27443***	***40.7%***	***8.7%***
Interstate	*203*	*5.8%*	*6168*	*9.1%*	*-3.3%*
Turnpike	*45*	*1.3%*	*1756*	*2.6%*	*-1.3%*
Rural	*1313*	*37.6%*	*33025*	*49.0%*	*-11.3%*
State Road	***2702***	***77.4%***	***48893***	***72.5%***	***4.9%***
Dark illumination	3329	16.1%	103832	38.2%	-22.2%
Curved road	*279*	*8.4%*	*25132*	*24.2%*	*-15.8%*
Local road	*1534*	*46.1%*	*47023*	*45.3%*	*0.8%*
Interstate	*289*	*8.7%*	*8827*	*8.5%*	*0.2%*
Turnpike	*47*	*1.4%*	*1586*	*1.5%*	*-0.1%*
Rural	*1122*	*33.7%*	*43204*	*41.6%*	*-7.9%*
State road	***2755***	***82.8%***	***72723***	***70.0%***	***12.7%***
Location type					
Ramp	644	3.1%	8652	3.2%	-0.1%
Bridge	230	1.1%	3561	1.3%	-0.2%
Driveway or parking lot	**1593**	**7.7%**	**12144**	**4.5%**	**3.2%**
No TCD controls	*1122*	*70.4%*	*8830*	*72.7%*	*-2.3%*
No clearance	***232***	***14.6%***	***1506***	***12.4%***	***2.2%***
Collision type					
Non collision	71	0.3%	7230	2.7%	-2.3%
Rear-end	**8360**	**40.3%**	**65844**	**24.2%**	**16.1%**
Head-on	**1074**	**5.2%**	**9589**	**3.5%**	**1.6%**
Angle	**9280**	**44.8%**	**72772**	**26.8%**	**18.0%**
Intersection	***7064***	***76.1%***	***53474***	***73.5%***	***2.6%***
Stop-controlled intersection	3067	43.4%	22506	42.1%	1.3%
Signalized intersection	3170	44.9%	23429	43.8%	1.1%
Other intersection	827	11.7%	7539	14.1%	-2.4%
Dark illumination (incl. dusk and dawn)	*1477*	*15.9%*	*21764*	*29.9%*	*-14.0%*
Inclement weather	*1150*	*12.4%*	*10436*	*14.3%*	*-1.9%*
Inclement road condition	*1612*	*17.4%*	*14222*	*19.5%*	*-2.2%*
Driveway or parking lot	*1108*	*11.9%*	*7838*	*10.8%*	*1.2%*
No clearance	***2137***	***23.0%***	***15568***	***21.4%***	***1.6%***
No traffic control device	*2634*	*28.4%*	*23853*	*32.8%*	*-4.4%*
Sideswipe (same dir.)	845	4.1%	13768	5.1%	-1.0%
Sideswipe (opposite dir.)	617	3.0%	5553	2.0%	0.9%

Category	# Crashes 65+ drivers not at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Hit fixed object	307	1.5%	89656	33.0%	-31.5%
Hit pedestrian	81	0.4%	5672	2.1%	-1.7%
Prime factor					
D1 Driver was distracted	**2675**	**12.9%**	**27273**	**10.0%**	**2.9%**
D4 Making illegal U-turn	62	0.3%	1098	0.4%	-0.1%
D5 Making improper or careless turn	**2285**	**11.0%**	**23980**	**8.8%**	**2.2%**
Intersection	*1645*	*72.0%*	*17863*	*74.5%*	*-2.5%*
Signalized intersection	965	58.7%	10457	58.5%	0.1%
Other intersection	382	23.2%	4431	24.8%	-1.6%
Stop-controlled intersection	298	18.1%	2975	16.7%	1.5%
No traffic control device	*916*	*40.1%*	*9560*	*39.9%*	*0.2%*
Midblock	***640***	***28.0%***	***6117***	***25.5%***	***2.5%***
Four way intersection	*948*	*41.5%*	*10400*	*43.4%*	*-1.9%*
Traffic signal	719	75.8%	7981	76.7%	-0.9%
Stop sign	99	10.4%	982	9.4%	1.0%
"T" intersection	*600*	*26.3%*	*6214*	*25.9%*	*0.3%*
No traffic control device	217	36.2%	2560	41.2%	-5.0%
Traffic signal	**195**	**32.5%**	**1786**	**28.7%**	**3.8%**
Stop sign	179	29.8%	1795	28.9%	0.9%
"Y" intersection	*49*	*2.1%*	*522*	*2.2%*	*0.0%*
Multi-leg intersection	*31*	*1.4%*	*453*	*1.9%*	*-0.5%*
Ramp	*11*	*0.5%*	*160*	*0.7%*	*-0.2%*
Single vehicle	*0*	*0.0%*	*1620*	*6.8%*	*-6.8%*
Angle Collision type	***1867***	***81.7%***	***17535***	***73.1%***	***8.6%***
Driveway or parking lot	***377***	***16.5%***	***3348***	***14.0%***	***2.5%***
Dark illumination (incl. dusk and dawn)	*405*	*17.7%*	*7959*	*33.2%*	*-15.5%*
Inclement weather	*235*	*10.3%*	*2893*	*12.1%*	*-1.8%*
Inclement road condition	*311*	*13.6%*	*3927*	*16.4%*	*-2.8%*
No clearance	*66*	*2.9%*	*592*	*2.5%*	*0.4%*
D6 Turning from wrong lane	80	0.4%	933	0.3%	0.0%
D7 Proceeding w/o clearance after stop	**2200**	**10.6%**	**16505**	**6.1%**	**4.5%**
Intersection	*1922*	*87.4%*	*14589*	*88.4%*	*-1.0%*
Other intersection	130	6.8%	1111	7.6%	-0.9%
Signalized intersection	109	5.7%	843	5.8%	-0.1%
Stop-controlled intersection	1683	87.6%	12635	86.6%	1.0%
Four way intersection	*1250*	*56.8%*	*9200*	*55.7%*	*1.1%*
No traffic control device	64	5.1%	514	5.6%	-0.5%
Traffic signal	59	4.7%	487	5.3%	-0.6%
Stop sign	1094	87.5%	7974	86.7%	0.8%
"T" intersection	*567*	*25.8%*	*4546*	*27.5%*	*-1.8%*
No traffic control device	38	6.7%	396	8.7%	-2.0%
Traffic signal	16	2.8%	113	2.5%	0.3%
Stop sign	510	89.9%	3999	88.0%	2.0%
"Y" intersection	*48*	*2.2%*	*405*	*2.5%*	*-0.3%*
Angle Collision type	***2006***	***91.2%***	***14431***	***87.4%***	***3.7%***
Driveway or parking lot	***195***	***8.9%***	***1256***	***7.6%***	***1.3%***
Dark illumination (incl. dusk and dawn)	*295*	*13.4%*	*3476*	*21.1%*	*-7.7%*
Inclement weather	*251*	*11.4%*	*2043*	*12.4%*	*-1.0%*

Category	# Crashes 65+ drivers not at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Inclement road condition	*364*	*16.5%*	*2867*	*17.4%*	*-0.8%*
D8 Running stop sign	**773**	**3.7%**	**5952**	**2.2%**	**1.5%**
Four way intersection	***596***	***77.1%***	***4192***	***70.4%***	***6.7%***
"T" intersection	*134*	*17.3%*	*1333*	*22.4%*	*-5.1%*
D9 Running red light	**1654**	**8.0%**	**10096**	**3.7%**	**4.3%**
Dark	*218*	*13.2%*	*2950*	*29.2%*	*-16.0%*
Inclement road condition	*220*	*13.3%*	*1722*	*17.1%*	*-3.8%*
D10 Failure to respond to TCD	259	1.2%	2854	1.1%	0.2%
D11 Tailgating	**1497**	**7.2%**	**11745**	**4.3%**	**2.9%**
D12 Sudden slowing or stopping	366	1.8%	3104	1.1%	0.6%
D14 Careless passing or lane change	792	3.8%	9573	3.5%	0.3%
D17 Careless or illegal backing on roadway	122	0.6%	1288	0.5%	0.1%
D18 Driving on wrong side of roadway	348	1.7%	3835	1.4%	0.3%
D19 Making improper entrance to highway	485	2.3%	3560	1.3%	1.0%
Dark	*49*	*10.1%*	*641*	*18.0%*	*-7.9%*
Inclement road condition	*78*	*16.1%*	*612*	*17.2%*	*-1.1%*
No traffic control device	*354*	*73.0%*	*2627*	*73.8%*	*-0.8%*
D21 Careless parking or unparking	72	0.3%	871	0.3%	0.0%
D22 Over or under compensation at curve	125	0.6%	6667	2.5%	-1.9%
D23 Speeding	250	1.2%	5437	2.0%	-0.8%
D24 Driving too fast for conditions	2636	12.7%	56189	20.7%	-8.0%
D25 Failure to maintain proper speed	353	1.7%	3738	1.4%	0.3%
D92 Affected by physical condition	635	3.1%	25660	9.4%	-6.4%
D98 Other improper driving actions	1717	8.3%	28594	10.5%	-2.3%
D99 Unknown	974	4.7%	15467	5.7%	-1.0%
Fatigue/asleep	222	1.1%	6817	2.5%	-1.4%
Aggressive driving	**14165**	**68.3%**	**164306**	**60.5%**	**7.8%**
Intersection	***8295***	***58.6%***	***73643***	***44.8%***	***13.7%***
Signalized intersection	***3606***	***25.5%***	***29600***	***18.0%***	***7.4%***
Stop controlled intersection	***3123***	***22.0%***	***25469***	***15.5%***	***6.5%***
Dark illumination	*1885*	*13.3%*	*51578*	*31.4%*	*-18.1%*
Inclement road condition	*2751*	*19.4%*	*51028*	*31.1%*	*-11.6%*
Inclement weather	*1971*	*13.9%*	*38388*	*23.4%*	*-9.4%*
Parking lot/driveway	***1197***	***8.5%***	***8994***	***5.5%***	***3.0%***
Tailgating	**1903**	**9.2%**	**14716**	**5.4%**	**3.8%**
No clearance	**2346**	**11.3%**	**17701**	**6.5%**	**4.8%**
Dark illumination	*257*	*11.0%*	*3223*	*18.2%*	*-7.3%*
Inclement road condition	*394*	*16.8%*	*3068*	*17.3%*	*-0.5%*
Inclement weather	*273*	*11.6%*	*2187*	*12.4%*	*-0.7%*
Intersection	*2009*	*85.6%*	*15393*	*87.0%*	*-1.3%*
Other intersection	*156*	*6.6%*	*1240*	*7.0%*	*-0.4%*
Signalized intersection	*140*	*6.0%*	*1120*	*6.3%*	*-0.4%*
Stop-controlled intersection	*1713*	*73.0%*	*13033*	*73.6%*	*-0.6%*

Category	# Crashes 65+ drivers not at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Parking lot/driveway	***232***	***9.9%***	***1506***	***8.5%***	***1.4%***
Curve driver error	220	1.1%	12668	4.7%	-3.6%
Impaired driver	1019	4.9%	35312	13.0%	-8.1%

Table 7. Crash Characteristics for not at-fault Mature Drivers Aged 75 and Over.

Category	# Crashes 75+ drivers not at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Total	**6832**	-	**271545**	-	-
Interstate	292	4.3%	22120	8.1%	-3.9%
Local road	**3608**	**52.8%**	**124496**	**45.8%**	**6.9%**
Curved road	519	7.6%	54734	20.2%	-12.6%
Rural	2370	34.7%	110046	40.5%	-5.9%
Turnpike	30	0.4%	4691	1.7%	-1.3%
State road	**5411**	**79.2%**	**196480**	**72.4%**	**6.8%**
State road, 2 lane, no divisor, rural, non-intersection	**2915**	**42.7%**	**37341**	**13.8%**	**28.9%**
Inclement weather	717	10.5%	49343	18.2%	-7.7%
Rain	**559**	**78.0%**	**31052**	**62.9%**	**15.0%**
Sleet (hail)	11	1.5%	1113	2.3%	-0.7%
Snow	126	17.6%	14587	29.6%	-12.0%
Fog	10	1.4%	1425	2.9%	-1.5%
Rain and fog	9	1.3%	975	2.0%	-0.7%
Sleet and fog	2	0.3%	191	0.4%	-0.1%
Dark illumination	815	11.9%	103832	38.2%	-26.3%
Dark (no street lights)	215	26.4%	40623	39.1%	-12.7%
Dark (street lights)	**450**	**55.2%**	**52452**	**50.5%**	**4.7%**
Dusk	**114**	**14.0%**	**5122**	**4.9%**	**9.1%**
Dawn	29	3.6%	4277	4.1%	-0.6%
Dark – unknown roadway lighting	7	0.9%	1358	1.3%	-0.4%
Inclement road condition	1024	15.0%	67437	24.8%	-9.9%
Wet	***847***	***82.7%***	***45110***	***66.9%***	***15.8%***
Snow covered	*80*	*7.8%*	*10224*	*15.2%*	*-7.3%*
Slush	*37*	*3.6%*	*3988*	*5.9%*	*-2.3%*
Ice	*15*	*1.5%*	*2695*	*4.0%*	*-2.5%*
Ice patches	*40*	*3.9%*	*4730*	*7.0%*	*-3.1%*
Water standing or moving	*5*	*0.5%*	*690*	*1.0%*	*-0.5%*
Wet road	847	12.4%	45110	16.6%	-4.2%
Dark (no street lights)	*31*	*3.7%*	*7556*	*16.8%*	*-13.1%*
Dark (street lights)	*86*	*10.2%*	*9686*	*21.5%*	*-11.3%*
Dusk	*23*	*2.7%*	*1103*	*2.4%*	*0.3%*
Dawn	*9*	*1.1%*	*932*	*2.1%*	*-1.0%*
Dark (unknown roadway lighting)	*1*	*0.1%*	*266*	*0.6%*	*-0.5%*
Snow/slush road	117	1.7%	14212	5.2%	-3.5%
Dark (no street lights)	*6*	*5.1%*	*3274*	*23.0%*	*-17.9%*
Dark (street lights)	*8*	*6.8%*	*1801*	*12.7%*	*-5.8%*
Dusk	*1*	*0.9%*	*249*	*1.8%*	*-0.9%*
Dawn	*0*	*0.0%*	*286*	*2.0%*	*-2.0%*
Dark (unknown roadway lighting)	*0*	*0.0%*	*61*	*0.4%*	*-0.4%*
Icy road	55	0.8%	7425	2.7%	-1.9%
Dark (no street lights)	*3*	*5.5%*	*2161*	*29.1%*	*-23.6%*

Category	# Crashes 75+ drivers not at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Dark (street lights)	*7*	*12.7%*	*1132*	*15.2%*	*-2.5%*
Dusk	*1*	*1.8%*	*100*	*1.3%*	*0.5%*
Dawn	*0*	*0.0%*	*284*	*3.8%*	*-3.8%*
Dark (unknown roadway lighting)	*0*	*0.0%*	*43*	*0.6%*	*-0.6%*
Inclement road condition	1024	15.0%	67437	24.8%	-9.9%
Dark illumination	*177*	*17.3%*	*29202*	*43.3%*	*-26.0%*
Interstate	5	2.8%	2759	9.4%	-6.6%
Local Road	**88**	**49.7%**	**12092**	**41.4%**	**8.3%**
Curved road	20	11.3%	8893	30.5%	-19.2%
Turnpike	4	2.3%	589	2.0%	0.2%
Rural	59	33.3%	13908	47.6%	-14.3%
State Road	**143**	**80.8%**	**20838**	**71.4%**	**9.4%**
Curved road	*135*	*13.2%*	*20774*	*30.8%*	*-17.6%*
Local road	***574***	***56.1%***	***27443***	***40.7%***	***15.4%***
Interstate	*34*	*3.3%*	*6168*	*9.1%*	*-5.8%*
Turnpike	*8*	*0.8%*	*1756*	*2.6%*	*-1.8%*
Rural	*366*	*35.7%*	*33025*	*49.0%*	*-13.2%*
State Road	***773***	***75.5%***	***48893***	***72.5%***	***3.0%***
Dark illumination	815	11.9%	103832	38.2%	-26.3%
Curved road	*63*	*7.7%*	*25132*	*24.2%*	*-16.5%*
Local road	*380*	*46.6%*	*47023*	*45.3%*	*1.3%*
Interstate	*60*	*7.4%*	*8827*	*8.5%*	*-1.1%*
Turnpike	*12*	*1.5%*	*1586*	*1.5%*	*-0.1%*
Rural	*260*	*31.9%*	*43204*	*41.6%*	*-9.7%*
State road	***664***	***81.5%***	***72723***	***70.0%***	***11.4%***
Location type					
Ramp	207	3.0%	8652	3.2%	-0.2%
Bridge	61	0.9%	3561	1.3%	-0.4%
Driveway or parking lot	**611**	**8.9%**	**12144**	**4.5%**	**4.5%**
No TCD controls	*424*	*69.4%*	*8830*	*72.7%*	*-3.3%*
No clearance	***94***	***15.4%***	***1506***	***12.4%***	***3.0%***
Collision type					
Non collision	15	0.2%	7230	2.7%	-2.4%
Rear-end	**2430**	**35.6%**	**65844**	**24.2%**	**11.3%**
Head-on	**366**	**5.4%**	**9589**	**3.5%**	**1.8%**
Angle	**3424**	**50.1%**	**72772**	**26.8%**	**23.3%**
Intersection	***2621***	***76.5%***	***53474***	***73.5%***	***3.1%***
Stop-controlled intersection	**1186**	**45.2%**	**22506**	**42.1%**	**3.2%**
Signalized intersection	1163	44.4%	23429	43.8%	0.6%
Other intersection	272	10.4%	7539	14.1%	-3.7%
Dark illumination (incl. dusk and dawn)	*378*	*11.0%*	*21764*	*29.9%*	*-18.9%*
Inclement weather	*382*	*11.2%*	*10436*	*14.3%*	*-3.2%*
Inclement road condition	*545*	*15.9%*	*14222*	*19.5%*	*-3.6%*
Driveway or parking lot	***450***	***13.1%***	***7838***	***10.8%***	***2.4%***
No clearance	***836***	***24.4%***	***15568***	***21.4%***	***3.0%***
No traffic control device	*924*	*27.0%*	*23853*	*32.8%*	*-5.8%*
Sideswipe (same dir.)	255	3.7%	13768	5.1%	-1.3%
Sideswipe (opposite dir.)	204	3.0%	5553	2.0%	0.9%

Category	# Crashes 75+ drivers not at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Hit fixed object	82	1.2%	89656	33.0%	-31.8%
Hit pedestrian	25	0.4%	5672	2.1%	-1.7%
Prime factor					
D1 Driver was distracted	**833**	**12.2%**	**27273**	**10.0%**	**2.1%**
D4 Making illegal U-turn	15	0.2%	1098	0.4%	-0.2%
D5 Making improper or careless turn	**839**	**12.3%**	**23980**	**8.8%**	**3.4%**
Intersection	*591*	*70.4%*	*17863*	*74.5%*	*-4.1%*
Signalized intersection	334	56.5%	10457	58.5%	-2.0%
Other intersection	136	23.0%	4431	24.8%	-1.8%
Stop-controlled intersection	**121**	**20.5%**	**2975**	**16.7%**	**3.8%**
No traffic control device	*341*	*40.6%*	*9560*	*39.9%*	*0.8%*
Midblock	***248***	***29.6%***	***6117***	***25.5%***	***4.1%***
Four way intersection	*352*	*42.0%*	*10400*	*43.4%*	*-1.4%*
Traffic signal	253	71.9%	7981	76.7%	-4.9%
Stop sign	**46**	**13.1%**	**982**	**9.4%**	**3.6%**
"T" intersection	*206*	*24.6%*	*6214*	*25.9%*	*-1.4%*
No traffic control device	72	35.0%	2560	41.2%	-6.2%
Traffic signal	66	32.0%	1786	28.7%	3.3%
Stop sign	66	32.0%	1795	28.9%	3.2%
"Y" intersection	*21*	*2.5%*	*522*	*2.2%*	*0.3%*
Multi-leg intersection	*6*	*0.7%*	*453*	*1.9%*	*-1.2%*
Ramp	*-47*	*-5.6%*	*160*	*0.7%*	*-6.3%*
Single vehicle	*0*	*0.0%*	*1620*	*6.8%*	*-6.8%*
Angle Collision type	***690***	***82.2%***	***17535***	***73.1%***	***9.1%***
Driveway or parking lot	***146***	***17.4%***	***3348***	***14.0%***	***3.4%***
Dark illumination (incl. dusk and dawn)	*105*	*12.5%*	*7959*	*33.2%*	*-20.7%*
Inclement weather	*78*	*9.3%*	*2893*	*12.1%*	*-2.8%*
Inclement road condition	*103*	*12.3%*	*3927*	*16.4%*	*-4.1%*
No clearance	*29*	*3.5%*	*592*	*2.5%*	*1.0%*
D6 Turning from wrong lane	22	0.3%	933	0.3%	0.0%
D7 Proceeding w/o clearance after stop	**858**	**12.6%**	**16505**	**6.1%**	**6.5%**
Intersection	*754*	*87.9%*	*14589*	*88.4%*	*-0.5%*
Other intersection	45	6.0%	1111	7.6%	-1.6%
Signalized intersection	31	4.1%	843	5.8%	-1.7%
Stop-controlled intersection	**678**	**89.9%**	**12635**	**86.6%**	**3.3%**
Four way intersection	*481*	*56.1%*	*9200*	*55.7%*	*0.3%*
No traffic control device	23	4.8%	514	5.6%	-0.8%
Traffic signal	21	4.4%	487	5.3%	-0.9%
Stop sign	**431**	**89.6%**	**7974**	**86.7%**	**2.9%**
"T" intersection	*232*	*27.0%*	*4546*	*27.5%*	*-0.5%*
No traffic control device	10	4.3%	396	8.7%	-4.4%
Traffic signal	4	1.7%	113	2.5%	-0.8%
Stop sign	**216**	**93.1%**	**3999**	**88.0%**	**5.1%**
"Y" intersection	*19*	*2.2%*	*405*	*2.5%*	*-0.2%*
Angle Collision type	***785***	***91.5%***	***14431***	***87.4%***	***4.1%***
Driveway or parking lot	***79***	***9.2%***	***1256***	***7.6%***	***1.6%***
Dark illumination (incl. dusk and dawn)	*76*	*8.9%*	*3476*	*21.1%*	*-12.2%*
Inclement weather	*89*	*10.4%*	*2043*	*12.4%*	*-2.0%*

Category	# Crashes 75+ drivers not at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Inclement road condition	*124*	*14.5%*	*2867*	*17.4%*	*-2.9%*
D8 Running stop sign	**283**	**4.1%**	**5952**	**2.2%**	**1.9%**
Four way intersection	*212*	*74.9%*	*4192*	*70.4%*	*4.5%*
"T" intersection	*51*	*18.0%*	*1333*	*22.4%*	*-4.4%*
D9 Running red light	**628**	**9.2%**	**10096**	**3.7%**	**5.5%**
Dark	*64*	*10.2%*	*2950*	*29.2%*	*-19.0%*
Inclement road condition	*79*	*12.6%*	*1722*	*17.1%*	*-4.5%*
D10 Failure to respond to TCD	71	1.0%	2854	1.1%	0.0%
D11 Tailgating	**441**	**6.5%**	**11745**	**4.3%**	**2.1%**
D12 Sudden slowing or stopping	104	1.5%	3104	1.1%	0.4%
D14 Careless passing or lane change	227	3.3%	9573	3.5%	-0.2%
D17 Careless or illegal backing on roadway	45	0.7%	1288	0.5%	0.2%
D18 Driving on wrong side of roadway	119	1.7%	3835	1.4%	0.3%
D19 Making improper entrance to highway	**191**	**2.8%**	**3560**	**1.3%**	**1.5%**
Dark	*9*	*4.7%*	*641*	*18.0%*	*-13.3%*
Inclement road condition	*31*	*16.2%*	*612*	*17.2%*	*-1.0%*
No traffic control device	*136*	*71.2%*	*2627*	*73.8%*	*-2.6%*
D21 Careless parking or unparking	30	0.4%	871	0.3%	0.1%
D22 Over or under compensation at curve	37	0.5%	6667	2.5%	-1.9%
D23 Speeding	87	1.3%	5437	2.0%	-0.7%
D24 Driving too fast for conditions	712	10.4%	56189	20.7%	-10.3%
D25 Failure to maintain proper speed	109	1.6%	3738	1.4%	0.2%
D92 Affected by physical condition	190	2.8%	25660	9.4%	-6.7%
D98 Other improper driving actions	528	7.7%	28594	10.5%	-2.8%
D99 Unknown	355	5.2%	15467	5.7%	-0.5%
Fatigue/asleep	57	0.8%	6817	2.5%	-1.7%
Aggressive driving	**4736**	**69.3%**	**164306**	**60.5%**	**8.8%**
Intersection	***2955***	***62.4%***	***73643***	***44.8%***	***17.6%***
Signalized intersection	***1262***	***26.6%***	***29600***	***18.0%***	***8.6%***
Stop controlled intersection	***1198***	***25.3%***	***25469***	***15.5%***	***9.8%***
Dark illumination	*455*	*9.6%*	*51578*	*31.4%*	*-21.8%*
Inclement road condition	*792*	*16.7%*	*51028*	*31.1%*	*-14.3%*
Inclement weather	*560*	*11.8%*	*38388*	*23.4%*	*-11.5%*
Parking lot/driveway	*467*	*9.9%*	*8994*	*5.5%*	*4.4%*
Tailgating	**572**	**8.4%**	**14716**	**5.4%**	**2.9%**
No clearance	**911**	**13.3%**	**17701**	**6.5%**	**6.8%**
Dark illumination	*69*	*7.6%*	*3223*	*18.2%*	*-10.6%*
Inclement road condition	*133*	*14.6%*	*3068*	*17.3%*	*-2.7%*
Inclement weather	*97*	*10.6%*	*2187*	*12.4%*	*-1.7%*
Intersection	*788*	*86.5%*	*15393*	*87.0%*	*-0.5%*
Other intersection	*57*	*6.3%*	*1240*	*7.0%*	*-0.7%*
Signalized intersection	*51*	*5.6%*	*1120*	*6.3%*	*-0.7%*
Stop-controlled intersection	*680*	*74.6%*	*13033*	*73.6%*	*1.0%*

Category	# Crashes 75+ drivers not at-fault	% within each group	# Crashes not involving mature drivers	% within each group	% Difference
Parking lot/driveway	***94***	***10.3%***	***1506***	***8.5%***	***1.8%***
Curve driver error	65	1.0%	12668	4.7%	-3.7%
Impaired driver	319	4.7%	35312	13.0%	-8.3%

APPENDIX B

Table 8. Crash Characteristics for Crashes Involving Pedestrians in which Pedestrians are at-fault.

Category	# Pedestrian Crashes, Ped at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Total	**4866**	-	**307027**	-	-
Interstate	32	0.7%	24333	7.9%	-7.3%
State road	2549	52.4%	227029	73.9%	-21.6%
Local road	**3186**	**65.5%**	**140260**	**45.7%**	**19.8%**
Urban area	**3983**	**81.9%**	**125803**	**41.0%**	**40.9%**
Curved road	133	2.7%	57635	18.8%	-16.0%
Inclement weather	682	14.0%	56665	18.5%	-4.4%
Rain	***504***	***73.9%***	***34665***	***61.2%***	***12.7%***
Sleet	*8*	*1.2%*	*1170*	*2.1%*	*-0.9%*
Snow	*82*	*12.0%*	*15775*	*27.8%*	*-15.8%*
Fog	*19*	*2.8%*	*1546*	*2.7%*	*0.1%*
Others	***69***	***10.1%***	***3509***	***6.2%***	***3.9%***
Non day-light	**2015**	**41.4%**	**108012**	**35.2%**	**6.2%**
Urban area	***1575***	***78.2%***	***45646***	***42.3%***	***35.9%***
Dark - no street lights	229	14.5%	30540	66.9%	-52.4%
Dark - street lights	**1159**	**73.6%**	**9402**	**20.6%**	**53.0%**
Surburban/rural area	*440*	*21.8%*	*62366*	*57.7%*	*-35.9%*
Dark - no street lights	**222**	**50.5%**	**11736**	**18.8%**	**31.6%**
Dark - street lights	182	41.4%	44515	71.4%	-30.0%
Inclement surface	853	17.5%	76083	24.8%	-7.3%
Wet	***726***	***85.1%***	***50654***	***66.6%***	***18.5%***
Sand/mud etc.	*7*	*0.8%*	*718*	*0.9%*	*-0.1%*
Snow covered	*42*	*4.9%*	*11057*	*14.5%*	*-9.6%*
Slush	*19*	*2.2%*	*4308*	*5.7%*	*-3.4%*
Others	*59*	*6.9%*	*9346*	*12.3%*	*-5.4%*
Intersection	1707	35.1%	122066	39.8%	-4.7%
Signalized intersection	***906***	***53.1%***	***48343***	***39.6%***	***13.5%***
Stop-controlled intersection	*283*	*16.6%*	*38733*	*31.7%*	*-15.2%*
Others	*518*	*30.3%*	*34990*	*28.7%*	*1.7%*
Mid Block	**3159**	**64.9%**	**184961**	**60.2%**	**4.7%**
State road	*1512*	*47.9%*	*133503*	*72.2%*	*-24.3%*
2 lane	817	54.0%	69739	52.2%	1.8%
Divided road	559	37.0%	50780	38.0%	-1.1%
Intersection + non day-light	**683**	**14.0%**	**36261**	**11.8%**	**2.2%**
Dark - no street lights	*77*	*11.3%*	*7557*	*20.8%*	*-9.6%*
Dark - street lights	***533***	***78.0%***	***24492***	***67.5%***	***10.5%***
Mid block + non day-light	**1332**	**27.4%**	**71751**	**23.4%**	**4.0%**
Dark - no street lights	*374*	*28.1%*	*34719*	*48.4%*	*-20.3%*
Dark - street lights	***808***	***60.7%***	***29425***	***41.0%***	***19.7%***

Table 9. Crash Characteristics for Crashes Involving Pedestrians in which Pedestrians are not at-fault.

Category	# Pedestrian Crashes, Ped not at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Total	**5862**	-	**307027**	-	-
Interstate	62	1.1%	24333	7.9%	-6.9%
State road	3063	52.3%	227029	73.9%	-21.7%
Local road	**4676**	**79.8%**	**140260**	**45.7%**	**34.1**
Urban area	**4813**	**82.1%**	**125803**	**41.0%**	**41.1%**
Curved road	240	4.1%	57635	18.8%	-14.7%
Inclement weather	910	15.5%	56665	18.5%	-2.9%
Rain	***656***	***72.1%***	***34665***	***61.2%***	***10.9%***
Sleet	*11*	*1.2%*	*1170*	*2.1%*	*-0.9%*
Snow	*117*	*12.9%*	*15775*	*27.8%*	*-15.0%*
Fog	*13*	*1.4%*	*1546*	*2.7%*	*-1.3%*
Others	***113***	***12.4%***	***3509***	***6.2%***	***6.2%***
Non day-light	2093	35.7%	108012	35.2%	0.5%
Urban area	***1727***	***82.5%***	***45646***	***42.3%***	***40.3%***
Dark - no street lights	153	8.9%	30540	66.9%	-58.0%
Dark - street lights	**1377**	**79.7%**	**9402**	**20.6%**	**59.1%**
Surburban/rural area	*366*	*17.5%*	*62366*	*57.7%*	*-40.3%*
Dark - no street lights	**164**	**44.8%**	**11736**	**18.8%**	**26.0%**
Dark - street lights	157	42.9%	44515	71.4%	-28.5%
Inclement surface	1108	18.9%	76083	24.8%	-5.9%
Wet	***917***	***82.8%***	***50654***	***66.6%***	***16.2%***
Sand/mud etc.	*7*	*0.6%*	*718*	*0.9%*	*-0.3%*
Snow covered	*62*	*5.6%*	*11057*	*14.5%*	*-8.9%*
Slush	*28*	*2.5%*	*4308*	*5.7%*	*-3.1%*
Others	*94*	*8.5%*	*9346*	*12.3%*	*-3.8%*
Intersection	**3887**	**66.3%**	**122066**	**39.8%**	**26.6%**
Signalized intersection	***2231***	***57.4%***	***48343***	***39.6%***	***17.8%***
Stop-controlled intersection	*933*	*24.0%*	*38733*	*31.7%*	*-7.7%*
Others	*723*	*18.6%*	*34990*	*28.7%*	*-10.1%*
D1 Distracted	*299*	*7.7%*	*10048*	*8.2%*	*-0.5%*
D5 Improper of careless turn	***1387***	***35.7%***	***21061***	***17.3%***	***18.4%***
Non day-light	**473**	**34.1%**	**6572**	**31.2%**	**2.9%**
Dark - no street lights	35	2.5%	929	4.4%	-1.9%
Dark - street lights	272	19.6%	4837	23.0%	-3.4%
D7 Proceeding w/o clearance	*362*	*9.3%*	*19478*	*16.0%*	*-6.6%*
Non day-light	**87**	**24.0%**	**3658**	**18.8%**	**5.3%**
Dark - no street lights	9	2.5%	896	4.6%	-2.1%
Dark - street lights	**67**	**18.5%**	**2106**	**10.8%**	**7.7%**
D8 Running stop sign	*74*	*1.9%*	*7335*	*6.0%*	*-4.1%*
D9 Running red light	*97*	*2.5%*	*12746*	*10.4%*	*-7.9%*
D10 Failure to respond to TCD	*40*	*1.0%*	*2660*	*2.2%*	*-1.2%*

Category	# Pedestrian Crashes, Ped not at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Mid Block	1975	33.7%	184961	60.2%	-26.6%
State road	*915*	*46.3%*	*133503*	*72.2%*	*-25.8%*
2 lane	**514**	**56.2%**	**69739**	**52.2%**	**3.9%**
Divided road	323	35.3%	50780	38.0%	-2.7%
D1 Distracted	*204*	*10.3%*	*21781*	*11.8%*	*-1.4%*
D5 Improper of careless turn	*83*	*4.2%*	*7768*	*4.2%*	*0.0%*
D14 Careless passing or lane change	*80*	*4.1%*	*8386*	*4.5%*	*-0.5%*
D17 Careless or illegal backing on roadway	***125***	***6.3%***	***1011***	***0.5%***	***5.8%***
D21 Careless parking or unparking	***121***	***6.1%***	***856***	***0.5%***	***5.7%***
Intersection + non day-light	**1313**	**22.4%**	**36261**	**11.8%**	**10.6%**
Dark - no street lights	*102*	*7.8%*	*7557*	*20.8%*	*-13.1%*
Dark - street lights	***1056***	***80.4%***	***24492***	***67.5%***	***12.9%***
Mid block + non day-light	780	13.3%	71751	23.4%	-10.1%
Dark - no street lights	*215*	*27.6%*	*34719*	*48.4%*	*-20.8%*
Dark - street lights	***478***	***61.3%***	***29425***	***41.0%***	***20.3%***

APPENDIX C

Table 10. Crash Characteristics for Crashes Involving Bicyclists in which Bicyclists are at-fault.

Category	# Bicyclist Crashes, Bicyclist at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Total	**1995**	**-**	**307027**	**-**	**-**
State road	875	43.9%	227029	73.9%	-30.1%
Local road	**1620**	**81.2%**	**140260**	**45.7%**	**35.5%**
Urban area	**1550**	**77.7%**	**125803**	**41.0%**	**36.7%**
Curved road	64	3.2%	57635	18.8%	-15.6%
Inclement weather	117	5.9%	56665	18.5%	-12.6%
Rain	***100***	***85.5%***	***34665***	***61.2%***	***24.3%***
Sleet	*0*	*0.0%*	*1170*	*2.1%*	*-2.1%*
Snow	*3*	*2.6%*	*15775*	*27.8%*	*-25.3%*
Fog	*1*	*0.9%*	*1546*	*2.7%*	*-1.9%*
Others	***13***	***11.1%***	***3509***	***6.2%***	***4.9%***
Non day-light	444	22.3%	108012	35.2%	-12.9%
Urban area	***377***	***84.9%***	***45646***	***42.3%***	***42.6%***
Dark - no street lights	28	7.4%	30540	66.9%	-59.5%
Dark - street lights	**297**	**78.8%**	**9402**	**20.6%**	**58.2%**
Surburban/rural area	*67*	*15.1%*	*62366*	*57.7%*	*-42.6%*
Dark - no street lights	**21**	**31.3%**	**11736**	**18.8%**	**12.5%**
Dark - street lights	29	43.3%	44515	71.4%	-28.1%
Inclement surface	150	7.5%	76083	24.8%	-17.3%
Wet	***138***	***92.0%***	***50654***	***66.6%***	***25.4%***
Sand/mud etc.	***2***	***1.3%***	***718***	***0.9%***	***0.4%***
Snow covered	*3*	*2.0%*	*11057*	*14.5%*	*-12.5%*
Slush	*3*	*2.0%*	*4308*	*5.7%*	*-3.7%*
Others	*4*	*2.7%*	*9346*	*12.3%*	*-9.6%*
Intersection	**1343**	**67.3%**	**122066**	**39.8%**	**27.6%**
Signalized intersection	*502*	*37.4%*	*48343*	*39.6%*	*-2.2%*
Stop-controlled intersection	***543***	***40.4%***	***38733***	***31.7%***	***8.7%***
Others	*298*	*22.2%*	*34990*	*28.7%*	*-6.5%*
Rear-end crashes	*23*	*1.7%*	*27209*	*22.3%*	*-20.6%*
Head-on crashes	*37*	*2.8%*	*5189*	*4.3%*	*-1.5%*
Angle crashes	***1167***	***86.9%***	***68234***	***55.9%***	***31.0%***
Sideswipe (same direction)	*40*	*3.0%*	*2873*	*2.4%*	*0.6%*
D1 Distracted	*44*	*3.3%*	*10048*	*8.2%*	*-5.0%*
D5 Improper of careless turn	*64*	*4.8%*	*21061*	*17.3%*	*-12.5%*
Non day-light	12	18.8%	6572	31.2%	-12.5%
Dark - no street lights	1	1.6%	929	4.4%	-2.8%
Dark - street lights	7	10.9%	4837	23.0%	-12.0%
D7 Proceeding w/o clearance	*57*	*4.2%*	*19478*	*16.0%*	*-11.7%*
Non day-light	12	21.1%	3658	18.8%	2.3%
Dark - no street lights	0	0.0%	896	4.6%	-4.6%
Dark - street lights	**11**	**19.3%**	**2106**	**10.8%**	**8.5%**

Category	# Bicyclist Crashes, Bicyclist at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
D8 Running stop sign	***217***	***16.2%***	***7335***	***6.0%***	***10.1%***
D9 Running red light	***173***	***12.9%***	***12746***	***10.4%***	***2.4%***
D16 Driving the wrong way on 1-way street	***72***	***5.4%***	***297***	***0.2%***	***5.1%***
D18 Driving on the wrong side of roadway	***100***	***7.4%***	***714***	***0.6%***	***6.9%***
D19 Making improper entrance to highway	***83***	***6.2%***	***1432***	***1.2%***	***5.0%***
Intersection + non day-light	**321**	**16.1%**	**36261**	**11.8%**	**4.3%**
Dark - no street lights	*23*	*7.2%*	*7557*	*20.8%*	*-13.7%*
Dark - street lights	***251***	***78.2%***	***24492***	***67.5%***	***10.6%***
Collision type					
Angle	**1568**	**78.6%**	**92011**	**30.0%**	**48.6%**
Intersection	*1167*	*74.4%*	*68234*	*74.2%*	*0.3%*
Signalized intersection	439	37.6%	28677	42.0%	-4.4%
Stop-controlled intersection	489	41.9%	29642	43.4%	-1.5%
Others	**239**	**20.5%**	**9915**	**14.5%**	**5.9%**
Non day-light	283	24.3%	17761	26.0%	-1.8%
Dark - no street lights	20	1.7%	2699	4.0%	-2.2%
Dark - street lights	224	19.2%	12765	18.7%	0.5%
Mid block	*401*	*25.6%*	*23777*	*25.8%*	*-0.3%*
Signalized	18	4.5%	1528	6.4%	-1.9%
Stop-controlled	22	5.5%	1572	6.6%	-1.1%
Others	**361**	**90.0%**	**20677**	**87.0%**	**3.1%**
Non day-light	61	15.2%	6442	27.1%	-11.9%
Dark - no street lights	12	3.0%	1968	8.3%	-5.3%
Dark - street lights	37	9.2%	3614	15.2%	-6.0%
Sideswipe (same direction)	**146**	**7.3%**	**15178**	**4.9%**	**2.4%**
Intersection	***40***	***27.4%***	***2873***	***18.9%***	***8.5%***
Non day-light	6	15.0%	770	26.8%	-11.8%
Dark - no street lights	0	0.0%	117	4.1%	-4.1%
Dark - street lights	4	10.0%	574	20.0%	-10.0%
Mid block	*106*	*72.6%*	*12305*	*81.1%*	*-8.5%*
Non day-light	23	21.7%	5525	44.9%	-23.2%
Dark - no street lights	4	3.8%	1133	9.2%	-5.4%
Dark - street lights	14	13.2%	3926	31.9%	-18.7%
D5 Improper or careless turn	***18***	***12.3%***	***635***	***4.2%***	***8.1%***
D14 Careless passing or lane change	*36*	*24.7%*	*4174*	*27.5%*	*-2.8%*

Table 11. Crash Characteristics for Crashes Involving Bicyclists in which Bicyclists are not at-fault.

Category	# Bicyclist Crashes, Bicyclist not at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Total	**1361**	-	**307027**	-	-
State road	728	53.5%	227029	73.9%	-20.5%
Local road	**1006**	**73.9%**	**140260**	**45.7%**	**28.2%**
Urban area	**1050**	**77.1%**	**125803**	**41.0%**	**36.2%**
Curved road	77	5.7%	57635	18.8%	-13.1%
Inclement weather	90	6.6%	56665	18.5%	-11.8%
Rain	***63***	***70.0%***	***34665***	***61.2%***	***8.8%***
Sleet	*0*	*0.0%*	*1170*	*2.1%*	*-2.1%*
Snow	*6*	*6.7%*	*15775*	*27.8%*	*-21.2%*
Fog	*2*	*2.2%*	*1546*	*2.7%*	*-0.5%*
Others	***19***	***21.1%***	***3509***	***6.2%***	***14.9%***
Non day-light	354	26.0%	108012	35.2%	-9.2%
Urban area	***278***	***78.5%***	***45646***	***42.3%***	***36.3%***
Dark - no street lights	23	8.3%	30540	66.9%	-58.6%
Dark - street lights	**203**	**73.0%**	**9402**	**20.6%**	**52.4%**
Surburban/rural area	*76*	*21.5%*	*62366*	*57.7%*	*-36.3%*
Dark - no street lights	**28**	**36.8%**	**11736**	**18.8%**	**18.0%**
Dark - street lights	27	35.5%	44515	71.4%	-35.9%
Inclement surface	97	7.1%	76083	24.8%	-17.7%
Wet	***86***	***88.7%***	***50654***	***66.6%***	***22.1%***
Sand/mud etc.	*0*	*0.0%*	*718*	*0.9%*	*-0.9%*
Snow covered	*0*	*0.0%*	*11057*	*14.5%*	*-14.5%*
Slush	*1*	*1.0%*	*4308*	*5.7%*	*-4.6%*
Others	*10*	*10.3%*	*9346*	*12.3%*	*-2.0%*
Intersection	**821**	**60.3%**	**122066**	**39.8%**	**20.6%**
Signalized intersection	*332*	*40.4%*	*48343*	*39.6%*	*0.8%*
Stop-controlled intersection	***303***	***36.9%***	***38733***	***31.7%***	***5.2%***
Others	*186*	*22.7%*	*34990*	*28.7%*	*-6.0%*
Rear-end crashes	*37*	*4.5%*	*27209*	*22.3%*	*-17.8%*
Head-on crashes	*26*	*3.2%*	*5189*	*4.3%*	*-1.1%*
Angle crashes	***628***	***76.5%***	***68234***	***55.9%***	***20.6%***
Sideswipe (same direction)	***51***	***6.2%***	***2873***	***2.4%***	***3.9%***
D1 Distracted	*40*	*4.9%*	*10048*	*8.2%*	*-3.4%*
D5 Improper of careless turn	***275***	***33.5%***	***21061***	***17.3%***	***16.2%***
Non day-light	61	22.2%	6572	31.2%	-9.0%
Dark - no street lights	1	0.4%	929	4.4%	-4.0%
Dark - street lights	47	17.1%	4837	23.0%	-5.9%
D7 Proceeding w/o clearance	***151***	***18.4%***	***19478***	***16.0%***	***2.4%***
Non day-light	20	13.2%	3658	18.8%	-5.5%
Dark - no street lights	4	2.6%	896	4.6%	-2.0%
Dark - street lights	13	8.6%	2106	10.8%	-2.2%

Category	# Bicyclist Crashes, Bicyclist not at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
D8 Running stop sign	*46*	*5.6%*	*7335*	*6.0%*	*-0.4%*
D9 Running red light	*42*	*5.1%*	*12746*	*10.4%*	*-5.3%*
D16 Driving the wrong way on 1-way street	*7*	*0.9%*	*297*	*0.2%*	*0.6%*
D18 Driving on the wrong side of roadway	*5*	*0.6%*	*714*	*0.6%*	*0.0%*
D19 Making improper entrance to highway	*3*	*0.4%*	*1432*	*1.2%*	*-0.8%*
Intersection + non day-light	**201**	**14.8%**	**36261**	**11.8%**	**3.0%**
Dark - no street lights	*15*	*7.5%*	*7557*	*20.8%*	*-13.4%*
Dark - street lights	***148***	***73.6%***	***24492***	***67.5%***	***6.1%***
Collision type					
Angle	**780**	**57.3%**	**92011**	**30.0%**	**27.3%**
Intersection	***628***	***80.5%***	***68234***	***74.2%***	***6.4%***
Signalized intersection	256	40.8%	28677	42.0%	-1.3%
Stop-controlled intersection	253	40.3%	29642	43.4%	-3.2%
Others	**119**	**18.9%**	**9915**	**14.5%**	**4.4%**
Non day-light	144	22.9%	17761	26.0%	-3.1%
Dark - no street lights	**107**	**17.0%**	**2699**	**4.0%**	**13.1%**
Dark - street lights	20	3.2%	12765	18.7%	-15.5%
Mid block	*152*	*19.5%*	*23777*	*25.8%*	*-6.4%*
Signalized	10	6.6%	1528	6.4%	0.2%
Stop-controlled	7	4.6%	1572	6.6%	-2.0%
Others	135	88.8%	20677	87.0%	1.9%
Non day-light	26	17.1%	6442	27.1%	-10.0%
Dark - no street lights	4	2.6%	1968	8.3%	-5.6%
Dark - street lights	16	10.5%	3614	15.2%	-4.7%
Sideswipe (same direction)	**263**	**19.3%**	**15178**	**4.9%**	**14.4%**
Intersection	*51*	*19.4%*	*2873*	*18.9%*	*0.5%*
Non day-light	13	25.5%	770	26.8%	-1.3%
Dark - no street lights	1	2.0%	117	4.1%	-2.1%
Dark - street lights	6	11.8%	574	20.0%	-8.2%
Mid block	*212*	*80.6%*	*12305*	*81.1%*	*-0.5%*
Non day-light	59	27.8%	5525	44.9%	-17.1%
Dark - no street lights	13	6.1%	1133	9.2%	-3.1%
Dark - street lights	30	14.2%	3926	31.9%	-17.8%
D5 Improper or careless turn	*8*	*3.0%*	*635*	*4.2%*	*-1.1%*
D14 Careless passing or lane change	*44*	*16.7%*	*4174*	*27.5%*	*-10.8%*

APPENDIX D

Table 12. Crash Characteristics for Single-Vehicle Motorcycle Crashes.

Category	# Single-Vehicle Motorcycle Crashes	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Total	**3316**	**-**	**307027**	**-**	**-**
Interstate	188	5.7%	24333	7.9%	-2.3%
State road	2419	72.9%	227029	73.9%	-1.0%
Local road	**1225**	**36.9%**	**140260**	**45.7%**	**-8.8%**
Curved road	**1773**	**53.5%**	**57635**	**18.8%**	**34.7%**
Non collision	***814***	***45.9%***	***2565***	***4.5%***	***41.5%***
Sideswipe - same	*-*	*-*	*1276*	*2.2%*	*-*
Sideswipe - opposite	*-*	*-*	*1937*	*3.4%*	*-*
Hit fixed objective	*939*	*53.0%*	*55971*	*97.1%*	*-44.2%*
D1 Distracted	*47*	*2.7%*	*3364*	*5.8%*	*-3.2%*
D5 Improper of careless turn	*35*	*2.0%*	*1858*	*3.2%*	*-1.2%*
D12 Sudden slowing or stopping	*16*	*0.9%*	*234*	*0.4%*	*0.5%*
D14 Careless passing or lane change	*14*	*0.8%*	*1025*	*1.8%*	*-1.0%*
D18 Driving on the wrong side of roadway	*4*	*0.2%*	*1241*	*2.2%*	*-1.9%*
D22 Over or under compensation at curve	***457***	***25.8%***	***6493***	***11.3%***	***14.5%***
D23 Speeding	***106***	***6.0%***	***2174***	***3.8%***	***2.2%***
D24 Driving too fast for conditions	*548*	*30.9%*	*22951*	*39.8%*	*-8.9%*
D27 Driver inexperienced	***137***	***7.7%***	***617***	***1.1%***	***6.7%***
D92 Affected by physical conditions	*147*	*8.3%*	*6719*	*11.7%*	*-3.4%*
Inclement weather	133	4.0%	56665	18.5%	-14.4%
Rain	***105***	***78.9%***	***34665***	***61.2%***	***17.8%***
Sleet	*0*	*0.0%*	*1170*	*2.1%*	*-2.1%*
Snow	*0*	*0.0%*	*15775*	*27.8%*	*-27.8%*
Fog	*8*	*6.0%*	*1546*	*2.7%*	*3.3%*
Others	*20*	*15.0%*	*3509*	*6.2%*	*8.8%*
Non day-light	1003	30.2%	108012	35.2%	-4.9%
Inclement surface	237	7.1%	76083	24.8%	-17.6%
Wet	*162*	*68.4%*	*50654*	*66.6%*	*1.8%*
Sand/mud etc.	***50***	***21.1%***	***718***	***0.9%***	***20.2%***
Snow covered	*0*	*0.0%*	*11057*	*14.5%*	*-14.5%*
Slush	*0*	*0.0%*	*4308*	*5.7%*	*-5.7%*
Others	*25*	*10.5%*	*9346*	*12.3%*	*-1.7%*
Intersection	760	22.9%	122066	39.8%	-16.8%
Signalized intersection	*155*	*20.4%*	*48343*	*39.6%*	*-19.2%*
Stop-controlled intersection	*166*	*21.8%*	*38733*	*31.7%*	*-9.9%*
Others	***439***	***57.8%***	***34990***	***28.7%***	***29.1%***
Rear-end crashes	*-*	*-*	*27209*	*22.3%*	*-*
Angle crashes	*-*	*-*	*68234*	*55.9%*	*-*
D1 Distracted	*23*	*3.0%*	*10048*	*8.2%*	*-5.2%*
D5 Improper of careless turn	*60*	*7.9%*	*21061*	*17.3%*	*-9.4%*
D7 Proceeding w/o clearance	*0*	*0.0%*	*19478*	*16.0%*	*-16.0%*

Category	# Single-Vehicle Motorcycle Crashes	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
D9 Running red light	*1*	*0.1%*	*12746*	*10.4%*	*-10.3%*
D12 Sudden slowing or stopping	***36***	***4.7%***	***1246***	***1.0%***	***3.7%***
D14 Careless passing or lane change	*17*	*2.2%*	*2217*	*1.8%*	*0.4%*
D22 Over or under compensation at curve	***72***	***9.5%***	***898***	***0.7%***	***8.7%***
D23 Speeding	***33***	***4.3%***	***1340***	***1.1%***	***3.2%***
D24 Driving too fast for conditions	***150***	***19.7%***	***11035***	***9.0%***	***10.7%***
D27 Driver inexperienced	***119***	***15.7%***	***829***	***0.7%***	***15.0%***
Curve + non day-light	**556**	**16.8%**	**25591**	**8.3%**	**8.4%**
Dark - no street lights	*326*	*58.6%*	*15281*	*59.7%*	*-1.1%*
Dark - street lights	*157*	*28.2%*	*7682*	*30.0%*	*-1.8%*
Curve + (speeding or driving too fast)	**654**	**19.7%**	**25125**	**8.2%**	**11.5%**
Intersection + non day-light	218	6.6%	36261	11.8%	-5.2%
Dark - no street lights	***73***	***33.5%***	***7557***	***20.8%***	***12.6%***
Dark - street lights	*125*	*57.3%*	*24492*	*67.5%*	*-10.2%*
Location type					
Ramp	148	4.5%	9830	3.2%	1.3%
Bridge	34	1.0%	3957	1.3%	-0.3%
Driveway or parking lot	46	1.4%	15347	5.0%	-3.6%
Collision type					
Non collision	**1817**	**54.8%**	**5463**	**1.8%**	**53.0%**
D23 Speeding	*68*	*3.7%*	*196*	*3.6%*	*0.2%*
D24 Driving too fast for conditions	*437*	*24.1%*	*2308*	*42.2%*	*-18.2%*
Curve	*814*	*44.8%*	*2565*	*47.0%*	*-2.2%*
Non day-light	*468*	*25.8%*	*2389*	*43.7%*	*-18.0%*
Rear-end	0	0.0%	79532	25.9%	-25.9%
Intersection	-	-	*27209*	*34.2%*	-
Signalized intersection	-	-	12644	46.5%	-
Stop-controlled intersection	-	-	3082	11.3%	-
Others	-	-	11483	42.2%	-
Non day-light	-	-	*19981*	*25.1%*	-
Head-on	0	0.0%	11715	3.8%	-3.8%
Angle	0	0.0%	92011	30.0%	-30.0%
Intersection	-	-	*68234*	*74.2%*	-
Signalized intersection	-	-	28677	42.0%	-
Stop-controlled intersection	-	-	29642	43.4%	-
Others	-	-	9915	14.5%	-
Non day-light	-	-	*24203*	*26.3%*	-
Sideswipe (same dir.)	0	0.0%	15178	4.9%	-4.9%
Sideswipe (Opposite dir.)	0	0.0%	6672	2.2%	-2.2%
Hit fixed object	**1435**	**43.3%**	**94845**	**30.9%**	**12.4%**
D23 Speeding	***103***	***7.2%***	***3246***	***3.4%***	***3.8%***
D24 Driving too fast for conditions	*367*	*25.6%*	*33486*	*35.3%*	*-9.7%*

Category	# Single-Vehicle Motorcycle Crashes	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Curve	***939***	***65.4%***	***38874***	***41.0%***	***24.4%***
Non day-light	*507*	*35.3%*	*47691*	*50.3%*	*-15.0%*
Drinking driver	**593**	**17.9%**	**29058**	**9.5%**	**8.4%**
Fatal	***98***	***16.5%***	***624***	***2.1%***	***14.4%***
Major injury	***141***	***23.8%***	***1372***	***4.7%***	***19.1%***

Table 13. Crash Characteristics for Multi-Vehicle Crashes Involving Motorcycles in which Motorcycles are at-fault.

Category	# Multi-Vehicle Motorcycle Crashes, Motorcycles at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Total	**2233**	**-**	**307027**	**-**	**-**
Interstate	121	5.4%	24333	7.9%	-2.5%
State road	1656	74.2%	227029	73.9%	0.2%
Local road	**1087**	**48.7%**	**140260**	**45.7%**	**3.0%**
Curved road	365	16.3%	57635	18.8%	-2.4%
Non collision	***43***	***11.8%***	***2565***	***4.5%***	***7.3%***
Sideswipe - same	***27***	***7.4%***	***1276***	***2.2%***	***5.2%***
Sideswipe - opposite	***62***	***17.0%***	***1937***	***3.4%***	***13.6%***
Hit fixed objective	*16*	*4.4%*	*55971*	*97.1%*	*-92.7%*
D1 Distracted	*12*	*3.3%*	*3364*	*5.8%*	*-2.5%*
D5 Improper of careless turn	*14*	*3.8%*	*1858*	*3.2%*	*0.6%*
D12 Sudden slowing or stopping	*7*	*1.9%*	*234*	*0.4%*	*1.5%*
D14 Careless passing or lane change	*19*	*5.2%*	*1025*	*1.8%*	*3.4%*
D18 Driving on the wrong side of roadway	***31***	***8.5%***	***1241***	***2.2%***	***6.3%***
D22 Over or under compensation at curve	***72***	***19.7%***	***6493***	***11.3%***	***8.5%***
D23 Speeding	***31***	***8.5%***	***2174***	***3.8%***	***4.7%***
D24 Driving too fast for conditions	*79*	*21.6%*	*22951*	*39.8%*	*-18.2%*
D27 Driver inexperienced	*16*	*4.4%*	*617*	*1.1%*	*3.3%*
D92 Affected by physical conditions	*13*	*3.6%*	*6719*	*11.7%*	*-8.1%*
Inclement weather	59	2.6%	56665	18.5%	-15.8%
Rain	***49***	***83.1%***	***34665***	***61.2%***	***21.9%***
Sleet	*0*	*0.0%*	*1170*	*2.1%*	*-2.1%*
Snow	*1*	*1.7%*	*15775*	*27.8%*	*-26.1%*
Fog	*4*	*6.8%*	*1546*	*2.7%*	*4.1%*
Others	*5*	*8.5%*	*3509*	*6.2%*	*2.3%*
Non day-light	487	21.8%	108012	35.2%	-13.4%
Inclement surface	85	3.8%	76083	24.8%	-21.0%
Wet	***79***	***92.9%***	***50654***	***66.6%***	***26.4%***
Sand/mud etc.	*3*	*3.5%*	*718*	*0.9%*	*2.6%*
Snow covered	*0*	*0.0%*	*11057*	*14.5%*	*-14.5%*
Slush	*0*	*0.0%*	*4308*	*5.7%*	*-5.7%*
Others	*3*	*3.5%*	*9346*	*12.3%*	*-8.8%*
Intersection	**955**	**42.8%**	**122066**	**39.8%**	**3.0%**
Signalized intersection	***287***	***30.1%***	***48343***	***39.6%***	***-9.6%***
Stop-controlled intersection	*278*	*29.1%*	*38733*	*31.7%*	*-2.6%*
Others	***390***	***40.8%***	***34990***	***28.7%***	***12.2%***
Rear-end crashes	*225*	*23.6%*	*27209*	*22.3%*	*1.3%*
Angle crashes	*529*	*55.4%*	*68234*	*55.9%*	*-0.5%*

Category	# Multi-Vehicle Motorcycle Crashes, Motorcycles at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
D1 Distracted	*61*	*6.4%*	*10048*	*8.2%*	*-1.8%*
D5 Improper of careless turn	*69*	*7.2%*	*21061*	*17.3%*	*-10.0%*
D7 Proceeding w/o clearance	*43*	*4.5%*	*19478*	*16.0%*	*-11.5%*
D9 Running red light	*70*	*7.3%*	*12746*	*10.4%*	*-3.1%*
D12 Sudden slowing or stopping	*18*	*1.9%*	*1246*	*1.0%*	*0.9%*
D14 Careless passing or lane change	***107***	***11.2%***	***2217***	***1.8%***	***9.4%***
D22 Over or under compensation at curve	*11*	*1.2%*	*898*	*0.7%*	*0.4%*
D23 Speeding	***81***	***8.5%***	***1340***	***1.1%***	***7.4%***
D24 Driving too fast for conditions	*93*	*9.7%*	*11035*	*9.0%*	*0.7%*
D27 Driver inexperienced	***35***	***3.7%***	***829***	***0.7%***	***3.0%***
Curve + non day-light	81	3.6%	25591	8.3%	-4.7%
Dark - no street lights	*43*	*53.1%*	*15281*	*59.7%*	*-6.6%*
Dark - street lights	*27*	*33.3%*	*7682*	*30.0%*	*3.3%*
Curve + (speeding or driving too fast)	110	4.9%	25125	8.2%	-3.3%
Intersection + non day-light	204	9.1%	36261	11.8%	-2.7%
Dark - no street lights	*32*	*15.7%*	*7557*	*20.8%*	*-5.2%*
Dark - street lights	*146*	*71.6%*	*24492*	*67.5%*	*4.0%*
Location type					
Ramp	51	2.3%	9830	3.2%	-0.9%
Bridge	25	1.1%	3957	1.3%	-0.2%
Driveway or parking lot	**208**	**9.3%**	**15347**	**5.0%**	**4.3%**
Collision type					
Non collision	**143**	**6.4%**	**5463**	**1.8%**	**4.6%**
D23 Speeding	***9***	***6.3%***	***196***	***3.6%***	***2.7%***
D24 Driving too fast for conditions	*34*	*23.8%*	*2308*	*42.2%*	*-18.5%*
Curve	*43*	*30.1%*	*2565*	*47.0%*	*-16.9%*
Non day-light	*27*	*18.9%*	*2389*	*43.7%*	*-24.8%*
Rear-end	**726**	**32.5%**	**79532**	**25.9%**	**6.6%**
Intersection	*225*	*31.0%*	*27209*	*34.2%*	*-3.2%*
Signalized intersection	54	7.4%	12644	46.5%	-39.0%
Stop-controlled intersection	34	4.7%	3082	11.3%	-6.6%
Others	137	18.9%	11483	42.2%	-23.3%
Non day-light	*122*	*16.8%*	*19981*	*25.1%*	*-8.3%*
Head-on	**145**	**6.5%**	**11715**	**3.8%**	**2.7%**
Angle	**835**	**37.4%**	**92011**	**30.0%**	**7.4%**
Intersection	*529*	*63.4%*	*68234*	*74.2%*	*-10.8%*
Signalized intersection	182	34.4%	28677	42.0%	-7.6%
Stop-controlled intersection	195	36.9%	29642	43.4%	-6.6%
Others	**152**	**28.7%**	**9915**	**14.5%**	**14.2%**
Non day-light	*172*	*20.6%*	*24203*	*26.3%*	*-5.7%*
Sideswipe (same dir.)	**206**	**9.2%**	**15178**	**4.9%**	**4.3%**

Category	# Multi-Vehicle Motorcycle Crashes, Motorcycles at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Sideswipe (Opposite dir.)	**97**	**4.3%**	**6672**	**2.2%**	**2.2%**
Hit fixed object	46	2.1%	94845	30.9%	-28.8%
D23 Speeding	***4***	***8.7%***	***3246***	***3.4%***	***5.3%***
D24 Driving too fast for conditions	*9*	*19.6%*	*33486*	*35.3%*	*-15.7%*
Curve	*16*	*34.8%*	*38874*	*41.0%*	*-6.2%*
Non day-light	*14*	*30.4%*	*47691*	*50.3%*	*-19.8%*
Drinking driver	187	8.4%	29058	9.5%	-1.1%
Fatal	***32***	***17.1%***	***624***	***2.1%***	***15.0%***
Major injury	***55***	***29.4%***	***1372***	***4.7%***	***24.7%***

Table 14. Crash Characteristics for Multi-Vehicle Crashes Involving Motorcycles in which Motorcycles are not at-fault.

Category	# Multi-Vehicle Motorcycle Crashes, Motorcycles not at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Total	**3008**	**-**	**307027**	**-**	**-**
Interstate	67	2.2%	24333	7.9%	-5.7%
State road	**2399**	**79.8%**	**227029**	**73.9%**	**5.8%**
Local road	**1621**	**53.9%**	**140260**	**45.7%**	**8.2%**
Curved road	243	8.1%	57635	18.8%	-10.7%
Non collision	***25***	***10.3%***	***2565***	***4.5%***	***5.8%***
Sideswipe - same	***13***	***5.3%***	***1276***	***2.2%***	***3.1%***
Sideswipe - opposite	***18***	***7.4%***	***1937***	***3.4%***	***4.0%***
Hit fixed objective	*8*	*3.3%*	*55971*	*97.1%*	*-93.8%*
D1 Distracted	*9*	*3.7%*	*3364*	*5.8%*	*-2.1%*
D5 Improper of careless turn	***59***	***24.3%***	***1858***	***3.2%***	***21.1%***
D12 Sudden slowing or stopping	*3*	*1.2%*	*234*	*0.4%*	*0.8%*
D14 Careless passing or lane change	*10*	*4.1%*	*1025*	*1.8%*	*2.3%*
D18 Driving on the wrong side of roadway	***29***	***11.9%***	***1241***	***2.2%***	***9.8%***
D22 Over or under compensation at curve	*9*	*3.7%*	*6493*	*11.3%*	*-7.6%*
D23 Speeding	*1*	*0.4%*	*2174*	*3.8%*	*-3.4%*
D24 Driving too fast for conditions	*4*	*1.6%*	*22951*	*39.8%*	*-38.2%*
D27 Driver inexperienced	*0*	*0.0%*	*617*	*1.1%*	*-1.1%*
D92 Affected by physical conditions	*8*	*3.3%*	*6719*	*11.7%*	*-8.4%*
Inclement weather	75	2.5%	56665	18.5%	-16.0%
Rain	***59***	***78.7%***	***34665***	***61.2%***	***17.5%***
Sleet	*0*	*0.0%*	*1170*	*2.1%*	*-2.1%*
Snow	*0*	*0.0%*	*15775*	*27.8%*	*-27.8%*
Fog	***9***	***12.0%***	***1546***	***2.7%***	***9.3%***
Others	*7*	*9.3%*	*3509*	*6.2%*	*3.1%*
Non day-light	658	21.9%	108012	35.2%	-13.3%
Inclement surface	97	3.2%	76083	24.8%	-21.6%
Wet	***89***	***91.8%***	***50654***	***66.6%***	***25.2%***
Sand/mud etc.	*5*	*5.2%*	*718*	*0.9%*	*4.2%*
Snow covered	*1*	*1.0%*	*11057*	*14.5%*	*-13.5%*
Slush	*1*	*1.0%*	*4308*	*5.7%*	*-4.6%*
Others	*1*	*1.0%*	*9346*	*12.3%*	*-11.3%*
Intersection	**1757**	**58.4%**	**122066**	**39.8%**	**18.7%**
Signalized intersection	*551*	*31.4%*	*48343*	*39.6%*	*-8.2%*
Stop-controlled intersection	***731***	***41.6%***	***38733***	***31.7%***	***9.9%***
Others	*475*	*27.0%*	*34990*	*28.7%*	*-1.6%*
Rear-end crashes	*194*	*11.0%*	*27209*	*22.3%*	*-11.2%*
Angle crashes	***1181***	***67.2%***	***68234***	***55.9%***	***11.3%***

Category	# Multi-Vehicle Motorcycle Crashes, Motorcycles not at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
D1 Distracted	*76*	*4.3%*	*10048*	*8.2%*	*-3.9%*
D5 Improper of careless turn	***618***	***35.2%***	***21061***	***17.3%***	***17.9%***
D7 Proceeding w/o clearance	***538***	***30.6%***	***19478***	***16.0%***	***14.7%***
D9 Running red light	*54*	*3.1%*	*12746*	*10.4%*	*-7.4%*
D12 Sudden slowing or stopping	*11*	*0.6%*	*1246*	*1.0%*	*-0.4%*
D14 Careless passing or lane change	***42***	***2.4%***	***2217***	***1.8%***	***0.6%***
D22 Over or under compensation at curve	*1*	*0.1%*	*898*	*0.7%*	*-0.7%*
D23 Speeding	*8*	*0.5%*	*1340*	*1.1%*	*-0.6%*
D24 Driving too fast for conditions	*20*	*1.1%*	*11035*	*9.0%*	*-7.9%*
D27 Driver inexperienced	*3*	*0.2%*	*829*	*0.7%*	*-0.5%*
Curve + non day-light	51	1.7%	25591	8.3%	-6.6%
Dark - no street lights	*12*	*23.5%*	*15281*	*59.7%*	*-36.2%*
Dark - street lights	***23***	***45.1%***	***7682***	***30.0%***	***15.1%***
Curve + (speeding or driving too fast)	5	0.2%	25125	8.2%	-8.0%
Intersection + non day-light	388	12.9%	36261	11.8%	1.1%
Dark - no street lights	*56*	*14.4%*	*7557*	*20.8%*	*-6.4%*
Dark - street lights	*264*	*68.0%*	*24492*	*67.5%*	*0.5%*
Location type					
Ramp	77	2.6%	9830	3.2%	-0.6%
Bridge	19	0.6%	3957	1.3%	-0.7%
Driveway or parking lot	**397**	**13.2%**	**15347**	**5.0%**	**8.2%**
Collision type					
Non collision	**270**	**9.0%**	**5463**	**1.8%**	**7.2%**
D23 Speeding	*0*	*0.0%*	*196*	*3.6%*	*-3.6%*
D24 Driving too fast for conditions	*0*	*0.0%*	*2308*	*42.2%*	*-42.2%*
Curve	*25*	*9.3%*	*2565*	*47.0%*	*-37.7%*
Non day-light	*39*	*14.4%*	*2389*	*43.7%*	*-29.3%*
Rear-end	472	15.7%	79532	25.9%	-10.2%
Intersection	***194***	***41.1%***	***27209***	***34.2%***	***6.9%***
Signalized intersection	94	48.5%	12644	46.5%	2.0%
Stop-controlled intersection	**34**	**17.5%**	**3082**	**11.3%**	**6.2%**
Others	66	34.0%	11483	42.2%	-8.2%
Non day-light	*122*	*25.8%*	*19981*	*25.1%*	*0.7%*
Head-on	**211**	**7.0%**	**11715**	**3.8%**	**3.2%**
Angle	**1763**	**58.6%**	**92011**	**30.0%**	**28.6%**
Intersection	*1181*	*67.0%*	*68234*	*74.2%*	*-7.2%*
Signalized intersection	341	28.9%	28677	42.0%	-13.2%
Stop-controlled intersection	**552**	**46.7%**	**29642**	**43.4%**	**3.3%**
Others	**288**	**24.4%**	**9915**	**14.5%**	**9.9%**
Non day-light	*371*	*21.0%*	*24203*	*26.3%*	*-5.3%*
Sideswipe (same dir.)	151	5.0%	15178	4.9%	0.1%

Category	# Multi-Vehicle Motorcycle Crashes, Motorcycles not at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Sideswipe (Opposite dir.)	77	2.6%	6672	2.2%	0.4%
Hit fixed object	37	1.2%	94845	30.9%	-29.7%
D23 Speeding	*0*	*0.0%*	*3246*	*3.4%*	*-3.4%*
D24 Driving too fast for conditions	*3*	*8.1%*	*33486*	*35.3%*	*-27.2%*
Curve	*8*	*21.6%*	*38874*	*41.0%*	*-19.4%*
Non day-light	*11*	*29.7%*	*47691*	*50.3%*	*-20.6%*
Drinking driver	149	5.0%	29058	9.5%	-4.5%
Fatal	***25***	***16.8%***	***624***	***2.1%***	***14.6%***
Major injury	***45***	***30.2%***	***1372***	***4.7%***	***25.5%***

APPENDIX E

Table 15. Crash Characteristics for Crashes Involving Horse-Driven Buggies in which Buggies are at-fault.

Category	# Horse and Buggy Crashes, H&B at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Total	**50**	**-**	**307027**	**-**	**-**
State road	39	78.0%	227029	73.9%	4.1%
Local road	**33**	**66.0%**	**140260**	**45.7%**	**20.3%**
Urban area	3	6.0%	125803	41.0%	-35.0%
Curved road	1	2.0%	57635	18.8%	-16.8%
Inclement weather	6	12.0%	56665	18.5%	-6.5%
Rain	*4*	*66.7%*	*34665*	*61.2%*	*5.5%*
Sleet	*0*	*0.0%*	*1170*	*2.1%*	*-2.1%*
Snow	*1*	*16.7%*	*15775*	*27.8%*	*-11.2%*
Fog	*1*	*16.7%*	*1546*	*2.7%*	*13.9%*
Others	*0*	*0.0%*	*3509*	*6.2%*	*-6.2%*
Non day-light	18	36.0%	108012	35.2%	0.8%
Dark - no street lights	***13***	***72.2%***	***42276***	***39.1%***	***33.1%***
Dark - street lights	*3*	*16.7%*	*53917*	*49.9%*	*-33.3%*
Inclement surface	7	14.0%	76083	24.8%	-10.8%
Wet	*5*	*71.4%*	*50654*	*66.6%*	*4.9%*
Sand/mud etc.	*0*	*0.0%*	*718*	*0.9%*	*-0.9%*
Snow covered	*1*	*14.3%*	*11057*	*14.5%*	*-0.2%*
Slush	*0*	*0.0%*	*4308*	*5.7%*	*-5.7%*
Others	*1*	*14.3%*	*9346*	*12.3%*	*2.0%*
Intersection	25	50.0%	122066	39.8%	10.2%
Signalized intersection	*4*	*16.0%*	*48343*	*39.6%*	*-23.6%*
Stop-controlled intersection	***14***	***56.0%***	***38733***	***31.7%***	***24.3%***
Others	*7*	*28.0%*	*34990*	*28.7%*	*-0.7%*
Rear-end crashes	*3*	*12.0%*	*27209*	*22.3%*	*-10.3%*
Angle crashes	***20***	***80.0%***	***68234***	***55.9%***	***24.1%***
D5 Improper of careless turn	*7*	*28.0%*	*21061*	*17.3%*	*10.7%*
Non day-light	4	57.1%	6572	31.2%	25.9%
Dark - no street lights	3	42.9%	929	4.4%	38.4%
Dark - street lights	0	0.0%	4837	23.0%	-23.0%
D7 Proceeding w/o clearance	*8*	*32.0%*	*19478*	*16.0%*	*16.0%*
Non day-light	4	50.0%	3658	18.8%	31.2%
Dark - no street lights	3	37.5%	896	4.6%	32.9%
Dark - street lights	1	12.5%	2106	10.8%	1.7%
D8 Running stop sign	*5*	*20.0%*	*7335*	*6.0%*	*14.0%*
D14 Careless passing or lane change	*0*	*0.0%*	*2217*	*1.8%*	*-1.8%*
D24 Driving too fast	*0*	*0.0%*	*11035*	*9.0%*	*-9.0%*
Mid block	25	50.0%	184961	60.2%	-10.2%
Rear-end crashes	*2*	*8.0%*	*52323*	*28.3%*	*-20.3%*
Head-on	*2*	*8.0%*	*6526*	*3.5%*	*4.5%*

Category	# Horse and Buggy Crashes, H&B at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Angle	*16*	*64.0%*	*23777*	*12.9%*	*51.1%*
D1 Distracted	*1*	*4.0%*	*21781*	*11.8%*	*-7.8%*
D5 Improper of careless turn	*5*	*20.0%*	*7768*	*4.2%*	*15.8%*
Non day-light	1	20.0%	1890	24.3%	-4.3%
Dark - no street lights	0	0.0%	515	6.6%	-6.6%
Dark - street lights	0	0.0%	1087	14.0%	-14.0%
D7 Proceeding w/o clearance	*3*	*12.0%*	*2582*	*1.4%*	*10.6%*
Non day-light	1	20.0%	460	5.9%	14.1%
Dark - no street lights	1	20.0%	105	1.4%	18.6%
Dark - street lights	0	0.0%	269	3.5%	-3.5%
D11 Tailgating	*0*	*0.0%*	*9681*	*5.2%*	*-5.2%*
D14 Careless passing or lane change	*1*	*4.0%*	*8386*	*4.5%*	*-0.5%*
D19 Making improper entrance to highway	*6*	*24.0%*	*3197*	*1.7%*	*22.3%*
D24 Driving too fast	*0*	*0.0%*	*49300*	*26.7%*	*-26.7%*
Intersection + non day-light	10	20.0%	36261	11.8%	8.2%
Dark - no street lights	*6*	*60.0%*	*7557*	*20.8%*	*39.2%*
Dark - street lights	*3*	*30.0%*	*24492*	*67.5%*	*-37.5%*
Mid block + non day-light	8	16.0%	71751	23.4%	-7.4%
Dark - no street lights	*7*	*87.5%*	*34719*	*48.4%*	*39.1%*
Dark - street lights	*0*	*0.0%*	*29425*	*41.0%*	*-41.0%*
Collision type					
Rear-end	5	10.0%	79532	25.9%	-15.9%
Intersection	*3*	*60.0%*	*27209*	*34.2%*	*25.8%*
Mid block	*2*	*40.0%*	*52323*	*65.8%*	*-25.8%*
Non day-light	*3*	*60.0%*	*19981*	*25.1%*	*34.9%*
Dark - no street lights	*2*	*40.0%*	*5434*	*6.8%*	*33.2%*
Dark - street lights	*1*	*20.0%*	*11861*	*14.9%*	*5.1%*
Dusk	*0*	*0.0%*	*1414*	*1.8%*	*-1.8%*
Head-on	3	6.0%	11715	3.8%	2.2%
Angle	**36**	**72.0%**	**92011**	**30.0%**	**42.0%**
Non day-light	*14*	*38.9%*	*24203*	*26.3%*	*12.6%*
Dark - no street lights	*10*	*27.8%*	*4667*	*5.1%*	*22.7%*
Dark - street lights	*2*	*5.6%*	*16379*	*17.8%*	*-12.2%*
Sideswipe (same dir.)	2	4.0%	15178	4.9%	-0.9%
Sideswipe (Opposite dir.)	3	6.0%	6672	2.2%	3.8%
Hit fixed object	1	2.0%	94845	30.9%	-28.9%
Relation to road					
On roadway	**48**	**96.0%**	**195916**	**63.8%**	**32.2%**
Shoulder	0	0.0%	20652	6.7%	-6.7%
Roadside	1	2.0%	52801	17.2%	-15.2%
Outside trafficway	1	2.0%	24510	8.0%	-6.0%

Table 16. Crash Characteristics for Crashes Involving Horse-Driven Buggies in which Buggies are not at-fault.

Category	# Horse and Buggy Crashes, H&B not at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Total	**114**	-	**307027**	-	
State road	**103**	**90.4%**	**227029**	**73.9%**	**16.4%**
Local road	20	17.5%	140260	45.7%	-28.2%
Urban area	3	2.6%	125803	41.0%	-38.3%
Curved road	11	9.6%	57635	18.8%	-9.1%
Inclement weather	12	10.5%	56665	18.5%	-7.9%
Rain	*10*	*83.3%*	*34665*	*61.2%*	*22.2%*
Sleet	*0*	*0.0%*	*1170*	*2.1%*	*-2.1%*
Snow	*0*	*0.0%*	*15775*	*27.8%*	*-27.8%*
Fog	*1*	*8.3%*	*1546*	*2.7%*	*5.6%*
Others	*1*	*8.3%*	*3509*	*6.2%*	*2.1%*
Non day-light	31	27.2%	108012	35.2%	-8.0%
Dark - no street lights	*16*	*51.6%*	*42276*	*39.1%*	*12.5%*
Dark - street lights	*3*	*9.7%*	*53917*	*49.9%*	*-40.2%*
Inclement surface	15	13.2%	76083	24.8%	-11.6%
Wet	*14*	*93.3%*	*50654*	*66.6%*	*26.8%*
Sand/mud etc.	*0*	*0.0%*	*718*	*0.9%*	*-0.9%*
Snow covered	*1*	*6.7%*	*11057*	*14.5%*	*-7.9%*
Slush	*0*	*0.0%*	*4308*	*5.7%*	*-5.7%*
Others	*0*	*0.0%*	*9346*	*12.3%*	*-12.3%*
Intersection	10	8.8%	122066	39.8%	-31.0%
Signalized intersection	*0*	*0.0%*	*48343*	*39.6%*	*-39.6%*
Stop-controlled intersection	*1*	*10.0%*	*38733*	*31.7%*	*-21.7%*
Others	*9*	*90.0%*	*34990*	*28.7%*	*61.3%*
Rear-end crashes	*4*	*40.0%*	*27209*	*22.3%*	*17.7%*
Angle crashes	*4*	*40.0%*	*68234*	*55.9%*	*-15.9%*
D5 Improper of careless turn	*0*	*0.0%*	*21061*	*17.3%*	*-17.3%*
Non day-light	0	0.0%	6572	31.2%	-31.2%
Dark - no street lights	0	0.0%	929	4.4%	-4.4%
Dark - street lights	0	0.0%	4837	23.0%	-23.0%
D7 Proceeding w/o clearance	*1*	*10.0%*	*19478*	*16.0%*	*-6.0%*
Non day-light	0	0.0%	3658	18.8%	-18.8%
Dark - no street lights	0	0.0%	896	4.6%	-4.6%
Dark - street lights	0	0.0%	2106	10.8%	-10.8%
D8 Running stop sign	*0*	*0.0%*	*7335*	*6.0%*	*-6.0%*
D14 Careless passing or lane change	*2*	*20.0%*	*2217*	*1.8%*	*18.2%*
D24 Driving too fast	*3*	*30.0%*	*11035*	*9.0%*	*21.0%*
Mid block	**104**	**91.2%**	**184961**	**60.2%**	**31.0%**
Rear-end crashes	*71*	*68.3%*	*52323*	*28.3%*	*40.0%*
Head-on	*6*	*5.8%*	*6526*	*3.5%*	*2.2%*

Category	# Horse and Buggy Crashes, H&B not at-fault	% within each group	# Crashes not involving vulnerable road user	% within each group	% Difference
Angle	*10*	*9.6%*	*23777*	*12.9%*	*-3.2%*
D1 Distracted	*13*	*12.5%*	*21781*	*11.8%*	*0.7%*
D5 Improper of careless turn	*1*	*1.0%*	*7768*	*4.2%*	*-3.2%*
Non day-light	1	100.0%	1890	24.3%	75.7%
Dark - no street lights	0	0.0%	515	6.6%	-6.6%
Dark - street lights	1	100.0%	1087	14.0%	86.0%
D7 Proceeding w/o clearance	*0*	*0.0%*	*2582*	*1.4%*	*-1.4%*
Non day-light	0	0.0%	460	5.9%	-5.9%
Dark - no street lights	0	0.0%	105	1.4%	-1.4%
Dark - street lights	0	0.0%	269	3.5%	-3.5%
D11 Tailgating	*8*	*7.7%*	*9681*	*5.2%*	*2.5%*
D14 Careless passing or lane change	*16*	*15.4%*	*8386*	*4.5%*	*10.9%*
D19 Making improper entrance to highway	*0*	*0.0%*	*3197*	*1.7%*	*-1.7%*
D24 Driving too fast	*24*	*23.1%*	*49300*	*26.7%*	*-3.6%*
Intersection + non day-light	3	2.6%	36261	11.8%	-9.2%
Dark - no street lights	*1*	*33.3%*	*7557*	*20.8%*	*12.5%*
Dark - street lights	*0*	*0.0%*	*24492*	*67.5%*	*-67.5%*
Mid block + non day-light	28	24.6%	71751	23.4%	1.2%
Dark - no street lights	*15*	*53.6%*	*34719*	*48.4%*	*5.2%*
Dark - street lights	*3*	*10.7%*	*29425*	*41.0%*	*-30.3%*
Collision type					
Rear-end	**75**	**65.8%**	**79532**	**25.9%**	**39.9%**
Intersection	*4*	*5.3%*	*27209*	*34.2%*	*-28.9%*
Mid block	***71***	***94.7%***	***52323***	***65.8%***	***28.9%***
Non day-light	*21*	*28.0%*	*19981*	*25.1%*	*2.9%*
Dark - no street lights	*13*	*17.3%*	*5434*	*6.8%*	*10.5%*
Dark - street lights	*1*	*1.3%*	*11861*	*14.9%*	*-13.6%*
Dusk	*6*	*8.0%*	*1414*	*1.8%*	*6.2%*
Head-on	6	5.3%	11715	3.8%	1.4%
Angle	14	12.3%	92011	30.0%	-17.7%
Non day-light	*2*	*14.3%*	*24203*	*26.3%*	*-12.0%*
Dark - no street lights	*0*	*0.0%*	*4667*	*5.1%*	*-5.1%*
Dark - street lights	*0*	*0.0%*	*16379*	*17.8%*	*-17.8%*
Sideswipe (same dir.)	14	12.3%	15178	4.9%	7.3%
Sideswipe (Opposite dir.)	4	3.5%	6672	2.2%	1.3%
Hit fixed object	1	0.9%	94845	30.9%	-30.0%
Relation to road					
On roadway	**108**	**94.7%**	**195916**	**63.8%**	**30.9%**
Shoulder	3	2.6%	20652	6.7%	-4.1%
Roadside	3	2.6%	52801	17.2%	-14.6%
Outside trafficway	0	0.0%	24510	8.0%	-8.0%

APPENDIX F

Table 17. Crash Characteristics for Single-Vehicle Fatal or Serious Injury Crashes Involving Guiderails (Reference Group: Single-Vehicle Non-Fatal or Serious Injury Crashes Involving Guiderails)

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Non-fatal/Serious Injury crashes	% within each group	% Difference
Total	**541**	-	**13706**	-	-
Interstate	90	16.6%	3194	23.3%	-6.7%
Turnpike	25	4.6%	813	5.9%	-1.3%
State Road	**471**	**87.1%**	**11418**	**83.3%**	**3.8%**
Dark illumination	*217*	*46.1%*	*5015*	*43.9%*	*2.2%*
Wet road	*57*	*12.1%*	*2315*	*20.3%*	*-8.2%*
Snow slush road	*12*	*2.5%*	*1239*	*10.9%*	*-8.3%*
Icy road	*7*	*1.5%*	*650*	*5.7%*	*-4.2%*
Local road	73	13.5%	2170	15.8%	-2.3%
Rural	**389**	**71.9%**	**8246**	**60.2%**	**11.7%**
Dark illumination	*176*	*45.2%*	*3478*	*42.2%*	*3.1%*
Wet road	*52*	*13.4%*	*1649*	*20.0%*	*-6.6%*
Snow slush road	*14*	*3.6%*	*983*	*11.9%*	*-8.3%*
Icy road	*6*	*1.5%*	*500*	*6.1%*	*-4.5%*
Curved road	**298**	**55.1%**	**6233**	**45.5%**	**9.6%**
Dark illumination	*137*	*46.0%*	*2743*	*44.0%*	*2.0%*
Wet road	16	11.7%	595	21.7%	-10.0%
Snow slush road	2	1.5%	204	7.4%	-6.0%
Icy road	1	0.7%	170	6.2%	-5.5%
Wet road	*34*	*11.4%*	*1510*	*24.2%*	*-12.8%*
Snow slush road	*5*	*1.7%*	*634*	*10.2%*	*-8.5%*
Icy road	*2*	*0.7%*	*371*	*6.0%*	*-5.3%*
Rural	***225***	***75.5%***	***3802***	***61.0%***	***14.5%***
Inclement weather	68	12.6%	3986	29.1%	-16.5%
Rain	*40*	*58.8%*	*2085*	*52.3%*	*6.5%*
Sleet (hail)	*0*	*0.0%*	*143*	*3.6%*	*-3.6%*
Snow	*18*	*26.5%*	*1532*	*38.4%*	*-12.0%*
Fog	*7*	*10.3%*	*112*	*2.8%*	*7.5%*
Rain and fog	*2*	*2.9%*	*92*	*2.3%*	*0.6%*
Sleet and fog	*1*	*1.5%*	*22*	*0.6%*	*0.9%*
Dark illumination	270	49.9%	6578	48.0%	1.9%
Dark (no street lights)	*181*	*67.0%*	*4194*	*63.8%*	*3.3%*
Dark (street lights)	*61*	*22.6%*	*1720*	*26.1%*	*-3.6%*
Dusk	*13*	*4.8%*	*230*	*3.5%*	*1.3%*
Dawn	*9*	*3.3%*	*336*	*5.1%*	*-1.8%*
Dark – unknown roadway lighting	*6*	*2.2%*	*98*	*1.5%*	*0.7%*
Dark illumination	248	45.8%	6012	43.9%	2.0%
Wet road	69	12.8%	2912	21.2%	-8.5%

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Non-fatal/Serious Injury crashes	% within each group	% Difference
Dark illumination	***38***	***55.1%***	***1209***	***41.5%***	***13.6%***
Snow slush road	15	2.8%	1444	10.5%	-7.8%
Dark illumination	*5*	*33.3%*	*503*	*34.8%*	*-1.5%*
Icy road	7	1.3%	762	5.6%	-4.3%
Dark illumination	*5*	*71.4%*	*335*	*44.0%*	*27.5%*
Prime factor					
D1 Driver was distracted	13	2.4%	1018	7.4%	-5.0%
First harmful event: 25 Hit guide rail	*10*	*76.9%*	*650*	*63.9%*	*13.1%*
Most harm event: 25 Hit guide rail	6	60.0%	519	79.8%	-19.8%
Most harm event: 50 Overturn/roll over	2	20.0%	54	8.3%	11.7%
Most harm event: 21 Hit tree or shrubbery	2	20.0%	29	4.5%	15.5%
First harmful event: 26 Hit guide rail end	*1*	*7.7%*	*193*	*19.0%*	*-11.3%*
Most harm event: 26 Hit guide rail end	1	100.0%	175	90.7%	9.3%
First harmful event: 37 Hit impact attenuator	*1*	*7.7%*	*47*	*4.6%*	*3.1%*
Most harm event: 37 Hit impact attenuator	1	100.0%	44	93.6%	6.4%
First harmful event: 50 Overturn/roll over	*1*	*7.7%*	*5*	*0.5%*	*7.2%*
Most harm event: 50 Overturn/roll over	1	100.0%	5	100.0%	0.0%
D14 Careless passing or lane change	20	3.7%	467	3.4%	0.3%
First harmful event: 22 Hit embankment	*1*	*5.0%*	*5*	*1.1%*	*3.9%*
Most harm event: 25 Hit guide rail	1	100.0%	2	40.0%	60.0%
First harmful event: 25 Hit guide rail	*10*	*50.0%*	*277*	*59.3%*	*-9.3%*
Most harm event: 25 Hit guide rail	3	30.0%	238	85.9%	-55.9%
Most harm event: 26 Hit guide rail end	1	10.0%	1	0.4%	9.6%
Most harm event: 30 Hit fence or wall	1	10.0%	0	0.0%	10.0%
Most harm event: 50 Overturn/roll over	4	40.0%	13	4.7%	35.3%
Most harm event: 58 Other non-collision	1	10.0%	0	0.0%	10.0%
First harmful event: 26 Hit guide rail end	*2*	*10.0%*	*55*	*11.8%*	*-1.8%*
Most harm event: 30 Hit fence or wall	1	50.0%	1	1.8%	48.2%
Most harm event: 50 Overturn/roll over	1	50.0%	6	10.9%	39.1%
First harmful event: 28 Hit concrete or longitudinal barrier	*2*	*10.0%*	*24*	*5.1%*	*4.9%*
Most harm event: 25 Hit guide rail	1	50.0%	9	37.5%	12.5%
Most harm event: 28 Hit concrete or longitudinal barrier	1	50.0%	13	54.2%	-4.2%
First harmful event: 37 Hit impact attenuator	*2*	*10.0%*	*78*	*16.7%*	*-6.7%*
Most harm event: 37 Hit impact attenuator	2	100.0%	72	92.3%	7.7%
First harmful event: 50 Overturn/roll over	*1*	*5.0%*	*5*	*1.1%*	*3.9%*
Most harm event: 25 Hit guide rail	1	100.0%	0	0.0%	100.0%
First harmful event: 52 Pot holes or other pavement irregularities	*1*	*5.0%*	*1*	*0.2%*	*4.8%*
Most harm event: 25 Hit guide rail	1	100.0%	0	0.0%	100.0%
First harmful event: 58 Other non-collision	*1*	*5.0%*	*5*	*1.1%*	*3.9%*
Most harm event: 25 Hit guide rail	1	100.0%	2	40.0%	60.0%
D22 Over or under compensation at curve	**45**	**8.3%**	**862**	**6.3%**	**2.0%**
Curved road	*45*	*100.0%*	*830*	*96.3%*	*3.7%*

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Non-fatal/Serious Injury crashes	% within each group	% Difference
Dark illumination	17	37.8%	405	48.8%	-11.0%
Wet road	*3*	*6.7%*	*149*	*17.3%*	*-10.6%*
Icy road	*1*	*2.2%*	*14*	*1.6%*	*0.6%*
Speeding related	*12*	*26.7%*	*177*	*20.5%*	*6.1%*
First harmful event: 22 Hit embankment	*2*	*4.4%*	*24*	*2.8%*	*1.7%*
Most harm event: 21 Hit tree or shrubbery	1	50.0%	0	0.0%	50.0%
Most harm event: 29 Hit ditch	1	50.0%	0	0.0%	50.0%
First harmful event: 23 Hit utility pole	*1*	*2.2%*	*7*	*0.8%*	*1.4%*
Most harm event: 21 Hit tree or shrubbery	1	100.0%	0	0.0%	100.0%
First harmful event: 25 Hit guide rail	*30*	*66.7%*	*629*	*73.0%*	*-6.3%*
Most harm event: 21 Hit tree or shrubbery	3	10.0%	17	2.7%	7.3%
Most harm event: 22 Hit embankment	1	3.3%	11	1.7%	1.6%
Most harm event: 23 Hit utility pole	1	3.3%	8	1.3%	2.1%
Most harm event: 25 Hit guide rail	18	60.0%	493	78.4%	-18.4%
Most harm event: 28 Hit concrete or longitudinal barrier	1	3.3%	10	1.6%	1.7%
Most harm event: 29 Hit ditch	1	3.3%	6	1.0%	2.4%
Most harm event: 50 Overturn/roll over	4	13.3%	65	10.3%	3.0%
Most harm event: 58 Other non-collision	1	3.3%	3	0.5%	2.9%
First harmful event: 26 Hit guide rail end	*10*	*22.2%*	*121*	*14.0%*	*8.2%*
Most harm event: 21 Hit tree or shrubbery	2	20.0%	3	2.5%	17.5%
Most harm event: 23 Hit utility pole	1	10.0%	2	1.7%	8.3%
Most harm event: 26 Hit guide rail end	5	50.0%	97	80.2%	-30.2%
Most harm event: 35 Hit bridge rail	1	10.0%	1	0.8%	9.2%
Most harm event: 58 Other non-collision	1	10.0%	0	0.0%	10.0%
First harmful event: 29 Hit ditch	*1*	*2.2%*	*9*	*1.0%*	*1.2%*
Most harm event: 25 Hit guide rail	1	100.0%	6	66.7%	33.3%
First harmful event: 48 Hit other fixed object	*1*	*2.2%*	*4*	*0.5%*	*1.8%*
Most harm event: 50 Overturn/roll over	1	100.0%	0	0.0%	100.0%
D23 Speeding	36	6.7%	366	2.7%	4.0%
Curved road	*25*	*69.4%*	*207*	*56.6%*	*12.9%*
Dark illumination	15	60.0%	104	50.2%	9.8%
Dark illumination	*20*	*55.6%*	*181*	*49.5%*	*6.1%*
Wet road	*3*	*8.3%*	*34*	*9.3%*	*-1.0%*
First harmful event: 22 Hit embankment	*3*	*8.3%*	*13*	*3.6%*	*4.8%*
Most harm event: 22 Hit embankment	2	66.7%	3	23.1%	43.6%
Most harm event: 50 Overturn/roll over	1	33.3%	3	23.1%	10.3%
First harmful event: 25 Hit guide rail	*18*	*50.0%*	*274*	*74.9%*	*-24.9%*
Most harm event: 21 Hit tree or shrubbery	3	16.7%	9	3.3%	13.4%
Most harm event: 25 Hit guide rail	10	55.6%	211	77.0%	-21.5%
Most harm event: 37 Hit impact attenuator	1	5.6%	0	0.0%	5.6%
Most harm event: 50 Overturn/roll over	4	22.2%	23	8.4%	13.8%
First harmful event: 26 Hit guide rail end	*6*	*16.7%*	*26*	*7.1%*	*9.6%*
Most harm event: 21 Hit tree or shrubbery	1	16.7%	0	0.0%	16.7%
Most harm event: 25 Hit guide rail	1	16.7%	0	0.0%	16.7%
Most harm event: 26 Hit guide rail end	3	50.0%	20	76.9%	-26.9%
Most harm event: 50 Overturn/roll over	1	16.7%	6	23.1%	-6.4%
First harmful event: 27 Hit curb	*2*	*5.6%*	*9*	*2.5%*	*3.1%*
Most harm event: 23 Hit utility pole	1	50.0%	1	11.1%	38.9%
Most harm event: 50 Overturn/roll over	1	50.0%	0	0.0%	50.0%
First harmful event: 32 Hit culvert	*1*	*2.8%*	*0*	*0.0%*	*2.8%*

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Non-fatal/Serious Injury crashes	% within each group	% Difference
Most harm event: 25 Hit guide rail	1	100.0%	0	0.0%	100.0%
First harmful event: 37 Hit impact attenuator	*2*	*5.6%*	*4*	*1.1%*	*4.5%*
Most harm event: 50 Overturn/roll over	1	50.0%	0	0.0%	50.0%
Most harm event: 54 Fire in vehicle	1	50.0%	0	0.0%	50.0%
First harmful event: 48 Hit other fixed object	*1*	*2.8%*	*1*	*0.3%*	*2.5%*
Most harm event: 28 Hit concrete or longitudinal barrier	1	100.0%	0	0.0%	100.0%
First harmful event: 58 Other non-collision	*3*	*8.3%*	*1*	*0.3%*	*8.1%*
Most harm event: 25 Hit guide rail	2	66.7%	1	100.0%	-33.3%
Most harm event: 58 Other non-collision	1	33.3%	0	0.0%	33.3%
D24 Driving too fast for conditions	150	27.7%	5237	38.2%	-10.5%
Curved road	***105***	***70.0%***	***2761***	***52.7%***	***17.3%***
Dark illumination	40	38.1%	1066	38.6%	-0.5%
Dark illumination	*60*	*40.0%*	*2042*	*39.0%*	*1.0%*
Wet road	*28*	*18.7%*	*1816*	*34.7%*	*-16.0%*
Snow slush road	*12*	*8.0%*	*1254*	*23.9%*	*-15.9%*
Icy road	*6*	*4.0%*	*654*	*12.5%*	*-8.5%*
First harmful event: 21 Hit tree or shrubbery	*1*	*0.7%*	*18*	*0.3%*	*0.3%*
First harmful event: 22 Hit embankment	*5*	*3.3%*	*113*	*2.2%*	*1.2%*
First harmful event: 23 Hit utility pole	*1*	*0.7%*	*18*	*0.3%*	*0.3%*
First harmful event: 24 Hit traffic sign	*1*	*0.7%*	*45*	*0.9%*	*-0.2%*
First harmful event: 25 Hit guide rail	*108*	*72.0%*	*4002*	*76.4%*	*-4.4%*
Most harm event: 21 Hit tree or shrubbery	12	11.1%	84	2.1%	9.0%
Most harm event: 25 Hit guide rail	45	41.7%	3335	83.3%	-41.7%
Most harm event: 50 Overturn/roll over	**38**	**35.2%**	**294**	**7.3%**	**27.8%**
First harmful event: 26 Hit guide rail end	*14*	*9.3%*	*455*	*8.7%*	*0.6%*
Most harm event: 26 Hit guide rail end	7	50.0%	379	83.3%	-33.3%
First harmful event: 27 Hit curb	*1*	*0.7%*	*39*	*0.7%*	*-0.1%*
First harmful event: 28 Hit concrete or longitudinal barrier	*5*	*3.3%*	*263*	*5.0%*	*-1.7%*
First harmful event: 29 Hit ditch	*2*	*1.3%*	*21*	*0.4%*	*0.9%*
First harmful event: 37 Hit impact attenuator	*1*	*0.7%*	*95*	*1.8%*	*-1.1%*
First harmful event: 40 Hit mailbox	*1*	*0.7%*	*14*	*0.3%*	*0.4%*
First harmful event: 42 Hit snow bank	*1*	*0.7%*	*6*	*0.1%*	*0.6%*
First harmful event: 50 Overturn/roll over	*2*	*1.3%*	*43*	*0.8%*	*0.5%*
First harmful event: 58 Other non-collision	*6*	*4.0%*	*14*	*0.3%*	*3.7%*
D92 Affected by physical condition	**124**	**22.9%**	**2323**	**16.9%**	**6.0%**
Fatigue asleep	*13*	*10.5%*	*605*	*26.0%*	*-15.6%*
Dark illumination	*73*	*58.9%*	*1342*	*57.8%*	*1.1%*
Impaired driver	***74***	***59.7%***	***1173***	***50.5%***	***9.2%***
Curved road	*54*	*43.5%*	*863*	*37.2%*	*6.4%*
First harmful event: 25 Hit guide rail	*86*	*69.4%*	*1578*	*67.9%*	*1.4%*
Most harm event: 21 Hit tree or shrubbery	17	19.8%	59	3.7%	16.0%
Most harm event: 25 Hit guide rail	36	41.9%	1223	77.5%	-35.6%
Most harm event: 50 Overturn/roll over	21	24.4%	121	7.7%	16.8%
First harmful event: 26 Hit guide rail end	*14*	*11.3%*	*383*	*16.5%*	*-5.2%*
Most harm event: 26 Hit guide rail end	6	42.9%	306	79.9%	-37.0%

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Non-fatal/Serious Injury crashes	% within each group	% Difference
D98 Other improper driving actions	75	13.9%	1928	14.1%	-0.2%
Curved road	*26*	*34.7%*	*571*	*29.6%*	*5.1%*
Dark illumination	11	42.3%	240	42.0%	0.3%
Dark illumination	*38*	*50.7%*	*839*	*43.5%*	*7.2%*
Wet road	*8*	*10.7%*	*249*	*12.9%*	*-2.2%*
First harmful event: 25 Hit guide rail	*52*	*69.3%*	*1317*	*68.3%*	*1.0%*
Most harm event: 25 Hit guide rail	23	44.2%	1053	80.0%	-35.7%
Most harm event: 50 Overturn/roll over	19	36.5%	116	8.8%	27.7%
First harmful event: 26 Hit guide rail end	*7*	*9.3%*	*290*	*15.0%*	*-5.7%*
D99 Unknown	**41**	**7.6%**	**477**	**3.5%**	**4.1%**
Curved road	*19*	*46.3%*	*163*	*34.2%*	*12.2%*
Dark illumination	4	21.1%	91	55.8%	-34.8%
Dark illumination	*13*	*31.7%*	*258*	*54.1%*	*-22.4%*
Wet road	*3*	*7.3%*	*85*	*17.8%*	*-10.5%*
First harmful event: 25 Hit guide rail	*24*	*58.5%*	*331*	*69.4%*	*-10.9%*
Most harm event: 25 Hit guide rail	11	45.8%	279	84.3%	-38.5%
First harmful event: 22 Hit embankment	19	3.5%	252	1.8%	1.7%
Most harm event: 21 Hit tree or shrubbery	*2*	*10.5%*	*5*	*2.0%*	*8.5%*
Most harm event: 22 Hit embankment	*5*	*26.3%*	*84*	*33.3%*	*-7.0%*
Most harm event: 25 Hit guide rail	*2*	*10.5%*	*92*	*36.5%*	*-26.0%*
Most harm event: 50 Overturn/rollover	*9*	*47.4%*	*46*	*18.3%*	*29.1%*
First harmful event: 25 Hit guide rail	364	67.3%	9838	71.8%	-4.5%
Most harm event: 25 Hit guide rail	*172*	*47.3%*	*8002*	*81.3%*	*-34.1%*
Most harm event: 21 Hit tree or shrubbery	***41***	***11.3%***	***256***	***2.6%***	***8.7%***
Most harm event: 22 Hit embankment	*11*	*3.0%*	*181*	*1.8%*	*1.2%*
Most harm event: 50 Overturn/rollover	*98*	*26.9%*	*754*	*7.7%*	*19.3%*
First harmful event: 26 Hit guide rail end	62	11.5%	1697	12.4%	-0.9%
Most harm event: 21 Hit tree or shrubbery	*7*	*11.3%*	*34*	*2.0%*	*9.3%*
Most harm event: 25 Hit guide rail	*2*	*3.2%*	*25*	*1.5%*	*1.8%*
Most harm event: 26 Hit guide rail end	*28*	*45.2%*	*1434*	*84.5%*	*-39.3%*
Most harm event: 50 Overturn/rollover	*13*	*21.0%*	*128*	*7.5%*	*13.4%*
First harmful event: 28 Hit concrete or longitudinal barrier	14	2.6%	516	3.8%	-1.2%
Most harm event: 25 Hit guide rail	*2*	*14.3%*	*205*	*39.7%*	*-25.4%*
Most harm event: 26 Hit guide rail end	*1*	*7.1%*	*14*	*2.7%*	*4.4%*
Most harm event: 28 Hit concrete or longitudinal barrier	*5*	*35.7%*	*266*	*51.6%*	*-15.8%*
Most harm event: 50 Overturn/rollover	*6*	*42.9%*	*20*	*3.9%*	*39.0%*
First harmful event: 48 Hit other fixed object	10	1.8%	73	0.5%	1.3%
Most harm event: 25 Hit guide rail	*2*	*20.0%*	*26*	*35.6%*	*-15.6%*
Most harm event: 26 Hit guide rail end	*1*	*10.0%*	*12*	*16.4%*	*-6.4%*
Most harm event: 48 Hit other fixed object	*1*	*10.0%*	*26*	*35.6%*	*-25.6%*
First harmful event: 58 Other non-collision	18	3.3%	43	0.3%	3.0%
Most harm event: 25 Hit guide rail	*8*	*44.4%*	*24*	*55.8%*	*-11.4%*
Most harm event: 26 Hit guide rail end	*3*	*16.7%*	*2*	*4.7%*	*12.0%*
Most harm event: 58 Other non-collision	*6*	*33.3%*	*11*	*25.6%*	*7.8%*
Most harmful event: 21 Hit tree or shrubbery	**57**	**10.5%**	**333**	**2.4%**	**8.1%**
Most harmful event: 22 Hit embankment	18	3.3%	289	2.1%	1.2%

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Non-fatal/Serious Injury crashes	% within each group	% Difference
Most harmful event: 23 Hit utility pole	11	2.0%	188	1.4%	0.7%
Most harmful event: 25 Hit guide rail	201	37.2%	8724	63.7%	-26.5%
Most harmful event: 26 Hit guide rail end	38	7.0%	1595	11.6%	-4.6%
Most harmful event: 28 Hit concrete or longitudinal barrier	14	2.6%	479	3.5%	-0.9%
Most harmful event: 50 Overturn/roll over	**146**	**27.0%**	**1115**	**8.1%**	**18.9%**
Most harmful event: 58 Other non-collision	13	2.4%	29	0.2%	2.2%
Speeding	**73**	**13.5%**	**722**	**5.3%**	**8.2%**
Speeding related	265	49.0%	6595	48.1%	0.9%
Curved road	***177***	***66.8%***	***3524***	***53.4%***	***13.4%***
Dark illumination	81	45.8%	1480	42.0%	3.8%
Wet road	23	13.0%	1132	32.1%	-19.1%
Snow slush road	5	2.8%	567	16.1%	-13.3%
Icy road	1	0.6%	334	9.5%	-8.9%
First harm event: 25 Hit guide rail	119	67.2%	2711	76.9%	-9.7%
First harm event: 26 Hit guide rail end	21	11.9%	289	8.2%	3.7%
Most harm event: 25 Hit guide rail	69	39.0%	2310	65.6%	-26.6%
Most harm event: 26 Hit guide rail end	16	9.0%	265	7.5%	1.5%
Dark illumination	*124*	*46.8%*	*2781*	*42.2%*	*4.6%*
Wet road	*38*	*14.3%*	*2022*	*30.7%*	*-16.3%*
Snow slush road	*13*	*4.9%*	*1299*	*19.7%*	*-14.8%*
Icy road	*6*	*2.3%*	*684*	*10.4%*	*-8.1%*
First harm event: 25 Hit guide rail	*180*	*67.9%*	*5005*	*75.9%*	*-8.0%*
First harm event: 26 Hit guide rail end	*30*	*11.3%*	*578*	*8.8%*	*2.6%*
Most harm event: 25 Hit guide rail	*95*	*35.8%*	*4433*	*67.2%*	*-31.4%*
Most harm event: 26 Hit guide rail end	*19*	*7.2%*	*537*	*8.1%*	*-1.0%*
Aggressive driving	287	53.0%	7238	52.8%	0.2%
Curved road	***182***	***63.4%***	***3636***	***50.2%***	***13.2%***
Dark illumination	84	46.2%	1528	42.0%	4.1%
Speeding related	172	94.5%	3413	93.9%	0.6%
Dark illumination	*131*	*45.6%*	*3038*	*42.0%*	*3.7%*
Wet road	*38*	*13.2%*	*2088*	*28.8%*	*-15.6%*
Snow slush road	*14*	*4.9%*	*1314*	*18.2%*	*-13.3%*
Icy road	*6*	*2.1%*	*693*	*9.6%*	*-7.5%*
Speeding related	*257*	*89.5%*	*6415*	*88.6%*	*0.9%*

Table 18. Crash Characteristics for Single-Vehicle Fatal or Serious Injury Crashes Involving Guiderails (Reference Group: Single-Vehicle Fatal or Serious Injury Crashes Involving Other Fixed Objects)

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% Difference
Total	**541**	-	**13706**	-	-
Interstate	**90**	**16.6%**	**159**	**4.9%**	**11.7%**
Turnpike	**25**	**4.6%**	**34**	**1.1%**	**3.6%**
State Road	**471**	**87.1%**	**2343**	**72.6%**	**14.4%**
Dark illumination	*217*	*46.1%*	*1224*	*52.2%*	*-6.2%*
Wet road	*57*	*12.1%*	*375*	*16.0%*	*-3.9%*
Snow slush road	*12*	*2.5%*	*70*	*3.0%*	*-0.4%*
Icy road	*7*	*1.5%*	*53*	*2.3%*	*-0.8%*
Local road	73	13.5%	1052	32.6%	-19.1%
Rural	**389**	**71.9%**	**2197**	**68.1%**	**3.8%**
Dark illumination	*176*	*45.2%*	*1103*	*50.2%*	*-5.0%*
Wet road	*52*	*13.4%*	*346*	*15.7%*	*-2.4%*
Snow slush road	*14*	*3.6%*	*80*	*3.6%*	*0.0%*
Icy road	*6*	*1.5%*	*45*	*2.0%*	*-0.5%*
Curved road	**298**	**55.1%**	**1590**	**49.3%**	**5.8%**
Dark illumination	*137*	*46.0%*	*867*	*54.5%*	*-8.6%*
Wet road	16	11.7%	134	15.5%	-3.8%
Snow slush road	2	1.5%	16	1.8%	-0.4%
Icy road	1	0.7%	13	1.5%	-0.8%
Wet road	*34*	*11.4%*	*271*	*17.0%*	*-5.6%*
Snow slush road	*5*	*1.7%*	*33*	*2.1%*	*-0.4%*
Icy road	*2*	*0.7%*	*17*	*1.1%*	*-0.4%*
Rural	*225*	*75.5%*	*1173*	*73.8%*	*1.7%*
Inclement weather	68	12.6%	419	13.0%	-0.4%
Rain	*40*	*58.8%*	*280*	*66.8%*	*-8.0%*
Sleet (hail)	*0*	*0.0%*	*7*	*1.7%*	*-1.7%*
Snow	*18*	*26.5%*	*84*	*20.0%*	*6.4%*
Fog	*7*	*10.3%*	*35*	*8.4%*	*1.9%*
Rain and fog	*2*	*2.9%*	*13*	*3.1%*	*-0.2%*
Sleet and fog	*1*	*1.5%*	*0*	*0.0%*	*1.5%*
Dark illumination	270	49.9%	1811	56.1%	-6.2%
Dark (no street lights)	*181*	*67.0%*	*1190*	*65.7%*	*1.3%*
Dark (street lights)	*61*	*22.6%*	*489*	*27.0%*	*-4.4%*
Dusk	*13*	*4.8%*	*71*	*3.9%*	*0.9%*
Dawn	*9*	*3.3%*	*43*	*2.4%*	*1.0%*
Dark – unknown roadway lighting	*6*	*2.2%*	*18*	*1.0%*	*1.2%*
Dark illumination	248	45.8%	1697	52.6%	-6.8%

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% Difference
Wet road	69	12.8%	498	15.4%	-2.7%
Dark illumination	*38*	*55.1%*	*262*	*52.6%*	*2.5%*
Snow slush road	15	2.8%	92	2.9%	-0.1%
Dark illumination	*5*	*33.3%*	*48*	*52.2%*	*-18.8%*
Icy road	7	1.3%	63	2.0%	-0.7%
Dark illumination	*5*	*71.4%*	*41*	*65.1%*	*6.3%*
Prime factor					
D1 Driver was distracted	13	2.4%	120	3.7%	-1.3%
First harmful event: 25 Hit guide rail	*10*	*76.9%*	*0*	*0.0%*	*76.9%*
Most harm event: 25 Hit guide rail	6	60.0%	0	0.0%	60.0%
Most harm event: 50 Overturn/roll over	2	20.0%	0	0.0%	20.0%
Most harm event: 21 Hit tree or shrubbery	2	20.0%	0	0.0%	20.0%
First harmful event: 26 Hit guide rail end	*1*	*7.7%*	*0*	*0.0%*	*7.7%*
Most harm event: 26 Hit guide rail end	1	100.0%	0	0.0%	100.0%
First harmful event: 37 Hit impact attenuator	*1*	*7.7%*	*0*	*0.0%*	*7.7%*
Most harm event: 37 Hit impact attenuator	1	100.0%	0	0.0%	100.0%
First harmful event: 50 Overturn/roll over	*1*	*7.7%*	*0*	*0.0%*	*7.7%*
Most harm event: 50 Overturn/roll over	1	100.0%	0	0.0%	100.0%
D14 Careless passing or lane change	20	3.7%	57	1.8%	1.9%
First harmful event: 22 Hit embankment	*1*	*5.0%*	*14*	*24.6%*	*-19.6%*
Most harm event: 25 Hit guide rail	1	100.0%	0	0.0%	100.0%
First harmful event: 25 Hit guide rail	*10*	*50.0%*	*0*	*0.0%*	*50.0%*
Most harm event: 25 Hit guide rail	3	30.0%	0	0.0%	30.0%
Most harm event: 26 Hit guide rail end	1	10.0%	0	0.0%	10.0%
Most harm event: 30 Hit fence or wall	1	10.0%	0	0.0%	10.0%
Most harm event: 50 Overturn/roll over	4	40.0%	0	0.0%	40.0%
Most harm event: 58 Other non-collision	1	10.0%	0	0.0%	10.0%
First harmful event: 26 Hit guide rail end	*2*	*10.0%*	*0*	*0.0%*	*10.0%*
Most harm event: 30 Hit fence or wall	1	50.0%	0	0.0%	50.0%
Most harm event: 50 Overturn/roll over	1	50.0%	0	0.0%	50.0%
First harmful event: 28 Hit concrete or longitudinal barrier	*2*	*10.0%*	*12*	*21.1%*	*-11.1%*
Most harm event: 25 Hit guide rail	1	50.0%	0	0.0%	50.0%
Most harm event: 28 Hit concrete or longitudinal barrier	1	50.0%	8	66.7%	-16.7%
First harmful event: 37 Hit impact attenuator	*2*	*10.0%*	*0*	*0.0%*	*10.0%*
Most harm event: 37 Hit impact attenuator	2	100.0%	0	0.0%	100.0%
First harmful event: 50 Overturn/roll over	*1*	*5.0%*	*0*	*0.0%*	*5.0%*
Most harm event: 25 Hit guide rail	1	100.0%	0	0.0%	100.0%
First harmful event: 52 Pot holes or other pavement irregularities	*1*	*5.0%*	*0*	*0.0%*	*5.0%*
Most harm event: 25 Hit guide rail	1	100.0%	0	0.0%	100.0%
First harmful event: 58 Other non-collision	*1*	*5.0%*	*0*	*0.0%*	*5.0%*
Most harm event: 25 Hit guide rail	1	100.0%	0	0.0%	100.0%

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% Difference
D22 Over or under compensation at curve	45	8.3%	283	8.8%	-0.5%
Curved road	*45*	*100.0%*	*279*	*98.6%*	*1.4%*
Dark illumination	17	37.8%	148	53.0%	-15.3%
Wet road	*3*	*6.7%*	*28*	*9.9%*	*-3.2%*
Icy road	*1*	*2.2%*	*2*	*0.7%*	*1.5%*
Speeding related	*12*	*26.7%*	*80*	*28.3%*	*-1.6%*
First harmful event: 22 Hit embankment	*2*	*4.4%*	*58*	*20.5%*	*-16.1%*
Most harm event: 21 Hit tree or shrubbery	1	50.0%	6	10.3%	39.7%
Most harm event: 29 Hit ditch	1	50.0%	0	0.0%	50.0%
First harmful event: 23 Hit utility pole	*1*	*2.2%*	*34*	*12.0%*	*-9.8%*
Most harm event: 21 Hit tree or shrubbery	1	100.0%	1	2.9%	97.1%
First harmful event: 25 Hit guide rail	***30***	***66.7%***	***0***	***0.0%***	***66.7%***
Most harm event: 21 Hit tree or shrubbery	3	10.0%	0	0.0%	10.0%
Most harm event: 22 Hit embankment	1	3.3%	0	0.0%	3.3%
Most harm event: 23 Hit utility pole	1	3.3%	0	0.0%	3.3%
Most harm event: 25 Hit guide rail	18	60.0%	0	0.0%	60.0%
Most harm event: 28 Hit concrete or longitudinal barrier	1	3.3%	0	0.0%	3.3%
Most harm event: 29 Hit ditch	1	3.3%	0	0.0%	3.3%
Most harm event: 50 Overturn/roll over	4	13.3%	0	0.0%	13.3%
Most harm event: 58 Other non-collision	1	3.3%	0	0.0%	3.3%
First harmful event: 26 Hit guide rail end	*10*	*22.2%*	*0*	*0.0%*	*22.2%*
Most harm event: 21 Hit tree or shrubbery	2	20.0%	0	0.0%	20.0%
Most harm event: 23 Hit utility pole	1	10.0%	0	0.0%	10.0%
Most harm event: 26 Hit guide rail end	5	50.0%	0	0.0%	50.0%
Most harm event: 35 Hit bridge rail	1	10.0%	0	0.0%	10.0%
Most harm event: 58 Other non-collision	1	10.0%	0	0.0%	10.0%
First harmful event: 29 Hit ditch	*1*	*2.2%*	*31*	*11.0%*	*-8.7%*
Most harm event: 25 Hit guide rail	1	100.0%	0	0.0%	100.0%
First harmful event: 48 Hit other fixed object	*1*	*2.2%*	*14*	*4.9%*	*-2.7%*
Most harm event: 50 Overturn/roll over	1	100.0%	1	7.1%	92.9%
D23 Speeding	36	6.7%	349	10.8%	-4.2%
Curved road	*25*	*69.4%*	*198*	*56.7%*	*12.7%*
Dark illumination	15	60.0%	126	63.6%	-3.6%
Dark illumination	*20*	*55.6%*	*229*	*65.6%*	*-10.1%*
Wet road	*3*	*8.3%*	*30*	*8.6%*	*-0.3%*
First harmful event: 22 Hit embankment	*3*	*8.3%*	*49*	*14.0%*	*-5.7%*
Most harm event: 22 Hit embankment	2	66.7%	10	20.4%	46.3%
Most harm event: 50 Overturn/roll over	1	33.3%	20	40.8%	-7.5%
First harmful event: 25 Hit guide rail	*18*	*50.0%*	*0*	*0.0%*	*50.0%*
Most harm event: 21 Hit tree or shrubbery	3	16.7%	0	0.0%	16.7%
Most harm event: 25 Hit guide rail	10	55.6%	0	0.0%	55.6%
Most harm event: 37 Hit impact attenuator	1	5.6%	0	0.0%	5.6%
Most harm event: 50 Overturn/roll over	4	22.2%	0	0.0%	22.2%
First harmful event: 26 Hit guide rail end	*6*	*16.7%*	*0*	*0.0%*	*16.7%*
Most harm event: 21 Hit tree or shrubbery	1	16.7%	0	0.0%	16.7%
Most harm event: 25 Hit guide rail	1	16.7%	0	0.0%	16.7%
Most harm event: 26 Hit guide rail end	3	50.0%	0	0.0%	50.0%
Most harm event: 50 Overturn/roll over	1	16.7%	0	0.0%	16.7%

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% Difference
First harmful event: 27 Hit curb	*2*	*5.6%*	*38*	*10.9%*	*-5.3%*
Most harm event: 23 Hit utility pole	1	50.0%	4	10.5%	39.5%
Most harm event: 50 Overturn/roll over	1	50.0%	6	15.8%	34.2%
First harmful event: 32 Hit culvert	*1*	*2.8%*	*4*	*1.1%*	*1.6%*
Most harm event: 25 Hit guide rail	1	100.0%	0	0.0%	100.0%
First harmful event: 37 Hit impact attenuator	*2*	*5.6%*	*0*	*0.0%*	*5.6%*
Most harm event: 50 Overturn/roll over	1	50.0%	0	0.0%	50.0%
Most harm event: 54 Fire in vehicle	1	50.0%	0	0.0%	50.0%
First harmful event: 48 Hit other fixed object	*1*	*2.8%*	*17*	*4.9%*	*-2.1%*
Most harm event: 28 Hit concrete or longitudinal barrier	1	100.0%	0	0.0%	100.0%
First harmful event: 58 Other non-collision	*3*	*8.3%*	*0*	*0.0%*	*8.3%*
Most harm event: 25 Hit guide rail	2	66.7%	0	0.0%	66.7%
Most harm event: 58 Other non-collision	1	33.3%	0	0.0%	33.3%
D24 Driving too fast for conditions	150	27.7%	833	25.8%	1.9%
Curved road	***105***	***70.0%***	***504***	***60.5%***	***9.5%***
Dark illumination	40	38.1%	259	51.4%	-13.3%
Dark illumination	*60*	*40.0%*	*433*	*52.0%*	*-12.0%*
Wet road	*28*	*18.7%*	*236*	*28.3%*	*-9.7%*
Snow slush road	*12*	*8.0%*	*70*	*8.4%*	*-0.4%*
Icy road	*6*	*4.0%*	*43*	*5.2%*	*-1.2%*
First harmful event: 21 Hit tree or shrubbery	*1*	*0.7%*	*293*	*35.2%*	*-34.5%*
First harmful event: 22 Hit embankment	*5*	*3.3%*	*168*	*20.2%*	*-16.8%*
First harmful event: 23 Hit utility pole	*1*	*0.7%*	*100*	*12.0%*	*-11.3%*
First harmful event: 24 Hit traffic sign	*1*	*0.7%*	*25*	*3.0%*	*-2.3%*
First harmful event: 25 Hit guide rail	***108***	***72.0%***	***0***	***0.0%***	***72.0%***
Most harm event: 21 Hit tree or shrubbery	12	11.1%	0	0.0%	11.1%
Most harm event: 25 Hit guide rail	45	41.7%	0	0.0%	41.7%
Most harm event: 50 Overturn/roll over	38	35.2%	0	0.0%	35.2%
First harmful event: 26 Hit guide rail end	*14*	*9.3%*	*0*	*0.0%*	*9.3%*
Most harm event: 26 Hit guide rail end	7	50.0%	0	0.0%	50.0%
First harmful event: 27 Hit curb	*1*	*0.7%*	*38*	*4.6%*	*-3.9%*
First harmful event: 28 Hit concrete or longitudinal barrier	*5*	*3.3%*	*33*	*4.0%*	*-0.6%*
First harmful event: 29 Hit ditch	*2*	*1.3%*	*61*	*7.3%*	*-6.0%*
First harmful event: 37 Hit impact attenuator	*1*	*0.7%*	*0*	*0.0%*	*0.7%*
First harmful event: 40 Hit mailbox	*1*	*0.7%*	*12*	*1.4%*	*-0.8%*
First harmful event: 42 Hit snow bank	*1*	*0.7%*	*4*	*0.5%*	*0.2%*
First harmful event: 50 Overturn/roll over	*2*	*1.3%*	*0*	*0.0%*	*1.3%*
First harmful event: 58 Other non-collision	*6*	*4.0%*	*0*	*0.0%*	*4.0%*
D92 Affected by physical condition	124	22.9%	785	24.3%	-1.4%
Fatigue asleep	*13*	*10.5%*	*65*	*8.3%*	*2.2%*
Dark illumination	*73*	*58.9%*	*442*	*56.3%*	*2.6%*
Impaired driver	*74*	*59.7%*	*522*	*66.5%*	*-6.8%*
Curved road	*54*	*43.5%*	*298*	*38.0%*	*5.6%*
First harmful event: 25 Hit guide rail	***86***	***69.4%***	***0***	***0.0%***	***69.4%***
Most harm event: 21 Hit tree or shrubbery	17	19.8%	0	0.0%	19.8%

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% Difference
Most harm event: 25 Hit guide rail	36	41.9%	0	0.0%	41.9%
Most harm event: 50 Overturn/roll over	21	24.4%	0	0.0%	24.4%
First harmful event: 26 Hit guide rail end	*14*	*11.3%*	*0*	*0.0%*	*11.3%*
Most harm event: 26 Hit guide rail end	6	42.9%	0	0.0%	42.9%
D98 Other improper driving actions	**75**	**13.9%**	**320**	**9.9%**	**3.9%**
Curved road	***26***	***34.7%***	***79***	***24.7%***	***10.0%***
Dark illumination	11	42.3%	42	53.2%	-10.9%
Dark illumination	*38*	*50.7%*	*160*	*50.0%*	*0.7%*
Wet road	*8*	*10.7%*	*40*	*12.5%*	*-1.8%*
First harmful event: 25 Hit guide rail	*52*	*69.3%*	*0*	*0.0%*	*69.3%*
Most harm event: 25 Hit guide rail	23	44.2%	0	0.0%	44.2%
Most harm event: 50 Overturn/roll over	19	36.5%	0	0.0%	36.5%
First harmful event: 26 Hit guide rail end	*7*	*9.3%*	*0*	*0.0%*	*9.3%*
D99 Unknown	41	7.6%	259	8.0%	-0.4%
Curved road	*19*	*46.3%*	*92*	*35.5%*	*10.8%*
Dark illumination	4	21.1%	33	35.9%	-14.8%
Dark illumination	*13*	*31.7%*	*102*	*39.4%*	*-7.7%*
Wet road	*3*	*7.3%*	*32*	*12.4%*	*-5.0%*
First harmful event: 25 Hit guide rail	*24*	*58.5%*	*0*	*0.0%*	*58.5%*
Most harm event: 25 Hit guide rail	11	45.8%	0	0.0%	45.8%
First harmful event: 22 Hit embankment	19	3.5%	517	16.0%	-12.5%
Most harm event: 21 Hit tree or shrubbery	*2*	*10.5%*	*79*	*15.3%*	*-4.8%*
Most harm event: 22 Hit embankment	*5*	*26.3%*	*154*	*29.8%*	*-3.5%*
Most harm event: 25 Hit guide rail	*2*	*10.5%*	*0*	*0.0%*	*10.5%*
Most harm event: 50 Overturn/rollover	*9*	*47.4%*	*224*	*43.3%*	*4.0%*
First harmful event: 25 Hit guide rail	**364**	**67.3%**	**0**	**0.0%**	**67.3%**
Most harm event: 25 Hit guide rail	*172*	*47.3%*	*0*	*0.0%*	*47.3%*
Most harm event: 21 Hit tree or shrubbery	*41*	*11.3%*	*0*	*0.0%*	*11.3%*
Most harm event: 22 Hit embankment	*11*	*3.0%*	*0*	*0.0%*	*3.0%*
Most harm event: 50 Overturn/rollover	*98*	*26.9%*	*0*	*0.0%*	*26.9%*
First harmful event: 26 Hit guide rail end	**62**	**11.5%**	**0**	**0.0%**	**11.5%**
Most harm event: 21 Hit tree or shrubbery	*7*	*11.3%*	*0*	*0.0%*	*11.3%*
Most harm event: 25 Hit guide rail	*2*	*3.2%*	*0*	*0.0%*	*3.2%*
Most harm event: 26 Hit guide rail end	*28*	*45.2%*	*0*	*0.0%*	*45.2%*
Most harm event: 50 Overturn/rollover	*13*	*21.0%*	*0*	*0.0%*	*21.0%*
First harmful event: 28 Hit concrete or longitudinal barrier	14	2.6%	133	4.1%	-1.5%
Most harm event: 25 Hit guide rail	*2*	*14.3%*	*0*	*0.0%*	*14.3%*
Most harm event: 26 Hit guide rail end	*1*	*7.1%*	*0*	*0.0%*	*7.1%*
Most harm event: 28 Hit concrete or longitudinal barrier	*5*	*35.7%*	*93*	*69.9%*	*-34.2%*
Most harm event: 50 Overturn/rollover	*6*	*42.9%*	*27*	*20.3%*	*22.6%*
First harmful event: 48 Hit other fixed object	10	1.8%	185	5.7%	-3.9%
Most harm event: 25 Hit guide rail	*2*	*20.0%*	*0*	*0.0%*	*20.0%*
Most harm event: 26 Hit guide rail end	*1*	*10.0%*	*0*	*0.0%*	*10.0%*
Most harm event: 48 Hit other fixed object	*1*	*10.0%*	*111*	*60.0%*	*-50.0%*
First harmful event: 58 Other non-collision	18	3.3%	0	0.0%	3.3%
Most harm event: 25 Hit guide rail	*8*	*44.4%*	*0*	*0.0%*	*44.4%*

Category	# Single Vehicle Fatal/Serious Injury Crashes	% within each group	# Single Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% Difference
Most harm event: 26 Hit guide rail end	*3*	*16.7%*	*0*	*0.0%*	*16.7%*
Most harm event: 58 Other non-collision	*6*	*33.3%*	*0*	*0.0%*	*33.3%*
Most harmful event: 21 Hit tree or shrubbery	57	10.5%	1115	34.6%	-24.0%
Most harmful event: 22 Hit embankment	18	3.3%	184	5.7%	-2.4%
Most harmful event: 23 Hit utility pole	11	2.0%	605	18.8%	-16.7%
Most harmful event: 25 Hit guide rail	**201**	**37.2%**	**0**	**0.0%**	**37.2%**
Most harmful event: 26 Hit guide rail end	**38**	**7.0%**	**0**	**0.0%**	**7.0%**
Most harmful event: 28 Hit concrete or longitudinal barrier	14	2.6%	109	3.4%	-0.8%
Most harmful event: 50 Overturn/roll over	**146**	**27.0%**	**538**	**16.7%**	**10.3%**
Most harmful event: 58 Other non-collision	13	2.4%	21	0.7%	1.8%
Speeding	73	13.5%	599	18.6%	-5.1%
Speeding related	265	49.0%	1682	52.1%	-3.2%
Curved road	***177***	***66.8%***	***977***	***58.1%***	***8.7%***
Dark illumination	81	45.8%	553	56.6%	-10.8%
Wet road	23	13.0%	195	20.0%	-7.0%
Snow slush road	5	2.8%	29	3.0%	-0.1%
Icy road	1	0.6%	22	2.3%	-1.7%
First harm event: 25 Hit guide rail	**119**	**67.2%**	**0**	**0.0%**	**67.2%**
First harm event: 26 Hit guide rail end	**21**	**11.9%**	**0**	**0.0%**	**11.9%**
Most harm event: 25 Hit guide rail	**69**	**39.0%**	**0**	**0.0%**	**39.0%**
Most harm event: 26 Hit guide rail end	**16**	**9.0%**	**0**	**0.0%**	**9.0%**
Dark illumination	*124*	*46.8%*	*971*	*57.7%*	*-10.9%*
Wet road	*38*	*14.3%*	*335*	*19.9%*	*-5.6%*
Snow slush road	*13*	*4.9%*	*80*	*4.8%*	*0.1%*
Icy road	*6*	*2.3%*	*55*	*3.3%*	*-1.0%*
First harm event: 25 Hit guide rail	***180***	***67.9%***	***0***	***0.0%***	***67.9%***
First harm event: 26 Hit guide rail end	***30***	***11.3%***	***0***	***0.0%***	***11.3%***
Most harm event: 25 Hit guide rail	***95***	***35.8%***	***0***	***0.0%***	***35.8%***
Most harm event: 26 Hit guide rail end	*19*	*7.2%*	*0*	*0.0%*	*7.2%*
Aggressive driving	287	53.0%	1745	54.1%	-1.0%
Curved road	***182***	***63.4%***	***985***	***56.4%***	***7.0%***
Dark illumination	84	46.2%	560	56.9%	-10.7%
Speeding related	172	94.5%	945	95.9%	-1.4%
Dark illumination	*131*	*45.6%*	*1005*	*57.6%*	*-11.9%*
Wet road	*38*	*13.2%*	*341*	*19.5%*	*-6.3%*
Snow slush road	*14*	*4.9%*	*81*	*4.6%*	*0.2%*
Icy road	*6*	*2.1%*	*55*	*3.2%*	*-1.1%*
Speeding related	*257*	*89.5%*	*1625*	*93.1%*	*-3.6%*

Table 19. Crash Characteristics for Multi-Vehicle Fatal or Serious Injury Crashes Involving Guiderails (Reference Group: Multi-Vehicle Non-Fatal or Serious Injury Crashes Involving Guiderails)

Category	# Multi Vehicle Fatal/Serious Injury Crashes	% within each group	# Multi Vehicle Non-fatal/serious Injury Crashes	% within each group	% Difference
Total	**275**	-	**3179**	-	
Interstate	64	23.3%	1033	32.5%	-9.2%
Turnpike	10	3.6%	197	6.2%	-2.6%
State Road	253	92.0%	2840	89.3%	2.7%
Dark illumination	*78*	*30.8%*	*829*	*29.2%*	*1.6%*
Wet road	*37*	*14.6%*	*446*	*15.7%*	*-1.1%*
Snow slush road	*10*	*4.0%*	*234*	*8.2%*	*-4.3%*
Icy road	*7*	*2.8%*	*108*	*3.8%*	*-1.0%*
Local road	42	15.3%	501	15.8%	-0.5%
Rural	**183**	**66.5%**	**1635**	**51.4%**	**15.1%**
Dark illumination	*53*	*29.0%*	*448*	*27.4%*	*1.6%*
Wet road	*30*	*16.4%*	*268*	*16.4%*	*0.0%*
Snow slush road	*9*	*4.9%*	*178*	*10.9%*	*-6.0%*
Icy road	*7*	*3.8%*	*78*	*4.8%*	*-0.9%*
Curved road	**105**	**38.2%**	**736**	**23.2%**	**15.0%**
Dark illumination	*32*	*30.5%*	*210*	*28.5%*	*1.9%*
Wet road	13	40.6%	54	25.7%	14.9%
Snow slush road	1	3.1%	19	9.0%	-5.9%
Icy road	0	0.0%	10	4.8%	-4.8%
Wet road	*24*	*22.9%*	*174*	*23.6%*	*-0.8%*
Snow slush road	*3*	*2.9%*	*89*	*12.1%*	*-9.2%*
Icy road	*3*	*2.9%*	*37*	*5.0%*	*-2.2%*
Rural	***80***	***76.2%***	***408***	***55.4%***	***20.8%***
Inclement weather	47	17.1%	743	23.4%	-6.3%
Rain	*27*	*57.4%*	*390*	*52.5%*	*5.0%*
Sleet (hail)	*2*	*4.3%*	*18*	*2.4%*	*1.8%*
Snow	*13*	*27.7%*	*294*	*39.6%*	*-11.9%*
Fog	*1*	*2.1%*	*25*	*3.4%*	*-1.2%*
Rain and fog	*4*	*8.5%*	*13*	*1.7%*	*6.8%*
Sleet and fog	*0*	*0.0%*	*3*	*0.4%*	*-0.4%*
Dark illumination	94	34.2%	1054	33.2%	1.0%
Dark (no street lights)	*59*	*62.8%*	*605*	*57.4%*	*5.4%*
Dark (street lights)	*24*	*25.5%*	*308*	*29.2%*	*-3.7%*
Dusk	*6*	*6.4%*	*60*	*5.7%*	*0.7%*
Dawn	*5*	*5.3%*	*69*	*6.5%*	*-1.2%*
Dark – unknown roadway lighting	*0*	*0.0%*	*12*	*1.1%*	*-1.1%*
Dark illumination (flag)	83	30.2%	925	29.1%	1.1%

Category	# Multi Vehicle Fatal/Serious Injury Crashes	% within each group	# Multi Vehicle Non-fatal/serious Injury Crashes	% within each group	% Difference
Wet road	43	15.6%	526	16.5%	-0.9%
Dark illumination	*27*	*62.8%*	*178*	*33.8%*	*29.0%*
Snow slush road	10	3.6%	265	8.3%	-4.7%
Dark illumination	*1*	*10.0%*	*63*	*23.8%*	*-13.8%*
Icy road	7	2.5%	120	3.8%	-1.2%
Dark illumination	*1*	*14.3%*	*43*	*35.8%*	*-21.5%*
Prime factor					
D5 Making improper or careless turn	11	4.0%	165	5.2%	-1.2%
Intersection	*10*	*90.9%*	*131*	*79.4%*	*11.5%*
Other intersection (unsignalized minus stop-controlled)	*4*	*36.4%*	*46*	*27.9%*	*8.5%*
Signalized intersection	*5*	*45.5%*	*62*	*37.6%*	*7.9%*
Stop controlled intersection	*1*	*9.1%*	*23*	*13.9%*	*-4.8%*
D14 Careless passing or lane change	31	11.3%	620	19.5%	-8.2%
Rural	*12*	*38.7%*	*244*	*39.4%*	*-0.6%*
Dark illumination	*7*	*22.6%*	*195*	*31.5%*	*-8.9%*
Curved road	*6*	*19.4%*	*100*	*16.1%*	*3.2%*
First harm event: 1 Hit unit 1	*2*	*6.5%*	*13*	*2.1%*	*4.4%*
First harm event: 2 Hit unit 2	*22*	*71.0%*	*451*	*72.7%*	*-1.8%*
Most harm event: 2 Hit unit 2	10	45.5%	190	42.1%	3.3%
Most harm event: 3 Hit unit 3	3	13.6%	11	2.4%	11.2%
Most harm event: 25 Hit guard rail	1	4.5%	161	35.7%	-31.2%
Most harm event: 26 Hit guard rail end	2	9.1%	6	1.3%	7.8%
Most harm event: 28 Hit concrete or longitudinal barrier	1	4.5%	18	4.0%	0.6%
Most harm event: 48 Hit other fixed object	1	4.5%	0	0.0%	4.5%
Most harm event: 50 Overturn/roll over	4	18.2%	29	6.4%	11.8%
First harm event: 4 Hit unit 4	*1*	*3.2%*	*0*	*0.0%*	*3.2%*
First harm event: 12 Struck by unit 2	*1*	*3.2%*	*44*	*7.1%*	*-3.9%*
First harm event: 25 Hit guard rail	*2*	*6.5%*	*50*	*8.1%*	*-1.6%*
First harm event: 26 Hit guard rail end	*1*	*3.2%*	*5*	*0.8%*	*2.4%*
First harm event: 37 Hit impact attenuator	*1*	*3.2%*	*22*	*3.5%*	*-0.3%*
First harm event: 43 Hit temporary construction barrier	*1*	*3.2%*	*1*	*0.2%*	*3.1%*
D18 Driving on the wrong side of roadway	**38**	**13.8%**	**90**	**2.8%**	**11.0%**
Curved road	*19*	*50.0%*	*44*	*48.9%*	*1.1%*
Dark illumination	7	36.8%	9	20.5%	16.4%
Dark illumination	*12*	*31.6%*	*27*	*30.0%*	*1.6%*
Impaired driver	*10*	*26.3%*	*21*	*23.3%*	*3.0%*
Fatigue asleep	*5*	*13.2%*	*4*	*4.4%*	*8.7%*
Wet road	*6*	*15.8%*	*14*	*15.6%*	*0.2%*
Rural	***34***	***89.5%***	***60***	***66.7%***	***22.8%***
Speeding related	*7*	*18.4%*	*14*	*15.6%*	*2.9%*
First harm event: 1 Hit unit 1	*1*	*2.6%*	*0*	*0.0%*	*2.6%*
First harm event 2 Hit unit 2	*33*	*86.8%*	*67*	*74.4%*	*12.4%*

Category	# Multi Vehicle Fatal/Serious Injury Crashes	% within each group	# Multi Vehicle Non-fatal/serious Injury Crashes	% within each group	% Difference
Most harm event: 2 Hit unit 2	27	81.8%	61	91.0%	-9.2%
Most harm event: 11 Struck by unit 1	3	9.1%	2	3.0%	6.1%
First harm event: 25 Hit guard rail	*2*	*5.3%*	*13*	*14.4%*	*-9.2%*
D22 Over or under compensation at curve	12	4.4%	52	1.6%	2.7%
Speeding related	*3*	*25.0%*	*9*	*17.3%*	*7.7%*
First harm event: 2 Hit unit 2	*10*	*83.3%*	*32*	*61.5%*	*21.8%*
Most harm event: 2 Hit unit 2	6	60.0%	18	56.3%	3.8%
Most harm event: 25 Hit guide rail	1	10.0%	6	18.8%	-8.8%
Most harm event: 50 Overturn/roll over	3	30.0%	3	9.4%	20.6%
First harm event: 25 Hit guard rail	*1*	*8.3%*	*15*	*28.8%*	*-20.5%*
Most harm event: 12 Struck by unit 2	1	100.0%	0	0.0%	100.0%
D23 Speeding	13	4.7%	56	1.8%	3.0%
Curved road	*7*	*53.8%*	*13*	*23.2%*	*30.6%*
Dark illumination	*8*	*61.5%*	*23*	*41.1%*	*20.5%*
First harm event: 2 Hit unit 2	*10*	*76.9%*	*30*	*53.6%*	*23.4%*
Most harm event: 2 Hit unit 2	5	50.0%	14	46.7%	3.3%
Most harm event: 3 Hit unit 3	1	10.0%	1	3.3%	6.7%
Most harm event: 11 Struck by unit 1	2	20.0%	3	10.0%	10.0%
Most harm event: 25 Hit guide rail	1	10.0%	7	23.3%	-13.3%
Most harm event: 50 Overturn/roll over	1	10.0%	3	10.0%	0.0%
First harm event: 25 Hit guard rail	*3*	*23.1%*	*16*	*28.6%*	*-5.5%*
Most harm event: 2 Hit unit 2	2	66.7%	3	18.8%	47.9%
Most harm event: 25 Hit guide rail	1	33.3%	7	43.8%	-10.4%
D24 Driving too fast for conditions	57	20.7%	881	27.7%	-7.0%
Curved road	***31***	***54.4%***	***295***	***33.5%***	***20.9%***
Dark illumination	8	25.8%	73	24.7%	1.1%
Dark illumination	*18*	*31.6%*	*242*	*27.5%*	*4.1%*
Wet road	*17*	*29.8%*	*254*	*28.8%*	*1.0%*
Snow slush road	*9*	*15.8%*	*227*	*25.8%*	*-10.0%*
Icy road	*7*	*12.3%*	*104*	*11.8%*	*0.5%*
First harm event: 1 Hit unit 2	*2*	*3.5%*	*10*	*1.1%*	*2.4%*
First harm event: 2 Hit unit 2	***37***	***64.9%***	***463***	***52.6%***	***12.4%***
Most harm event: 2 Hit unit 2	22	59.5%	291	62.9%	-3.4%
Most harm event: 50 Overturn/roll over	7	18.9%	16	3.5%	15.5%
First harm event: 11 Struck by unit 1	*1*	*1.8%*	*3*	*0.3%*	*1.4%*
First harm event: 12 Struck by unit 2	*5*	*8.8%*	*46*	*5.2%*	*3.6%*
First harm event: 25 Hit guard rail	*8*	*14.0%*	*294*	*33.4%*	*-19.3%*
Most harm event: 1 Hit unit 1	3	37.5%	14	4.8%	32.7%
Most harm event: 12 Struck by unit 2	2	25.0%	43	14.6%	10.4%
First harm event: 28 Hit concrete or longitudinal barrier	*3*	*5.3%*	*19*	*2.2%*	*3.1%*
First harm event: 50 Overturn/roll over	*1*	*1.8%*	*3*	*0.3%*	*1.4%*
D92 Affected by physical condition	**34**	**12.4%**	**228**	**7.2%**	**5.2%**
Fatigue asleep	*8*	*23.5%*	*56*	*24.6%*	*-1.0%*
Dark illumination	*10*	*29.4%*	*104*	*45.6%*	*-16.2%*
Impaired driver	*14*	*41.2%*	*131*	*57.5%*	*-16.3%*
Curved road	*11*	*32.4%*	*54*	*23.7%*	*8.7%*

Category	# Multi Vehicle Fatal/Serious Injury Crashes	% within each group	# Multi Vehicle Non-fatal/serious Injury Crashes	% within each group	% Difference
First harm event: 2 Hit unit 2	*20*	*58.8%*	*143*	*62.7%*	*-3.9%*
Most harm event: 2 Hit unit 2	13	65.0%	88	61.5%	3.5%
Most harm event: 3 Hit unit 3	2	10.0%	4	2.8%	7.2%
Most harm event: 11 Struck by unit 1	2	10.0%	4	2.8%	7.2%
First harm event: 25 Hit guard rail	*7*	*20.6%*	*52*	*22.8%*	*-2.2%*
Most harm event: 2 Hit unit 2	3	42.9%	17	32.7%	10.2%
Most harm event: 25 Hit guide rail	1	14.3%	21	40.4%	-26.1%
Most harm event: 50 Overturn/roll over	2	28.6%	1	1.9%	26.6%
D98 Other improper driving actions	21	7.6%	262	8.2%	-0.6%
Curved road	*5*	*23.8%*	*48*	*18.3%*	*5.5%*
First harm event: 2 Hit unit 2	*14*	*66.7%*	*160*	*61.1%*	*5.6%*
Most harm event: 2 Hit unit 2	9	64.3%	88	55.0%	9.3%
Most harm event: 25 Hit guide rail	2	14.3%	49	30.6%	-16.3%
First harm event: 25 Hit guard rail	*4*	*19.0%*	*50*	*19.1%*	*0.0%*
Most harm event: 1 Hit unit 1	1	25.0%	1	2.0%	23.0%
Most harm event: 2 Hit unit 2	0	0.0%	16	32.0%	-32.0%
Most harm event: 3 Hit unit 3	1	25.0%	0	0.0%	25.0%
Most harm event: 12 Struck by unit 2	2	50.0%	4	8.0%	42.0%
First harm event: 26 Hit guard rail end	*1*	*4.8%*	*10*	*3.8%*	*0.9%*
First harmful event: 1 Hit unit 1	14	5.1%	81	2.5%	2.5%
Most harm event: 1 Hit unit 1	*10*	*71.4%*	*62*	*76.5%*	*-5.1%*
Most harm event: 12 Struck by unit 2	*3*	*21.4%*	*5*	*6.2%*	*15.3%*
Most harm event: 50 Overturn/rollover	*1*	*7.1%*	*2*	*2.5%*	*4.7%*
First harmful event: 2 Hit unit 2	182	66.2%	1948	61.3%	4.9%
Most harm event: 2 Hit unit 2	***123***	***67.6%***	***1154***	***59.2%***	***8.3%***
Most harm event: 3 Hit unit 3	*12*	*6.6%*	*34*	*1.7%*	*4.8%*
Most harm event: 11 Struck by unit 1	*9*	*4.9%*	*99*	*5.1%*	*-0.1%*
Most harm event: 21 Hit tree or shrubbery	*3*	*1.6%*	*10*	*0.5%*	*1.1%*
Most harm event: 25 Hit guide rail	*7*	*3.8%*	*448*	*23.0%*	*-19.2%*
Most harm event: 26 Hit guide rail end	*3*	*1.6%*	*32*	*1.6%*	*0.0%*
Most harm event: 50 Overturn/rollover	*19*	*10.4%*	*75*	*3.9%*	*6.6%*
First harmful event: 12 Struck by unit 2	23	8.4%	303	9.5%	-1.2%
Most harm event: 1 Hit unit 1	*2*	*8.7%*	*26*	*8.6%*	*0.1%*
Most harm event: 12 Struck by unit 2	*19*	*82.6%*	*223*	*73.6%*	*9.0%*
Most harm event: 25 Hit guide rail	*1*	*4.3%*	*37*	*12.2%*	*-7.9%*
First harmful event: 25 Hit guide rail	32	11.6%	568	17.9%	-6.2%
Most harm event: 1 Hit unit 1	*4*	*12.5%*	*24*	*4.2%*	*8.3%*
Most harm event: 2 Hit unit 2	*12*	*37.5%*	*178*	*31.3%*	*6.2%*
Most harm event: 3 Hit unit 3	*2*	*6.3%*	*4*	*0.7%*	*5.5%*
Most harm event: 12 Struck by unit 2	*6*	*18.8%*	*53*	*9.3%*	*9.4%*
Most harm event: 25 Hit guide rail	*4*	*12.5%*	*211*	*37.1%*	*-24.6%*
First harmful event: 26 Hit guide rail end	3	1.1%	43	1.4%	-0.3%
Most harm event: 11 Struck by unit 1	*1*	*33.3%*	*1*	*2.3%*	*31.0%*
Most harm event: 12 Struck by unit 2	*2*	*66.7%*	*3*	*7.0%*	*59.7%*
Most harmful event: 1 Hit unit 1	18	6.5%	129	4.1%	2.5%
Most harmful event: 2 Hit unit 2	**141**	**51.3%**	**1379**	**43.4%**	**7.9%**
Most harmful event: 3 Hit unit 3	14	5.1%	50	1.6%	3.5%
Most harmful event: 11 Struck by unit 1	10	3.6%	140	4.4%	-0.8%

Category	# Multi Vehicle Fatal/Serious Injury Crashes	% within each group	# Multi Vehicle Non-fatal/serious Injury Crashes	% within each group	% Difference
Most harmful event: 12 Struck by unit 2	32	11.6%	290	9.1%	2.5%
Most harmful event: 25 Hit guide rail	13	4.7%	766	24.1%	-19.4%
Most harmful event: 26 Hit guide rail end	4	1.5%	63	2.0%	-0.5%
Most harmful event: 50 Overturn/roll over	26	9.5%	120	3.8%	5.7%
Speeding	**29**	**10.5%**	**168**	**5.3%**	**5.3%**
Speeding related	116	42.2%	1217	38.3%	3.9%
Curved road	***55***	***47.4%***	***377***	***31.0%***	***16.4%***
Dark illumination	20	36.4%	103	27.3%	9.0%
Wet road	15	27.3%	119	31.6%	-4.3%
Snow slush road	3	5.5%	82	21.8%	-16.3%
Icy road	3	5.5%	36	9.5%	-4.1%
First harm event: 25 Hit guide rail	13	23.6%	139	36.9%	-13.2%
Most harm event: 25 Hit guide rail	3	5.5%	91	24.1%	-18.7%
Dark illumination	***44***	***37.9%***	***370***	***30.4%***	***7.5%***
Wet road	*24*	*20.7%*	*292*	*24.0%*	*-3.3%*
Snow slush road	*9*	*7.8%*	*235*	*19.3%*	*-11.6%*
Icy road	*7*	*6.0%*	*110*	*9.0%*	*-3.0%*
First harm event: 25 Hit guide rail	*17*	*14.7%*	*358*	*29.4%*	*-14.8%*
Most harm event: 25 Hit guide rail	*6*	*5.2%*	*310*	*25.5%*	*-20.3%*
Most harm event: 26 Hit guide rail end	*2*	*1.7%*	*17*	*1.4%*	*0.3%*
Aggressive driving	172	62.5%	2368	74.5%	-11.9%
Curved road	***61***	***35.5%***	***530***	***22.4%***	***13.1%***
Dark illumination	20	32.8%	145	27.4%	5.4%
Speeding related	**51**	**83.6%**	**371**	**70.0%**	**13.6%**
Dark illumination	*52*	*30.2%*	*656*	*27.7%*	*2.5%*
Wet road	*31*	*18.0%*	*431*	*18.2%*	*-0.2%*
Snow slush road	*10*	*5.8%*	*246*	*10.4%*	*-4.6%*
Icy road	*7*	*4.1%*	*117*	*4.9%*	*-0.9%*
Speeding related	***110***	***64.0%***	***1179***	***49.8%***	***14.2%***
Intersection (flag)	52	18.9%	795	25.0%	-6.1%
Curved road	*11*	*21.2%*	*142*	*17.9%*	*3.3%*
Dark illumination	*7*	*13.5%*	*172*	*21.6%*	*-8.2%*
Stop controlled intersection (flag)	*25*	*48.1%*	*258*	*32.5%*	*15.6%*
Signalized intersection (flag)	*12*	*23.1%*	*200*	*25.2%*	*-2.1%*
Other intersection (unsignalized minus stop-controlled)	*15*	*28.8%*	*337*	*42.4%*	*-13.5%*
Curved road	3	20.0%	88	26.1%	-6.1%

Table 20. Crash Characteristics for Multi-Vehicle Fatal or Serious Injury Crashes Involving Guiderails (Reference Group: Multi-Vehicle Fatal or Serious Injury Crashes Involving Other Fixed Objects)

Category	# Multi Vehicle Fatal/Serious Injury Crashes	% within each group	# Multi Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% within each group
Total	**275**	-	**174**	-	-
Interstate	**64**	**23.3%**	**21**	**12.1%**	**11.2%**
Turnpike	10	3.6%	8	4.6%	-1.0%
State Road	**253**	**92.0%**	**127**	**73.0%**	**19.0%**
Dark illumination	*78*	*30.8%*	*59*	*46.5%*	*-15.6%*
Wet road	*37*	*14.6%*	*22*	*17.3%*	*-2.7%*
Snow slush road	*10*	*4.0%*	*3*	*2.4%*	*1.6%*
Icy road	*7*	*2.8%*	*5*	*3.9%*	*-1.2%*
Local road	42	15.3%	52	29.9%	-14.6%
Rural	**183**	**66.5%**	**94**	**54.0%**	**12.5%**
Dark illumination	*53*	*29.0%*	*47*	*50.0%*	*-21.0%*
Wet road	*30*	*16.4%*	*15*	*16.0%*	*0.4%*
Snow slush road	*9*	*4.9%*	*4*	*4.3%*	*0.7%*
Icy road	*7*	*3.8%*	*5*	*5.3%*	*-1.5%*
Curved road	105	38.2%	61	35.1%	3.1%
Dark illumination	*32*	*30.5%*	*32*	*52.5%*	*-22.0%*
Wet road	13	40.6%	3	9.4%	31.3%
Snow slush road	1	3.1%	1	3.1%	0.0%
Icy road	0	0.0%	0	0.0%	0.0%
Wet road	*24*	*22.9%*	*9*	*14.8%*	*8.1%*
Snow slush road	*3*	*2.9%*	*1*	*1.6%*	*1.2%*
Icy road	*3*	*2.9%*	*1*	*1.6%*	*1.2%*
Rural	***80***	***76.2%***	***37***	***60.7%***	***15.5%***
Inclement weather	47	17.1%	30	17.2%	-0.2%
Rain	*27*	*57.4%*	*22*	*73.3%*	*-15.9%*
Sleet (hail)	*2*	*4.3%*	*2*	*6.7%*	*-2.4%*
Snow	*13*	*27.7%*	*3*	*10.0%*	*17.7%*
Fog	*1*	*2.1%*	*0*	*0.0%*	*2.1%*
Rain and fog	*4*	*8.5%*	*3*	*10.0%*	*-1.5%*
Sleet and fog	*0*	*0.0%*	*0*	*0.0%*	*0.0%*
Dark illumination	94	34.2%	84	48.3%	-14.1%
Dark (no street lights)	*59*	*62.8%*	*45*	*53.6%*	*9.2%*
Dark (street lights)	*24*	*25.5%*	*33*	*39.3%*	*-13.8%*
Dusk	*6*	*6.4%*	*3*	*3.6%*	*2.8%*
Dawn	*5*	*5.3%*	*1*	*1.2%*	*4.1%*
Dark – unknown roadway lighting	*0*	*0.0%*	*2*	*2.4%*	*-2.4%*
Dark illumination (flag)	83	30.2%	80	46.0%	-15.8%
Wet road	43	15.6%	30	17.2%	-1.6%

Category	# Multi Vehicle Fatal/Serious Injury Crashes	% within each group	# Multi Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% within each group
Dark illumination	*27*	*62.8%*	*13*	*43.3%*	*19.5%*
Snow slush road	10	3.6%	4	2.3%	1.3%
Dark illumination	*1*	*10.0%*	*3*	*75.0%*	*-65.0%*
Icy road	7	2.5%	6	3.4%	-0.9%
Dark illumination	*1*	*14.3%*	*2*	*33.3%*	*-19.0%*
Prime factor					
D5 Making improper or careless turn	11	4.0%	5	2.9%	1.1%
Intersection	*10*	*90.9%*	*2*	*40.0%*	*50.9%*
Other intersection (unsignalized minus stop-controlled)	*4*	*36.4%*	*1*	*20.0%*	*16.4%*
Signalized intersection	*5*	*45.5%*	*0*	*0.0%*	*45.5%*
Stop controlled intersection	*1*	*9.1%*	*1*	*20.0%*	*-10.9%*
D14 Careless passing or lane change	**31**	**11.3%**	**9**	**5.2%**	**6.1%**
Rural	*12*	*38.7%*	*7*	*77.8%*	*-39.1%*
Dark illumination	*7*	*22.6%*	*4*	*44.4%*	*-21.9%*
Curved road	*6*	*19.4%*	*0*	*0.0%*	*19.4%*
First harm event: 1 Hit unit 1	*2*	*6.5%*	*0*	*0.0%*	*6.5%*
First harm event: 2 Hit unit 2	*22*	*71.0%*	*0*	*0.0%*	*71.0%*
Most harm event: 2 Hit unit 2	10	45.5%	0	0.0%	45.5%
Most harm event: 3 Hit unit 3	3	13.6%	0	0.0%	13.6%
Most harm event: 25 Hit guard rail	1	4.5%	0	0.0%	4.5%
Most harm event: 26 Hit guard rail end	2	9.1%	0	0.0%	9.1%
Most harm event: 28 Hit concrete or longitudinal barrier	1	4.5%	0	0.0%	4.5%
Most harm event: 48 Hit other fixed object	1	4.5%	0	0.0%	4.5%
Most harm event: 50 Overturn/roll over	4	18.2%	0	0.0%	18.2%
First harm event: 4 Hit unit 4	*1*	*3.2%*	*0*	*0.0%*	*3.2%*
First harm event: 12 Struck by unit 2	*1*	*3.2%*	*0*	*0.0%*	*3.2%*
First harm event: 25 Hit guard rail	*2*	*6.5%*	*0*	*0.0%*	*6.5%*
First harm event: 26 Hit guard rail end	*1*	*3.2%*	*0*	*0.0%*	*3.2%*
First harm event: 37 Hit impact attenuator	*1*	*3.2%*	*0*	*0.0%*	*3.2%*
First harm event: 43 Hit temporary construction barrier	*1*	*3.2%*	*0*	*0.0%*	*3.2%*
D18 Driving on the wrong side of roadway	**38**	**13.8%**	**4**	**2.3%**	**11.5%**
Curved road	*19*	*50.0%*	*2*	*50.0%*	*0.0%*
Dark illumination	7	36.8%	2	100.0%	-63.2%
Dark illumination	*12*	*31.6%*	*4*	*100.0%*	*-68.4%*
Impaired driver	*10*	*26.3%*	*3*	*75.0%*	*-48.7%*
Fatigue asleep	*5*	*13.2%*	*0*	*0.0%*	*13.2%*
Wet road	*6*	*15.8%*	*0*	*0.0%*	*15.8%*
Rural	***34***	***89.5%***	***2***	***50.0%***	***39.5%***
Speeding related	*7*	*18.4%*	*1*	*25.0%*	*-6.6%*
First harm event: 1 Hit unit 1	*1*	*2.6%*	*0*	*0.0%*	*2.6%*
First harm event 2 Hit unit 2	***33***	***86.8%***	***0***	***0.0%***	***86.8%***
Most harm event: 2 Hit unit 2	27	81.8%	0	0.0%	81.8%
Most harm event: 11 Struck by unit 1	3	9.1%	0	0.0%	9.1%

Category	# Multi Vehicle Fatal/Serious Injury Crashes	% within each group	# Multi Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% within each group
First harm event: 25 Hit guard rail	*2*	*5.3%*	*0*	*0.0%*	*5.3%*
D22 Over or under compensation at curve	12	4.4%	8	4.6%	-0.2%
Speeding related	*3*	*25.0%*	*4*	*50.0%*	*-25.0%*
First harm event: 2 Hit unit 2	*10*	*83.3%*	*0*	*0.0%*	*83.3%*
Most harm event: 2 Hit unit 2	6	60.0%	0	0.0%	60.0%
Most harm event: 25 Hit guide rail	1	10.0%	0	0.0%	10.0%
Most harm event: 50 Overturn/roll over	3	30.0%	0	0.0%	30.0%
First harm event: 25 Hit guard rail	*1*	*8.3%*	*0*	*0.0%*	*8.3%*
Most harm event: 12 Struck by unit 2	1	100.0%	0	0.0%	100.0%
D23 Speeding	13	4.7%	18	10.3%	-5.6%
Curved road	*7*	*53.8%*	*6*	*33.3%*	*20.5%*
Dark illumination	*8*	*61.5%*	*12*	*66.7%*	*-5.1%*
First harm event: 2 Hit unit 2	*10*	*76.9%*	*0*	*0.0%*	*76.9%*
Most harm event: 2 Hit unit 2	5	50.0%	0	0.0%	50.0%
Most harm event: 3 Hit unit 3	1	10.0%	0	0.0%	10.0%
Most harm event: 11 Struck by unit 1	2	20.0%	0	0.0%	20.0%
Most harm event: 25 Hit guide rail	1	10.0%	0	0.0%	10.0%
Most harm event: 50 Overturn/roll over	1	10.0%	0	0.0%	10.0%
First harm event: 25 Hit guard rail	*3*	*23.1%*	*0*	*0.0%*	*23.1%*
Most harm event: 2 Hit unit 2	2	66.7%	0	0.0%	66.7%
Most harm event: 25 Hit guide rail	1	33.3%	0	0.0%	33.3%
D24 Driving too fast for conditions	57	20.7%	39	22.4%	-1.7%
Curved road	***31***	***54.4%***	***13***	***33.3%***	***21.1%***
Dark illumination	**8**	**25.8%**	**5**	**38.5%**	**-12.7%**
Dark illumination	*18*	*31.6%*	*16*	*41.0%*	*-9.4%*
Wet road	*17*	*29.8%*	*15*	*38.5%*	*-8.6%*
Snow slush road	*9*	*15.8%*	*3*	*7.7%*	*8.1%*
Icy road	*7*	*12.3%*	*4*	*10.3%*	*2.0%*
First harm event: 1 Hit unit 2	*2*	*3.5%*	*0*	*0.0%*	*3.5%*
First harm event: 2 Hit unit 2	***37***	***64.9%***	***0***	***0.0%***	***64.9%***
Most harm event: 2 Hit unit 2	22	59.5%	0	0.0%	59.5%
Most harm event: 50 Overturn/roll over	7	18.9%	0	0.0%	18.9%
First harm event: 11 Struck by unit 1	*1*	*1.8%*	*0*	*0.0%*	*1.8%*
First harm event: 12 Struck by unit 2	*5*	*8.8%*	*0*	*0.0%*	*8.8%*
First harm event: 25 Hit guard rail	*8*	*14.0%*	*0*	*0.0%*	*14.0%*
Most harm event: 1 Hit unit 1	3	37.5%	0	0.0%	37.5%
Most harm event: 12 Struck by unit 2	2	25.0%	0	0.0%	25.0%
First harm event: 28 Hit concrete or longitudinal barrier	*3*	*5.3%*	*14*	*35.9%*	*-30.6%*
First harm event: 50 Overturn/roll over	*1*	*1.8%*	*0*	*0.0%*	*1.8%*
D92 Affected by physical condition	34	12.4%	32	18.4%	-6.0%
Fatigue asleep	*8*	*23.5%*	*3*	*9.4%*	*14.2%*
Dark illumination	*10*	*29.4%*	*17*	*53.1%*	*-23.7%*
Impaired driver	*14*	*41.2%*	*19*	*59.4%*	*-18.2%*
Curved road	*11*	*32.4%*	*13*	*40.6%*	*-8.3%*
First harm event: 2 Hit unit 2	*20*	*58.8%*	*0*	*0.0%*	*58.8%*
Most harm event: 2 Hit unit 2	13	65.0%	0	0.0%	65.0%
Most harm event: 3 Hit unit 3	2	10.0%	0	0.0%	10.0%

Category	# Multi Vehicle Fatal/Serious Injury Crashes	% within each group	# Multi Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% within each group
Most harm event: 11 Struck by unit 1	2	10.0%	0	0.0%	10.0%
First harm event: 25 Hit guard rail	*7*	*20.6%*	*0*	*0.0%*	*20.6%*
Most harm event: 2 Hit unit 2	3	42.9%	0	0.0%	42.9%
Most harm event: 25 Hit guide rail	1	14.3%	0	0.0%	14.3%
Most harm event: 50 Overturn/roll over	2	28.6%	0	0.0%	28.6%
D98 Other improper driving actions	21	7.6%	27	15.5%	-7.9%
Curved road	*5*	*23.8%*	*4*	*14.8%*	*9.0%*
First harm event: 2 Hit unit 2	*14*	*66.7%*	*0*	*0.0%*	*66.7%*
Most harm event: 2 Hit unit 2	9	64.3%	0	0.0%	64.3%
Most harm event: 25 Hit guide rail	2	14.3%	0	0.0%	14.3%
First harm event: 25 Hit guard rail	*4*	*19.0%*	*0*	*0.0%*	*19.0%*
Most harm event: 1 Hit unit 1	1	25.0%	0	0.0%	25.0%
Most harm event: 2 Hit unit 2	0	0.0%	0	0.0%	0.0%
Most harm event: 3 Hit unit 3	1	25.0%	0	0.0%	25.0%
Most harm event: 12 Struck by unit 2	2	50.0%	0	0.0%	50.0%
First harm event: 26 Hit guard rail end	*1*	*4.8%*	*0*	*0.0%*	*4.8%*
First harmful event: 1 Hit unit 1	14	5.1%	0	0.0%	5.1%
Most harm event: 1 Hit unit 1	*10*	*71.4%*	*0*	*0.0%*	*71.4%*
Most harm event: 12 Struck by unit 2	*3*	*21.4%*	*0*	*0.0%*	*21.4%*
Most harm event: 50 Overturn/rollover	*1*	*7.1%*	*0*	*0.0%*	*7.1%*
First harmful event: 2 Hit unit 2	**182**	**66.2%**	**0**	**0.0%**	**66.2%**
Most harm event: 2 Hit unit 2	*123*	*67.6%*	*0*	*0.0%*	*67.6%*
Most harm event: 3 Hit unit 3	*12*	*6.6%*	*0*	*0.0%*	*6.6%*
Most harm event: 11 Struck by unit 1	*9*	*4.9%*	*0*	*0.0%*	*4.9%*
Most harm event: 21 Hit tree or shrubbery	*3*	*1.6%*	*0*	*0.0%*	*1.6%*
Most harm event: 25 Hit guide rail	*7*	*3.8%*	*0*	*0.0%*	*3.8%*
Most harm event: 26 Hit guide rail end	*3*	*1.6%*	*0*	*0.0%*	*1.6%*
Most harm event: 50 Overturn/rollover	*19*	*10.4%*	*0*	*0.0%*	*10.4%*
First harmful event: 12 Struck by unit 2	23	8.4%	0	0.0%	8.4%
Most harm event: 1 Hit unit 1	*2*	*8.7%*	*0*	*0.0%*	*8.7%*
Most harm event: 12 Struck by unit 2	*19*	*82.6%*	*0*	*0.0%*	*82.6%*
Most harm event: 25 Hit guide rail	*1*	*4.3%*	*0*	*0.0%*	*4.3%*
First harmful event: 25 Hit guide rail	**32**	**11.6%**	**0**	**0.0%**	**11.6%**
Most harm event: 1 Hit unit 1	*4*	*12.5%*	*0*	*0.0%*	*12.5%*
Most harm event: 2 Hit unit 2	*12*	*37.5%*	*0*	*0.0%*	*37.5%*
Most harm event: 3 Hit unit 3	*2*	*6.3%*	*0*	*0.0%*	*6.3%*
Most harm event: 12 Struck by unit 2	*6*	*18.8%*	*0*	*0.0%*	*18.8%*
Most harm event: 25 Hit guide rail	*4*	*12.5%*	*0*	*0.0%*	*12.5%*
First harmful event: 26 Hit guide rail end	3	1.1%	0	0.0%	1.1%
Most harm event: 11 Struck by unit 1	*1*	*33.3%*	*0*	*0.0%*	*33.3%*
Most harm event: 12 Struck by unit 2	*2*	*66.7%*	*0*	*0.0%*	*66.7%*
Most harmful event: 1 Hit unit 1	18	6.5%	3	1.7%	4.8%
Most harmful event: 2 Hit unit 2	**141**	**51.3%**	**53**	**30.5%**	**20.8%**
Most harmful event: 3 Hit unit 3	14	5.1%	4	2.3%	2.8%
Most harmful event: 11 Struck by unit 1	10	3.6%	6	3.4%	0.2%
Most harmful event: 12 Struck by unit 2	32	11.6%	14	8.0%	3.6%
Most harmful event: 25 Hit guide rail	13	4.7%	0	0.0%	4.7%
Most harmful event: 26 Hit guide rail end	4	1.5%	0	0.0%	1.5%
Most harmful event: 50 Overturn/roll over	26	9.5%	20	11.5%	-2.0%

Category	# Multi Vehicle Fatal/Serious Injury Crashes	% within each group	# Multi Vehicle Fatal/Serious Injury Hit Fixed Object Crashes (Non-guiderail)	% within each group	% within each group
Speeding	29	10.5%	28	16.1%	-5.5%
Speeding related	116	42.2%	87	50.0%	-7.8%
Curved road	*55*	*47.4%*	*38*	*43.7%*	*3.7%*
Dark illumination	20	36.4%	21	55.3%	-18.9%
Wet road	15	27.3%	7	18.4%	8.9%
Snow slush road	3	5.5%	1	2.6%	2.8%
Icy road	3	5.5%	1	2.6%	2.8%
First harm event: 25 Hit guide rail	13	23.6%	0	0.0%	23.6%
Most harm event: 25 Hit guide rail	3	5.5%	0	0.0%	5.5%
Dark illumination	*44*	*37.9%*	*45*	*51.7%*	*-13.8%*
Wet road	*24*	*20.7%*	*20*	*23.0%*	*-2.3%*
Snow slush road	*9*	*7.8%*	*4*	*4.6%*	*3.2%*
Icy road	*7*	*6.0%*	*4*	*4.6%*	*1.4%*
First harm event: 25 Hit guide rail	*17*	*14.7%*	*0*	*0.0%*	*14.7%*
Most harm event: 25 Hit guide rail	*6*	*5.2%*	*0*	*0.0%*	*5.2%*
Most harm event: 26 Hit guide rail end	*2*	*1.7%*	*0*	*0.0%*	*1.7%*
Aggressive driving	172	62.5%	103	59.2%	3.4%
Curved road	*61*	*35.5%*	*40*	*38.8%*	*-3.4%*
Dark illumination	20	32.8%	21	52.5%	-19.7%
Speeding related	51	83.6%	35	87.5%	-3.9%
Dark illumination	*52*	*30.2%*	*50*	*48.5%*	*-18.3%*
Wet road	*31*	*18.0%*	*21*	*20.4%*	*-2.4%*
Snow slush road	*10*	*5.8%*	*4*	*3.9%*	*1.9%*
Icy road	*7*	*4.1%*	*5*	*4.9%*	*-0.8%*
Speeding related	*110*	*64.0%*	*83*	*80.6%*	*-16.6%*
Intersection (flag)	52	18.9%	26	14.9%	4.0%
Curved road	*11*	*21.2%*	*9*	*34.6%*	*-13.5%*
Dark illumination	*7*	*13.5%*	*8*	*30.8%*	*-17.3%*
Stop controlled intersection (flag)	*25*	*48.1%*	*5*	*19.2%*	*28.8%*
Signalized intersection (flag)	*12*	*23.1%*	*11*	*42.3%*	*-19.2%*
Other intersection (unsignalized minus stop-controlled)	*15*	*28.8%*	*10*	*38.5%*	*-9.6%*
Curved road	3	20.0%	5	50.0%	-30.0%

APPENDIX G

Table 21. Crash Characteristics for Motor Vehicle Failure Crashes

Category	Motor Vehicle Failure Crashes	% within the group
Total	**8813**	**-**
Interstate	1053	11.9%
State road	**6101**	**69.2%**
Local road	**3361**	**38.1%**
Urban area	**4475**	**50.8%**
Failure type		
Tires	1987	22.5%
Curved road	**523**	**26.3%**
Inclement weather	402	20.2%
Non daylight	**609**	**30.6%**
Inclement surface	**503**	**25.3%**
Intersection	200	10.1%
Speeding related	274	13.8%
Brake system	2192	24.9%
Curved road	289	13.2%
Inclement weather	227	10.4%
Non daylight	**450**	**20.5%**
Inclement surface	313	14.3%
Intersection	**997**	**45.5%**
Rear-end	**344**	**34.5%**
Angle	231	23.2%
Hit fixed object	**304**	**30.5%**
Speeding related	125	5.7%
Steering	1045	11.9%
Curved road	**236**	**22.6%**
Inclement weather	99	9.5%
Non daylight	**356**	**34.1%**
Inclement surface	137	13.1%
Intersection	175	16.7%
Speeding related	5	0.5%
Suspension	269	3.1%
Curved road	53	19.7%
Inclement weather	27	10.0%
Non daylight	**83**	**30.9%**
Inclement surface	40	14.9%
Intersection	36	13.4%
Power train	780	8.9%
Curved road	82	10.5%
Inclement weather	91	11.7%
Non daylight	**198**	**25.4%**
Inclement surface	128	16.4%
Intersection	**163**	**20.9%**

Category	Motor Vehicle Failure Crashes	% within the group
Wheels	791	9.0%
Curved road	132	16.7%
Inclement weather	84	10.6%
Non daylight	246	31.1%
Inclement surface	104	13.1%
Intersection	118	14.9%