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NATIONAL CENTER for TRANSIT RESEARCH

Evaluation of Rear-end Bus Collisions and Identification of Possible Solutions

Final Report

BDK85-977-50

March 2014

PREPARED FOR
Florida Department of Transportation

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NCTR at CUTR
National Center for Transit Research

National Center for Transit Research
Center for Urban Transportation Research
University of South Florida
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Evaluation of Rear-end Bus Collisions and Identification of Possible Solutions

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Metric Conversion

SI* Modern Metric Conversion Factors as provided by the Department of Transportation, Federal Highway Administration http://www.fhwa.dot.gov/aaa/metricp.htm

LENGTH				
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
in	Inches	25.4	millimeters	mm
ft	Feet	0.305	meters	m
yd	Yards	0.914	meters	m
mi	Miles	1.61	kilometers	km

AREA				
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m2
yd^2	square yard	0.836	square meters	m2
ac	Acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2

LENGTH				
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi

AREA				
SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
mm^2	square millimeters	0.0016	square inches	in^2
m2	square meters	10.764	square feet	ft^2
m2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

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16. Abstract

The purpose of this project was to conduct a systematic study to examine rear-end collisions between motorists and public transit buses to achieve the following objectives: determine if rear-end collisions are increasing; conduct an assessment to ascertain the prevalence of rear-end collisions; identify conditions that exist when rear-end collisions occur; identify mitigation strategies for agencies that have identified rear-end collisions as a major issue; assess impact of Yield to Bus and pull-out bays on rear-end collisions; identify solutions and/or strategies to reduce rear-end collisions, and examine bus safety legislation in other states and assess whether Florida's current statutes need to be revised.

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The Research Team would like to express our appreciation for FDOT staff members for their oversight, management, and support of this research effort.

Executive Summary

The purpose of this project was to conduct a systematic study of rear-end collisions between motorists and public transit buses. We examined both cases in which the vehicle rear-ended the bus (rear-ended collision) and in which the bus rear-ended the vehicle (rear-ending collision); the term rear-end collision includes both types of collision. The project had the following objectives:

- Determine if rear-end collisions are increasing
- Conduct an assessment to ascertain the prevalence of rear-end collisions
- Identify conditions that exist when rear-end collisions occur
- Identify mitigation strategies for agencies that have identified rear-end collisions as a major issue
- Assess impact of Yield to Bus and pull-out bays on rear-end collisions, and
- Identify solutions and/or strategies to reduce rear-end collisions.

Literature Review

For this research, a general literature review of bus transit safety, collisions, and bus safety legislation was conducted. Major findings found that over the past ten years, there have been improvements made in transit accident reporting. Past research has called out the need for a more standardized method of data collection so that accident data can be reviewed across systems and states. While some states and transit agencies report accident data addressing many characteristics, there was no federal reporting requirement regarding identification of rear-end collisions. In response, the Federal Transit Administration (FTA) modified (in 2008) its accident reporting requirements within the National Transit Database to require more detailed information about transit bus accidents. These reporting changes included rear-end collisions as a separate reporting category. Going forward, the data collected through this system will allow further comparisons of rear-end collisions across transit systems.

Prevalence of Rear-end Collisions

In examining existing literature and reports related to the incidence of transit bus rear-end collisions over time, previous research is fairly limited. While there have been studies documenting the characteristics of where and when these accidents occured, there is no substantive research or conclusions regarding causes or prevalence of these types of accidents. In addition, there is no literature that points to a trend toward more or fewer transit bus rear-end collisions.

Strategies

Based on the inconclusiveness of past research found during our literature review, it is difficult to identify strategies to specifically reduce the incidence of rear-end bus collisions. While it is important to continue to collect accident data for review and analysis, no trends have been identified regarding the prevalence of rear-end collisions.

Data Collection

The Federal Transit Administration maintains a database of major incidents as reported by transit agencies across the country. Most major incidents are collisions and in 2008, the reporting criteria were modified to include rear-ended and rear-ending collisions. According to the S&S 40 Form, a rear-ending collision is defined as, "{the} agency's transit vehicle was impacted on its front end when it rear-ended another vehicle." A rear-ended collision is defined as, "{the} agency's transit vehicle was impacted on its rear end by the front of another vehicle." Thus rear-ending refers to the bus hitting another vehicle in the rear and rear-ended refers to another vehicle hitting the bus in the rear. From this database, data was compiled and aggregated on total, rear-ended and rear-ending collisions for the following:

- United States and territories;
- The ten FTA Regions;
- Florida;
- Florida transit agencies; and
- The six most populous states in 2012.

This analysis showed that Florida's total and rear-ended collision rates, expressed in collisions per 100,000 miles and rear-ended collisions as a percent of total collisions, were much higher when compared to FTA Region 4 (Southeastern U.S.), the national aggregate data (United States and territories), and the six most populous states. Figure ES-1 displays total rear-ended collisions per 100,000 miles for Florida, Region 4, and the United States plus territories, 2008-2012.

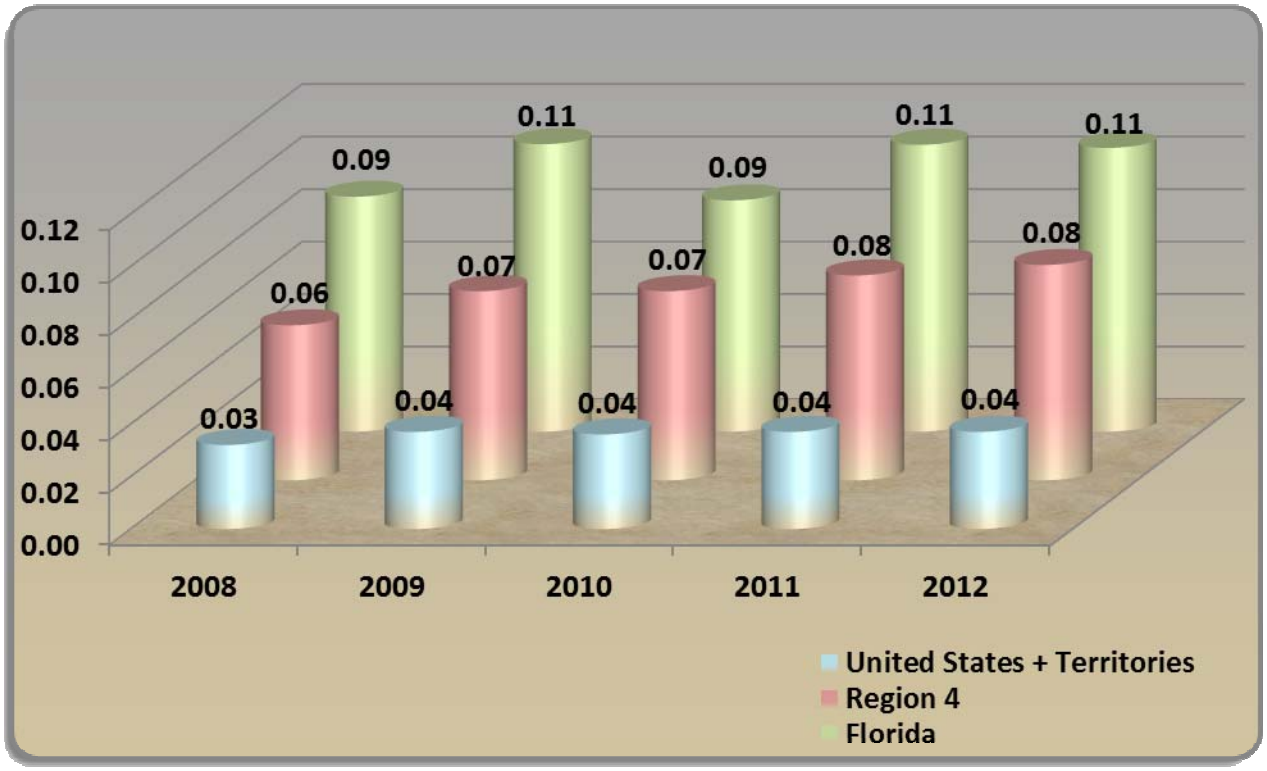

Figure ES-1. Aggregate Total Rear-ended Collisions per 100,000 miles for Florida, Region 4, and the United States plus Territories for the Years 2008-2012

Examination of Collision Files

From the outset, two transit properties in Florida were selected for examinations of collision files: LYNX (The Central Florida Regional Transportation Authority) and Broward County Transit (BCT). In the case of LYNX, Orange, Seminole and Osceola Counties comprise a 2,700 square mile service area that contains many road facility types. Broward County has the most bus bays in Florida, which was a consideration in selecting it to examine whether bus bays prevent or contribute to collisions. LYNX and Broward also had upward trends in rear-ended collisions; however, this was not known until later in the research effort.

The project team reviewed a total of 55 files of rear-ended collisions from January 2011 through December 2012 and a total of 51 rear-ended collision files from October 2011 to September 2013. Data was collected and coded in the following categories:

- **Route direction,** direction the bus was traveling when the collision occurred;
- **Roadway surface conditions,** expressed as dry or wet;
- **Lighting conditions,** expressed as light, dark (lighting and no-lighting), dawn and dusk;
- **Weather conditions,** expressed as clear, cloudy, or raining;
- **Time factors,** including day of week and time of day;
- **Roadway factors**, which include prevalent rear-ended collision corridors, roadway classifications, ownership, lanes, divided/undivided, jurisdiction, and posted speed limits;
- **Transit factors,** including stop location (near side, far side and mid-block), bus movement at rear-ended collision location, passenger injuries, and estimated damage; and
- **Other vehicle factors,** reported for Broward only and including estimated speed of vehicle rear-ending the bus, distraction, obstructed vision, suspicion of drug and/or alcohol use, and whether the driver of the vehicle was transported for medical treatment.

Interviews with Transit Agencies

The Center for Urban Transportation Research (CUTR) conducted a total of seven interviews with representatives of both larger and smaller transit agencies. Interviews were held with PSTA (Pinellas County), Lee County Transit, VOTRAN (Volusia County), PCPT (Pasco County), Spacecoast Area Transit (Brevard), Regional Transit System (Gainesville), and HART (Hillsborough County). The project team sent via e-mail to each interviewee the data that was obtained on their property from the National Transit Database (NTD) Major Incident database and a list of four topical areas to discuss with associated questions: Operations, Risk Management, Training, and Technology. Subsequent to the interviews, the Florida Transit Safety Network met on February 11, 2014, and a workshop was held that day to discuss items from the interviews.

Synthesis and Conclusions

Project findings were synthesized and conclusions drawn, when appropriate, to address the following topical areas:

- **Additional insights – NTD Major Incident Database –** Data was presented to assess prevalence and increases in rear-ended collisions by comparing agency data to National Aggregate, Region 4, six most populous states in 2012, and Florida. All Florida transit agency data was aggregated to establish total collisions per 100,000 miles, rear-ended collisions per 100,000 miles, and rear-ended collisions as a percentage of total collisions. Finally, data will be presented for the average days between collisions for total collisions and rear-ended collisions.
- **Collision reporting and documentation –** This section provided agency examples of checklists to assure file completeness with all agency-gathered reporting and documentation (included as an appendix to the report).
- **Collisions from the operator's perspective –** This section addressed the implications of rear-ended collisions on bus operators in terms of what they can and cannot do in this particular type of collision in relation to defensive driving strategies that might be in place for other types of collisions.
- **Collisions from the other driver's perspective –** This section demonstrated the insights that are gained or not gained from the data examined in Broward files.
- **Implications for law enforcement –** This section provided law enforcement with potential opportunities to ascertain the root causes of rear-ended bus collisions in light of new laws that prohibit certain distractions for drivers.
- **Implications for operations managers –** Implications for operations managers come largely from interviews and the Florida Transit Safety Network (FTSN). This section addressed training, procedures, and technology.
- **Future research –** This section addressed the limitations of this study and areas that might more fully inform this topic, especially in the areas of risk management, roadway facilities, and public awareness campaigns.

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List of Acronyms

BCT	Broward County Transit
CFRTA	Central Florida Regional Transportation Authority
CUTR	Center for Urban Transportation Research
DHSMV	Division of Highway Safety and Motor Vehicles
ECAT	Escambia County Area Transit
FDLE	Florida Department of Law Enforcement
FDOT	Florida Department of Transportation
FHP	Florida Highway Patrol
F.S.	Florida Statutes
FTA	Federal Transit Administration
FTSN	Florida Transit Safety Network
GOLINE	GoLine Transit
HART	Hillsborough Area Regional Transit Authority
JTA	Jacksonville Transportation Authority
LEETRAN	Lee County Transit
MCAT	Manatee County Area Transit
NCTR	National Center for Transit Research
NTD	National Transit Database
OCT	Okaloosa County Transit
PALM TRAN	Palm Beach County Surface Transportation
PCPT	Pasco County Public Transportation
PSTA	Pinellas Suncoast Transit Authority
PCTS	Polk County Transit
SAMIS	Safety Management Information Statistics
SCAT	Sarasota County Area Transit
SCAT	Space Coast Area Transit
SFRTA	South Florida Regional Transportation Association
SCAT	Space Coast Area Transit
USF	University of South Florida
VOTRAN	Volusia County Transit

Chapter 1
Literature Review

Literature Review

The purpose of this project is to conduct a systematic study to examine rear-end collisions, between motorists and public transit buses to achieve the following objectives:

- Determine if rear-end collisions are increasing
- Conduct an assessment to ascertain the prevalence of rear-end collisions
- Identify conditions that exist when rear-end collisions occur
- Identify mitigation strategies for agencies that have identified rear-end collisions as a major issue
- Assess impact of Yield to Bus and pull out bays on rear-end collisions
- Identify solutions and/or strategies to reduce rear-end collisions
- Examine bus safety legislation in other states and assess whether Florida's current statutes need to be revised

For this research, a general literature review of bus transit safety, collisions and bus safety legislation was conducted. A summary of the findings from eight reports selected for this review comprise the remainder of this chapter.

Transit Cooperative Research Project Synthesis 18: Bus Occupant Safety

Developed by the Transit Cooperative Research Program in 1996, this report synthesized methods and findings related to keeping passengers safe while riding fixed-route systems. The report used existing literature, as well as, conducted surveys, interviews, and site visits to explore methods used by transit agencies to reduce and minimize passengers' injuries while riding, boarding, and exiting the fixed-route bus system. Broken into two main parts, the report first reviewed and discussed the characteristics of bus passenger safety, and then provided a background on existing transit industry programs that aim to reduce the incidence of transit bus accidents.

Bus Passenger Safety

By reviewing and analyzing existing Safety Management Information Statistics (SAMIS) data and National Transit Summaries from the Federal Transit Administration (FTA), the report discussed the types of information available on transit bus accidents/incidents, passenger injuries, and where and how incidents occurred. The accident/incident data was reported both in aggregate and as incidents per vehicle miles, as well as per passenger miles. The report also discussed types of accidents. It should be noted that, at the time of this report (1996), rear-end collisions were not specified as an individual category in the SAMIS data. However, the report did look at individual agency data, some of which identified rear-end collisions as a sub-category.

Transit Industry Programs

By surveying transit agencies, conducting site visits and interviewing existing transit leaders, this report also considered how programs and policies within the agencies addressed the issue or bus accidents and passenger safety. Information was gathered and review regarding the selection and hiring processes of drivers at the agencies, including driver selection/hiring and driver incentive programs. Many agencies had existing customer safety programs in operation, such as education and media campaigns assisting passenger in providing information about how to stay safe while riding and waiting for the bus. Materials were also gathered and reviewed regarding the buses themselves, including the brake lights/warning systems installed on buses, deceleration systems installed and the environment surrounding bus stop/station locations and how they can factor into collisions and passenger injuries.

Findings and Recommendations

This report concluded by identifying several areas for further research, to better understand and alleviate the incidence of bus accidents and passenger injury. A few recommendations pertinent to our current study include:

- Standardization of data for accident/incident collection
- Identification of accident/incidents costs to justify future industry action/planning
- Effectiveness of new safety countermeasures/programs
- Rear-end collision research to identify best methods for bus marking/lighting

Transit Cooperative Research Project Report 72: Simulators and Bus Safety: Guidelines for Acquiring and Using Transit Bus Operator Driving Simulators

This 2001 report, produced by the Transit Cooperative Research Program reviewed the use of bus driving simulator systems for training transit bus drivers. While this report did not directly discuss the issue to rear-end collisions, the use of driver simulators is one driver training tool that certainly can result in a possible reduction of rear-end collisions and passenger injuries. By reviewing existing literature on the use of simulator training, as well as conducting surveys and on-site visits to select transit agencies, this report discussed the various types of simulator training that occurs within the industry and their possible advantages/disadvantages. Finally, the report produced a set of guidelines for transit agency leaders and managers to assist in helping them decide if driver simulator training should be added to their existing driver training programs.

Findings and Recommendations

The report drew the following conclusions:

- While simulation systems can enhance the driver training process, they do not replace traditional driver training programs that exist at individual transit agencies. For simulator training to be successful, agencies must plan and integrate it into the existing driver training program and instructional staff must be trained.

- A guided process (guidelines) should be developed for transit agencies to assist them in assessing, acquiring and implementing simulator training within their own agencies.

Transit Cooperative Research Synthesis 49: Yield to Bus State of the Practice

This report was released in 2003 by the Transit Cooperative Research Program on the topic of Yield to Bus programs. Bus pull out lanes remove the transit bus from stopping along a free-flowing roadway. In general, traffic engineers encourage the use of "out of traffic lane" bus stops to minimize the impact of bus stops on traffic. These pull out lanes may also provide a safer situation for passengers to board and disembark the bus. However, bus pull outs require bus operators to safely maneuver back into the flow of traffic following the bus stop. Legislation has been enacted in several States that require traffic to "Yield to Bus". This study sought to analyze the practices and experiences of transit agencies operating under "Yield to Bus" legislation.

By reviewing existing literature and websites, conducting on-site case study visits at several transit agencies, administering industry-wide surveys of fixed-route transit agencies and analyzing safety (crash) data of existing accidents within the bus pull-out process, this study drew conclusions and made recommendations on existing Yield to Bus programs.

In documenting the survey results, data analysis and discussions with the agencies, the report found the following findings and made recommendations for other agencies/states interested in establishing Yield to Bus programs:

Findings

- Agencies using decal markings were much less satisfied with programs as opposed to agencies using flashing lighting (LED) type markings (survey results).
- Lighting costs were greater than decal costs, but more satisfaction received from LED systems.
- Location of lighting and/or decals varied, with majority half way up back of bus on the left side of rear of bus.
- Most agencies did not have accident data available before the changes so comparisons could not be made.

Recommendations

- For States/Jurisdictions interested in legislation, buy in from community is necessary. Public education component, both for motorists and transit operators is necessary for success of Yield to Bus program.
- Yield to Bus markings and lighting on rear of bus vary in effectiveness. Agencies with active lighting/markings rather than decals reported better satisfaction with program.
- Existing roadway conditions can impact effectiveness. Most agencies saw better time savings on slower MPH posted roadways.

- Data Collection/Analysis – agencies should have data – time delay/safety/crash from before program implemented to compare to after program implemented during an evaluation phase.

Analysis of Florida Transit Bus Crashes

Completed in 2001, Analysis of Florida Transit Bus Crashes was produced by the National Center for Transit Research at the Center for Urban Transportation Research. This report reviewed actual transit accident data from select transit agencies within the State of Florida, with an emphasis on agencies that had recently implemented various transit safety training/bus marking/lighting programs.

The report reviewed existing crash data from the agencies prior to implementation of training/bus marking programs and compared it to subsequent crash data from the agency which followed a period of bus operator refresher training or installation of bus rear-lighting mechanisms within the agency.

Impact of Safety Training/Bus Markings

While the study could not conclusively determine that bus operator refresher training led to decrease in total overall crashes, the installation of high density lighting on the rear of the bus led to over a 7 percent decline in rear-end collisions within the transit agency. While the addition of rear-end lighting led to a decline in the rear-end collision rates, the authors suggested further study of other operational campaigns (bus striping, lighted message signs) aimed at reducing rear-end collision should be considered.

Recommended Bus Crash Characteristics

Based on the analysis of before and after crash data, the authors were also able to recommend a comprehensive list of crash occurrence characteristics that are recommended to be compiled/collected during crash reporting so as to assess the effectiveness of future safety campaigns related to reducing the rates of bus collisions within the agencies.

- Recommended crash data characteristics include:
- Date/day of week/time of crash
- Specific location (intersection, bus stop, plaza, cross street)
- Roadway geometry (number of lanes, speed limit)
- Roadway conditions (wet, dry, rough roadway)
- Lighting conditions (sunny, dawn, dusk, cloudy, no streetlights)
- Bus Route number/Bus type & manufacturer
- Operator hire data
- Operator last training course date
- Impact type (head-on, rear-end, sideswipe, bus was hit, bus hit other) (emphasis added)
- Involvement type (other moving vehicle, pedestrian, bicyclist, fixed object, parked object)

National Transit Bus Accident Data Collection and Analysis

Produced by the National Center for Transit Research at the Center for Urban Transportation Research, this 2002 report sought to review and analyze existing data from around the United States documenting public transit bus accidents. While this report sought to compare public transit accident data from across the U.S., it was found early on that statewide accident reporting was not easily obtainable for the parameters of the study. Case studies were conducted on three states (Kansas, Arizona and Idaho). From analysis of the data provided, the study identified a major obstacle in reporting public transit bus accidents. Each individual state developed their own reporting system which made it difficult to analyze and draw conclusions. Based on the results of the study, several recommendations were made:

Findings and Recommendations

- Federal uniform monetary reporting criteria threshold
- Providing "transit bus" category as opposed to "bus/school bus/commercial bus" category
- Identification of key reporting variables to provide full details of transit bus accident
- Ensuring uniformity from accident reporting forms to what is entered into accident database, and
- Develop a national accident tracking and reporting process for uniform analysis.

Analysis of Florida Transit Bus Accidents

Following up on the 2001 study, Analysis of Transit Bus Crashes, and 2002 report, National Transit Bus Accident Data Collection and Analysis, the National Center for Transit Research at the Center for Urban Transportation Research produced this 2004 report. This report was completed by conducting four case studies of medium sized transit agencies within the State of Florida following bus operator training courses within the agencies and sought to identify the outcome in reducing overall transit bus crashes. Also developed with this report was database reporting system for transit system to use to track accident data so that it can be useable for analysis purposes by the agency. While all agencies were gathering crash data as required by FTA for reporting purposes, this project sought to develop a tool (Access database reporting system) for agencies to not only collect crash data, but to provide critical information for future analysis by the agencies when considering future actions for training and safety campaigns.

The case study subjects were chosen based on their recent bus operator training programs and crash data from the four agencies was collected and analyzed based on the crash characteristics identified in the 2001 Analysis of Florida Transit Bus Crashes report.

Findings and Recommendations

While this report could not draw any conclusions as to the effectiveness or impact of bus operator training programs on the occurrences of transit bus crashes over time, several recommendations were made for future analysis of crash data:

- Crash data should be analyzed by the transit agencies to a localized degree: identify where/what routes are experiences most accident, identify how crashes are impacting revenue service miles, etc.
- Federal crash accident reporting requirements should be more comprehensive to provide opportunity for analysis. Agencies should consider collecting more information than is required by federal funding agencies.
- Agencies should consider using a computer-based data collection tool to ensure all pertinent crash data characteristics are being collected to use for future analysis and possible future action.

Florida Bus Incident Reporting Tracking and Analysis System

Building upon its past studies addressing bus crash reporting and analysis, the National Center for Transit Research (NCTR) at the Center for Urban Transportation Research (CUTR) completed this 2006 report. Based on the findings from CUTR's 2001 and 2004 studies, this report developed a basic bus incident database reporting system to assist transit agencies in documenting and analyzing accident data within their agencies. By assisting the agencies with a standardized method of data collection, the report sought to aggregate the data collected by the many transit agencies in Florida so that a statewide web-based incident system could be developed.

Prior to the computer-based tool being developed, the authors identified and reviewed accident reporting standards with the U.S. State Departments of Transportation. The report identified several states that had developed similar tools for accident data collection and/or had mandated State programs to assist the transit agencies in collecting and reporting their accident data. Based on past research, these programs/systems not only should assist with the collection of the crash data (characteristics), but should provide a method for agencies to analyze the crash data to look for trends and commonalities that can be alleviated by the agencies perhaps through training and/or bus control devices. Reporting systems in three States (New York, North Carolina and Texas) were reviewed and summarized.

With consideration of the existing systems in place in New York, North Carolina and Texas, and the FTA's National Transit Database Safety and Security module, the Florida Bus Incident Reporting, Tracking and Analysis System was developed. It utilized much of the recommended bus crash characteristics identified in the 2001 study (Analysis of Transit Bus Crashes) and built upon the recommendations made in the 2004 Analysis of Florida Transit Bus Accidents.

Florida State Highway System Transit Safety Study

This report was produced by Luke Transportation Engineering Consultants in 2004 to determine traffic design systems along the State and Federal Highway System in order to reduce accidents with public transit vehicles along established transit routes and at transit stops and stations. In conducting the study, the authors reviewed crash data and conducted surveys with many transit agencies within the State of Florida.

Findings

- The major cause of accidents with public transit vehicles was inattentive and careless driving on the part of automobile operators.
- The most serious accidents resulting in injuries near transit stops occurred when automobile operators rear-ended a bus.
- Most transit systems surveyed have evaluated and implemented (installed) lighting of the rear of buses to alert automobile operators.

Summary and Conclusions

In the past ten years, there have been improvements made in transit accident reporting. Past research has called out the need for a more standardized method of data collection so that accident data can be reviewed across systems and states. While some states and transit agencies report accident data addressing many characteristics, there was no federal reporting requirement regarding identification of rear-end collisions. In response, the FTA modified (in 2008) its accident reporting requirements within the National Transit Database to require more detailed information about transit bus accidents. These reporting changes identified rear-end collisions as a separate reporting category. Going forward, the data collected through this system will allow further comparisons of rear-end collisions across transit systems.

Prevalence of Rear-end Collisions

In examining existing literature and reports related to the incidence of transit bus rear-end collisions over time, previous research is fairly limited. While there have been studies documenting the characteristics of where and when these accidents are occurring, there is no substantive research or conclusions regarding causes or prevalence of these types of accidents. In addition, there is no literature that points to an upward or downward trend in transit bus rear-end collisions.

Strategies

Based on the inconclusiveness of past research found during our literature review, it is difficult to identify strategies to specifically reduce the incidence of rear-end bus collisions. While it is important to continue to collect accident data for review and analysis, no trends have been identified regarding the prevalence of rear-end collisions.

Yield to Bus Legislation

At the time of this study, we found seven US States to have implemented "Yield to Bus" legislation, requiring motorists to yield the right-of-way to a bus trying to re-enter the flow of traffic following a bus stop. Florida, as well as California, Washington, Oregon, New Jersey, Colorado and Minnesota all have adopted legislation requiring motorists to yield to the bus trying to re-enter traffic.

The effectiveness of Yield to Bus legislation is inconclusive. Even in states where legislation has been enacted, transit operators complain of drivers not yielding the right-of-way to the transit bus attempting to re-enter the flow of traffic. Research has found education of the public about the law and enforcement of the law varies from state to state.

Bus Marking and Lighting

Some industry research has been done on the use of rear-end lighting and marking systems. While some research has shown a decrease in rear-end collisions after the initial installation of the systems, there is no substantive research that the new lighting systems cause a permanent reduction in rear-end collisions.

Often automobile operators are distracted and inattentive to the operation of the transit bus in front of them. While rear-end lighting systems certainly alert automobile operators of the actions of the transit bus, there will always exist the uncontrolled variable of the automobile operator. While bus operators can continue to be trained and lighting can continue to be installed on transit buses, there will always be an independent variable (automobile operator) that may be distracted, inattentive to transit bus warning lights or uneducated about yield to bus laws.

Chapter 2
Examination of National, FTA Regional, and Florida Motorbus Collisions

Introduction

When the scope of services of this study was prepared, CUTR proposed utilizing databases available from the Florida Division of Highway Safety and Motor Vehicles (DHSMV) for collision reporting.

Specifically, the scope called for utilizing the following:

- The statewide crash database, which is the database maintained by the Florida DHSMV for collision reporting.
- The database for citations issued, also maintained by DHSMV and which will assist in determining the incidence of motorists being cited for the Yield to Bus Law (Chapter 316.0815);
- The Florida Traffic Crash Report/Long Form editions; and
- The collision investigation files maintained by the targeted transit agencies for a reasonably available period, such as three years.

Subsequent to preparation of this scope of services, the FTA asked CUTR to play a significant role in assisting FTA with implementing the many safety provisions under the new MAP-21 legislation. As part of this new role, FTA made data available to, including a database of collisions from the National Transit Database dating back to 2002. In 2008, FTA conducted a major revamping of how collision data was to be reported. The FTA uses the National Transit Database (NTD) for transit agencies to report collisions. According to the S&S 40 Form, a rear-ending collision is defined as, "{the} agency's transit vehicle was impacted on its front end when it rear-ended another vehicle." A rear-ended collision is defined as, "{the} agency's transit vehicle was impacted on its rear end by the front of another vehicle." Thus rear-ending refers to the bus hitting another vehicle in the rear and rear-ended refers to another vehicle hitting the bus in the rear.

Acquisition of this National Transit Database (NTD) greatly opened up the opportunity to enrich this research effort by providing national trends in collisions as well as detailed trends for Florida transit agencies for the five year reporting period of 2008 through 2012.

In an attempt to match up collisions between the NTD database and the Florida crash database, the research team discovered that the formats of the NTD database and the Florida crash database were structurally different. The effort proved to be unsuccessful. The NTD Database and the Florida crash database are completely different in terms of reporting such that the only common data set between both databases was the date of the incident and in some cases, the location of the incident. Otherwise, the records were irreconcilable. As a result, the NTD database will be used as the foundation for data reporting for this study and not the Florida crash database.

According to the NTD, Major Incidents must meet at least one of the following thresholds:

- A fatality (not including deaths due to natural causes)
- An injury requiring immediate medical attention away from the scene
- Property damage (to transit agency property and other parties' property) of $25,000 or more
- Evacuations due to life safety reasons ("imminent danger")
- Mainline derailment (rail modes only).

Safety incidents that are reported as Major Incidents, reported on the Safety and Security-40 (S&S-40) forms, if meeting one of the above thresholds, include:

- Collisions (meets one of the above thresholds)
- Mainline derailment (always report, but if due to a collision then report as collision)
- Fire (meets one of the thresholds AND requires act of suppression)
- Hazardous material spill (meets one of the thresholds AND imminent danger AND requires specialized clean-up)
- "Acts of God" or weather/natural event (meets one of the thresholds)
- Other safety occurrences not classified (meets one of the thresholds—but if ONLY meets injury threshold, then it is not a Major Incident, but reported as a non-major incident on the S&S-50 forms—see below).

Non-major incidents (not included in the FTA NTD database supplied to CUTR) are reported on the S&S-50 forms and include:

- Other safety occurrences not otherwise classified that require immediate medical attention away from the scene (only injury threshold)
    - Injuries from slips and falls (these represents the largest number of incidents overall)
    - Electric shocks
    - Yard derailments
- Fires NOT meeting a major threshold, bur requiring suppression.

Sources: NTD 2013 Safety and Security Reporting Manual

http://www.ntdprogram.gov/ntdprogram/pubs/safetyRM/2013/2013%20S&S%20Reporting%20Manual.pdf and the FDOT 2013 NTD Data Collection & Reporting Training Seminar Workbook

National Trends in Collisions

There are many modes of travel reported on the NTD and it would be impractical to examine all of them. The first step was to select modes that are traditional transit modes to compare over a ten year period in order to establish a magnitude of collisions by mode. The modes selected are as follows:

- Heavy Rail
- Light Rail
- Trolley Bus
- Demand Response
- Motorbus
- Vanpool Year

Table 2-1 below shows that between 2002 and 2012, there were a total of 31,412 collisions on the selected modes of travel. With 23,955 total collisions, motorbus accounted for 76.3 percent of the total for the selected modes. The demand response mode accounted for 3,748 collisions, or 12.0 percent of the total. Of note for this table is the total number of collisions, reported between 2002 and 2007, which then has a sharp increase beginning in 2008. This change is due to a major overhaul by the FTA in changing the criteria and the definitions for reporting major incidents versus minor incidents. As mentioned previously, in 2008 the incident types of "rear-ended" and "rear-ending" were added to the reporting structure. Table 2-1 below displays the collisions by year from 2002 through 2012.

Table 2-1. Total Collisions for Selected Modes - 2002 – 2012

Year	Heavy Rail	% of Total Collisions	Light Rail	% of Total Collisions	Trolley Bus	% of Total Collisions	Demand Response	% of Total Collisions	Motor Bus	% of Total Collisions	Vanpool	% of Total Collisions	NTD Total Collisions (Selected Modes)
2002	70	3.9%	392	22.2%	10	0.6%	80	4.5%	1,211	68.5%	5	0.3%	1,768
2003	45	2.6%	287	16.9%	7	0.4%	110	6.5%	1,252	73.5%	2	0.1%	1,703
2004	34	1.8%	349	18.0%	7	0.4%	87	4.5%	1,456	75.1%	6	0.3%	1,939
2005	26	1.4%	508	28.3%	7	0.4%	104	5.8%	1,147	63.9%	4	0.2%	1,796
2006	24	1.7%	142	10.0%	12	0.8%	114	8.0%	1,129	78.8%	11	0.8%	1,432
2007	39	2.4%	142	8.6%	8	0.5%	156	9.4%	1,296	78.7%	5	0.3%	1,646
2008	62	1.5%	162	3.9%	18	0.4%	771	18.4%	3,162	75.6%	8	0.2%	4,183
2009	81	2.0%	169	4.2%	26	0.6%	569	14.3%	3,121	78.2%	23	0.6%	3,989
2010	116	2.7%	177	4.1%	15	0.4%	750	17.5%	3,224	75.0%	14	0.3%	4,296
2011	121	2.9%	182	4.4%	20	0.4%	519	12.6%	3,261	79.3%	10	0.2%	4,113
2012	142	3.1%	174	3.8%	32	0.7%	488	10.7%	3,696	81.3%	15	0.3%	4,547
Total	**760**	**2.4%**	**2,684**	**8.5%**	**162**	**0.5%**	**3,748**	**12.0%**	**23,955**	**76.3%**	**103**	**0.3%**	**31,412**

Source: NTD Major Incident Database

National Profile of Motorbus Collisions

As mentioned earlier, the National Transit Database implemented an overhaul in 2008 that changed the definitions of major incidents. Virtually every major incident is a collision with the exception of an occasional passenger injury that is non-collision based. The NTD Major Incident database, which is comprised of all 50 states and U.S. territories, was used to determine the total number of bus collisions, the total number of rear-ended collisions and the number of rear-ending collisions between 2008 and 2012. Figure 2-1 below shows that collisions were between 3,100 and 3,300 from 2008 through 2011, then increasing to 3,696 in 2012. Rear-ended collisions ranged from a low of 633 in 2008 to a high of 722 in 2009, but overall account for 20 percent of total collisions. Rear-ending collisions are less than 10 percent of all collisions.

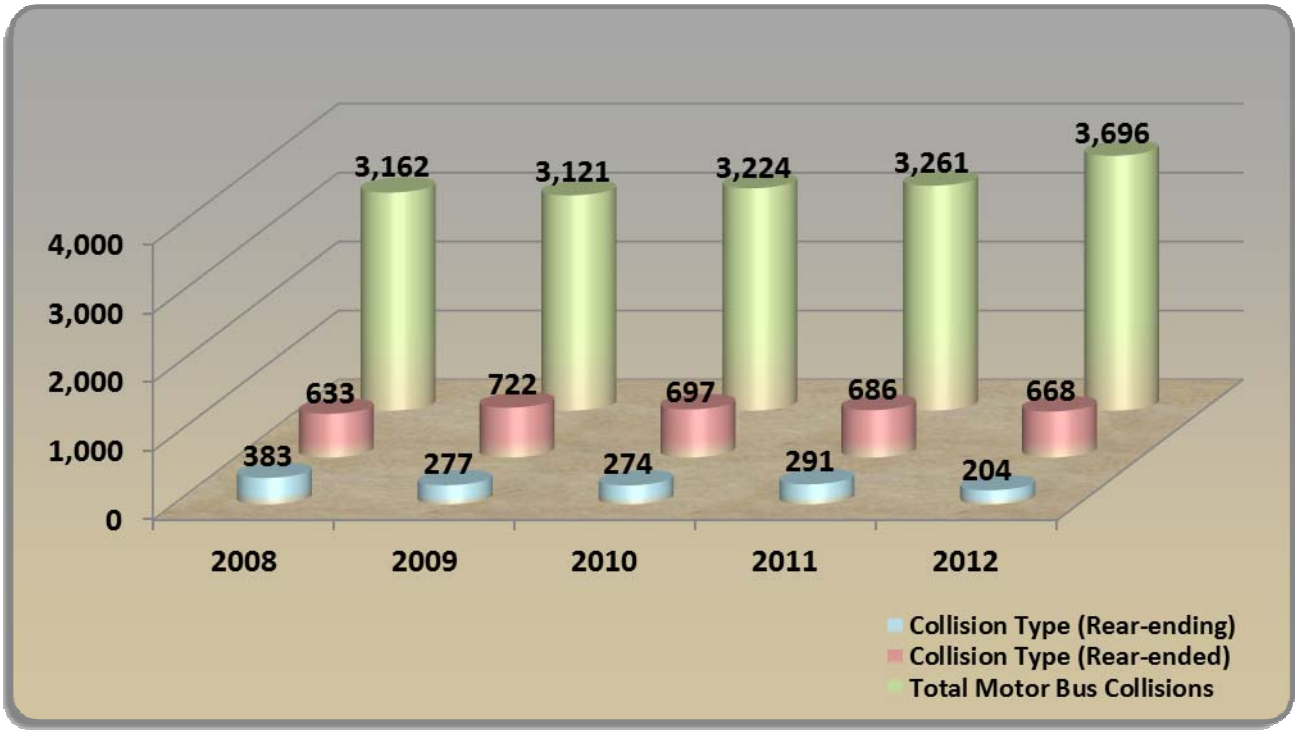

Figure 2-1. Total Annual Motorbus Collisions with Rear-ended and Rear-ending (2008-2012)

In order to establish comparative measures for collisions at the national, regional, state, and transit agency levels, data were derived to display collisions per 100,000 miles and rear-ended and rear-ending collisions as a percentage of total collisions. Figure 2-2 below shows that total collisions range from a low of 0.158 in 2009 to a high of 0.203 in 2012.

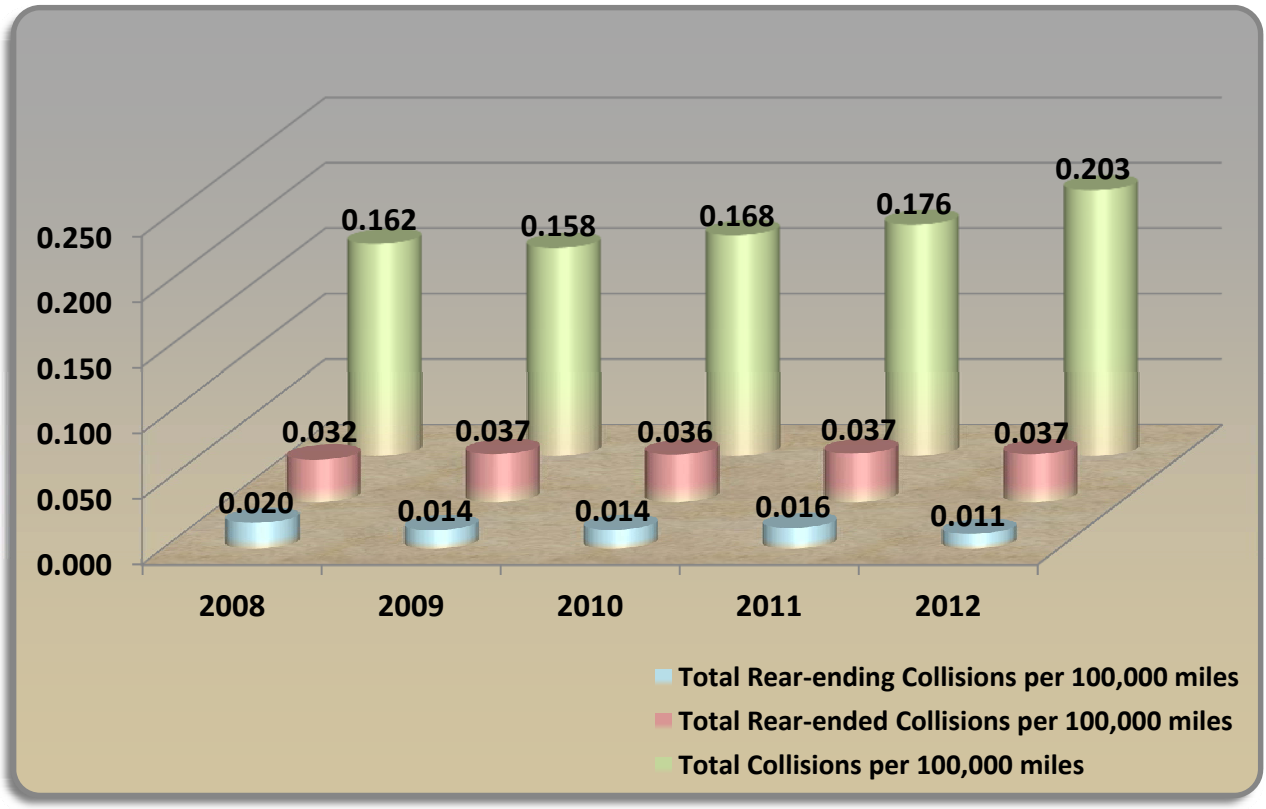

Figure 2-2. Total Annual Motorbus Collisions per 100,000 miles - 2008-2012

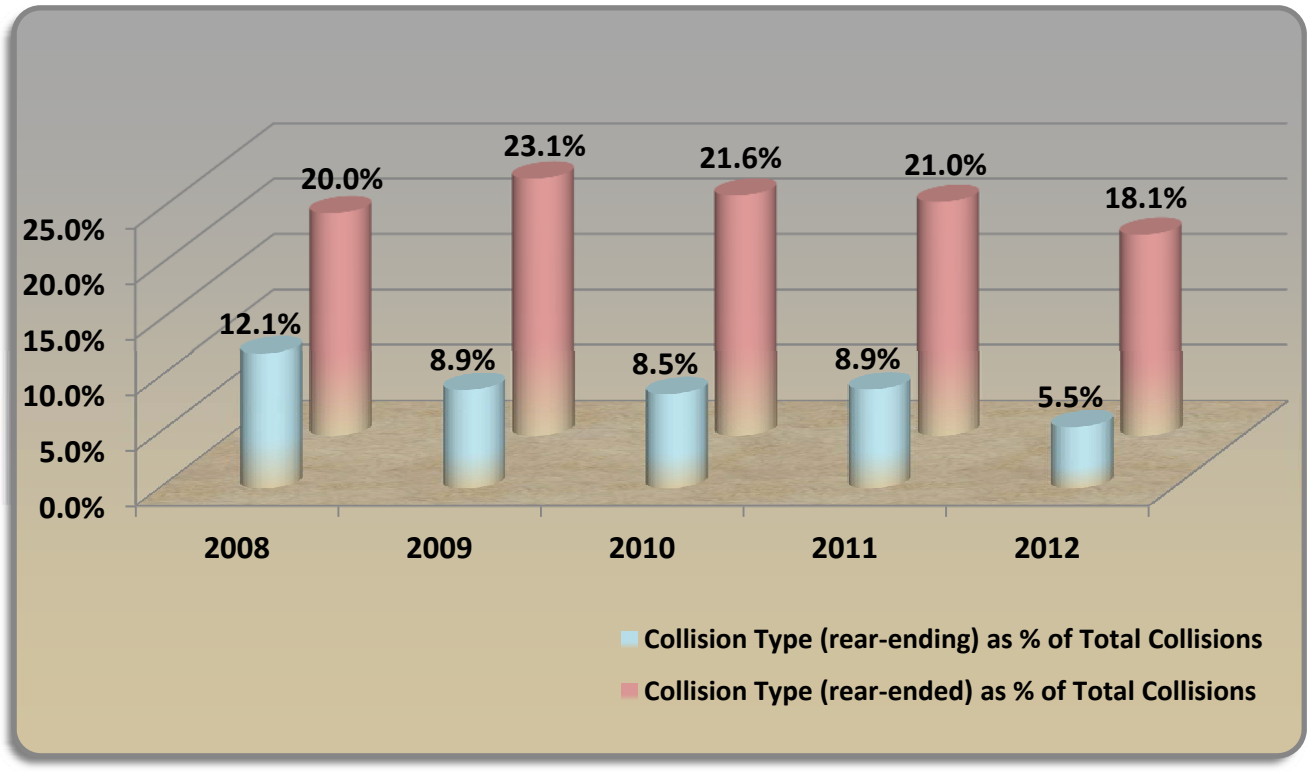

Figure 2-3. Rear-ended and Rear-ending as a Percentage of Total Collisions – 2008-2012

Motorbus Collisions within the Ten FTA Regions

In order to report national trends on collision data, the project team determined the state or territory of every transit system reporting to the NTD. From there, data on total collisions, rear-ended collisions, and rear-ending collisions was collected for each of the ten FTA regions. The ten FTA regions with associated states and territories are listed below. Table 2-2 displays Regions 2, 3, 4, 5, 6 and 9 have one of the six most populous states within the region. Region 4 is the largest region with 8 states and two territories.

Table 2-2. FTA Regions and Associated States

Region 1 • Connecticut • Massachusetts • Maine • New Hampshire • Rhode Island • Vermont **Region 2** • New York • New Jersey **Region 3** • Delaware • District of Columbia • Maryland • Pennsylvania • Virginia • West Virginia **Region 4** • Alabama • Florida • Georgia • Kentucky • Mississippi • North Carolina • South Carolina • Tennessee • The Commonwealth of Puerto Rico • United States Virgin Islands **Region 5** • Illinois • Indiana • Minnesota • Michigan • Ohio • Wisconsin	**Region 6** • Arkansas • Louisiana • New Mexico • Oklahoma • Texas **Region 7** • Iowa • Kansas • Missouri • Nebraska **Region 8** • Colorado • Montana • North Dakota • South Dakota • Utah • Wyoming **Region 9** • Arizona • California • Hawaii • Nevada • Guam • American Samoa • North Marianas **Region 10** • Alaska • Idaho • Oregon • Washington

In the first series of data below, the raw total number of collisions will be reported along with the percentage that rear-ended and rear-ending collisions represent of the total. However, raw numbers and percentages do not create a level playing field among regions because each region has different numbers and sizes of transit systems. In the second

section, in order to display comparative data by region, the total mileage for each region was collected and collisions are reported in total collisions, rear-ended, and rear-ending collisions per 100,000 miles. The data reported below are from 2008 through 2012, with 2008 representing the first year that collision type became part of the reporting system.

In 2008, Region 5 had the most total Motorbus (MB) collisions at 715, and the most total rear-ended collisions at 155, or 21.7 percent of the total. Region 5 was followed by Region 4 with a total of 550 collisions and 144 rear-ended collisions, or 26.2 percent of the total. Region 8 had the lowest number of rear-ended collisions at 7; however, those 7 accounted for 23.3 percent of the region's total collisions. Region 3 had the most rear-ending collisions at 107, or 24.7 percent of the total for that region. Overall for the nation and territories, there were 3,162 total collisions with 633 rear-ended collisions (20.0 percent) and 383 rear-ending collisions (12.1 percent). Figure 2-4 below displays collisions for all ten FTA regions while Figure 2-5 displays rear-ended and rear-ending collisions as a percentage of total collisions.

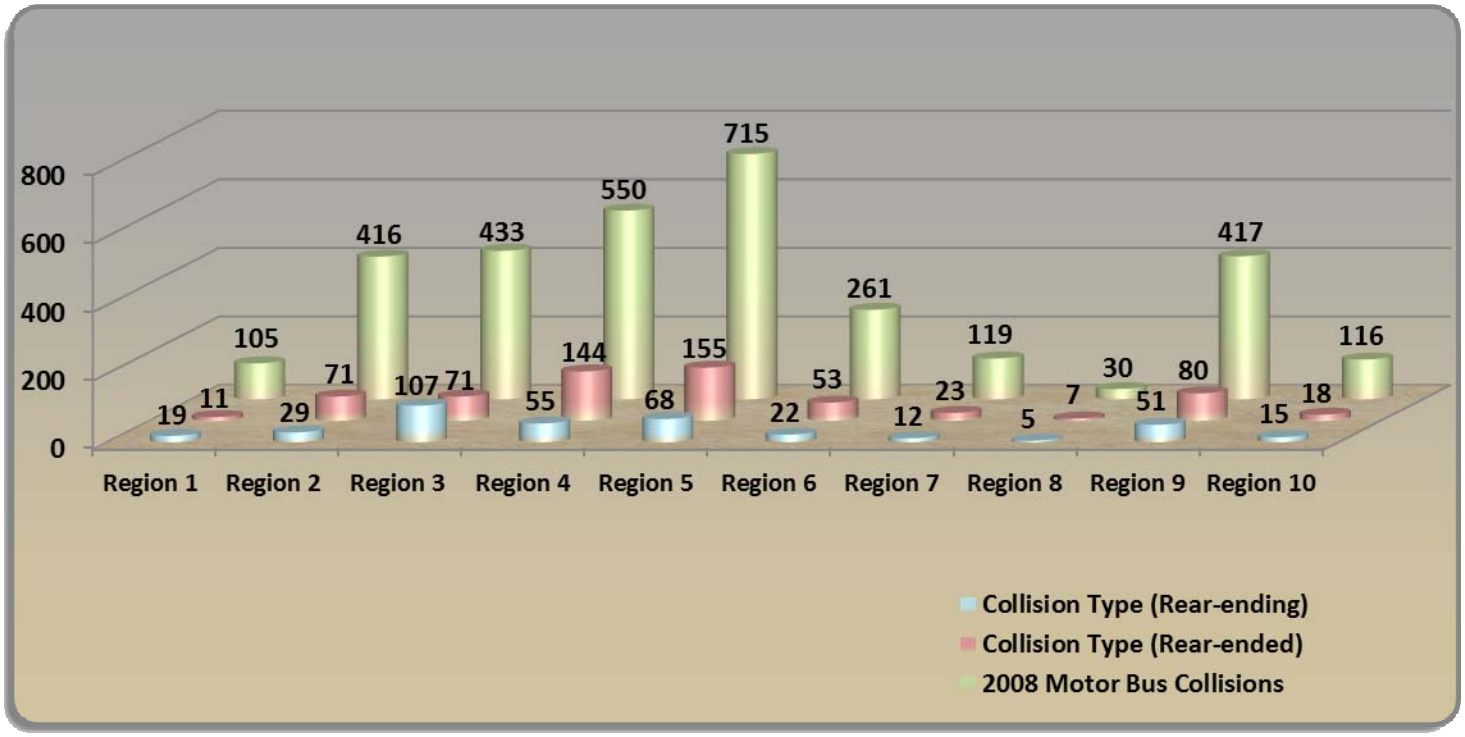

Figure 2-4. Motorbus Collisions by FTA Region - 2008

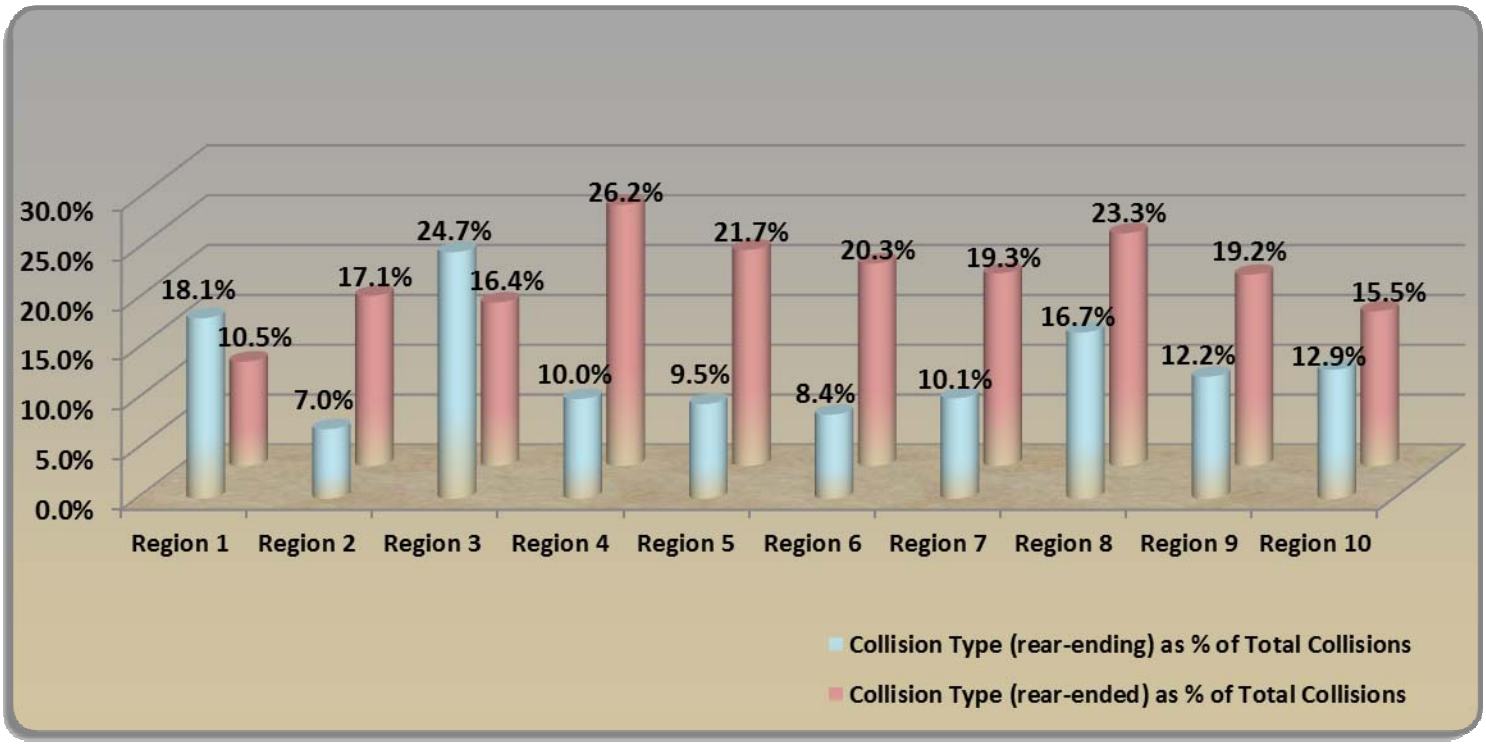

Figure 2-5. Motorbus Collisions by Collision Type as a Percentage of Total Collisions by FTA Region - 2008

In 2009, Region 5 once again had the most total Motorbus collisions at 745, but Region 4 had the most total rear-ended collisions at 178, or 34.3 percent of the total for that region. Region 8 had the lowest number of rear-ended collisions at 19; however, those 19 accounted for 28.4 percent of the region's total collisions. Region 5 had the most rear-ending collisions at 58, or 9.0 percent of the total for that region. Overall for the nation and territories, there were 3,121 total collisions with 722 rear-ended collisions (23.1 percent of the total and a 14 percent increase over 2008) and 277 rear-ending collisions (8.9 percent of the total and a 27.6 percent decrease from 2008). Figure 2-6 below displays the collisions for all ten FTA regions and Figure 2-7 displays rear-ended and rear-ending collisions as a percentage of total collisions.

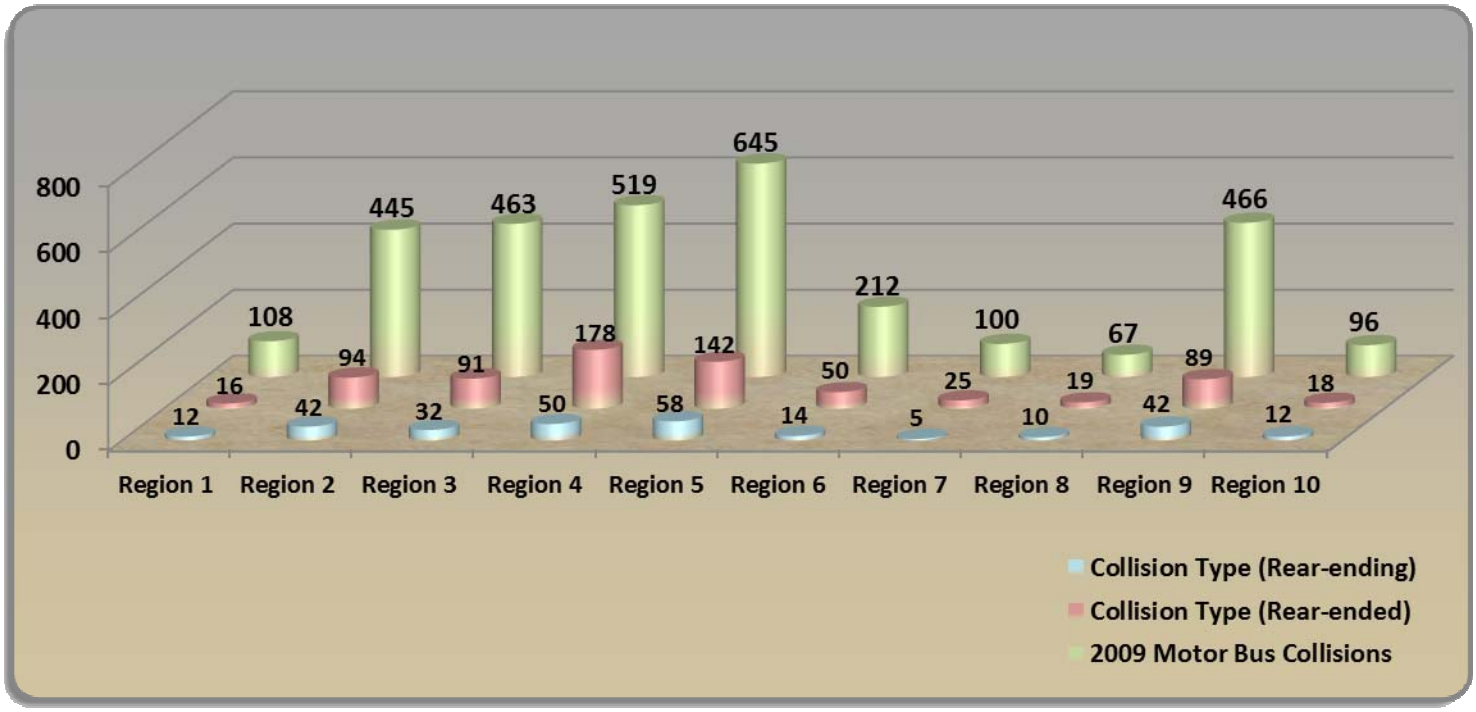

Figure 2-6. Motorbus Collisions by FTA Region - 2009

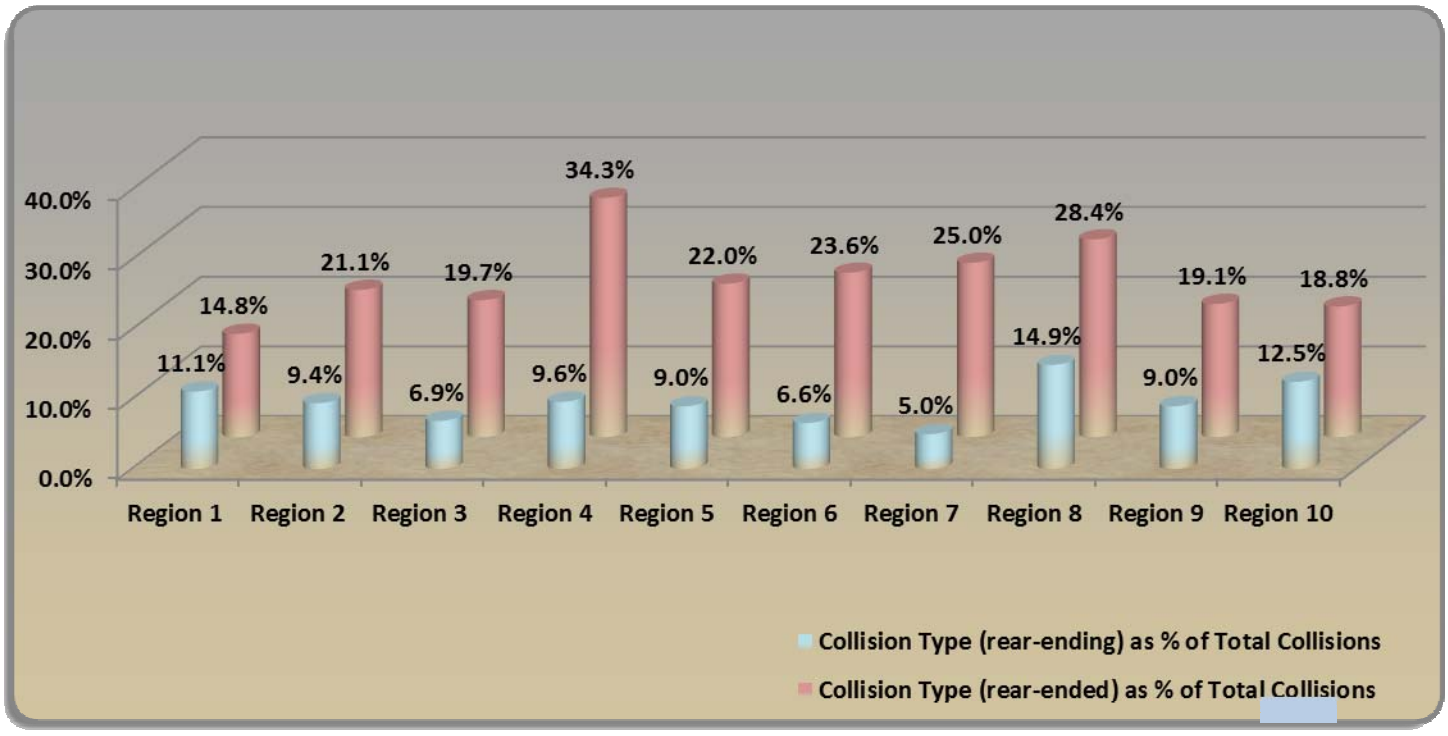

Figure 2-7. Motorbus Collisions by Collision Type as a Percentage of Total Collisions by FTA Region - 2009

In 2010, Region 5 once again had the most total Motorbus collisions at 587, which was a 9 percent decrease over 2009, and Region 4 once again had the most total rear-ended collisions at 176, or 30.9 percent of the total for that region. Region 2 had the most rear-ending collisions at 56, or 11.9 percent of the total for that region. Overall for the nation and territories, there were 3,224 total collisions with 697 rear-ended collisions (21.6 percent of the total and a 3.4 percent decrease over 2009) and 274 rear-ending collisions (8.5 percent of the total and a 1 percent decrease from 2009). Figure 2-8 below displays the collisions for all ten FTA regions and Figure 2-9 displays rear-ended and rear-ending collisions as a percentage of total collisions.

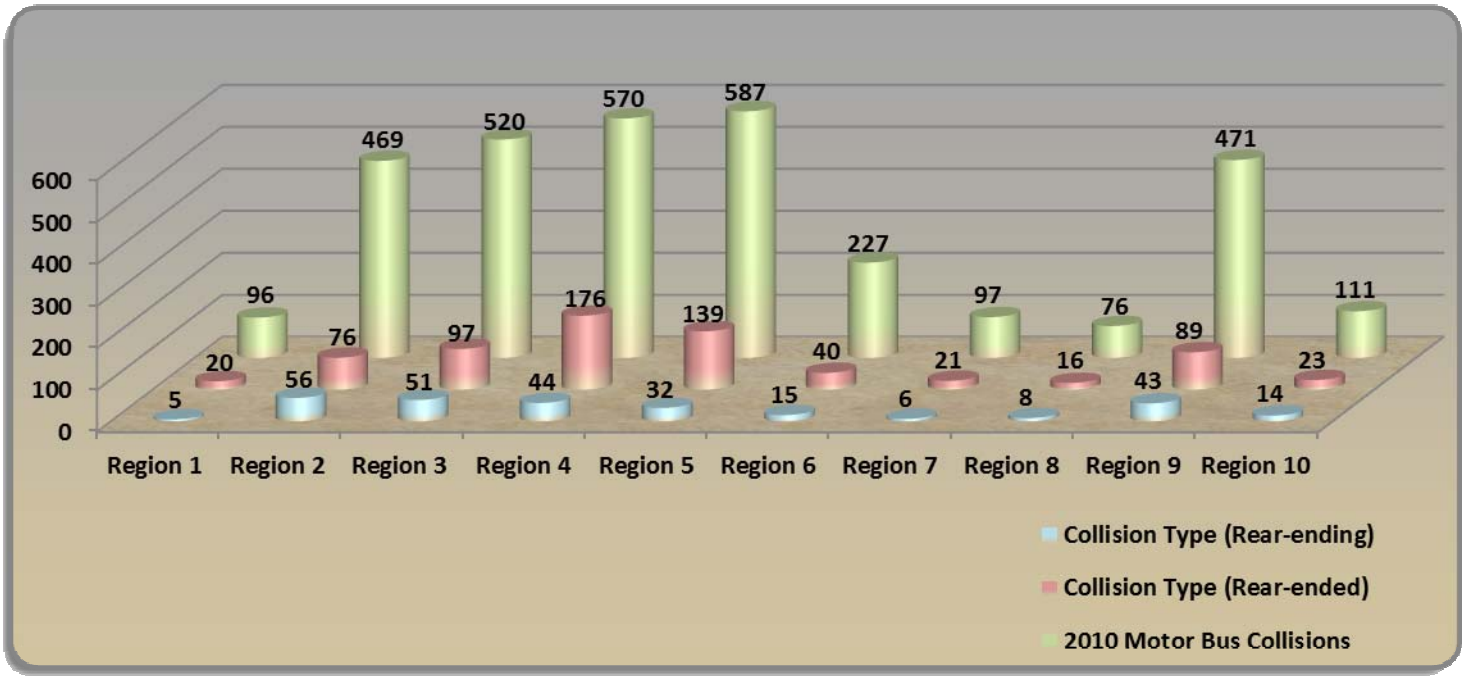

Figure 2-8. Motorbus Collisions by FTA Region - 2010

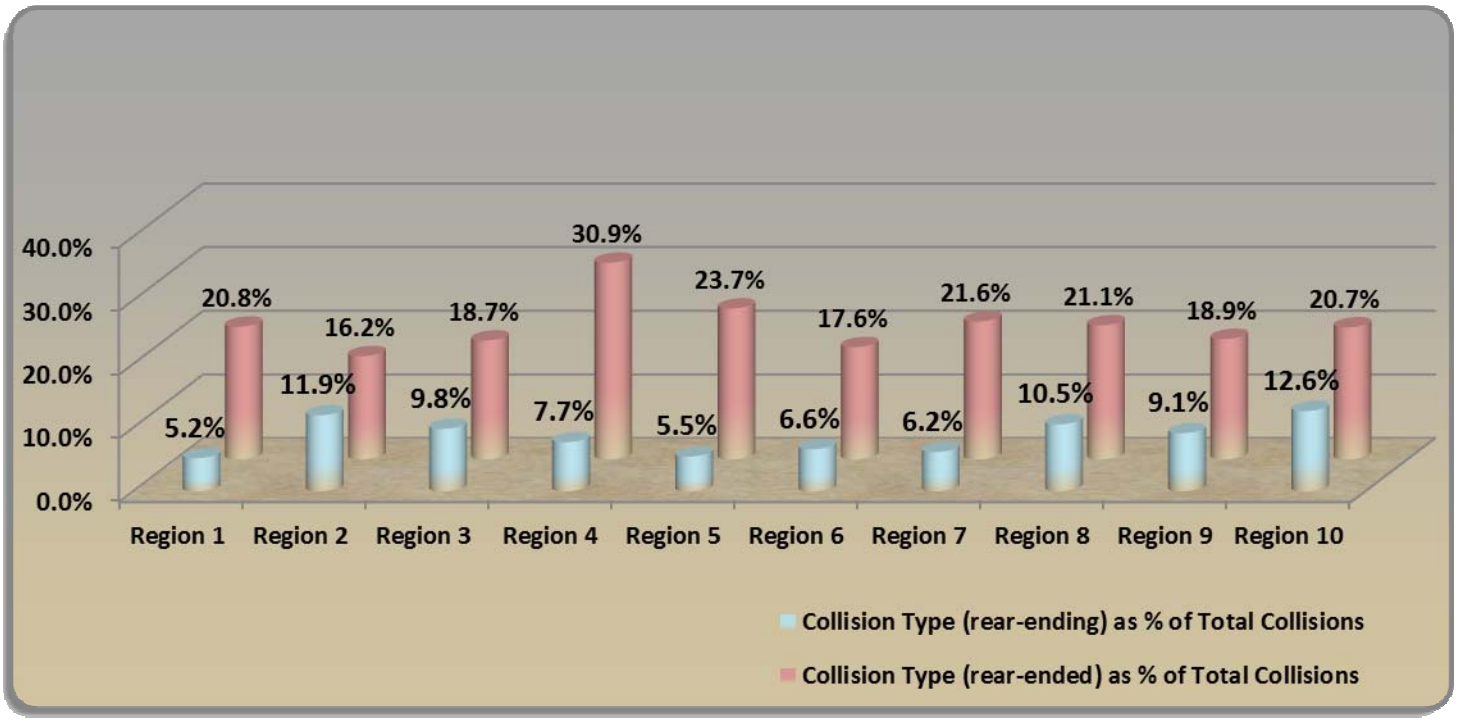

Figure 2-9. Motorbus Collisions by Collision Type as a Percentage of Total Collisions by FTA Region - 2010

In 2011, Region 5 once again had the most total motorbus collisions at 661, which was a 12.6 percent increase over 2010, and Region 4 once again had the most total rear-ended collisions at 186, or 32.5 percent of the total for that region. Region 5 had the most rear-ending collisions at 53, or 8.0 percent of the total for that region. Overall for the nation and territories, there were 3,261 total collisions with 686 rear-ended collisions (21.0 percent of the total and a 1.6 percent decrease over 2010) and 291 rear-ending collisions (8.9 percent of the total and a 6.2 percent increase from 2010). Figure 2-10 below displays the collisions for all ten FTA regions, and Figure 2-11 displays rear-ended and rear-ending collisions as a percentage of total collisions.

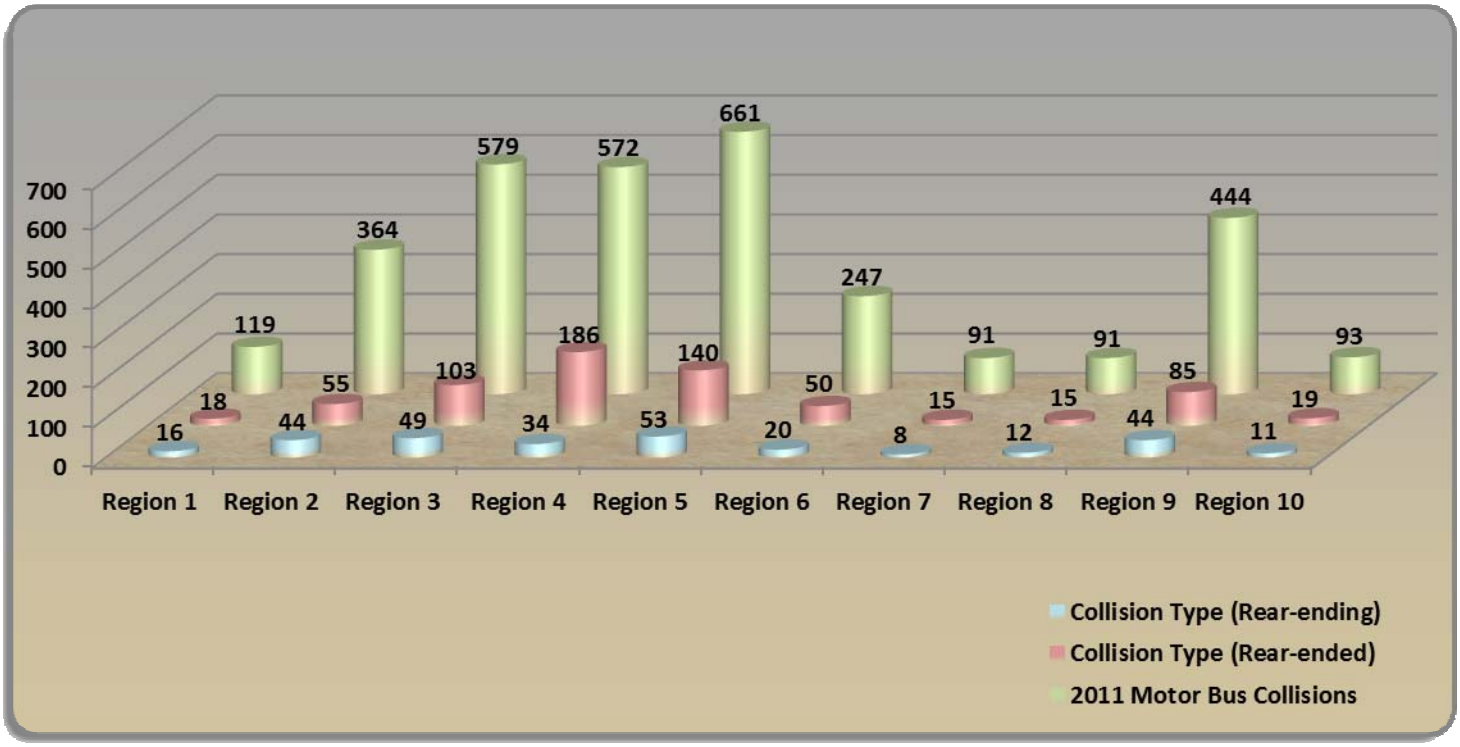

Figure 2-10. Motorbus Collisions by FTA Region - 2011

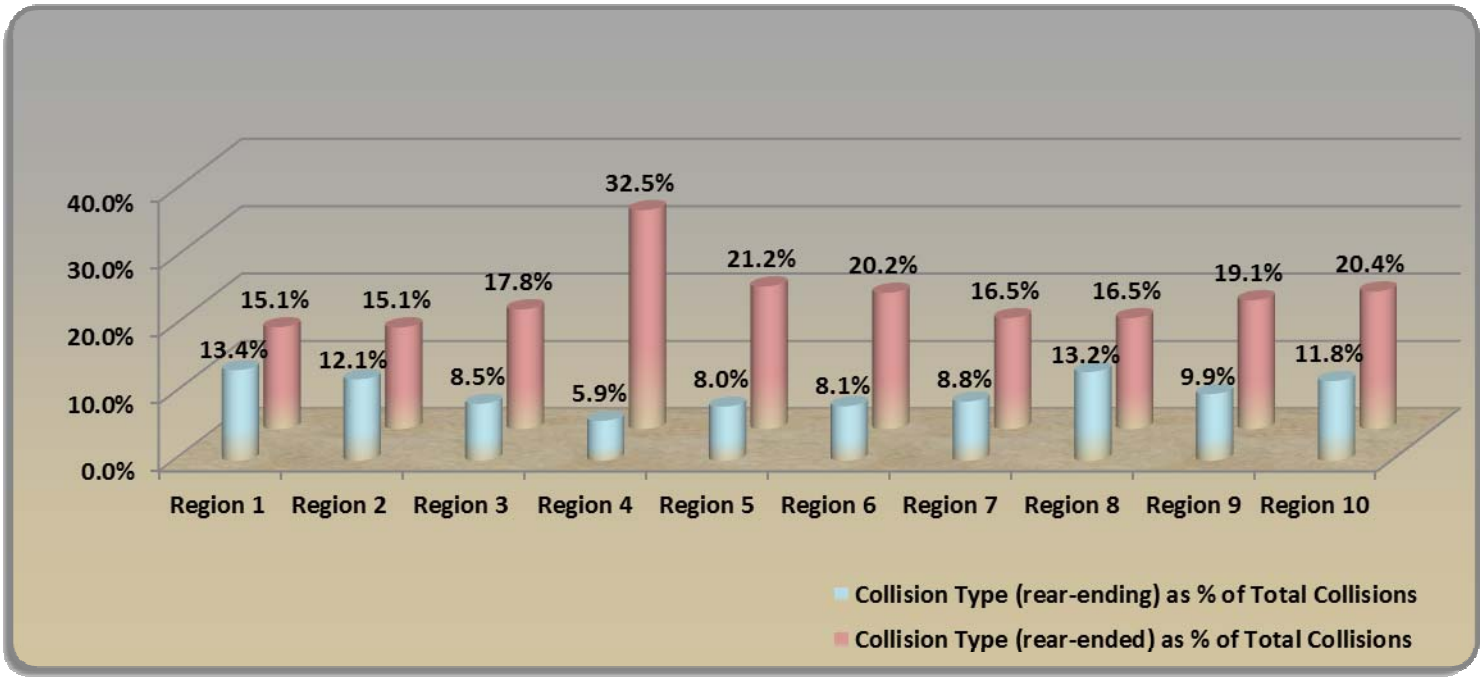

Figure 2-11. Motorbus Collisions by Collision Type as Percentage of Total Collisions by FTA Region - 2011

However, overall rear-ended collisions declined by 2.6 percent to 668 in 2012 from 686 in 2011. Figure 2-12 below displays total collisions for the ten FTA regions and Figure 2-13 displays rear-ended and rear-ending collisions as a percentage of total collisions.

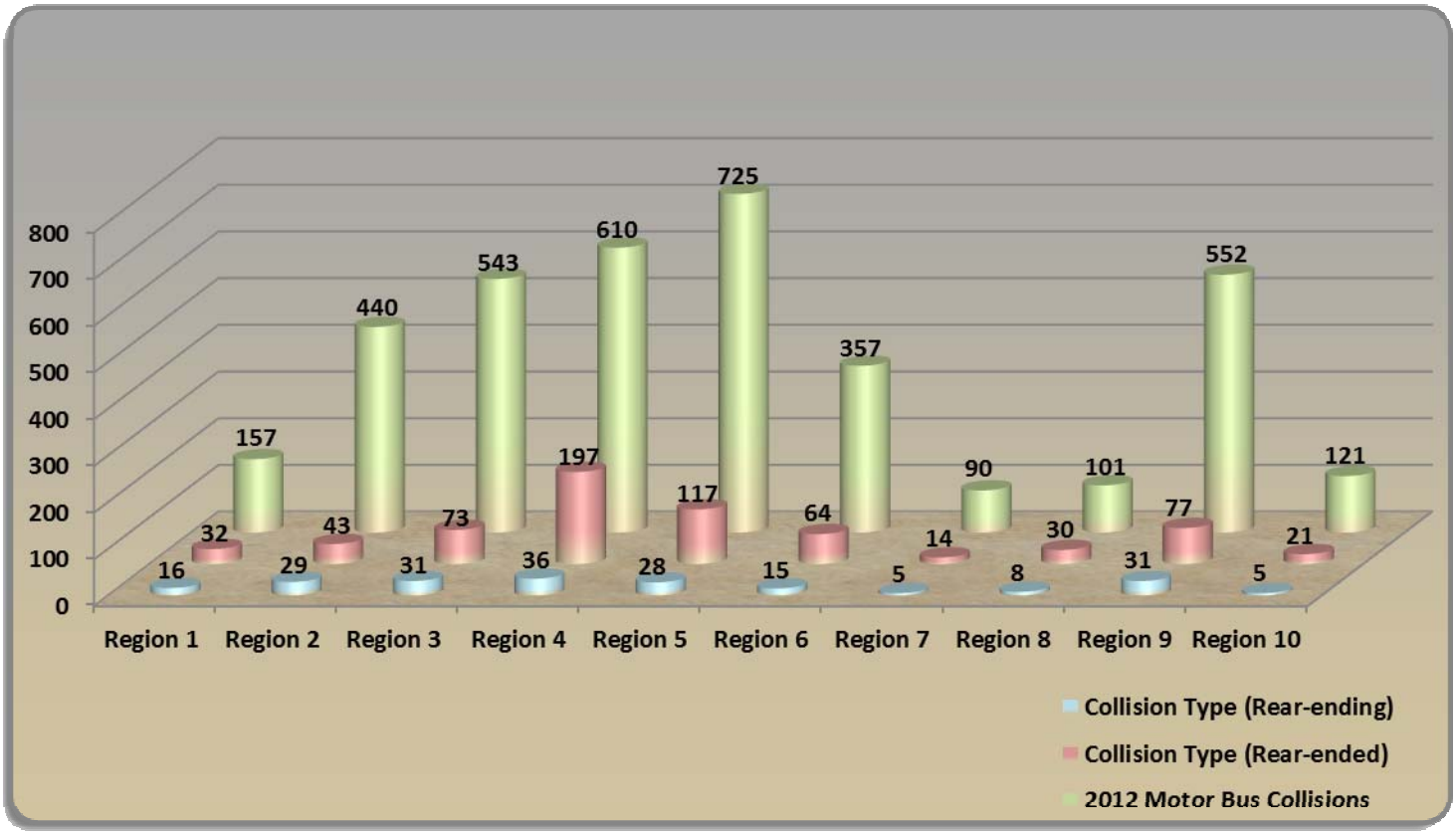

Figure 2-12. Total Collisions with Rear-ended and Rear-ending by FTA Region - 2012

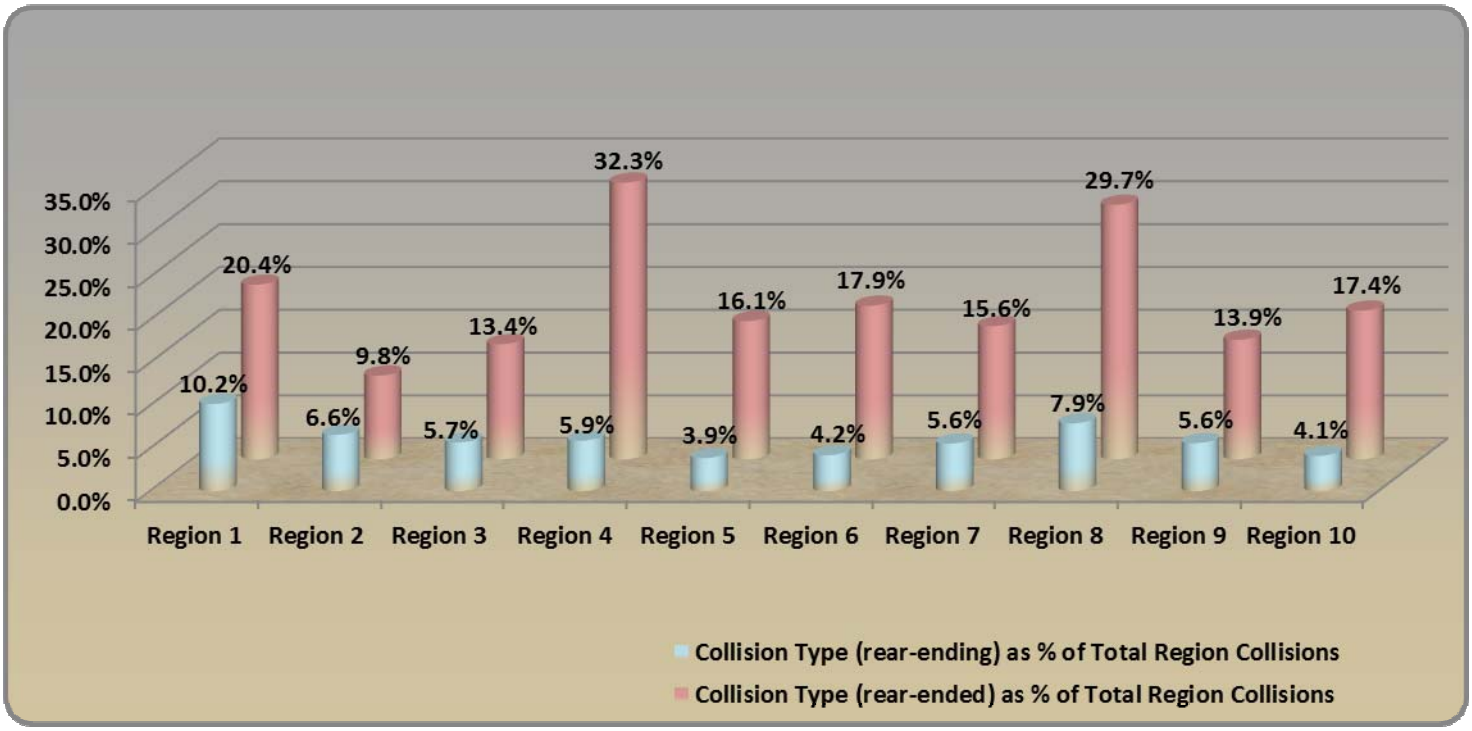

Figure 2-13. Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions by FTA Region - 2012

Rates of Motorbus Collisions within the Ten FTA Regions

In this section, the project team extracted the vehicle miles for each region in order to level the field and compare collisions based not on whole numbers, but on the incidences of collisions per 100,000 miles. In each of the figures presented below, the collisions per 100,000 miles results in a fraction of 1.

In each of the cases below, Region 4 has a higher incidence of rear-ended collisions per 100,000 miles, and different regions have a higher incidence of rear-ending collisions per 100,000 miles.

In 2008, the aggregate total collisions per 100,000 miles for the nation and territories was 0.088. Five regions had aggregate total collisions higher than the nation: Region 3 at 0.107, Region 4 at 0.129, Region 5 at 0.145, Region 6 at 0.109, and Region 7 at 0.166 (the highest incidence). Region 4 had the highest incidence of rear-ended collisions at 0.034 with Region 5 next at 0.031 collisions per 100,000 miles. Overall the aggregate for the nation and territories was 0.018 rear-ended collisions per 100,000 miles. Region 3 had the highest incidence of rear-ending collisions in 2008 with 0.026 collisions per 100,000 miles. The aggregate for the nation and territories was 0.011. Figure 2-14 below displays the incidence of collisions per 100,000 miles for the ten FTA regions.

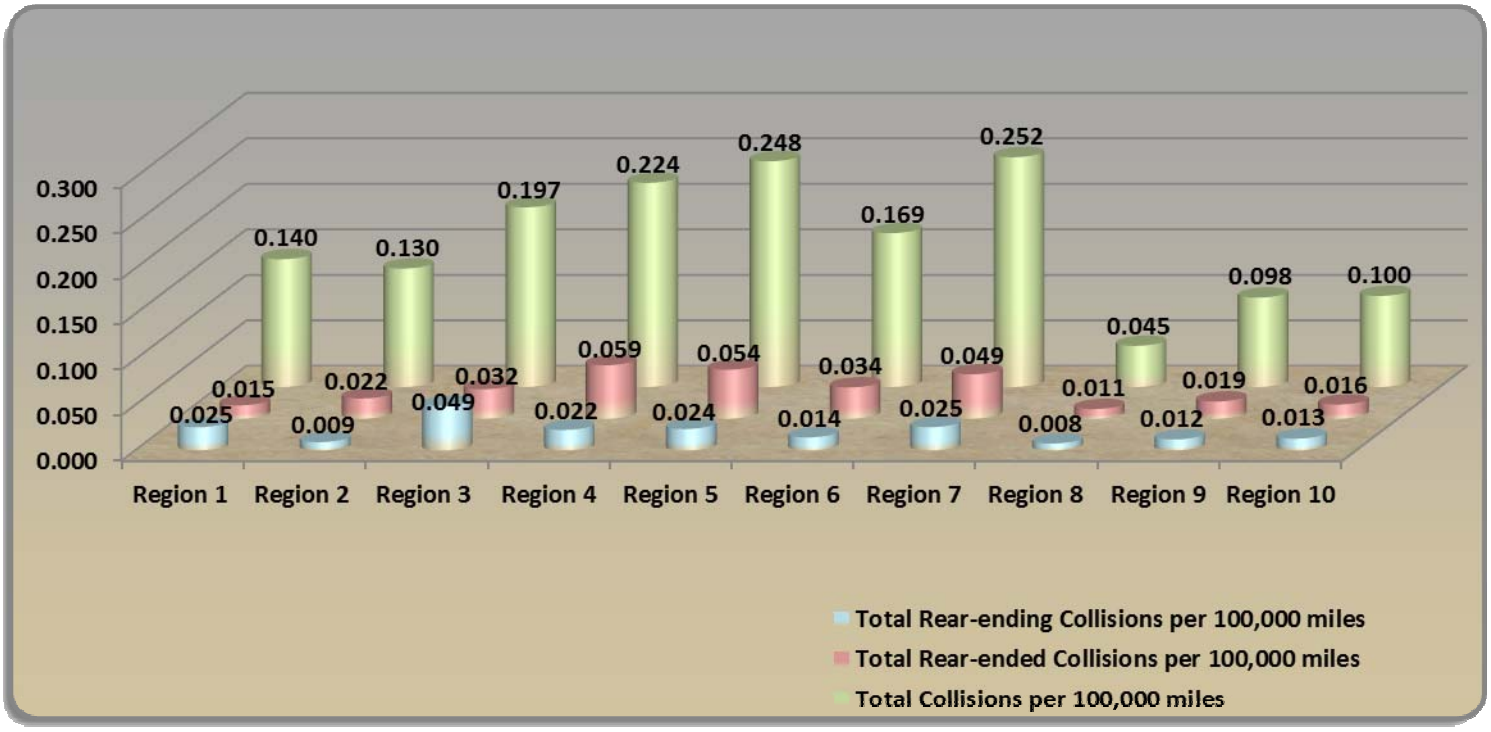

Figure 2-14. Motorbus Collisions per 100,000 Miles by FTA Region - 2008

In 2009, the aggregate total collisions per 100,000 miles for the nation and territories was 0.085. The same five regions as 2008 had aggregate total collisions greater than the national aggregate. Region 4 had the highest incidence of rear-ended collisions at 0.040 with Region 7 next at 0.034 collisions per 100,000 miles. Overall the aggregate for the nation and territories was 0.020 rear-ended collisions per 100,000 miles. Region 5 had the highest incidence of rear-ending collisions in 2008 with 0.012 collisions per 100,000 miles. The aggregate for the nation and territories was 0.008 for rear-ending. Figure 2-15 below displays the incidence of collisions per 100,000 miles for the ten FTA regions.

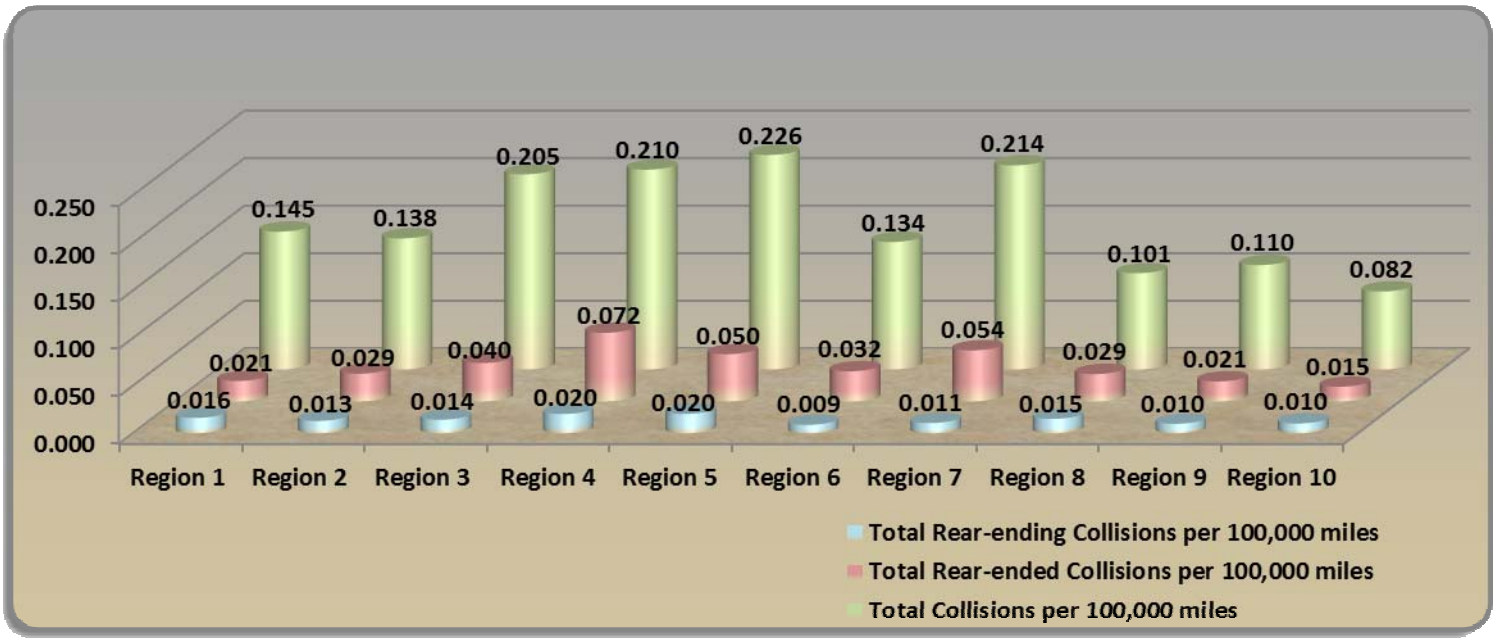

Figure 2-15. Motorbus Collisions per 100,000 Miles by FTA Region - 2009

In 2010, the aggregate total collisions per 100,000 miles was 0.090. Region 4 had the highest rate of rear-ended collisions per 100,000 miles at 0.040 compared to 0.019 for the nation and territories. Region 3 had the highest rate of rear-ending at 0.012 collisions per 100,000 miles compared to .0008 for the nation and territories. Figure 2-16 below displays the collisions per 100,000 miles for 2010.

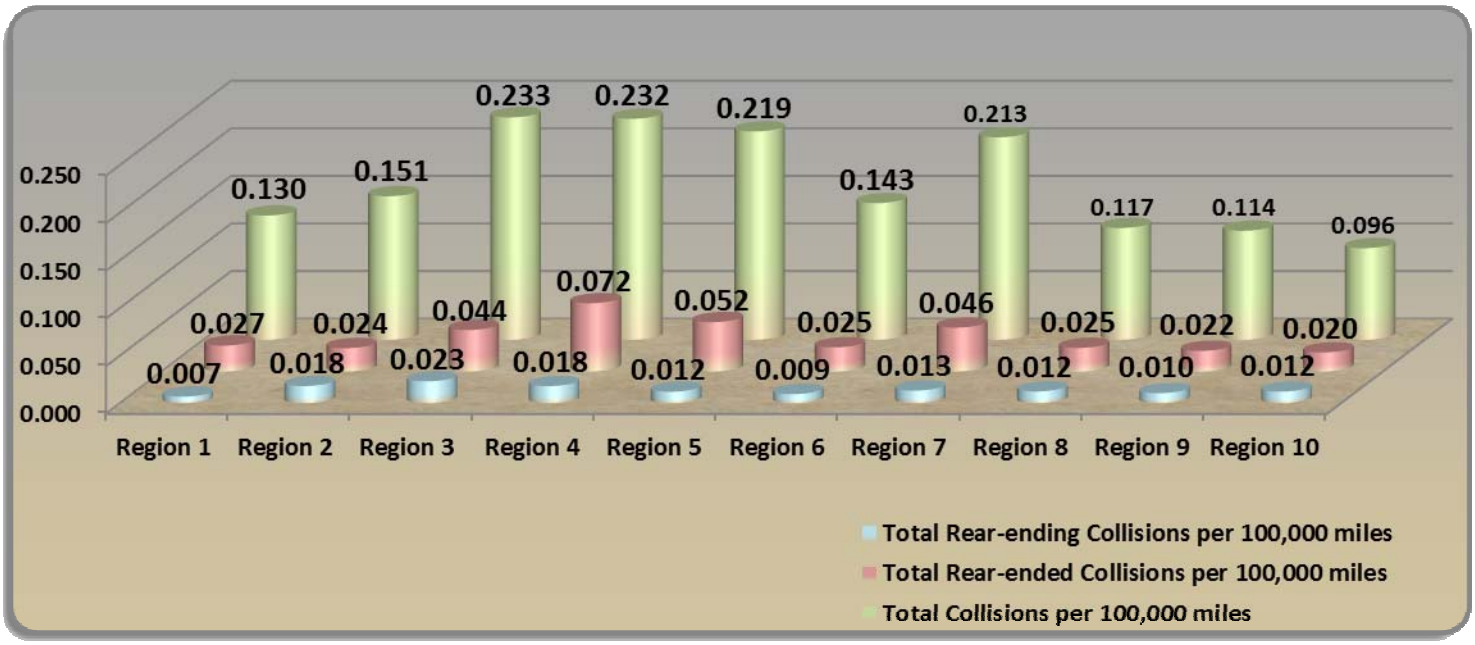

Figure 2-16. Motorbus Collisions per 100,000 Miles by FTA Region - 2010

In 2011, Region 4 had the highest incidence of rear-ended collision with 0.042 compared to 0.019 for the nation and territories. Regions 3, 5, 7 and 8 all had 0.11 rear-ending collisions per 100,00 miles compared to 0.008 for the nation and territories. Overall, national aggregate data has been steady for all four years. Figure 2-17 below displays the collisions per 100,000 miles for 2011.

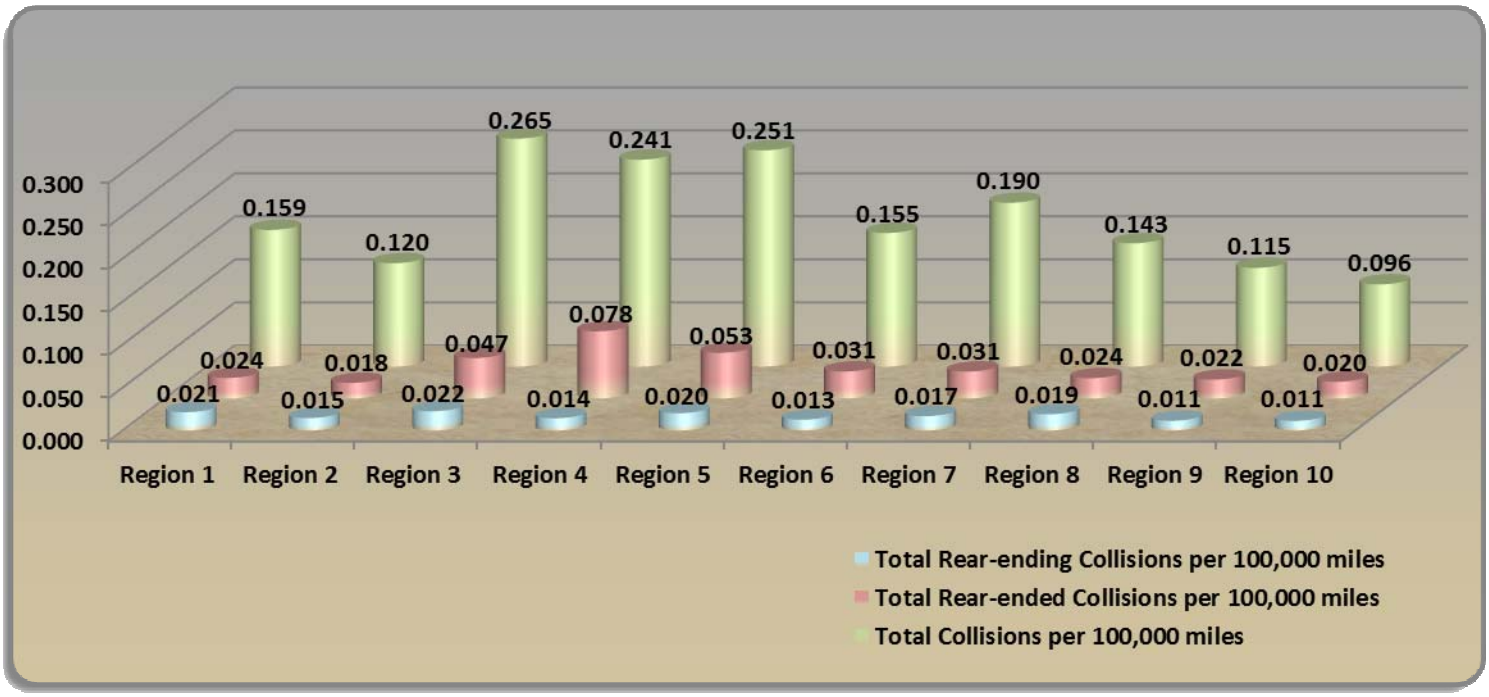

Figure 2-17. Motorbus Collisions per 100,000 Miles by FTA Region - 2011

In 2011, Region 4 had the highest incidence of rear-ended collision with 0.082 compared to 0.019 for the nation and territories. Overall, national aggregate data has been steady for all five years. Figure 2-18 below displays the collisions per 100,000 miles for 2012.

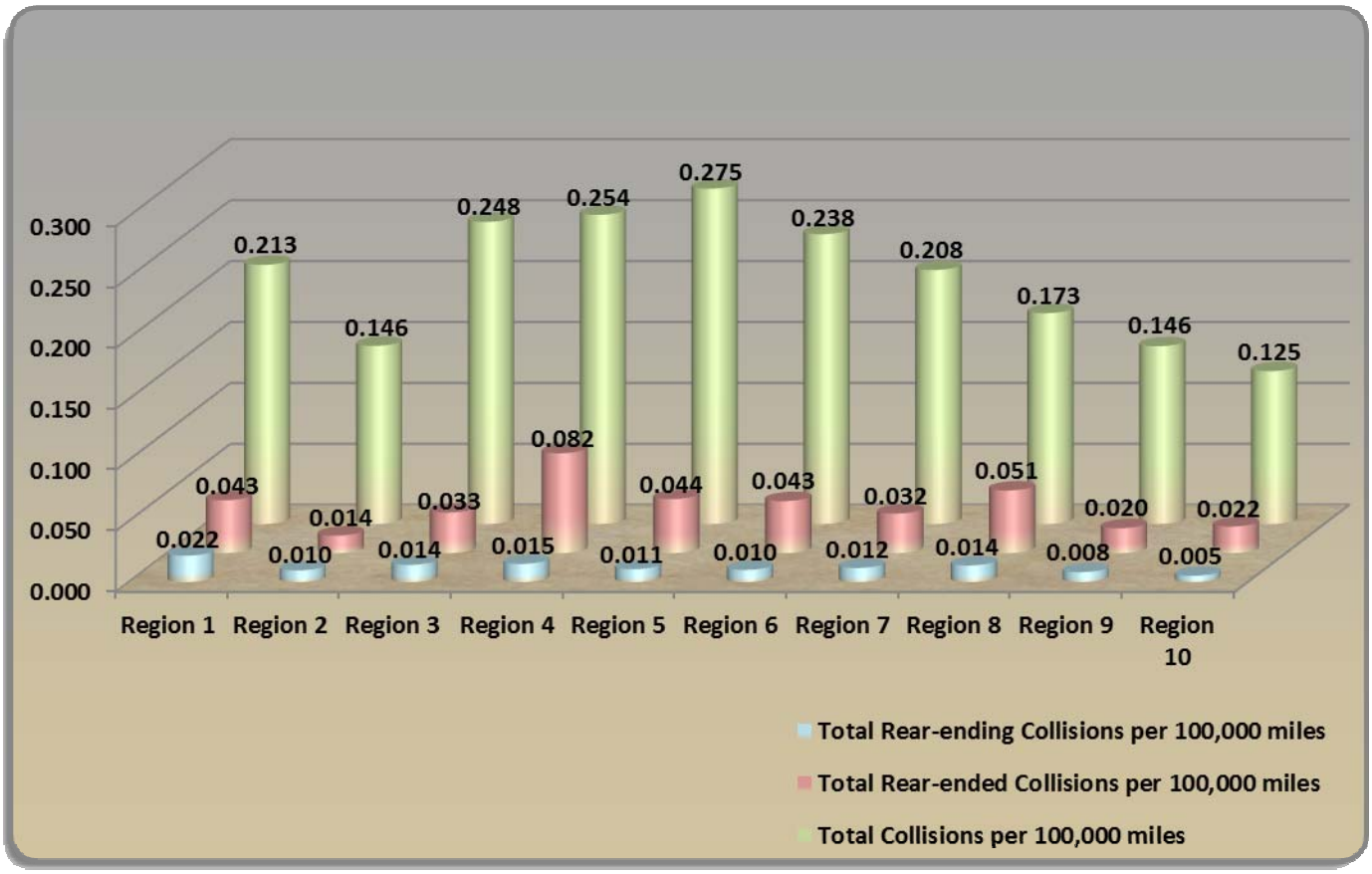

Figure 2-18. Total Motorbus Collisions per 100,000 Miles by FTA Region - 2012

Collision Data for Florida Transit Agencies

The FTA NTD collision database was used to pull data for all Florida transit agencies. Not all agencies reported collisions for the five years; however, data was available for 13 systems each year from 2008 through 2012. Florida data were first aggregated and then in the following section, data for each system are provided. There are some limitations on these data. First, collision data were self-reported by transit agencies and not audited by the FTA. Second, consultation with in-house statisticians reveals that five years of data were not sufficient to determine a specific trend that can be utilized to forecast rates of collisions into the future. Therefore, the data from the five years between 2008 through 2012 would require at least ten to fifteen years of historical data in order to perform a regression analysis that would predict trends in the future. Also, collision data did not follow a specific pattern of upward or downward trends. If collisions went down in one year from the previous year, that of course would be the desired outcome. Unlike other forms of data such as ridership and revenue, collision totals fluctuated from year to year. Therefore, the data presented below are intended to inform and enlighten and to provide individual transit systems with meaningful data on what has occurred with their own system in relation to other Florida systems.

Aggregate Collision Data – Florida, 2008 - 2012

Over the five year period, total collisions ranged from a low of 276 in 2010 to a high of 312 in 2012, with an average of 299 collisions per year. Rear-ended collisions ranged from a low of 97 in 2010 to a high of 129 in 2012, with an average of 115 per year. Rear-ending collisions ranged from a high of 30 in 2008 and 2009, reducing to 14 in 2010 and 2011 and 13 in 2012, for an average of 20 collisions per year. Figure 2-19 below displays the annual collision data for Florida from 2008 through 2012.

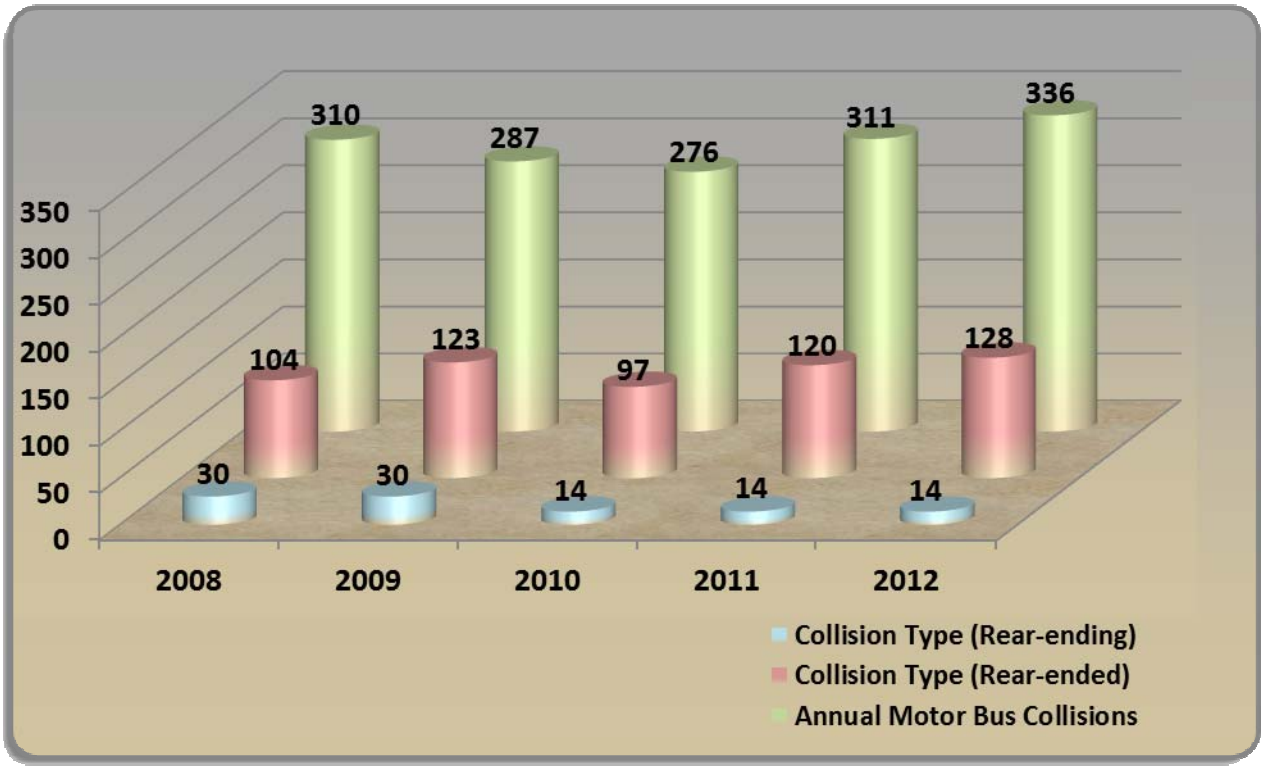

Figure 2-19. Annual Motorbus Collisions, All Florida Agencies, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

As a percentage of total collisions, rear-ended collisions ranged from a low of 33.5 percent in 2008 to a high of 42.9 percent in 2009, with an average of 38.3 percent of all collisions. Rear-ending collisions range from a low of 4.2 percent in 2012 to a high of 10.5 percent in 2009, with an average of 6.8 percent of all collisions. Figure 2-20 below displays rear-ended and rear-ending collisions as a percent of total collisions from 2008 through 2012.

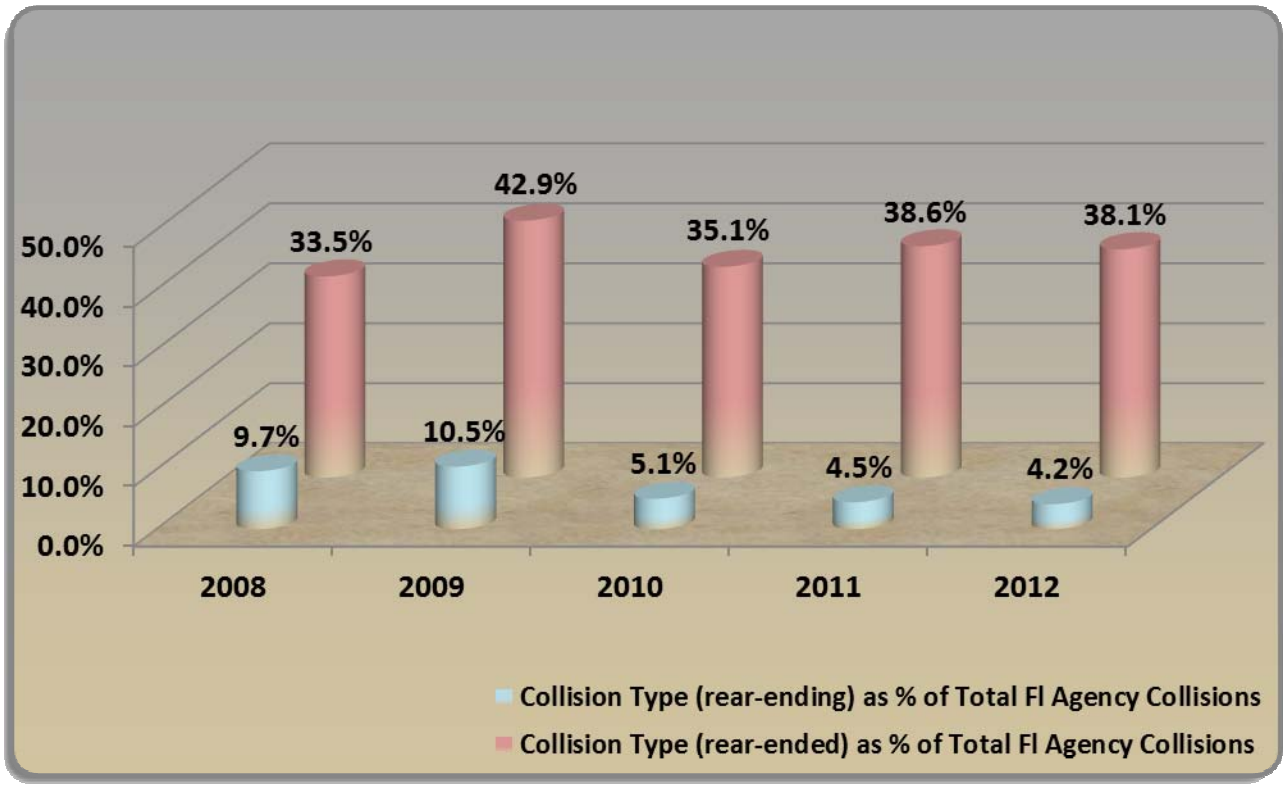

Figure 2-20. Annual Motorbus Collisions by Collision Type as a Percentage of Total Florida Transit Agency Collisions, 2008-2012

Total Annual Revenue Miles – All Florida Transit Agencies – 2008-2012

In order to ascertain the collisions per 100,000 miles, Figure 2-21 below is a compilation of the annual revenue hours aggregated for all Florida transit agencies.

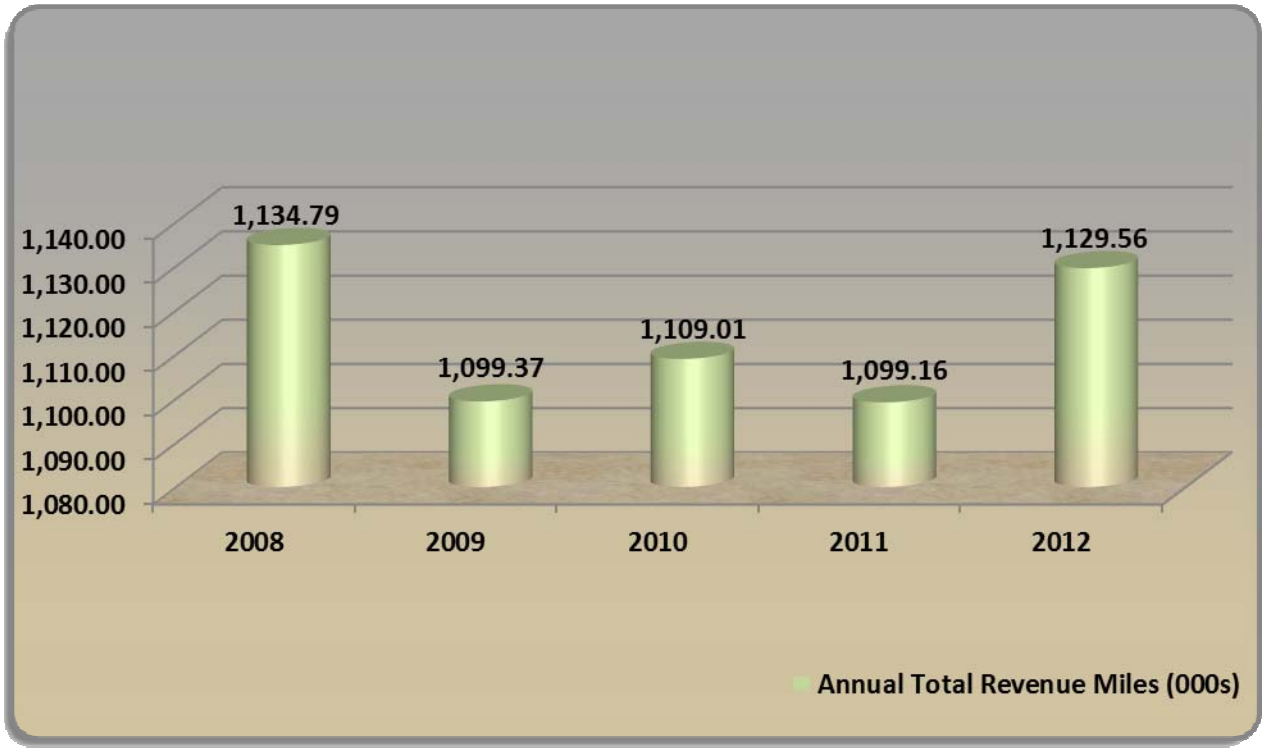

Figure 2-21. Annual Total Revenue Miles (000s). All Florida Agencies, 2008-2012

Annual Motorbus Collisions per 100,000 miles – All Florida Transit Agencies, 2008-2012

Total collisions per 100,000 miles range from a low of 0.25 in 2010 to a high of 0.30 in 2012, with an average of 0.27. In 2008 and 2010, rear-ended were 0.09 collisions per 100,000 miles; in 2009 and 2011, 0.11; and in 2012, 0.10, for an average of 0.10 collisions per 100,000 miles. In 2008 and 2009, rear-ending collisions were 0.03 and in 2010, 2011, and 2012 0.01 collisions per 100,000 miles. Figure 2-22 below displays annual aggregate Florida data for 2008 through 2012.

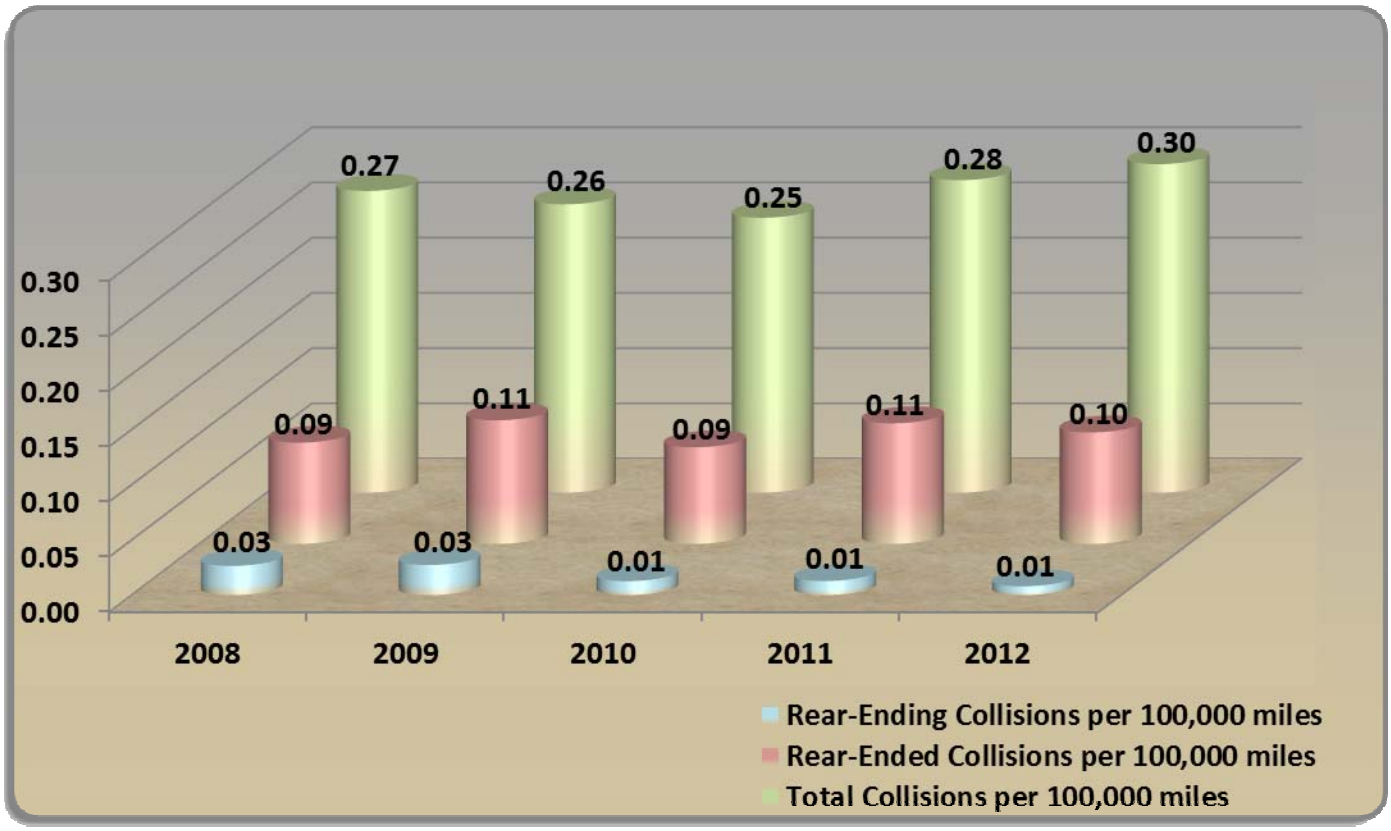

Figure 2-22. Annual Motorbus Collisions per 100,000 Miles, All Florida Agencies, 2008-2012

Transit System Data

There were 13 transit agencies that reported data for all five years between 2008 and 2012, as follows:

- PalmTran, Inc.
- Broward County Transit Division
- Central Florida Regional Transportation Authority (CFRTA)
- County of Volusia, dba: VOTRAN
- Escambia County Area Transit (ECAT)
- Gainesville Regional Transit
- Hillsborough Area Regional Transit Authority (HART)
- Jacksonville Transportation Authority (JTA)
- Lee County Transit
- Miami-Dade Transit
- Pasco County Public Transportation
- Pinellas Suncoast Transit Authority (PSTA)
- Space Coast Area Transit (SCAT)

For each of the agencies below, graphics are presented for the following:

- Motorbus Collisions – Total, Rear-ended and Rear-ending
- Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions
- Total Annual Revenue Miles
- Collisions per 100,000 Miles

Broward County Transit Division

Figure 2-23 below shows that total collisions for Broward County ranged from 44 in 2008 to 79 in 2012. Rear-ended collisions were at 13 for 2008 and 2010, 21 in 2009, 24 in 2011 and 26 in 2012. For rear-ending collisions, Broward had a high of 11 in 2008 but then dropped to 5 in 2009 and 2011 and 4 in 2010 and 2012.

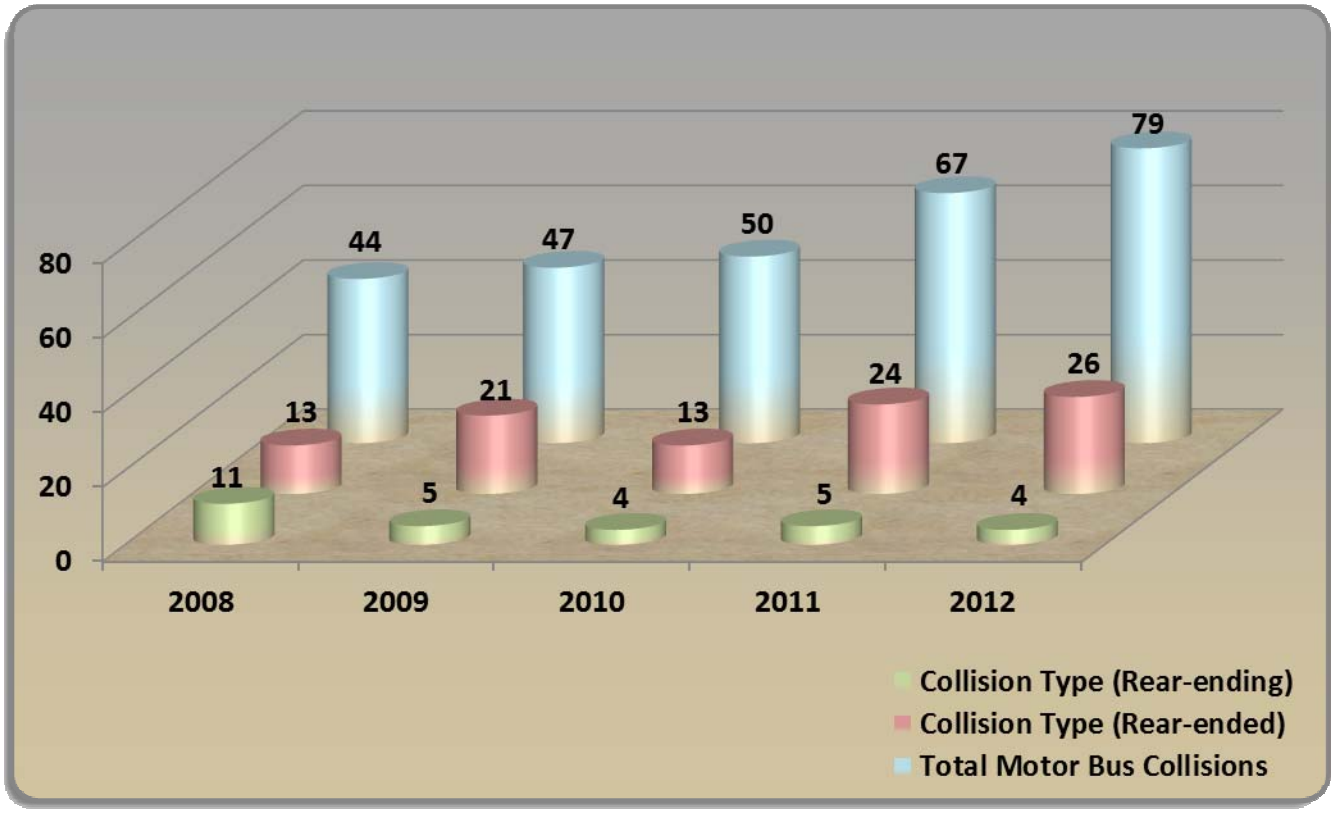

Figure 2-23. Broward County Transit Division: Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

Rear-ended collisions ranged from a low of 26 percent of total collisions in 2010 to a high of 45 percent in 2009. Rear-ending collisions ranged from a high of 25 percent in 2008 to a low of 5 percent in 2012, with a clear downward trend over the five year timeframe. Figure 2-24 below displays rear-ended and rear-ending collisions as a percentage of total collisions.

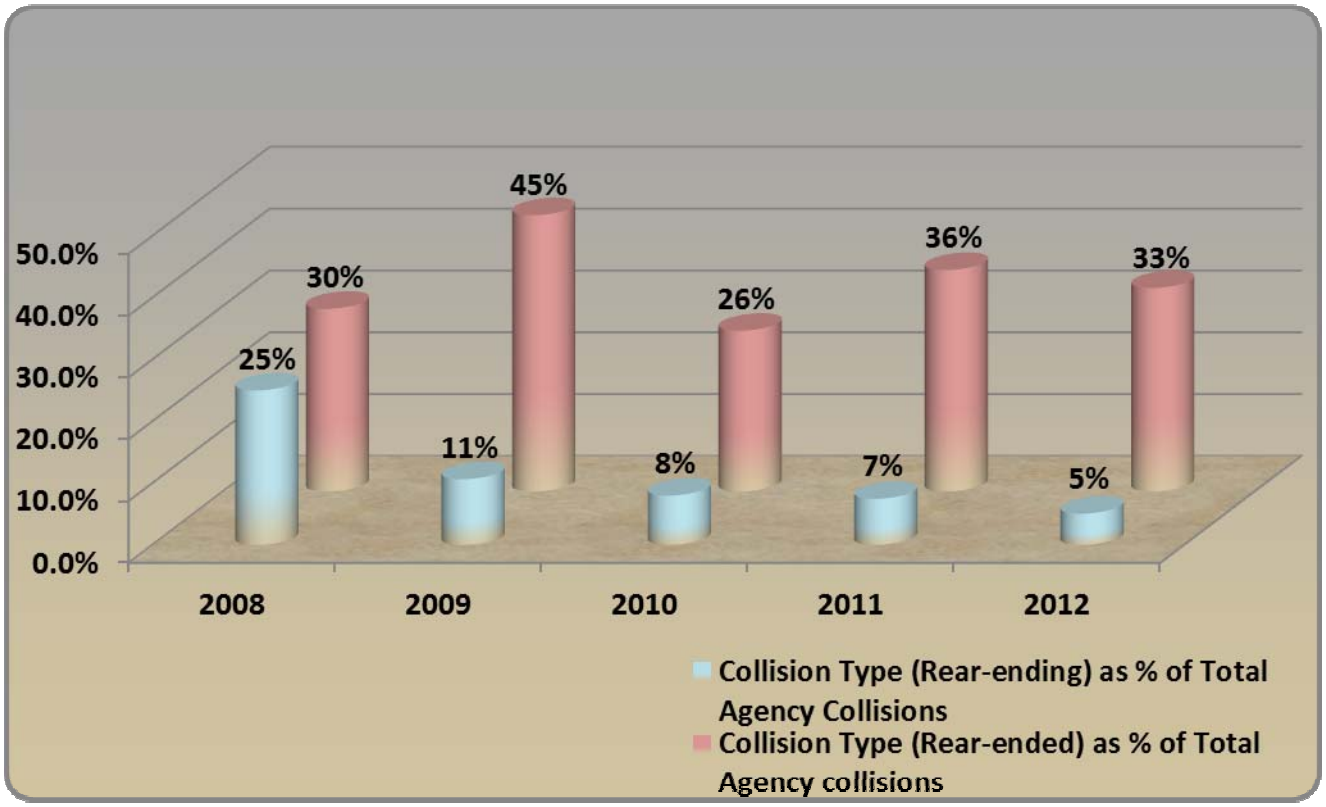

Figure 2-24. Broward County Transit Division: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Total Annual Revenue Miles

Figure 2-25 below displays annual revenue miles to form the foundation of determining collisions per 100,000 miles.

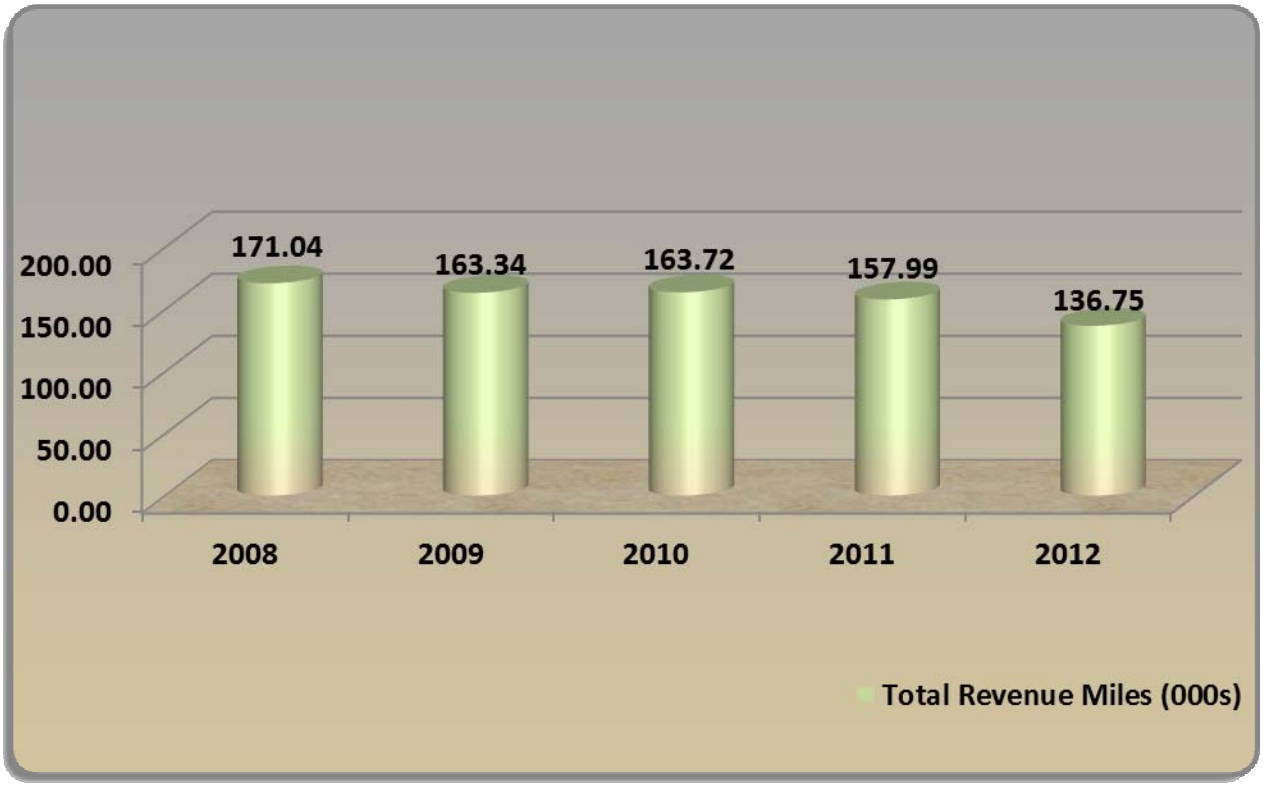

Figure 2-25. Broward County Division: Annual Total Revenue Miles (000s)

Collisions per 100,000 Miles

Figure 2-26 displays the total collisions per 100,000 miles were 0.26 in 2008 with a clear upward trend each year to 0.58 in 2012. Rear-ended collisions per 100,000 miles ranged from 0.08 in 2008 and 2010 to 0.13 in 2009, 0.15 in 2011 and 0.19 in 2012. Rear-ending collisions per 100,000 miles was 0.06 in 2008, declining to 0.03 in 2009, 2011 and 2012 and 0.03 in 2011.

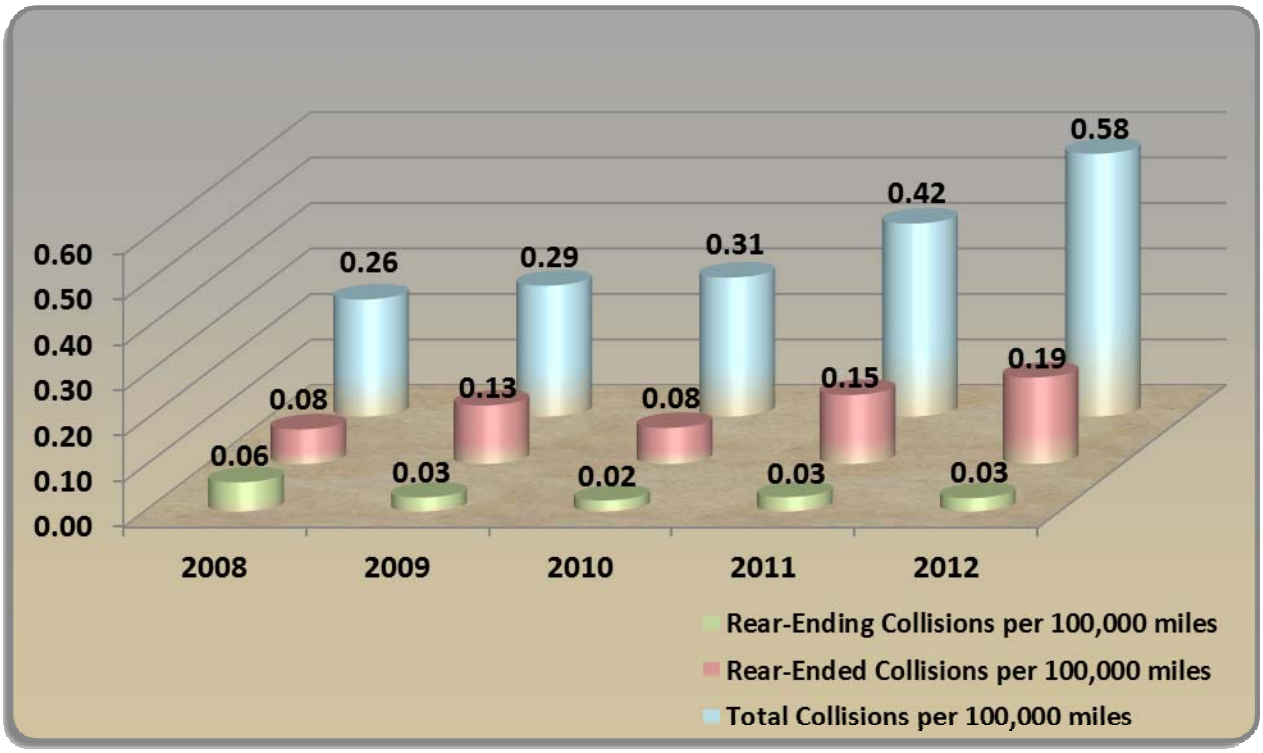

Figure 2-26. Broward County Transit Division: Motorbus Collisions per Mileage, 2008-2012

PalmTran, Inc.

Total collisions for PalmTran ranged from a low of 25 in 2008, with 28 in 2009, 2010 and 2011, and 26 in 2012. Rear-ended collisions ranged from a low of 5 in 2008 to a high of 16 in 2009, with 12 in 2010, 9 in 2011, and 11 in 2012. PalmTran had three rear-ending collisions in 2008, none in 2009 and 2010, and 2 in 2011 and 2012. Figure 2-27 below displays total collisions from 2008 to 2012.

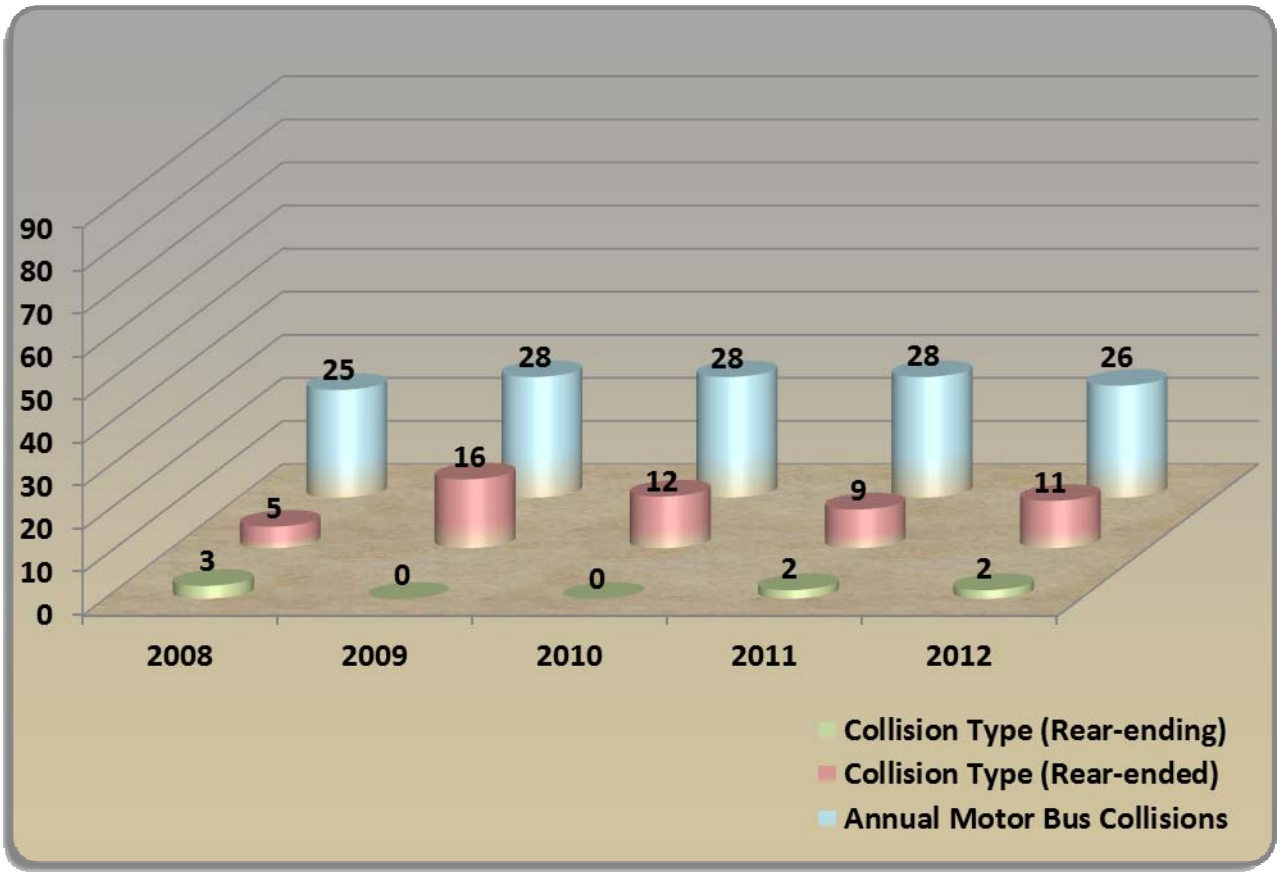

Figure 2-27. PalmTran, Inc.: Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

Rear-ended collisions ranged from a low of 20 percent of all collisions in 2008 to a high of 57 percent in 2009, with a decreasing trend in 2010 (43 percent), 2011 (32 percent) and 2012 (42 percent). Rear-ending collisions were at 12 percent in 2008, declined to 0 percent in 2009 and 2010, then were 7 percent in 2011 and 8 percent in 2012. Figure 2-28 below displays rear-ended and rear-ending collisions as a perce ntage of total collisions.

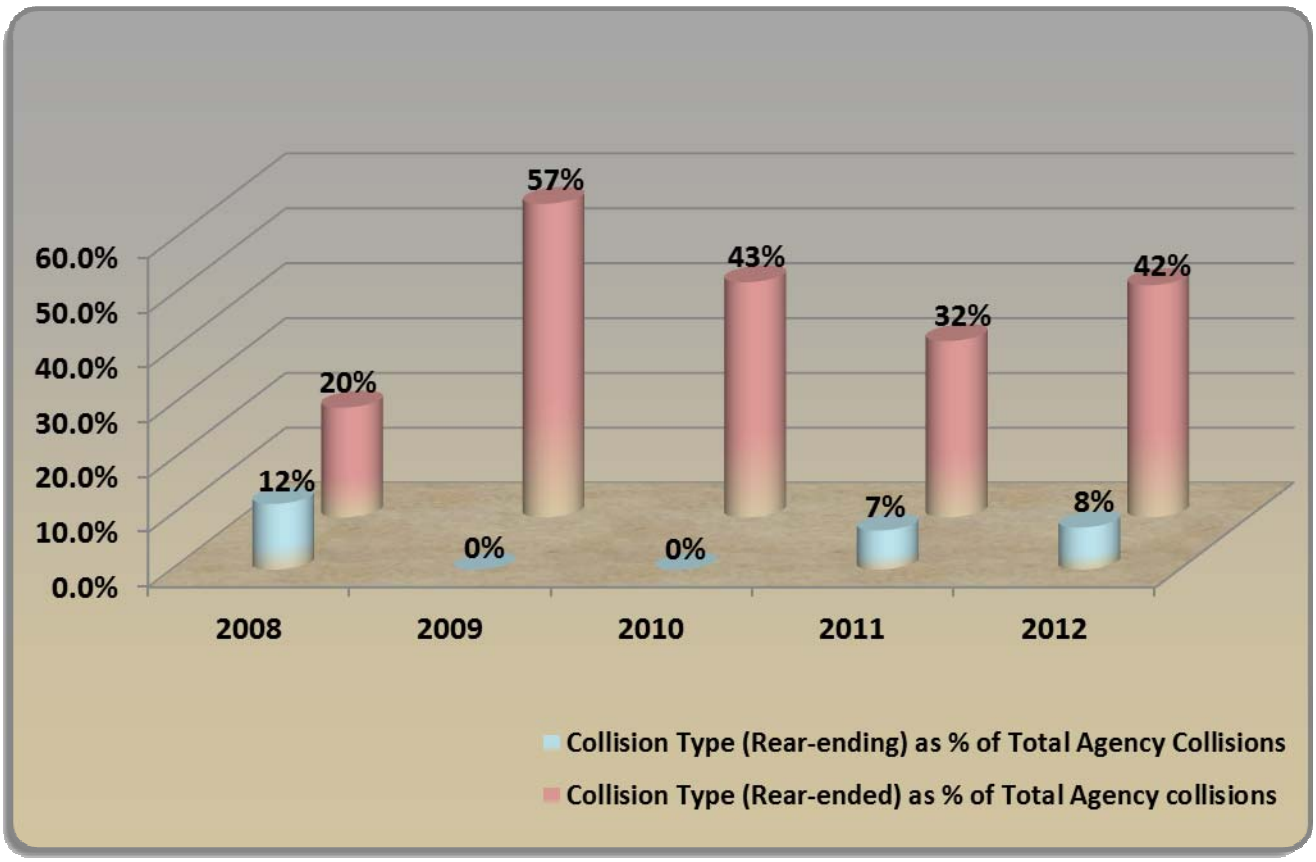

Figure 2-28. PalmTran, Inc.: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Total Annual Revenue Miles

Figure 2-29 below displays the annual revenue miles to form the foundation of reporting collisions per 100,000 miles.

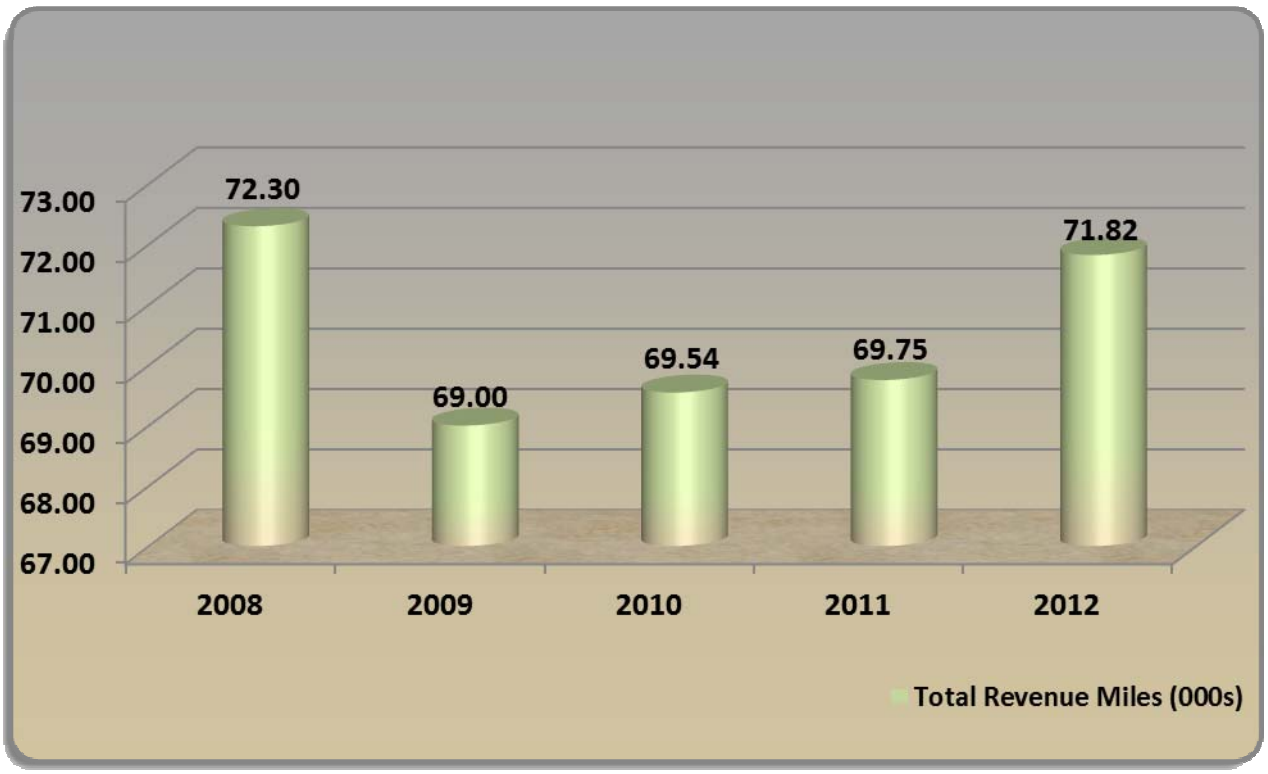

Figure 2-29. PalmTran, Inc.: Total Annual Revenue Miles (000s)

Collisions per 100,000 Miles

Total collisions per 100,000 miles were 0.35 in 2008, increasing to 0.41 in 2009, 0.40 in 2010 and 2011, and 0.36 in 2012. Rear-ended collisions were at the lowest in 2008 with 0.07, then increased to 0.23 in 2009 and then were on a downward trend with 0.17 in 2010, 0.13 in 2011, and 0.15 in 2012. Rear-ending collisions were 0.04 in 2008, 0.00 in 2009 and 2010, and 0.03 in 2011 and 2012. Figure 2-30 below displays rear-ended and rear-ending collisions as a percentage of total collisions.

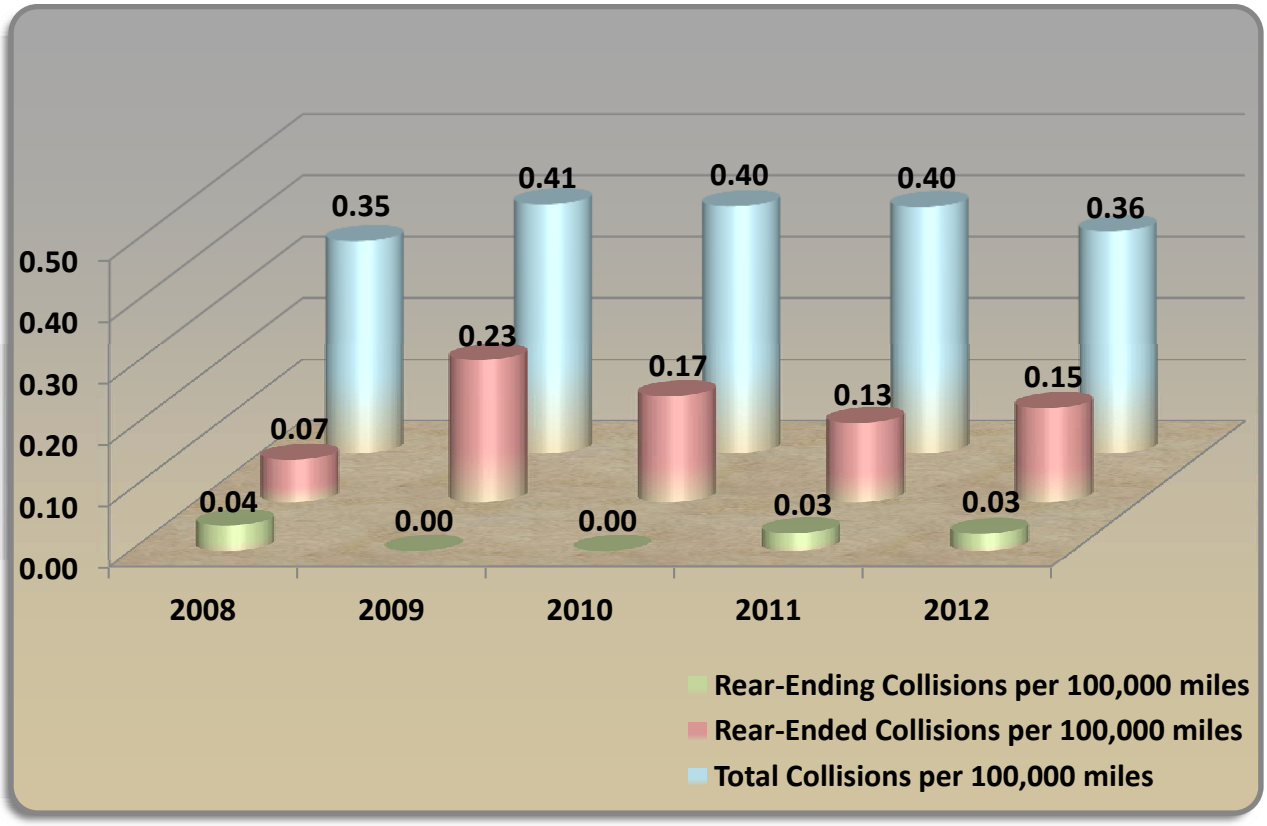

Figure 2-30. PalmTran, Inc.: Motorbus Collisions per Mileage, 2008-2012

Central Florida Regional Transportation Authority (LYNX)

Total collisions showed an upward trend beginning with 31 in 2008 and ending with 66 in 2012. Rear-ended collisions began at 11 in 2008, increased to 18 in 2009 and 2010, 27 in 2011 and 39 in 2012. Rear-ending collisions were highest in 2009 with 4, 1 in 2008, 2 in 2010 and 3 in 2011 and 2012. Figure 2-31 below displays the total annual bus collisions for years 2008 to 2012.

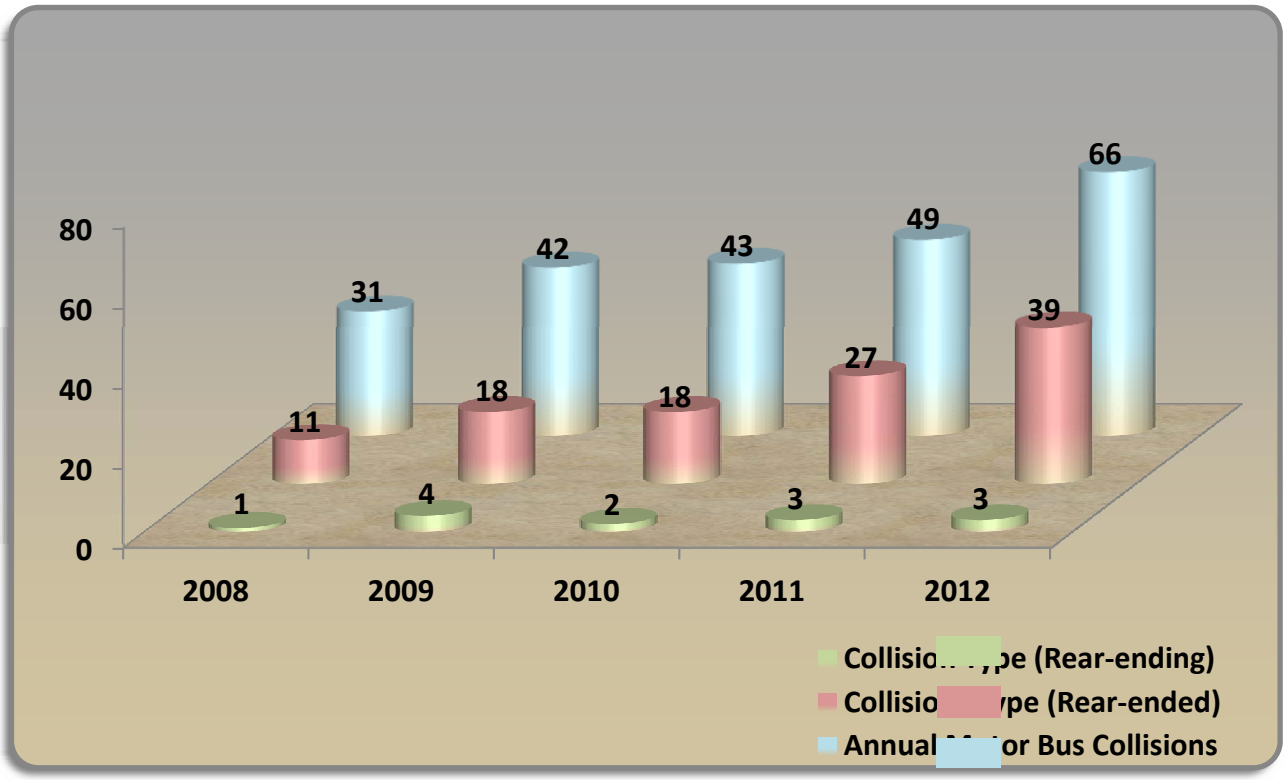

Figure 2-31. Central Florida Regional Transportation: Annual Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

Rear-ended collisions ranged from a low of 35 percent of total collisions in 2008 to a high of 59 percent in 2012, displaying a clear upward trend. Rear-ending collisions ranged from 3 percent in 2008 to a high of 10 percent in 2009, declining after 2009 to 5 percent in 2010 and 2012 and 6 percent in 2011. Figure 2-32 below displays rear-ended and rear-ending collisions as a percentage of total collisions.

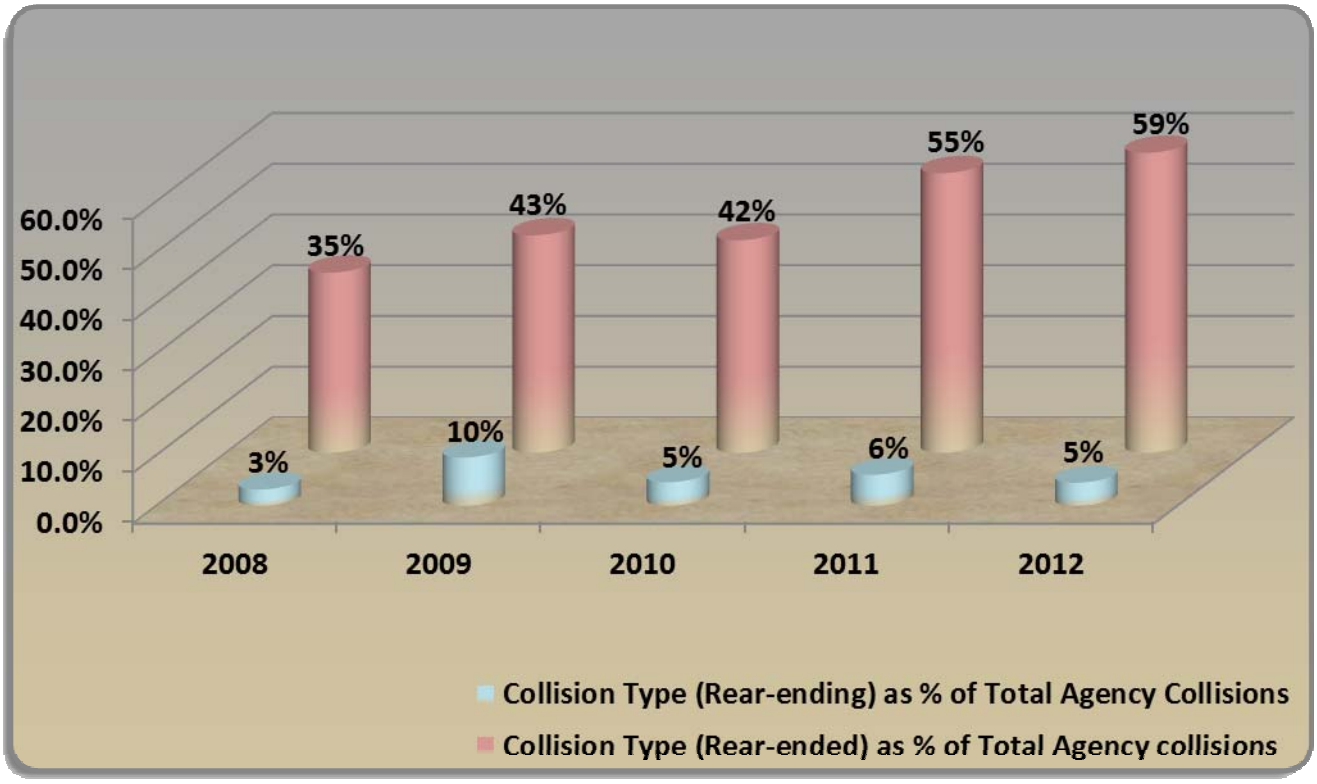

Figure 2-32. Central Florida Regional Transportation: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Annual Revenue Miles

Figure 2-33 below displays annual revenue miles to form the foundation for reporting collisions per 100,000 miles.

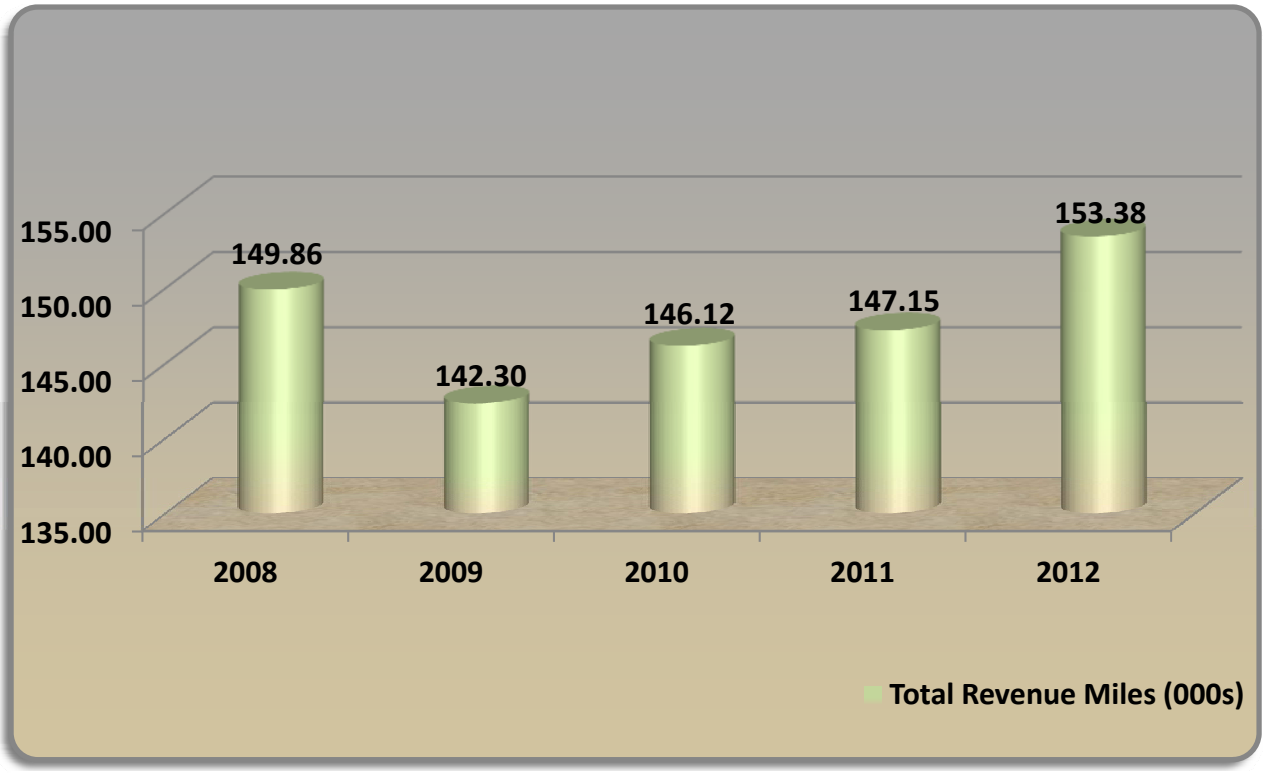

Figure 2-33. Central Florida Regional Transportation: Annual Total Revenue Miles (000s)

Collisions per 100,000 Miles

Total collisions ranged from a low of 0.21 in 2008 to a high of 0.43 in 2012, with a clear upward trend for the five years. Rear-ended collisions also showed a clear upward trend with a low of 0.07 in 2008 to 0.25 in 2012. Rear-ending collisions were 0.01 in 2008 and 2010, 0.03 in 2009 and 0.02 in 2011 and 2012, displaying a stable trend. Figure 2-34 below presents rear-ended and rear-ending collisions as a percentage of total collisions per 100,000 miles.

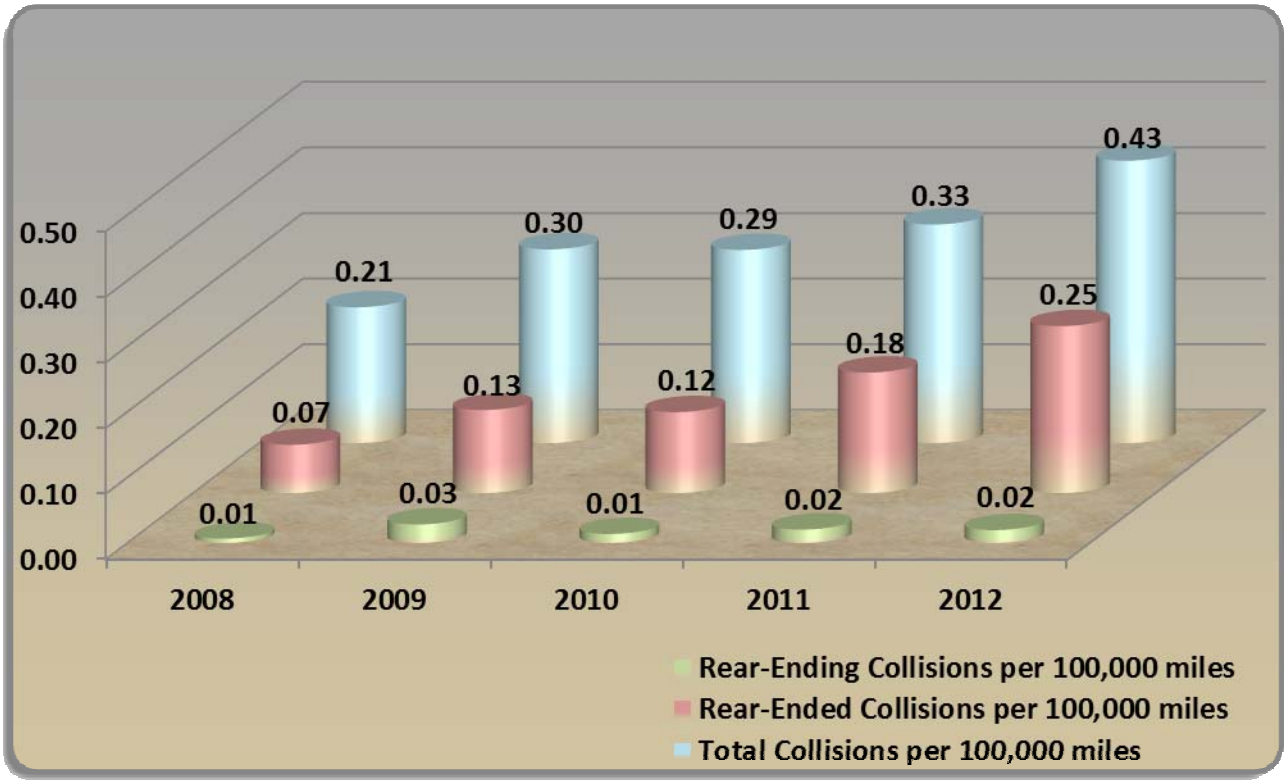

Figure 2-34. Central Florida Regional Transportation: Motorbus Collisions per Mileage, 2008-2012

County of Volusia, dba: VOTRAN

Total collisions ranged from 2 in 2012 to 9 in 2009, with 4 in 2008 and 6 in 2010 and 2011. VOTRAN had no rear-ended collisions in 2008 and 2012, with 3 in 2009, 1 in 2010 and 2 in 2011. There was only one rear-ending collision in the entire five year period. Figure 2-35 below displays total annual motorbus collisions for years 2008 to 2012.

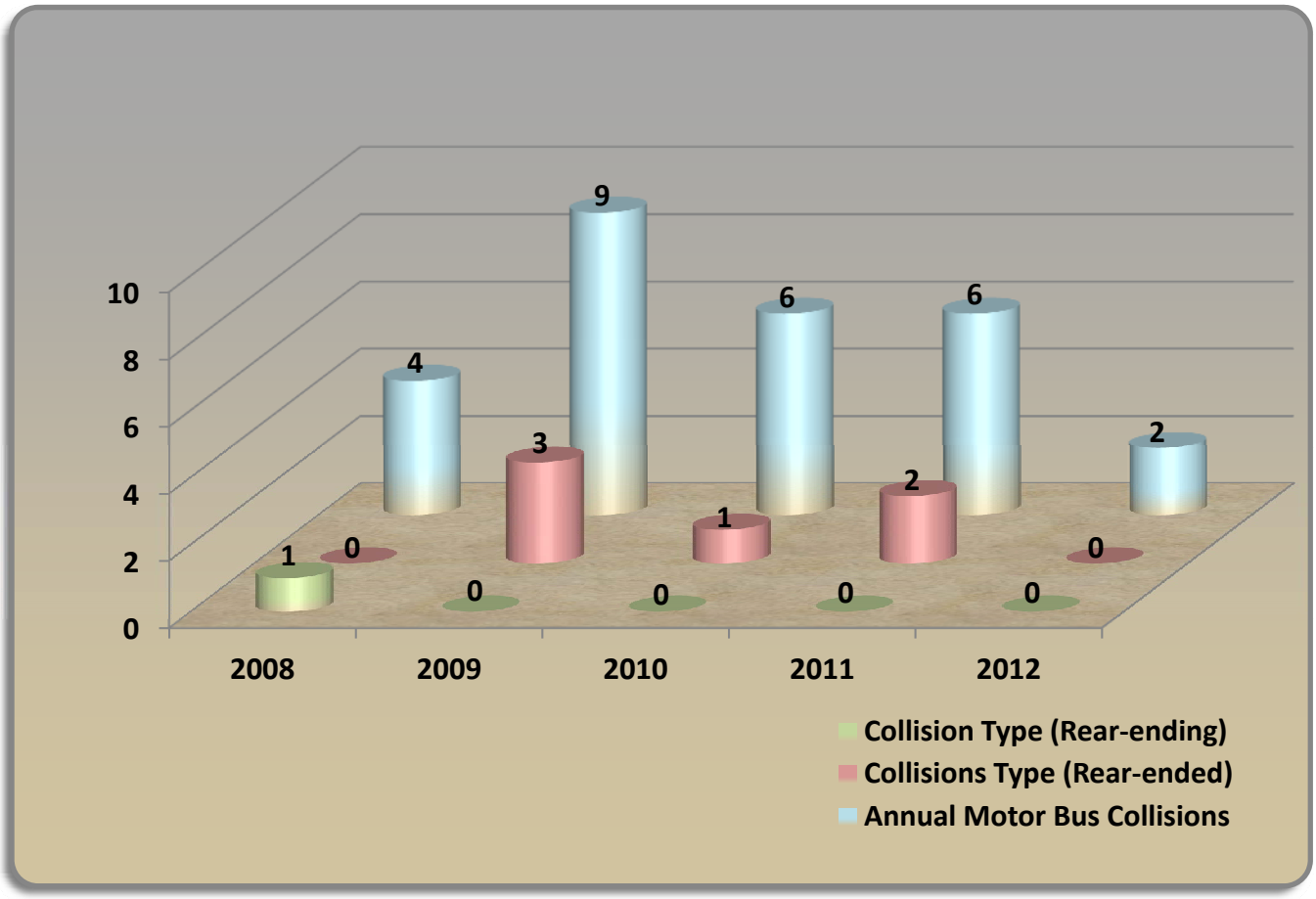

Figure 2-35. County of Volusia, dba: VOTRAN: Annual Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

Since VOTRAN's collisions are low, rear-ended collisions accounted for 33 percent of all collisions in 2009 and 2011, 17 percent in 2010 and 0 percent in 2009 and 2012. Rear-ending collisions were 25 percent in 2008 and 0 percent in the remaining four years. Figure 2-36 below shows rear-ended and rear-ending collisions as a percentage of total collisions.

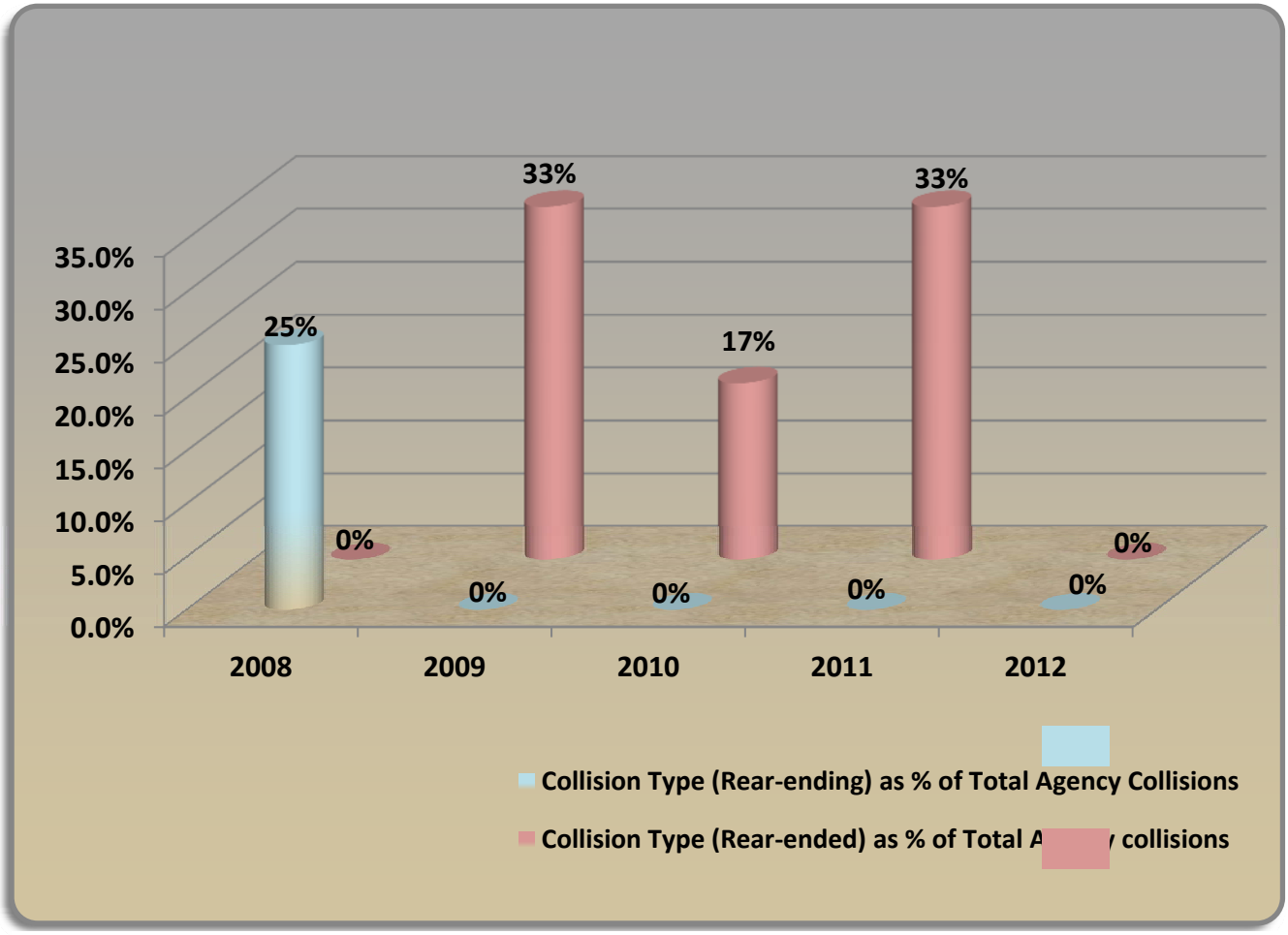

Figure 2-36. County of Volusia, dba: VOTRAN: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Annual Revenue Miles

Annual revenue miles are presented in Figure 2-37 below to form the foundation for reporting collisions per 100,000 miles.

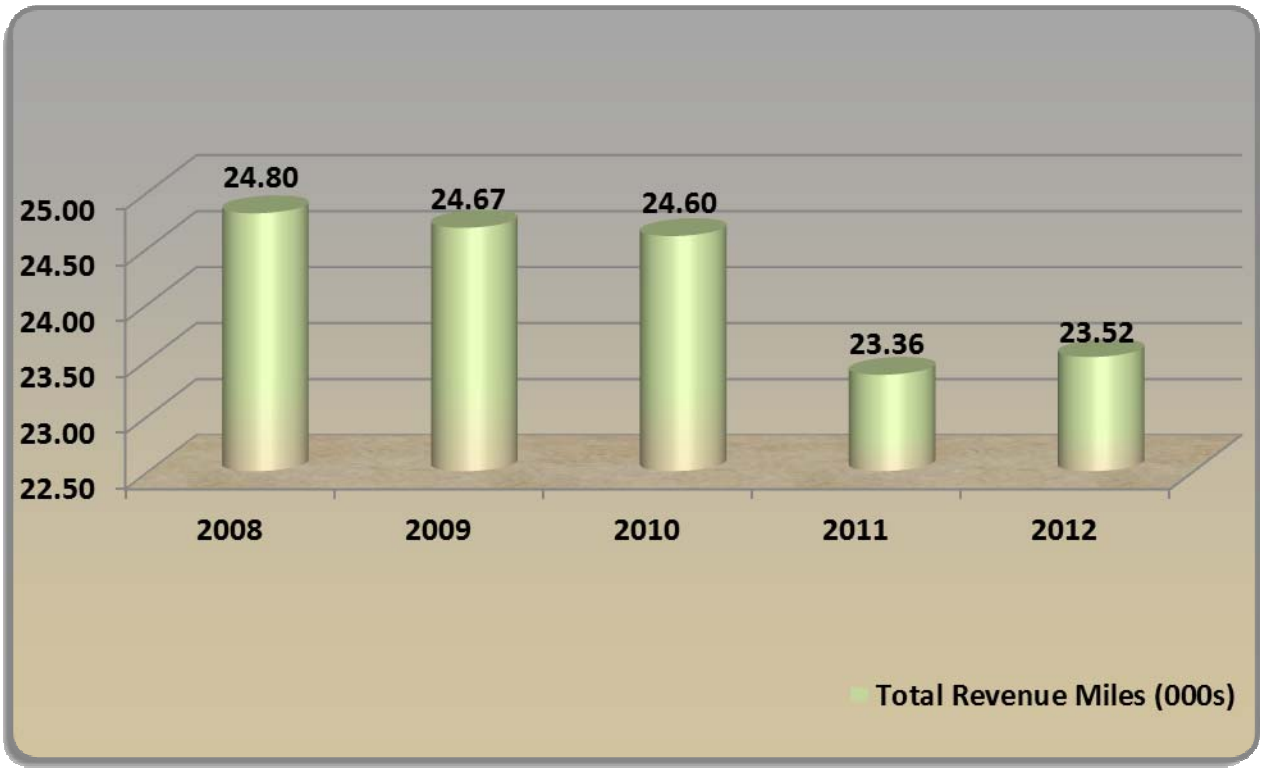

Figure 2-37. County of Volusia, dba: VOTRAN: Annual Total Revenue Miles (000s)

Collisions per 100,000 Miles

Total collisions per 100,000 miles ranged from a low of 0.04 in 2012 to a high of 0.36 in 2009, with 0.16 in 2008, 0.24 in 2010 and 0.26 in 2011. Rear-ended collisions were 0.04 in 2010, 0.09 in 2011 and 0.12 collisions per 100,000 miles in 2009. Rear-ending collisions were 0.04 in 2008. Figure 2-38 below presents motorbus collisions per 100,000 miles.

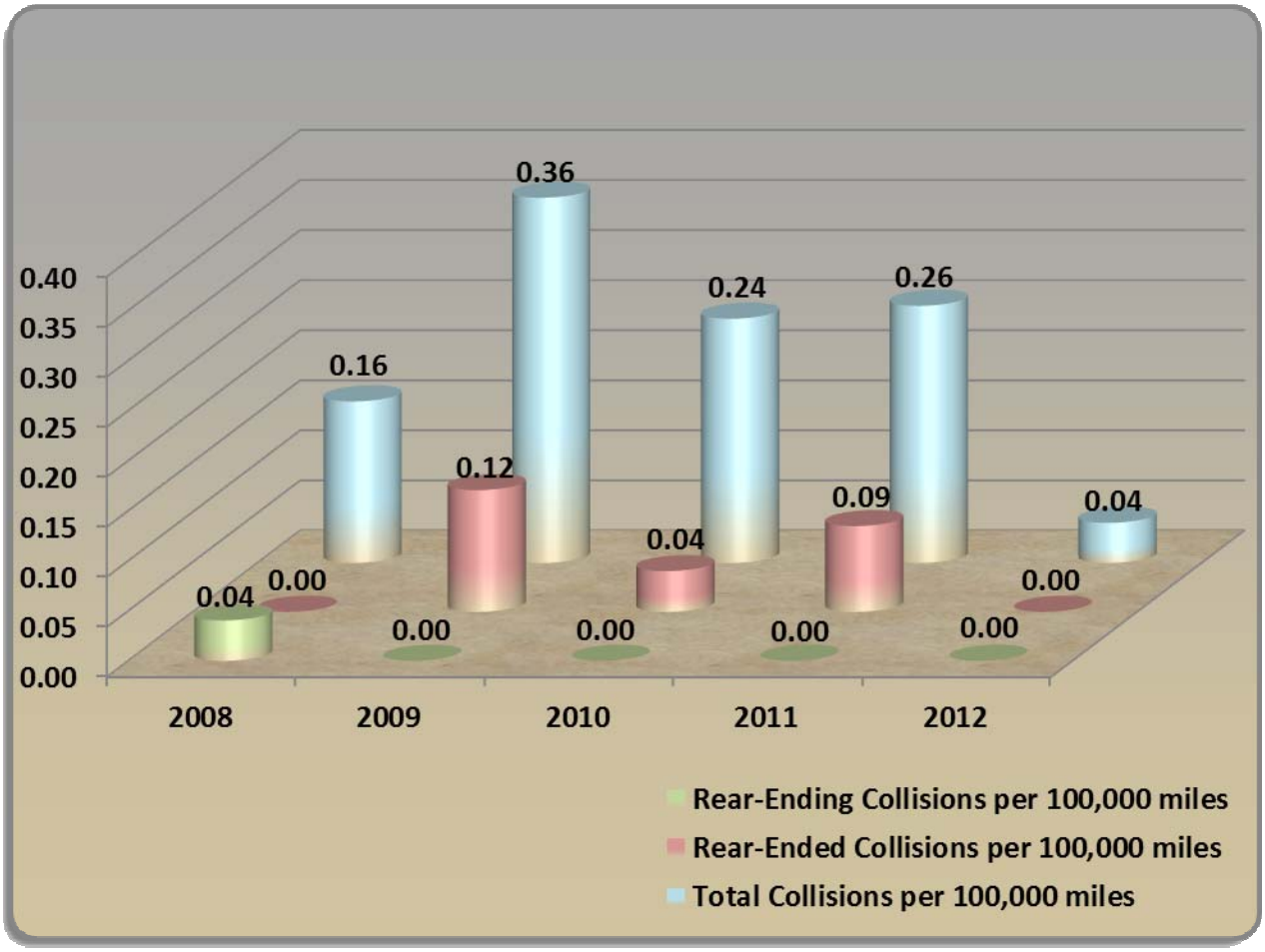

Figure 2-38. County of Volusia, dba: VOTRAN: Motorbus Collisions per Mileage, 2008-2012

Escambia County Area Transit

Reported collisions for Escambia County Area Transit are very low with 1 total collision in 2011 and 2012, 2 total collisions in 2008 and 2010, and 4 in 2009. There was one rear-ended collision in each year from 2008 to 2010, and only one rear-ending collision in 2010. Figure 2-39 below displays total annual motorbus collisions for years 2008 to 2012.

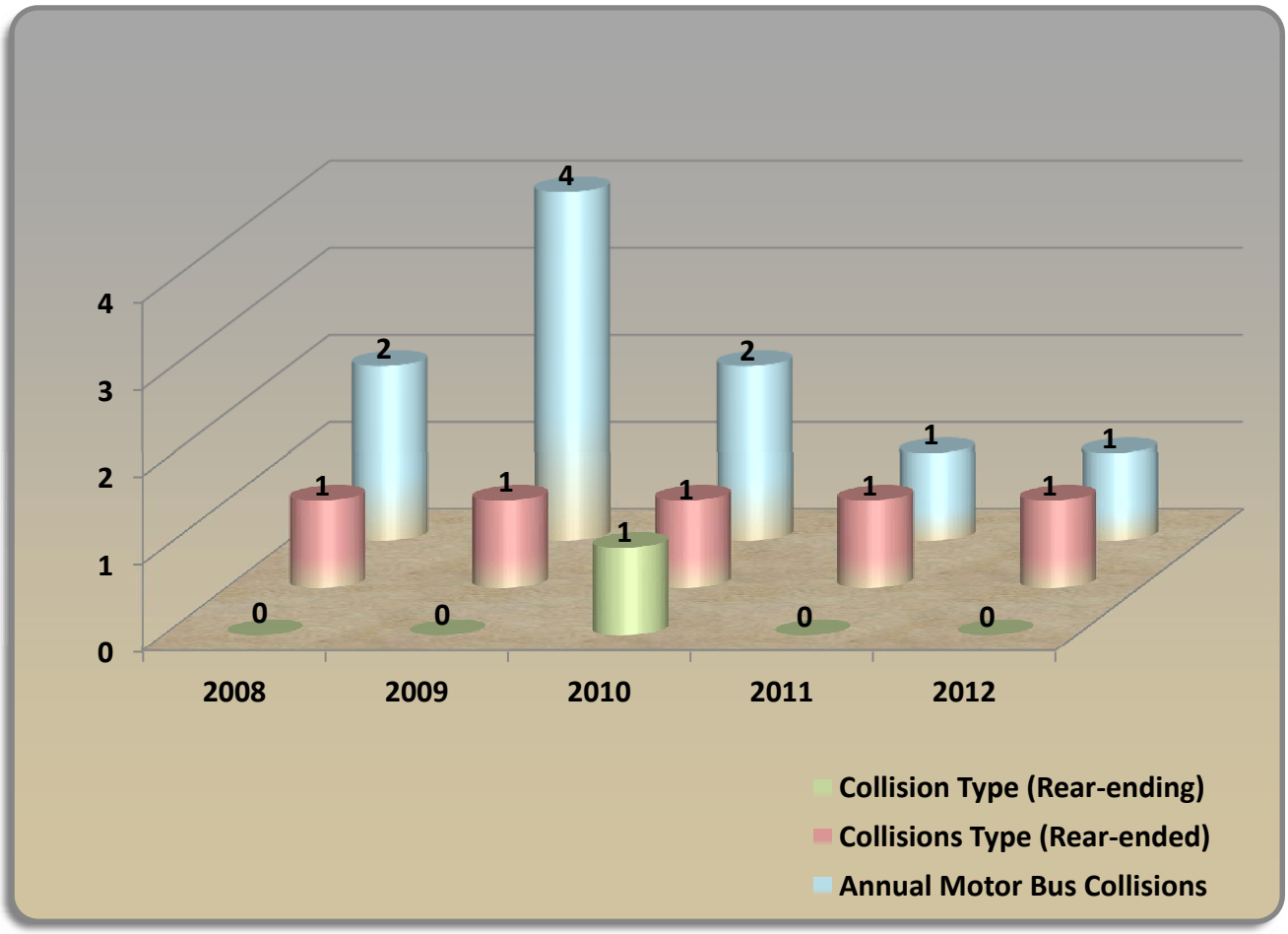

Figure 2-39. Escambia County Area Transit: Annual Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

Figure 2-40 below displays the percentage breakdowns of rear-ended and rear-ending collisions in relation to total collisions. Since Escambia's reported accidents are so low, the percentages are not significant.

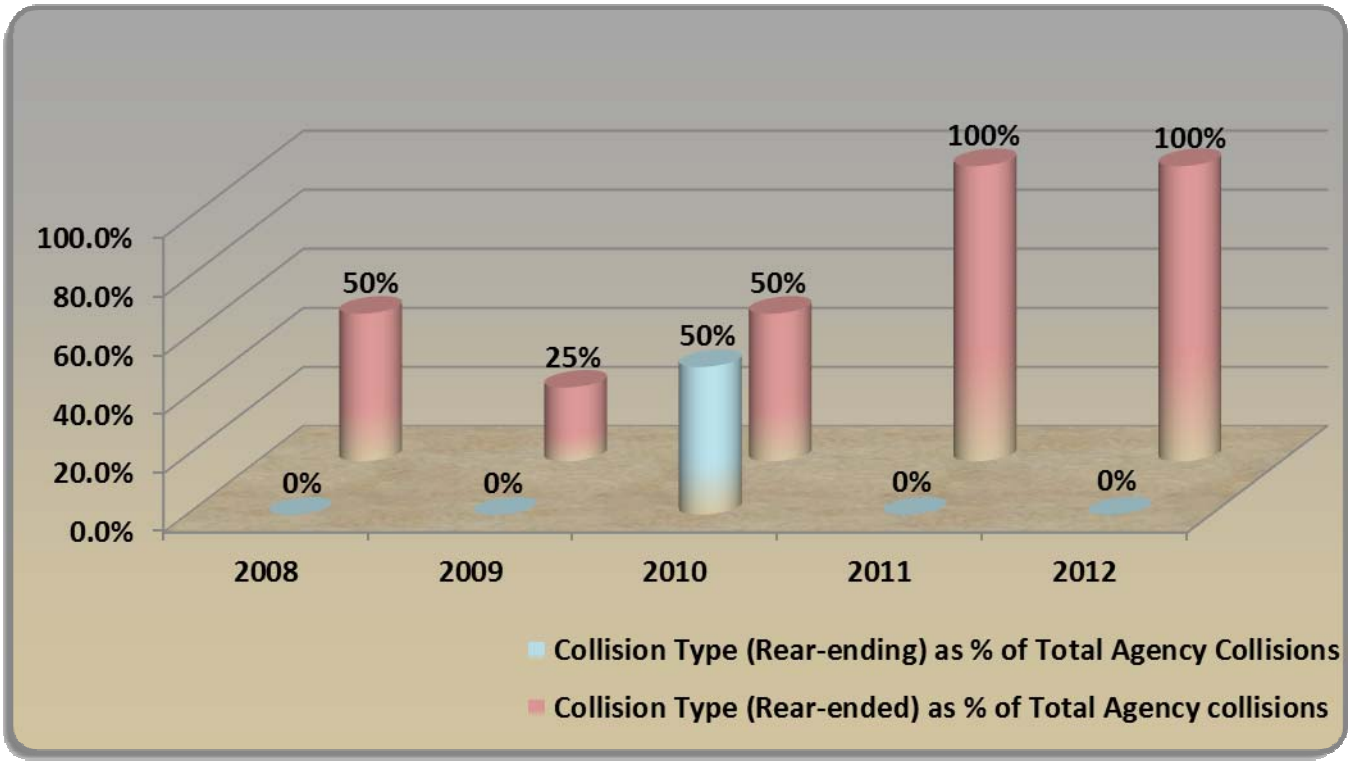

Figure 2-40. Escambia County Area Transit: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Total Annual Revenue Miles

Figure 2-41 below displays the annual revenue miles from 2008 to 2012 to form the foundation of reporting collisions per 100,000 miles.

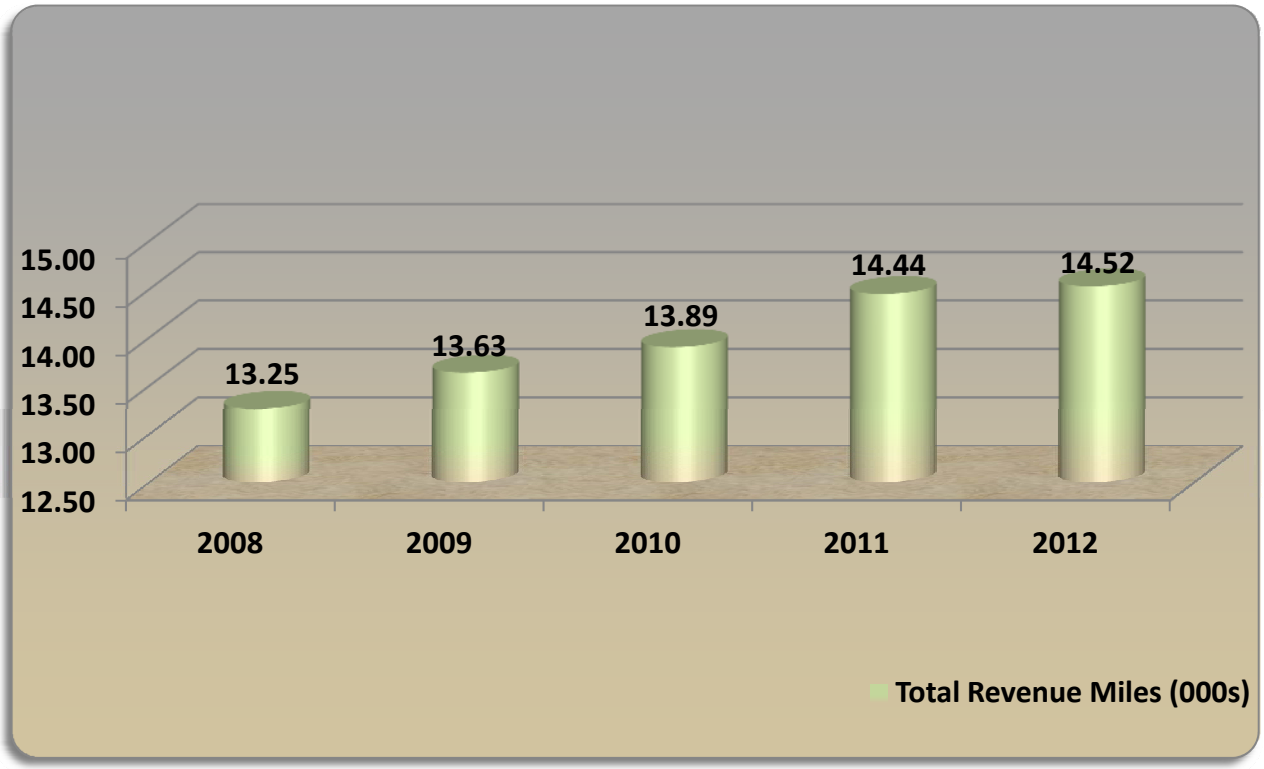

Figure 2-41. Escambia County Area Transit: Annual Total Revenue Miles (000s)

Collisions per 100,000 Miles

Total collisions per 100,000 miles were at 0.07 in 2011 and 2012, with 0.14 in 2010, 0.15 in 2008, and peaking at 0.29 in 2009. Rear-ended collisions were 0.08 and then 0.07 collisions per 100,000 miles in 2009, 2010, 2011 and 2012. With only one rear-ending collision over the five years, rear-ending collisions were at 0.07 in 2010 only. Figure 2-42 below displays motorbus collisions per 100,000 miles.

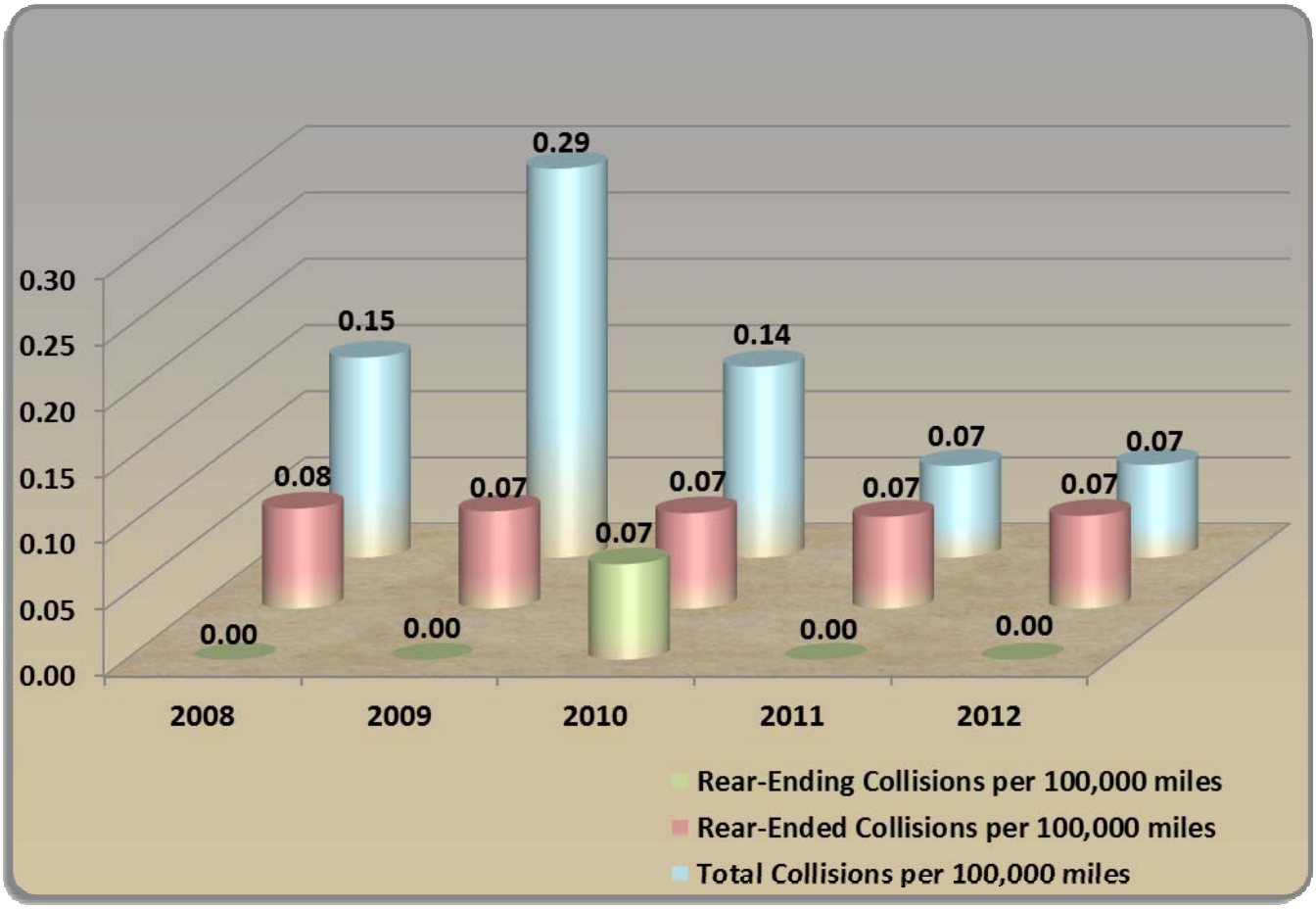

Figure 2-42. Escambia County Area Transit: Motorbus Collisions per Mileage, 2008 - 2012

Gainesville Regional Transit

Reported collisions for Gainesville are also very low with two total collisions in 2008, three total in 2009 and 2010, five in 2011 and four in 2012. There was one rear-ended collision in 2008, 2010 and 2012 and 2 in 2009 and none in 2011. Gainesville Regional Transit did not report any rear-ending collisions in the five year period. Figure 2-43 below presents total annual motorbus collisions for years 2008 to 2012.

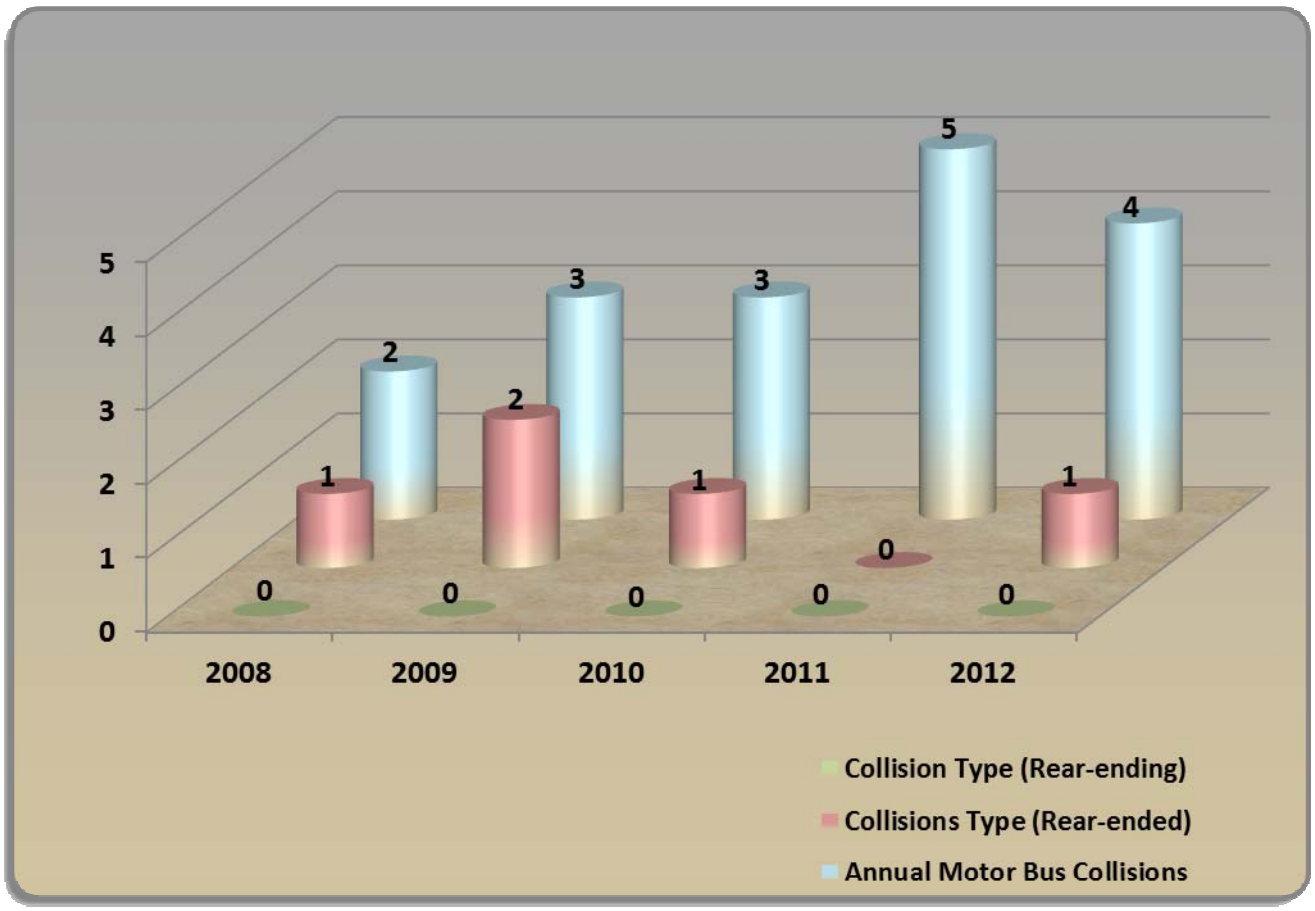

Figure 2-43. Gainesville Regional Transit: Annual Motorbus Collisions, 2008 -2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

Figure 2-44 below displays the percentage breakdowns which are not significant given the low number of overall collisions.

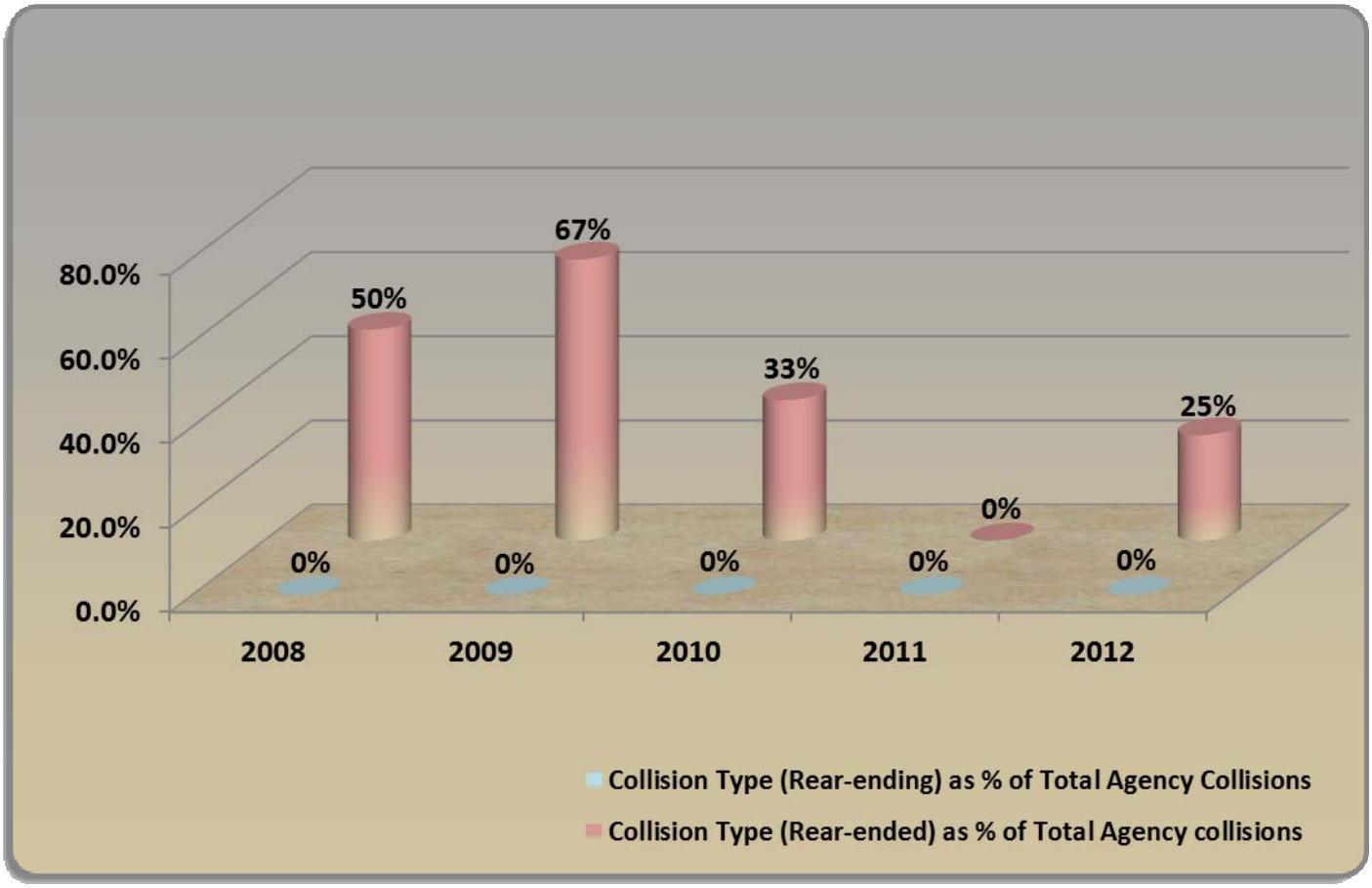

Figure 2-44. Gainesville Regional Transit: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008 - 2012

Total Annual Revenue Miles

Figure 2-45 below displays the total annual revenue miles as a foundation for reporting collisions per 100,000 miles.

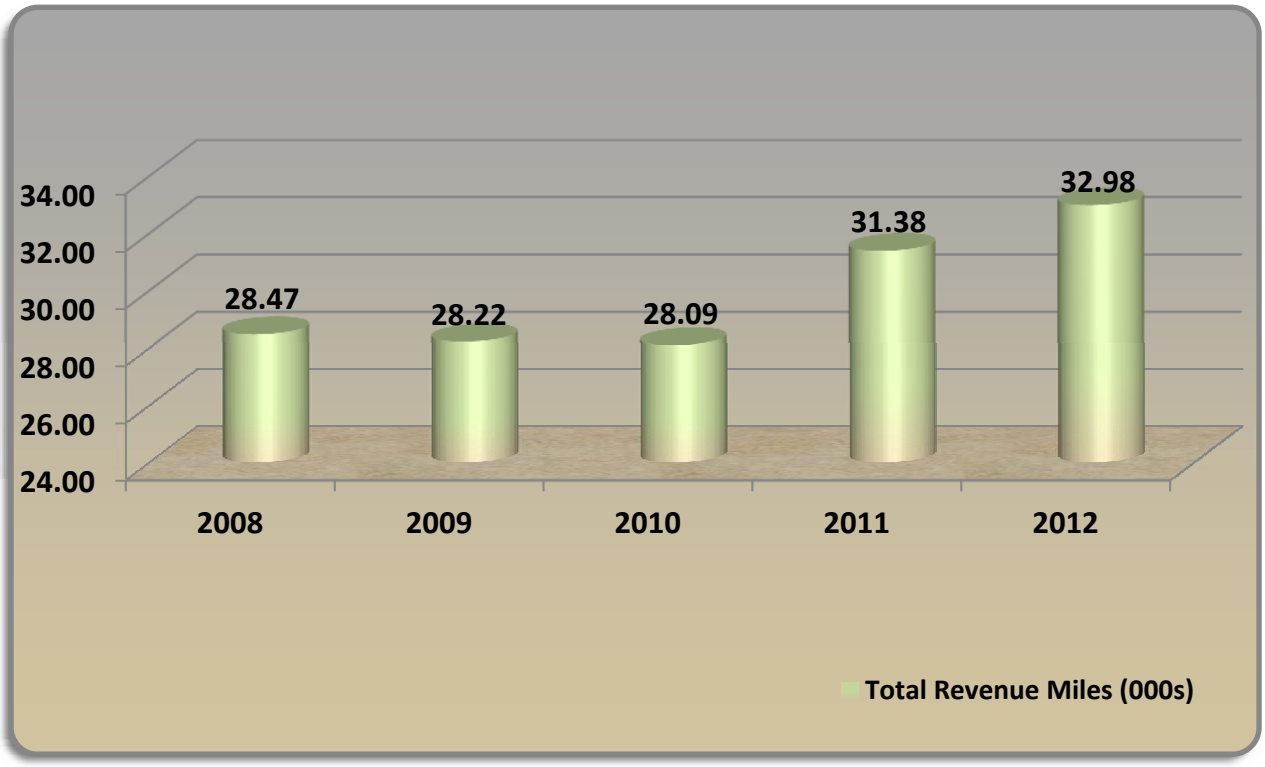

Figure 2-45. Gainesville Regional Transit: Annual Total Revenue Miles (000s)

Collisions per 100,000 Miles

Total collisions per 100,000 miles were at 0.07 in 2008, increased to 0.11 in 2009 and 2010, increased to 0.16 in 2011 and then decreased to 0.09 in 2012. Rear-ended collisions peaked in 2009 with 0.07, 0.04 in 2008 and 2010, 0.00 in 2011 and 0.03 in 2012. There were no rear-ending collisions over the five year period. Figure 2-46 below shows motorbus collisions per 100,000 miles.

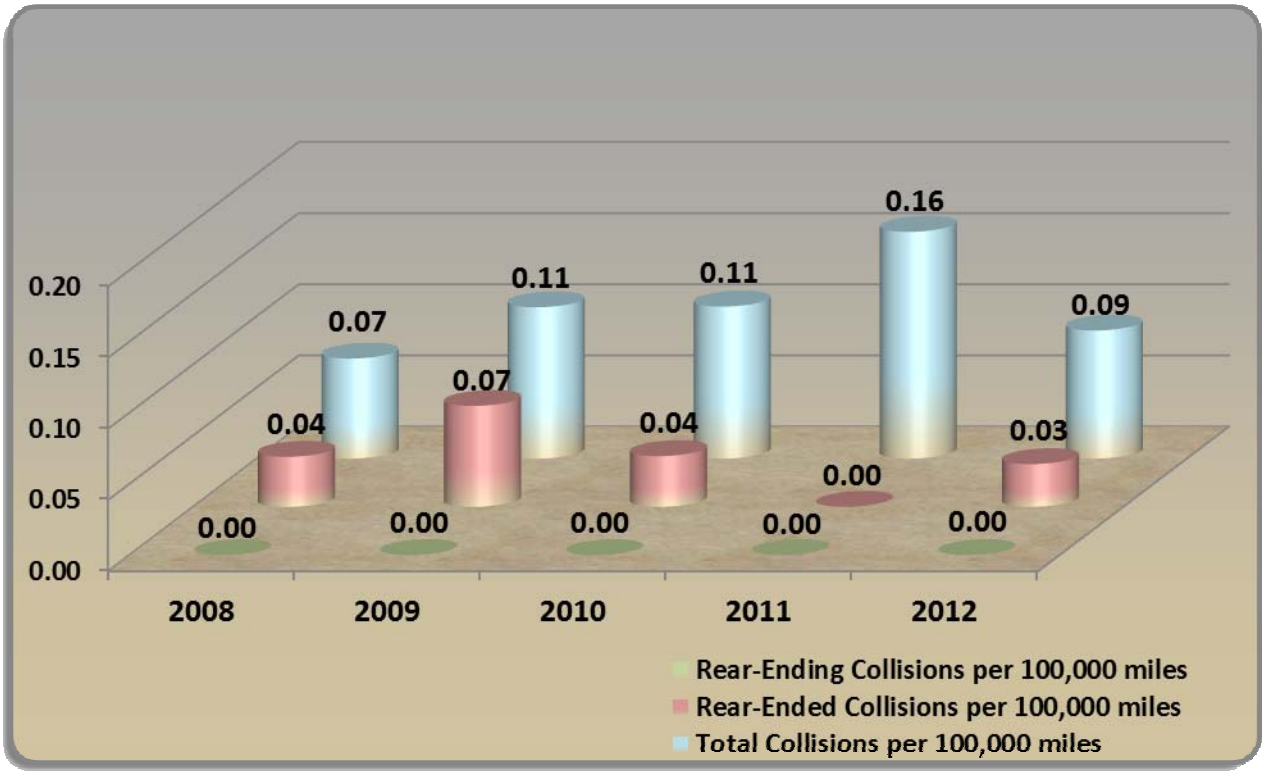

Figure 2-46. Gainesville Regional Transit: Motorbus Collisions per Mileage, 2008-2012

Hillsborough Area Regional Transit (HART)

Total collisions ranged from a low of 31 in 2009 and a high of 40 in 2010, with 34 in 2008, 39 in 2011 and 39 in 2012. Rear-ended collisions ranged from a low of 12 in 2009 to a high of 17 in 2011, with 13 in 2008, 15 in 2010 and 16 in 2012. HART reported 3 rear-ending collisions in 2008 and 2010 and five in 2009. Figure 2-47 below displays total annual motorbus collisions for years 2008-2012.

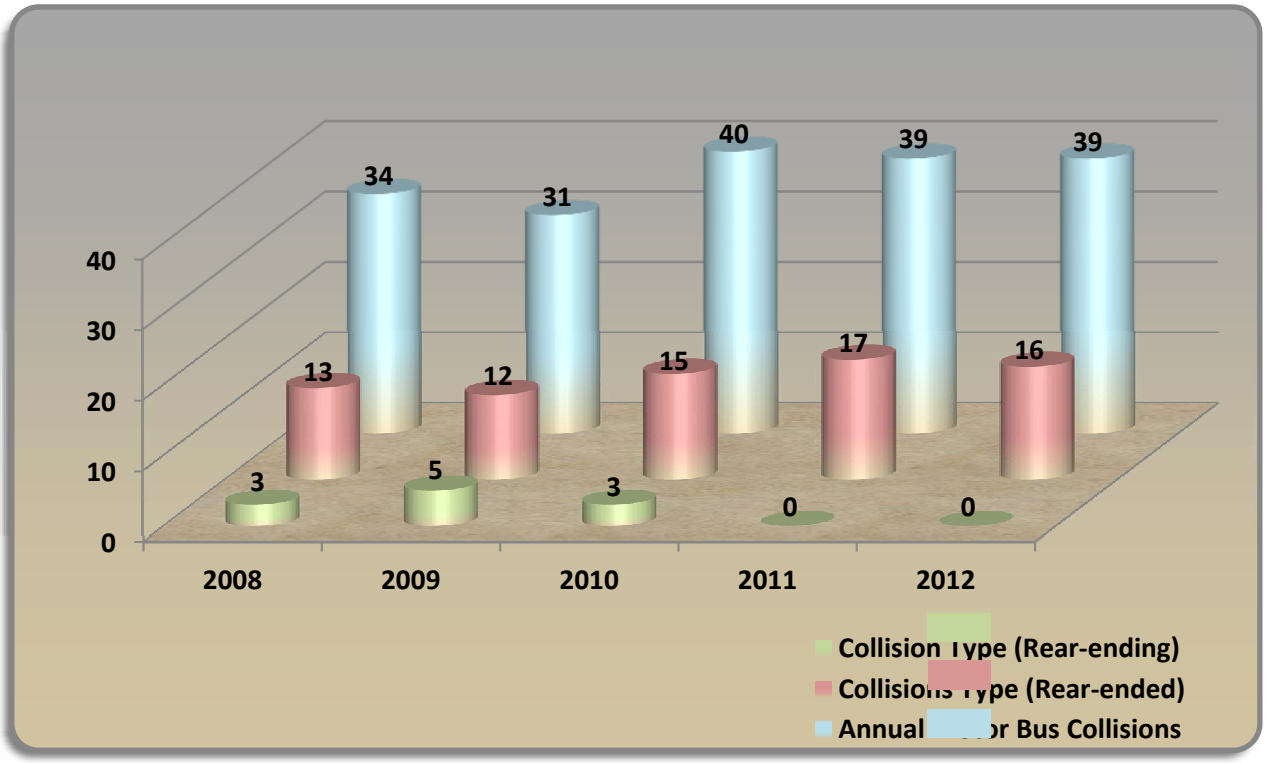

Figure 2-47. Hillsborough Area Regional Transit Authority: Annual Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percent of Total Collisions

Figure 2-48 below displays the percentage breakdown of rear-ended and rear-ending collisions as a percentage of total collisions. Rear-ended-collisions range from 38 percent in 2008 and 2010 to 39 percent in 2009, 44 percent in 2011 and 41 percent in 2012. Rear-ending collisions were 8 percent in 2010, 9 percent in 2008 and 16 percent in 2009. There were not rear-ending collisions reported in 2011 and 2012.

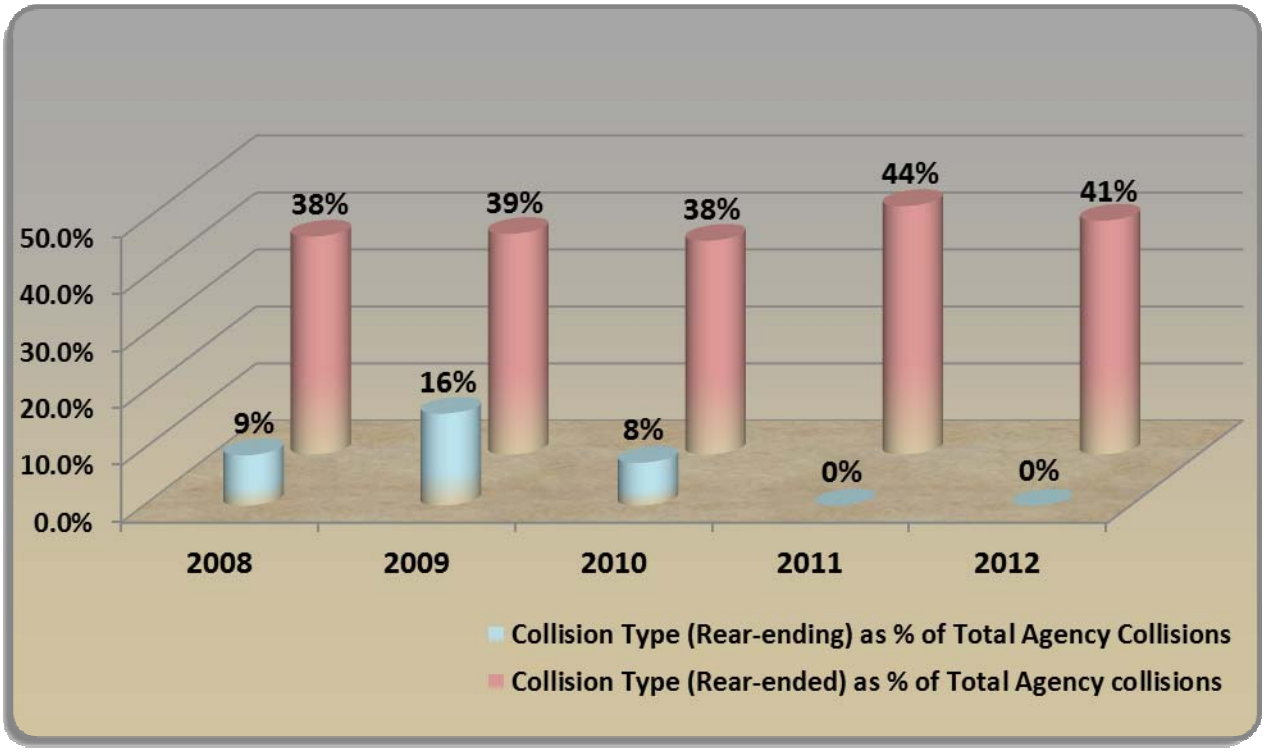

Figure 2-48. Hillsborough Area Regional Transit Authority: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Total Annual Revenue Miles

Figure 2-49 below displays total annual revenue miles to form the foundation for reporting collisions per 100,000 miles.

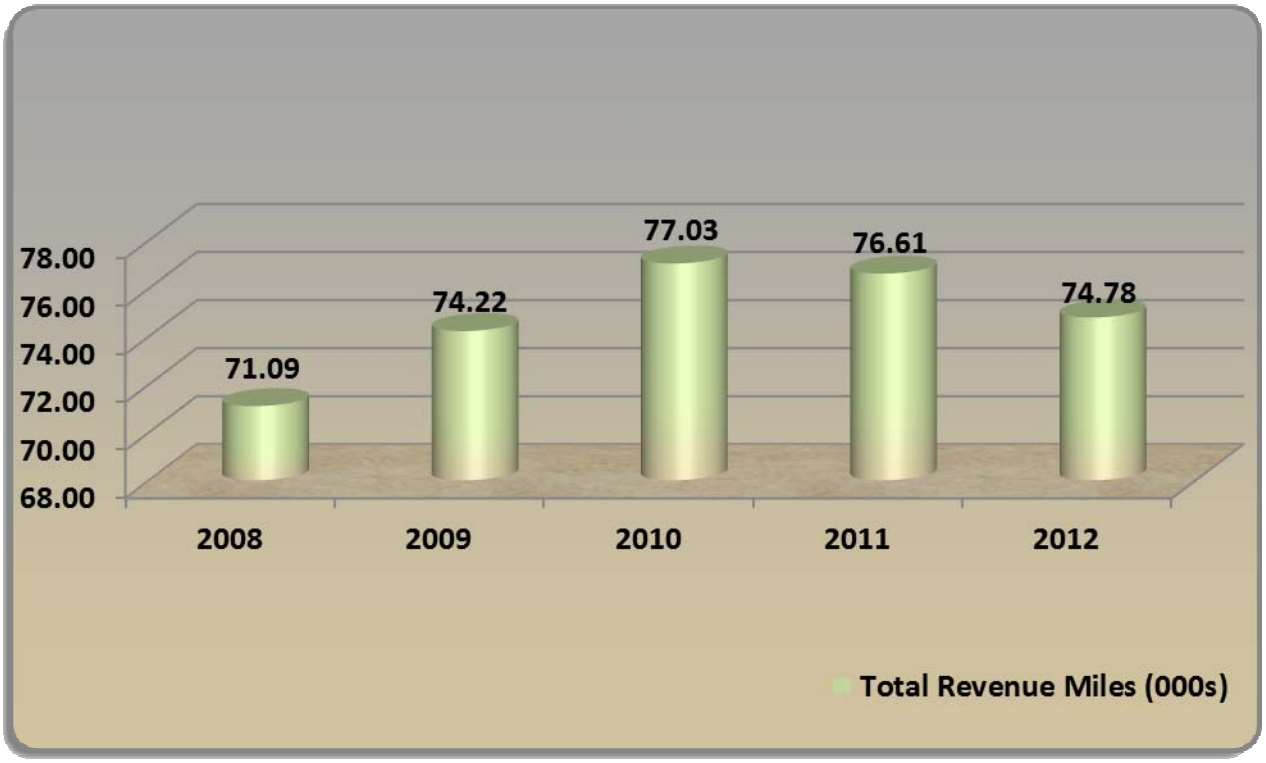

Figure 2-49. Hillsborough Area Regional Transit Authority: Annual Total Revenue Miles (000s)

Collisions per 100,000 miles

HART displays a stable trend in the rate of collisions with total collisions ranging from 0.42 in 2009 to 0.52 in 2010, with 0.48 in 2008, 0.51 in 2011 and 0.52 in 2012. However, these rates are significantly higher than the Florida aggregate data. Correspondingly, rear-ended collisions ranged from a low of 0.16 in 2009 to 0.22 in 2011, with 0.18 in 2008, 0.19 in 2010 and 0.21 in 2012. Rear-ending collisions were at 0.04 in 2008 and 2010 and 0.07 in 2009. Figure 2-50 below presents annual motorbus collisions per 100,000 miles.

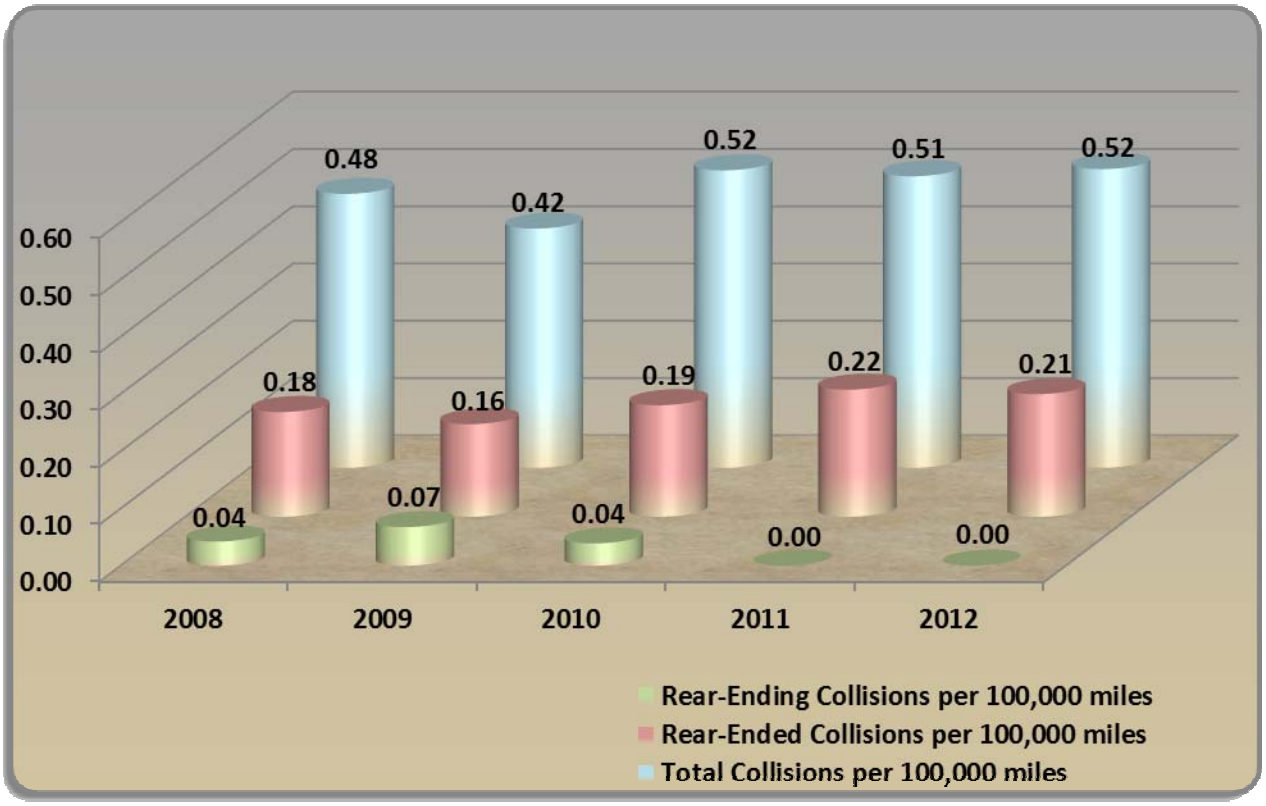

Figure 2-50. Hillsborough Area Regional Transit Authority: Motorbus Collisions per Mileage, 2008-2012

Jacksonville Transportation Authority

Total collisions fluctuated over the five year period for JTA, with 21 in 2008, 13 in 2009, 23 in 2010, 10 in 2011 and 23 in 2012. Rear-ended collisions also fluctuated with 8 in 2008, 3 in 2009, 8 in 2010, 2 in 2011 and 7 in 2012. Rear-ending collisions displayed a stable trend with 1 in 2008, 2009 and 2010, none in 2011 and 2 in 2012. Figure 2-51 displays total annual motorbus collisions for years 2008 to 2012.

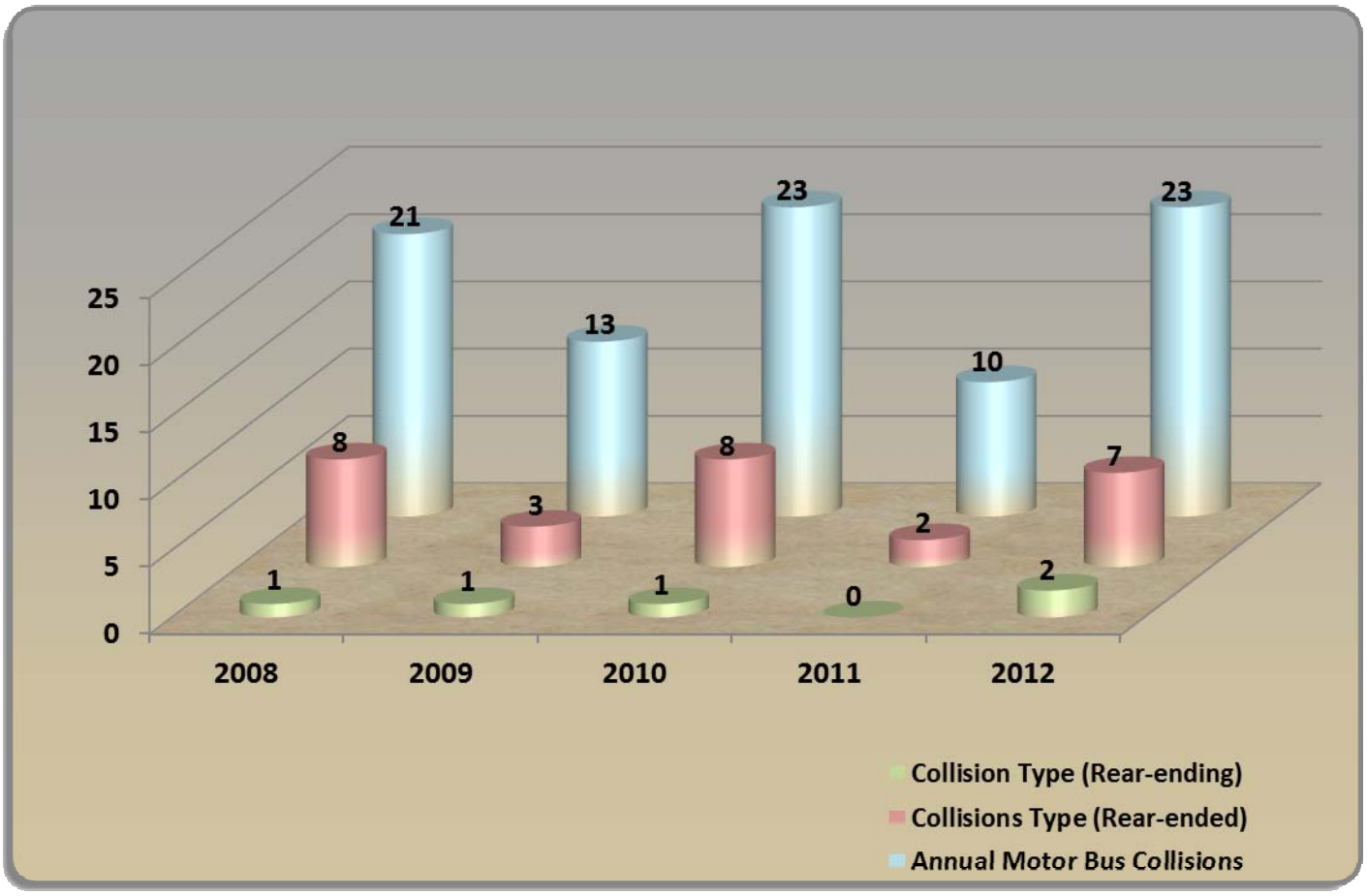

Figure 2-51. Jacksonville Transportation Authority: Annual Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

Rear-ended collisions ranged from a low of 20 percent in 2011 to a high of 38 percent in 2008, with 23 percent in 2009, 35 percent in 2010, and 30 percent in 2012. JTA reported no rear-ending collisions in 2011, and rear-ending collisions accounted for 5 percent in 2008, 8 percent in 2009, 4 percent in 2010, and 9 percent in 2012. Figure 2-52 below presents rear-ended and rear-ending collisions as a percentage of total collisions.

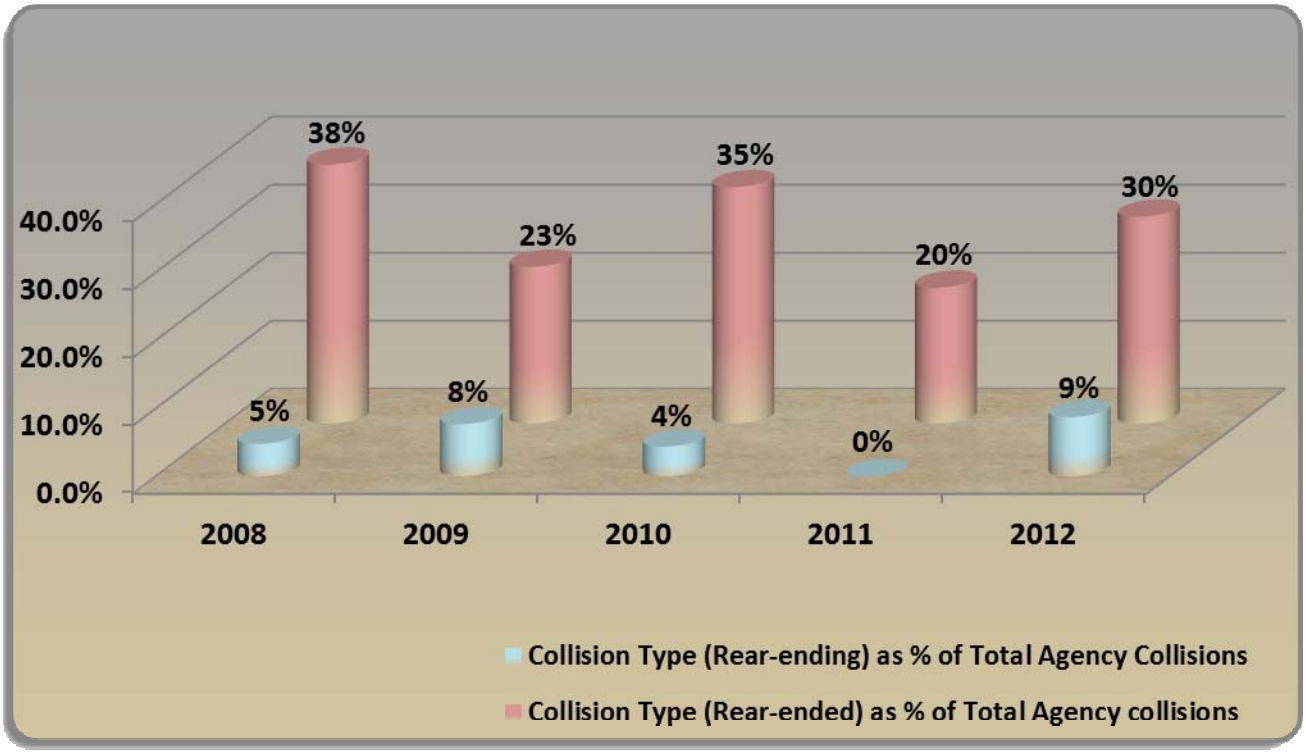

Figure 2-52. Jacksonville Transportation Authority: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Total Annual Revenue Miles

Figure 2-53 below displays the annual revenue miles of service to form the foundation for reporting collisions per 100,000 miles.

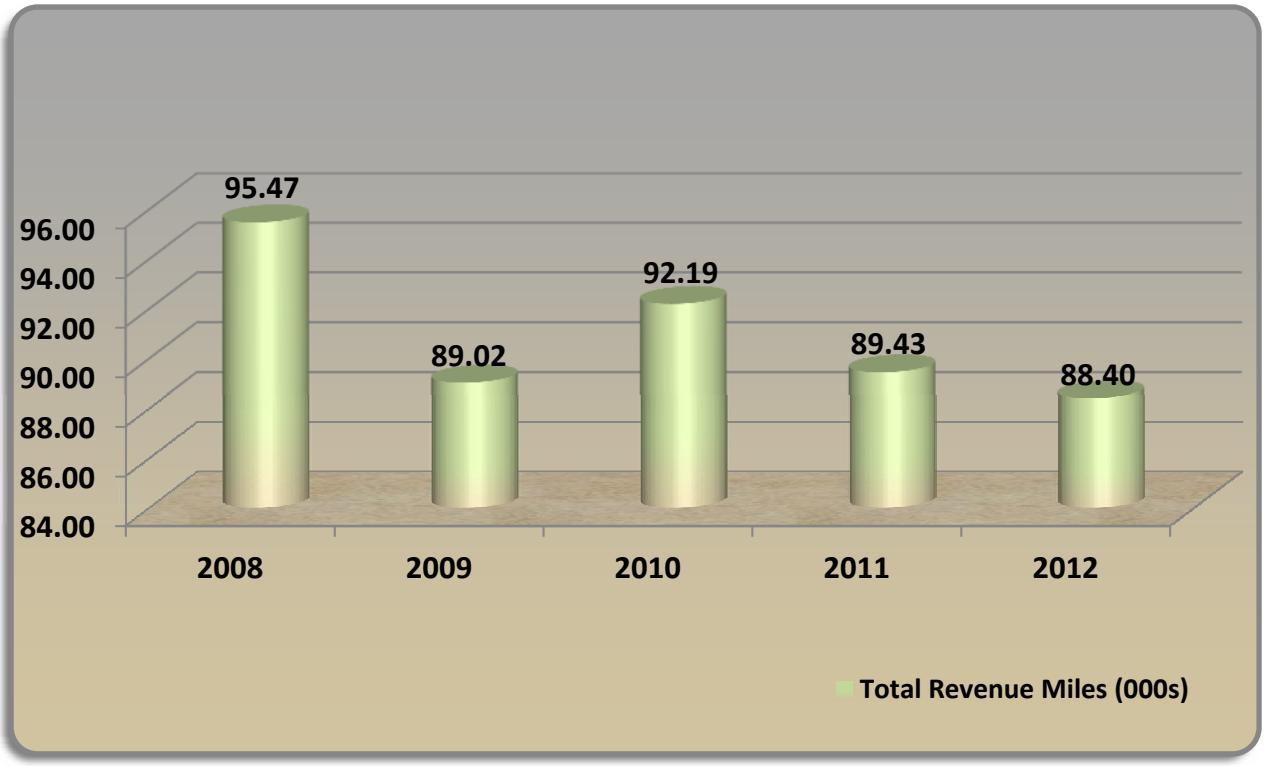

Figure 2-53. Jacksonville Transit Authority: Annual Total Revenue Miles (000s)

Collisions per 100,000 Miles

Just as total accidents fluctuated for JTA, so do collisions per 100,000 miles. Total collisions per 100,000 miles were at a low in 2011 at 0.11 and a high in 2012 with 0.26, with 0.22 in 2008, 0.15 in 2009, and 0.25 in 2010. Rear-ended collisions were at 0.02 in 2011 and 0.03 in 2009, with 0.08 in 2008 and 2012 and 0.11 in 2011. Rear-ending collisions are stable 0.01 in 2008, 2009, 2010 and 0.02 in 2012. Figure 2-54 below shows motorbus collisions per 100,000 miles.

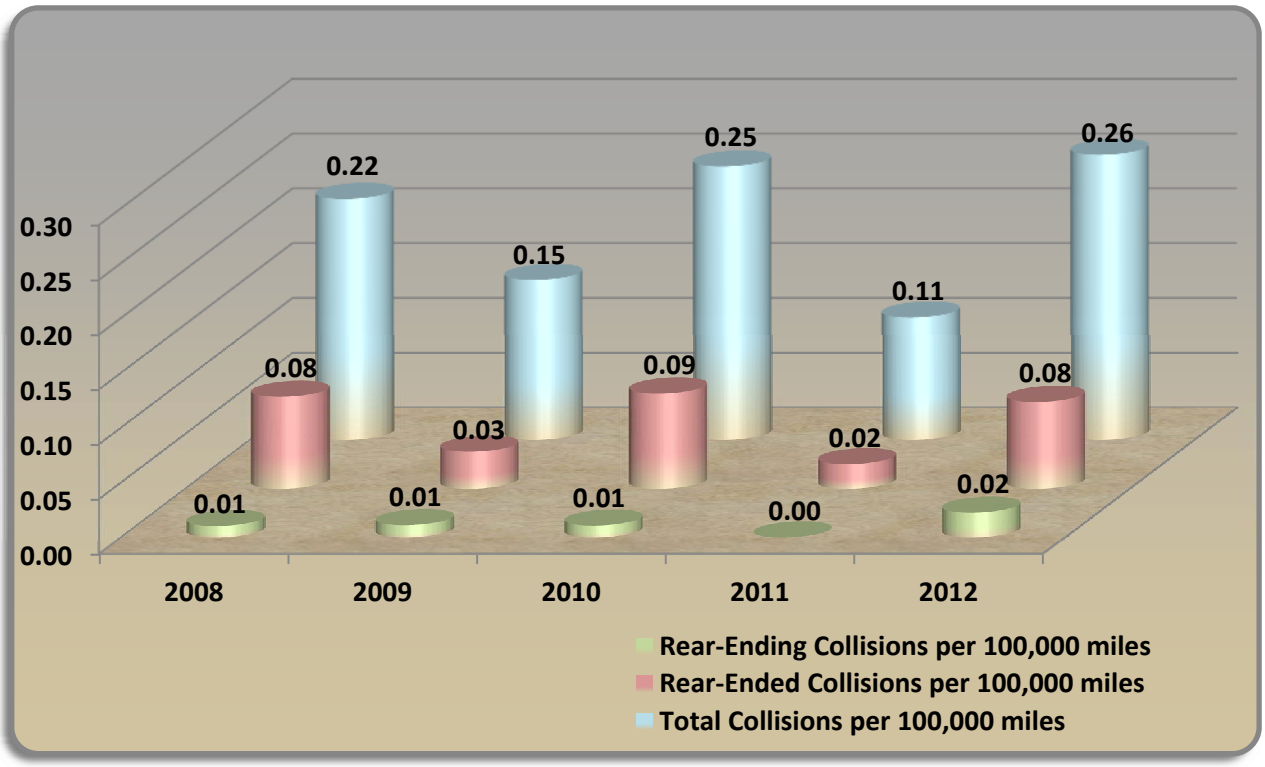

Figure 2-54. Jacksonville Transportation Authority: Motorbus Collisions per Mileage, 2008-2012

Lee County Transit

Total collisions fluctuated for LeeTran over the five year period, with 4 collisions in 2008, 2010 and 2011 and 10 collisions in 2009 and 11 in 2012. Rear-ended collisions were highest during the two highest years of collisions, with 7 each in 2009 and 2012. LeeTran had three years with no reported rear-ending collisions, with 2 in 2009 and 1 in 2010. Figure 2-55 displays total annual motorbus collisions for years 2008 to 2012.

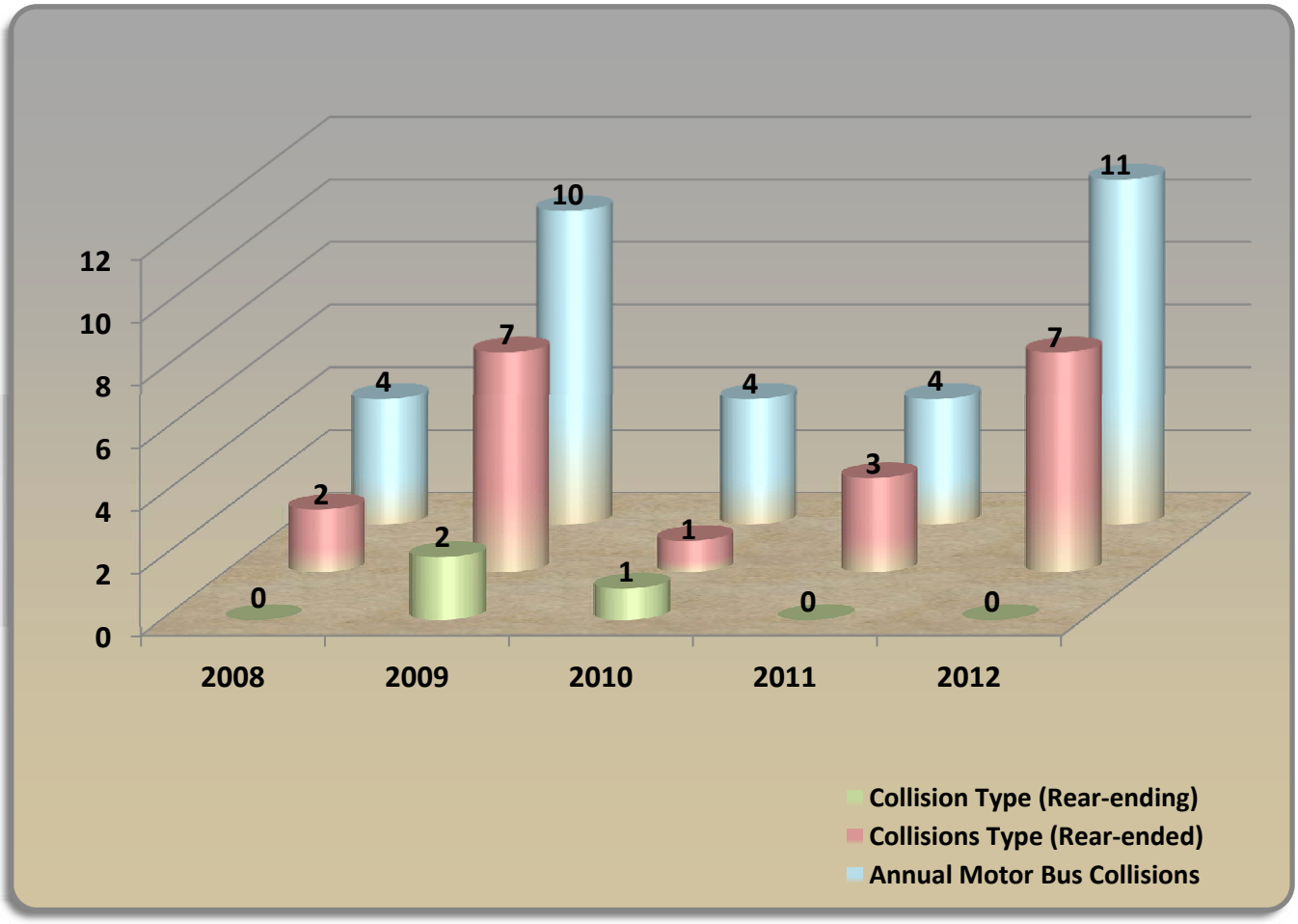

Figure 2-55. Lee County Transit: Annual Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

With 2009 and 2012 as the year with the highest number of collisions, 70 percent were rear-ended in 2009 and 64 percent in 2012; in 2011, rear-ended collisions were 75 percent of the total (3 of 4 collisions). Figure 2-46 below presents rear-ended and rear-ending collisions as a percentage of total collisions.

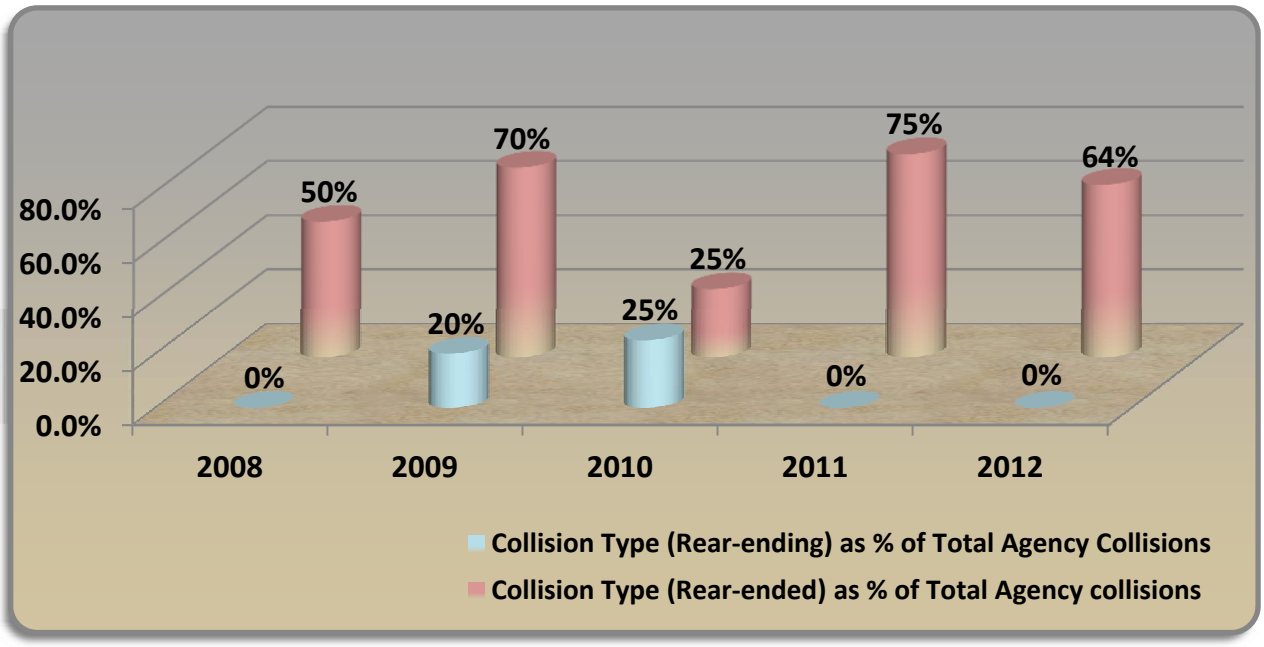

Figure 2-56. Lee County Transit: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Total Annual Revenue Miles

Figure 2-57 below displays the annual revenue miles of service to form the foundation for reporting collisions per 100,000 miles.

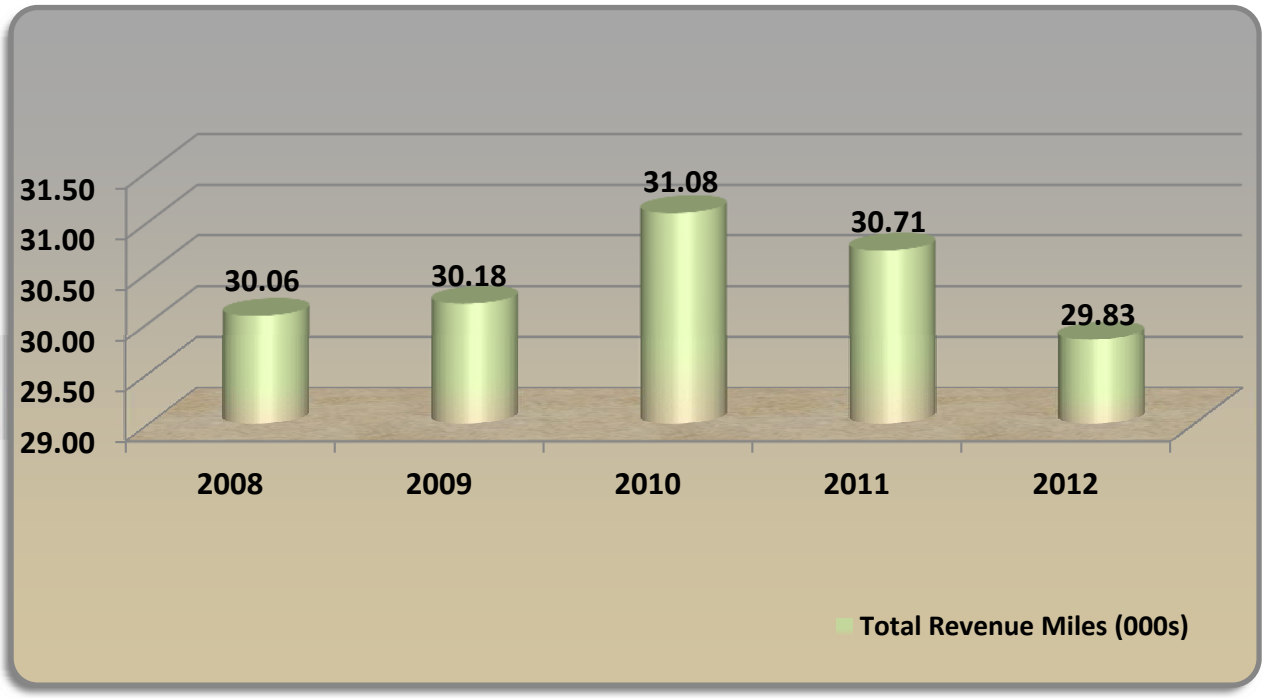

Figure 2-57. Lee County Transit: Annual Total Revenue Miles (000s)

Collisions per 100,000 Miles

Total collisions per 100,000 miles were stable at 0.13 in 2008, 2010 and 2011. In 2009, total collisions per 100,000 miles were 0.33 and in 2012, 0.37. Clearly, most of the collisions are rear-ended with 0.23 collisions per 100,000 miles in 2009 and 2012. Figure 2-58 below presents motorbus collisions per 100,000 miles.

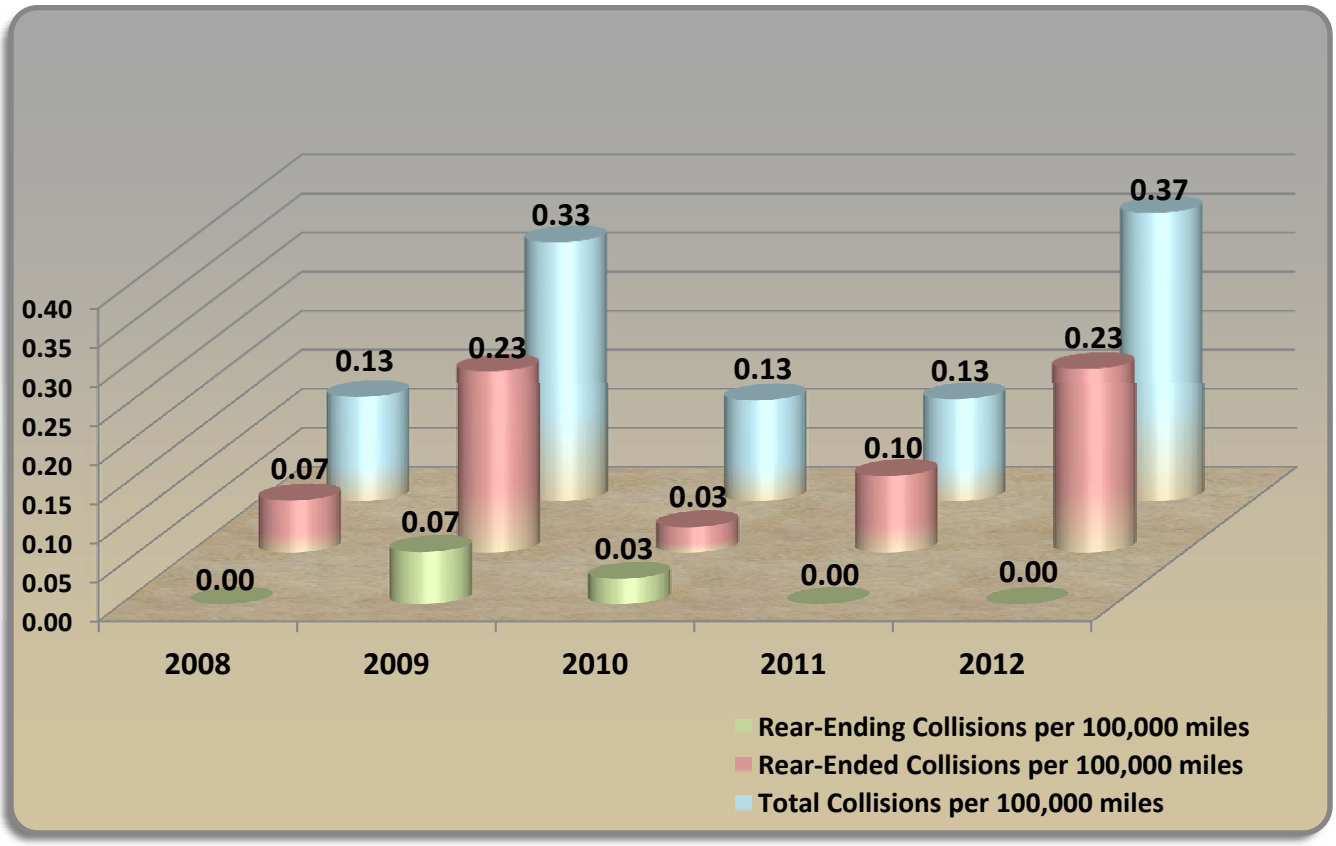

Figure 2-58. Lee County Transit: Motorbus Collisions per Mileage, 2008-2012

Miami-Dade Transit

From a research perspective, Miami-Dade Transit's collision totals are difficult to interpret. As the state's largest urban area, one would assume that the highest number of collisions would take place in this system, as did happen in 2008 and 2009. However, in 2010, Miami-Dade Transit reported 25 total collisions, with 38 in 2011 and 25 in 2012. It is clear in the data collection process so far that the state's largest systems, Broward County Transit, PalmTran, Pinellas Suncoast Transit Authority, Central Florida Regional Transportation Authority, and the Jacksonville Transportation Authority, generate more collisions than smaller properties. However, as was mentioned earlier, collision data are self reported by agencies and are not audited by the FTA. Also, the agency's number of rear-ended and rear-ending collisions significantly dropped from 2010 forward. Figure 2-59 below displays total annual motorbus collisions for years 2008 to 2012.

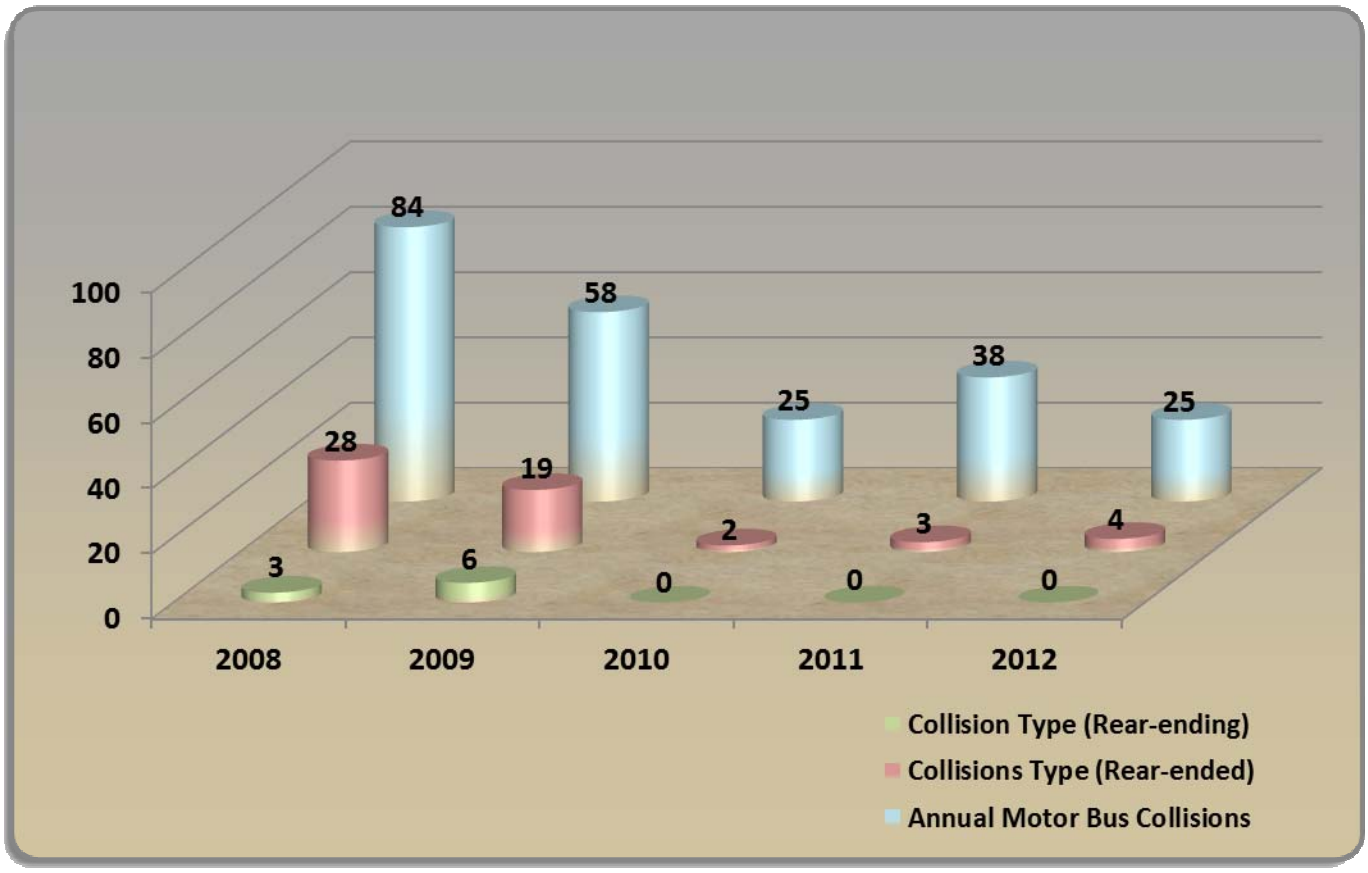

Figure 2-59. Miami-Dade Transit: Annual Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

In 2008 and 2009, rear-ended collisions were 33 percent of total accidents, this dropped to 8 percent in 2010 and 2011 and 16 percent in 2012. In 2008, rear-ending collisions were 4 percent of the total and in 2009, 10 percent of the total. In 2010, 2011 and 2012, MDT did not report an rear-ending collisions. Figure 2-60 below shows rear-ended and rear-ending collisions as a percentage of total collisions.

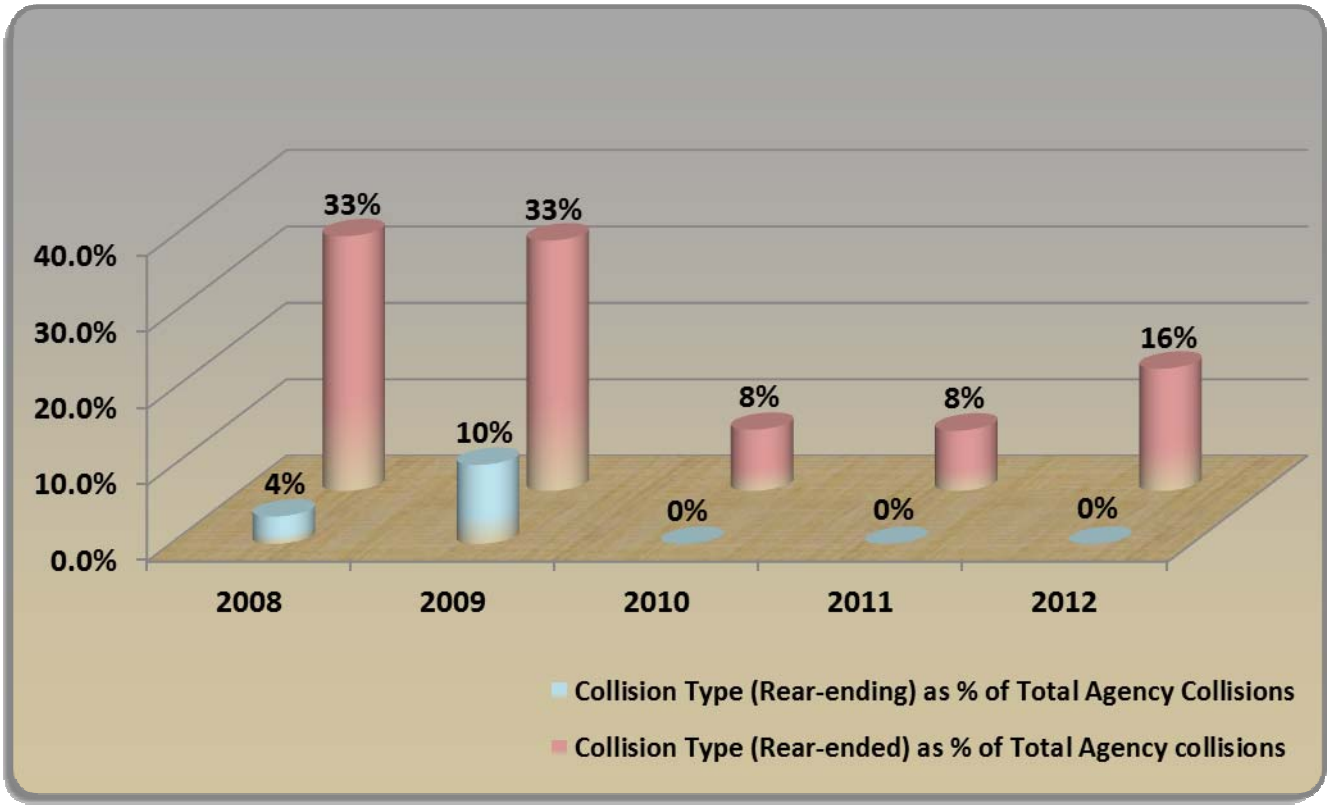

Figure 2-60. Miami-Dade Transit: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Total Annual Revenue Miles

Figure 2-61 below displays the total annual revenue miles to form the foundation for reporting collisions per 100,000 miles.

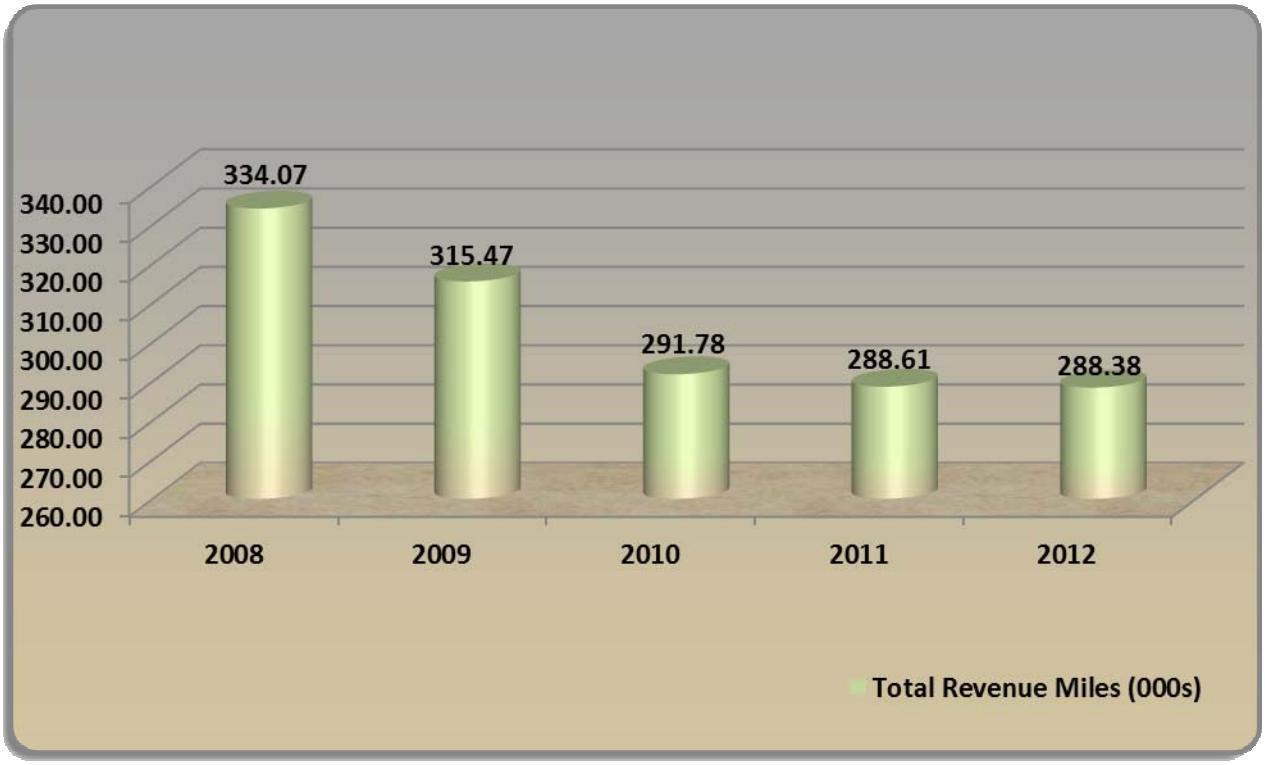

Figure 2-61. Miami-Dade Transit: Annual Total Revenue Miles (000s)

Collisions per 100,000 Miles

In 2008 and 2009, total collisions per 100,000 miles were at 0.25 and 0.18; however, this dropped off to 0.09 in 2010 and 2012 and 0.13 in 2011. Rear-ended-collisions were at 0.08 in 2008 and 0.06 collisions per 100,000 miles in 2009. In 2010, 2011 and 2012, rear-ended collisions were at 0.01. Miami Dade Transit reported no rear-ended collisions in 2010, 2011 and 2012. Figure 2-62 below shows motorbus collisions per 100,000 miles.

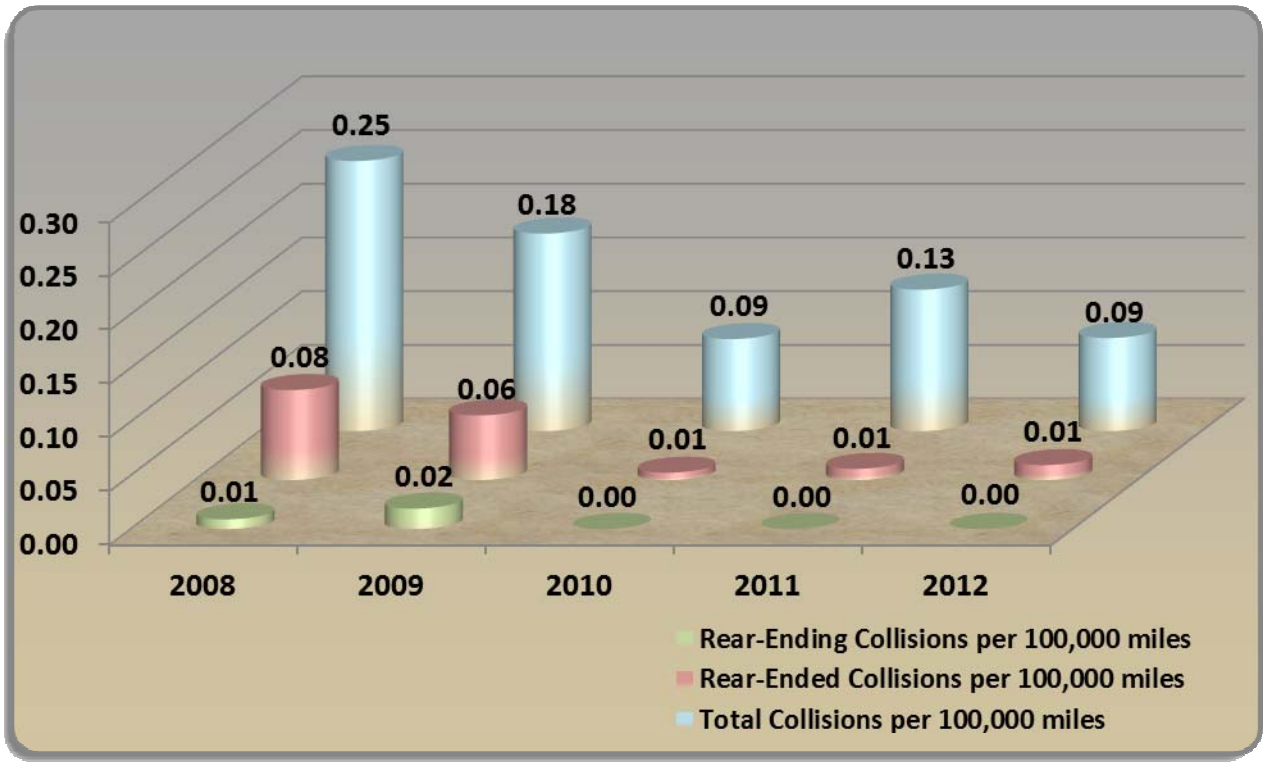

Figure 2-62. Miami-Dade Transit: Motorbus Collisions per Mileage, 2008-2012

Pasco County Public Transportation

Total collisions in Pasco County peaked at 10 in 2008, went down to 4 in 2009, then 8 in 2009, 5 in 2011 and 8 in 2012. It appears that most of Pasco County's collisions were rear-ended, with only one rear-ending collision in 2009 and one in 2011. Figure 2-63 below displays total annual motorbus collisions for years 2008 to 2012.

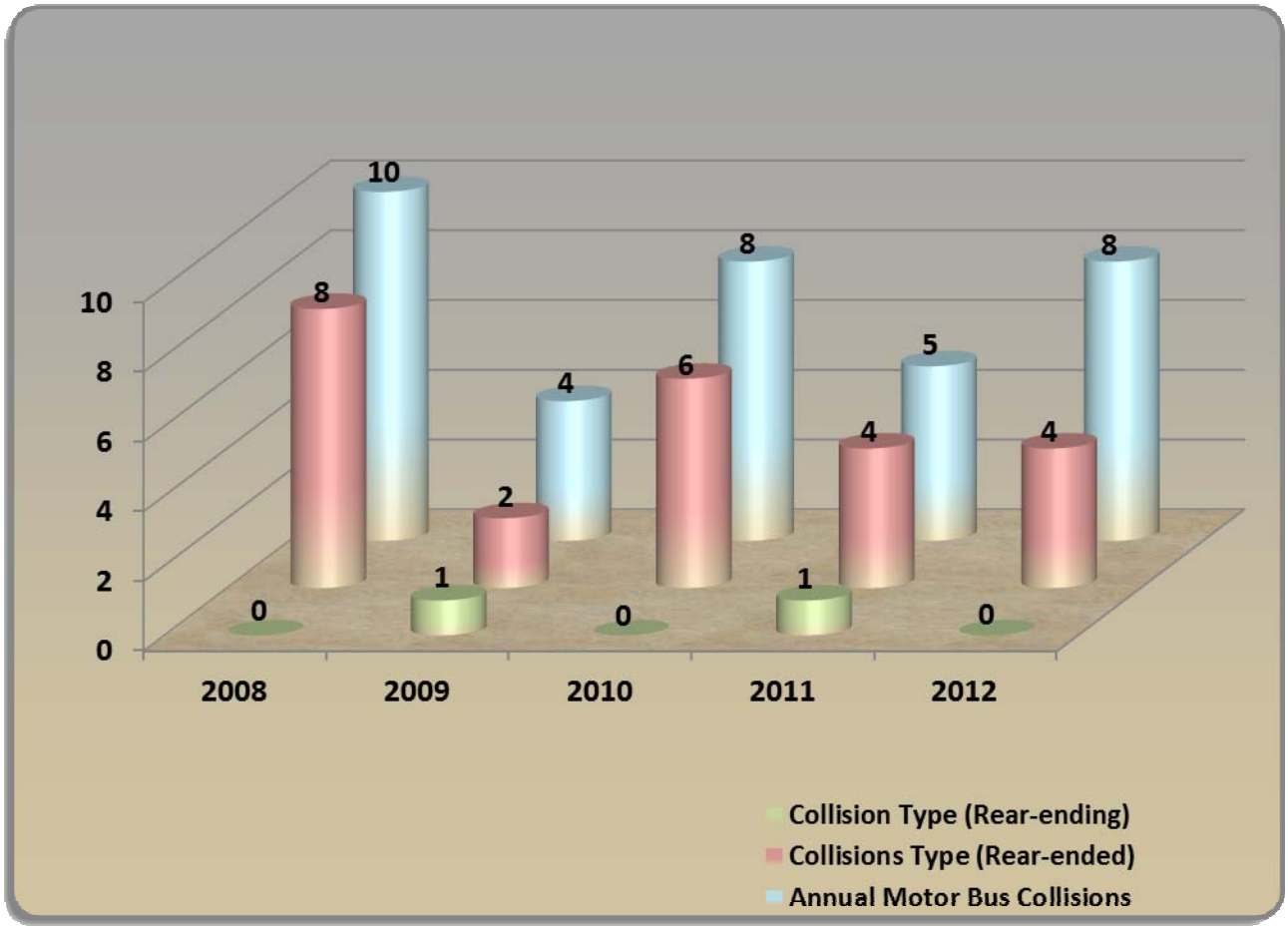

Figure 2-63. Pasco County Public Transportation: Annual Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

As mentioned earlier, most of Pasco County's collisions are rear-ended with 80 percent of the total in 2008 and 2011, 75 percent in 2010 and 50 percent in 2009 and 2012. Figure 2-64 below shows rear-ended and rear-ending collisions as a percentage of total collisions.

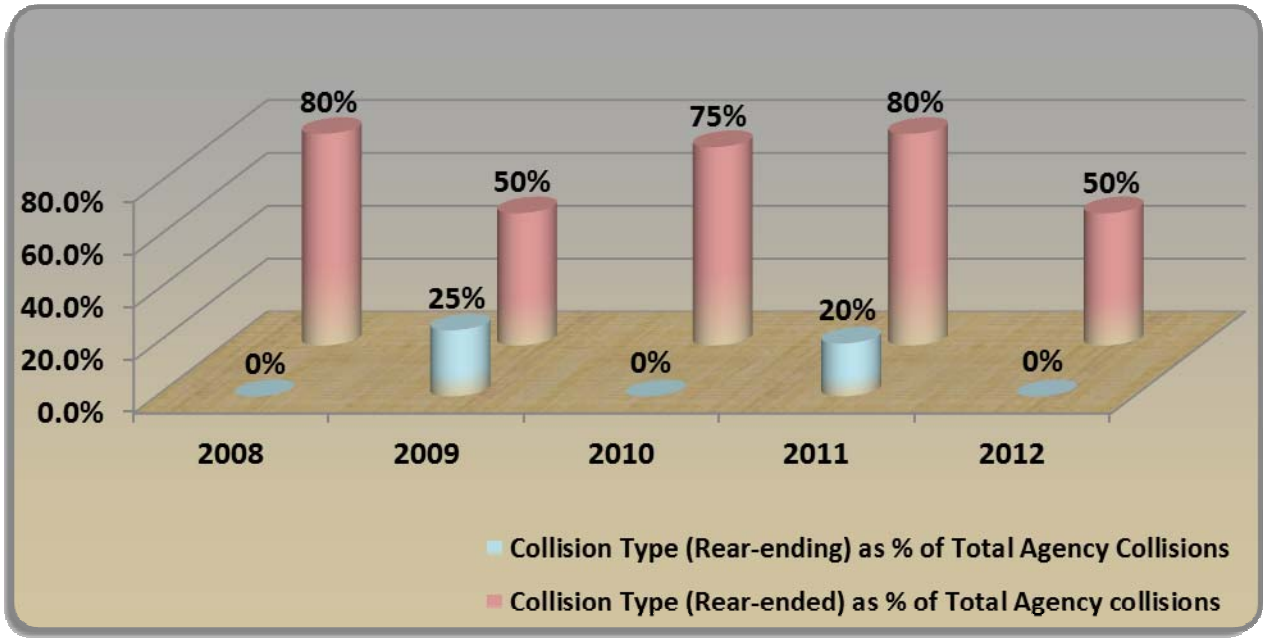

Figure 2-64. Pasco County Public Transportation: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Total Annual Revenue Miles

Figure 2-65 below displays the total annual revenue miles to form the foundation for reporting collisions per 100,000 miles.

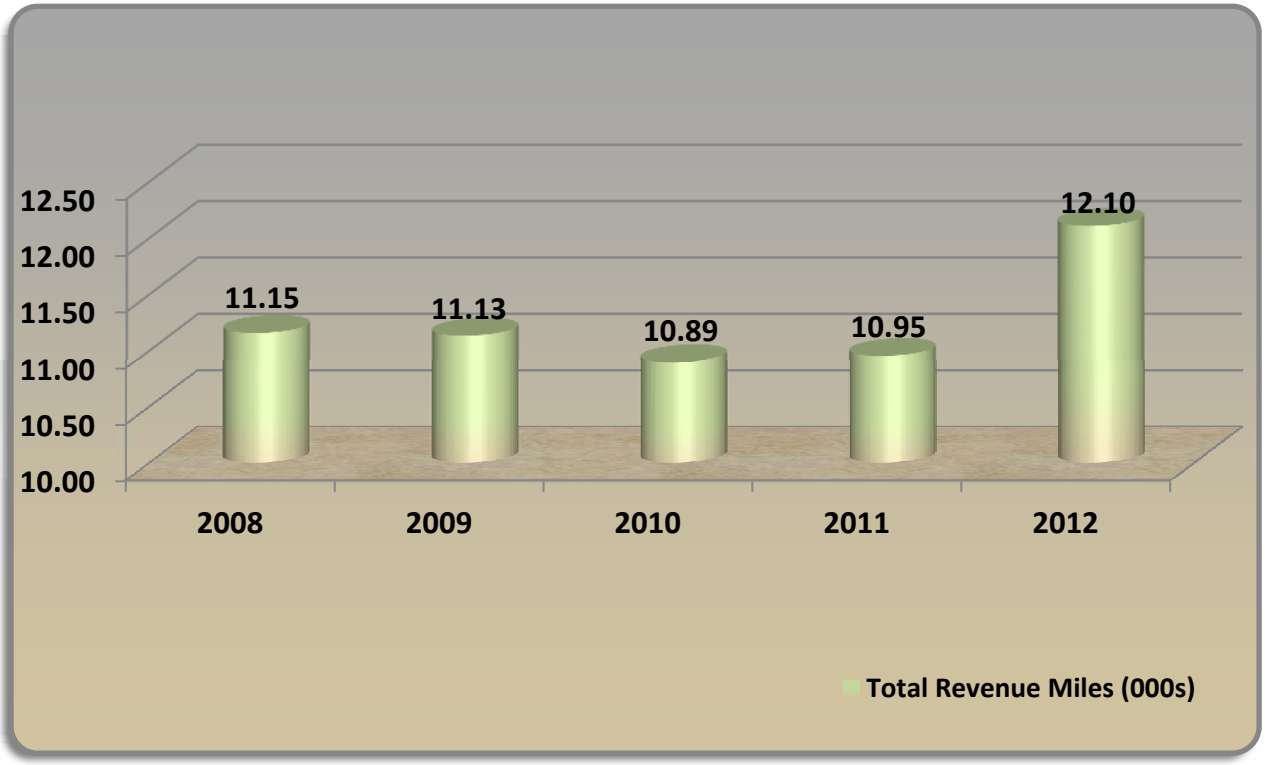

Figure 2-65. Pasco County Public Transportation: Annual Total Revenue Miles (000s)

Collisions per 100,000 miles

Total collisions and rear-ended collisions per 100,000 miles is high for Pasco County. Total collisions per 100,000 miles peaked in 2008 at 0.90, then dropped to 0.36 in 2009, then increased to 0.73 in 2010, decreased to 0.46 in 2011 and then increased to 0.66 in 2012. Rear-ended collisions per 100,000 miles also peaked in 2008 at 0.72, then declined to 0.18 in 2009, then increased to 0.55 in 2010, then decreased to 0.37 and 0.33 in 2011 and 2012, respectively. Rear-ending collisions were 0.09 in 2009 and 2011, the only years with reported rear-ending collisions. Figure 2-66 below shows motorbus collisions per 100,000 miles.

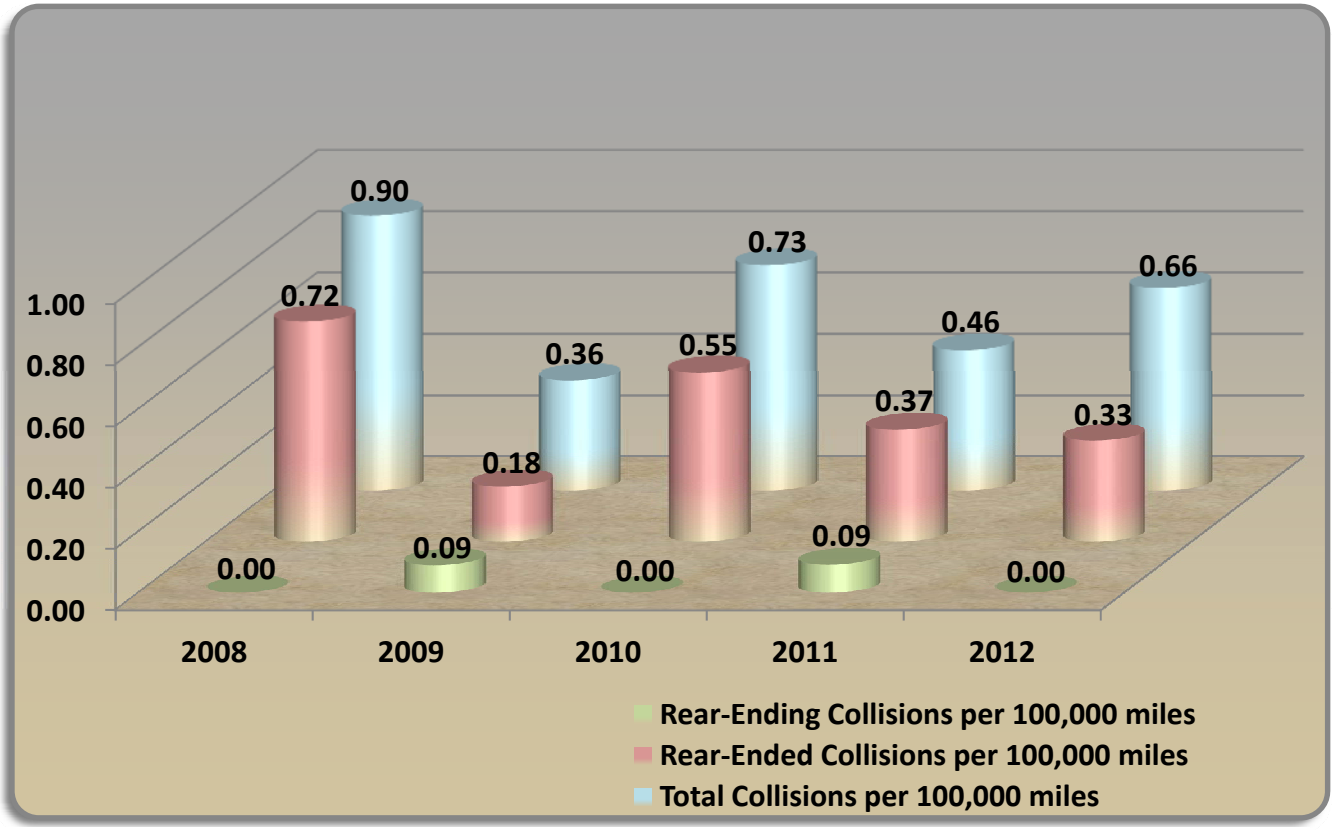

Figure 2-66. Pasco County Public Transportation: Motorbus Collisions per Mileage, 2008-2012

Pinellas Suncoast Transit Authority

Total collisions peaked at 36 in 2008 and 2011, with 31 in 2009 and 2010 and 30 in 2012. Rear-ended collisions ranged from 9 in 2012 to 18 in 2011, with 10 in 2008, 14 in 2009 and 12 in 2010. Rear-ending collisions were at 4 in 2008 and 2009 with one in 2010 and 2 in 2011 and 2012. Figure 2-67 below displays total annual motorbus collisions for years 2008-2012.

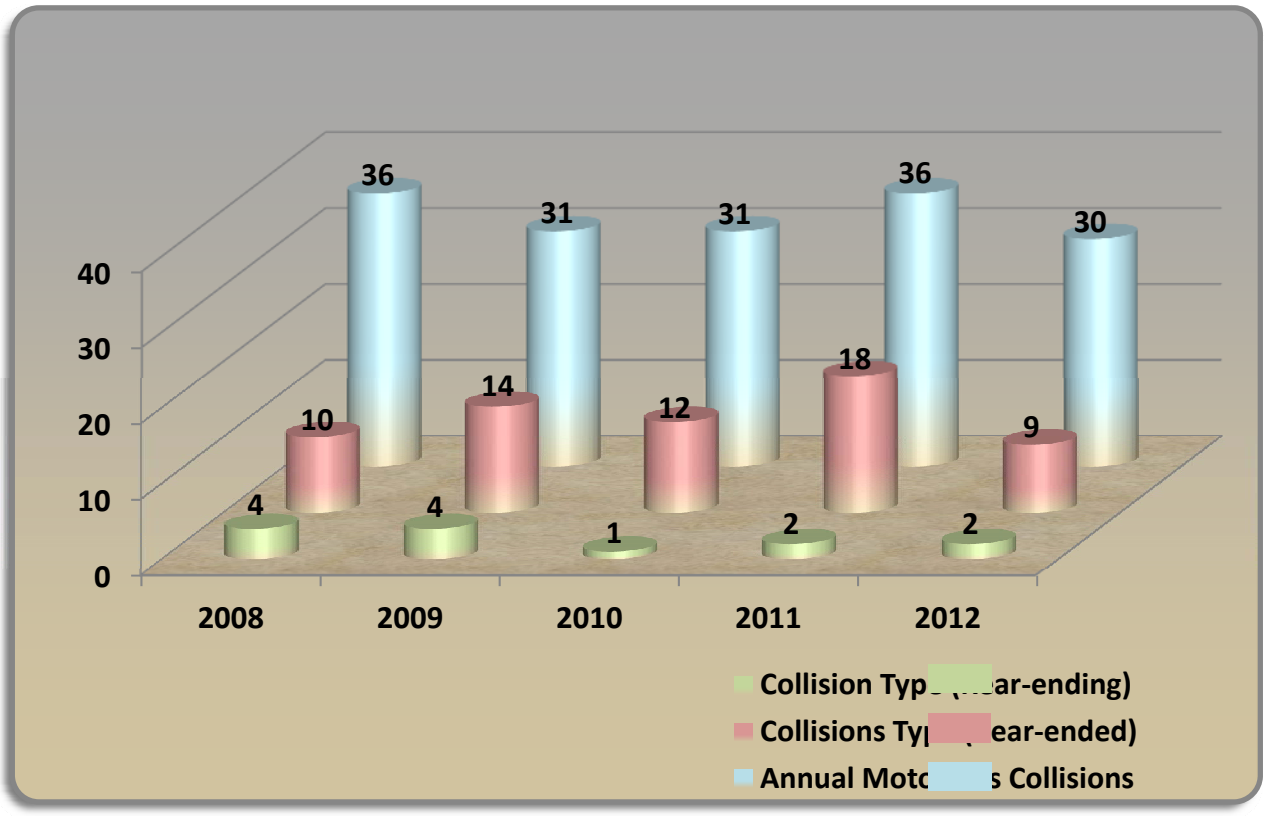

Figure 2-67. Pinellas Suncoast Transit Authority: Annual Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

Rear-ended Collisions ranged from 28 percent of total collisions in 2008 to 50 percent in 2011, with 45 percent in 2009, 39 percent in 2010 and 31 percent in 2012. Rear-endings displayed a downward trend with 11 percent in 2008 and 13 percent in 2009 dropping to 3 percent in 2010, 6 percent in 2011 and 7 percent in 2012. Figure 2-68 below presents rear-ended and rear-ending collisions as a percentage of total collisions.

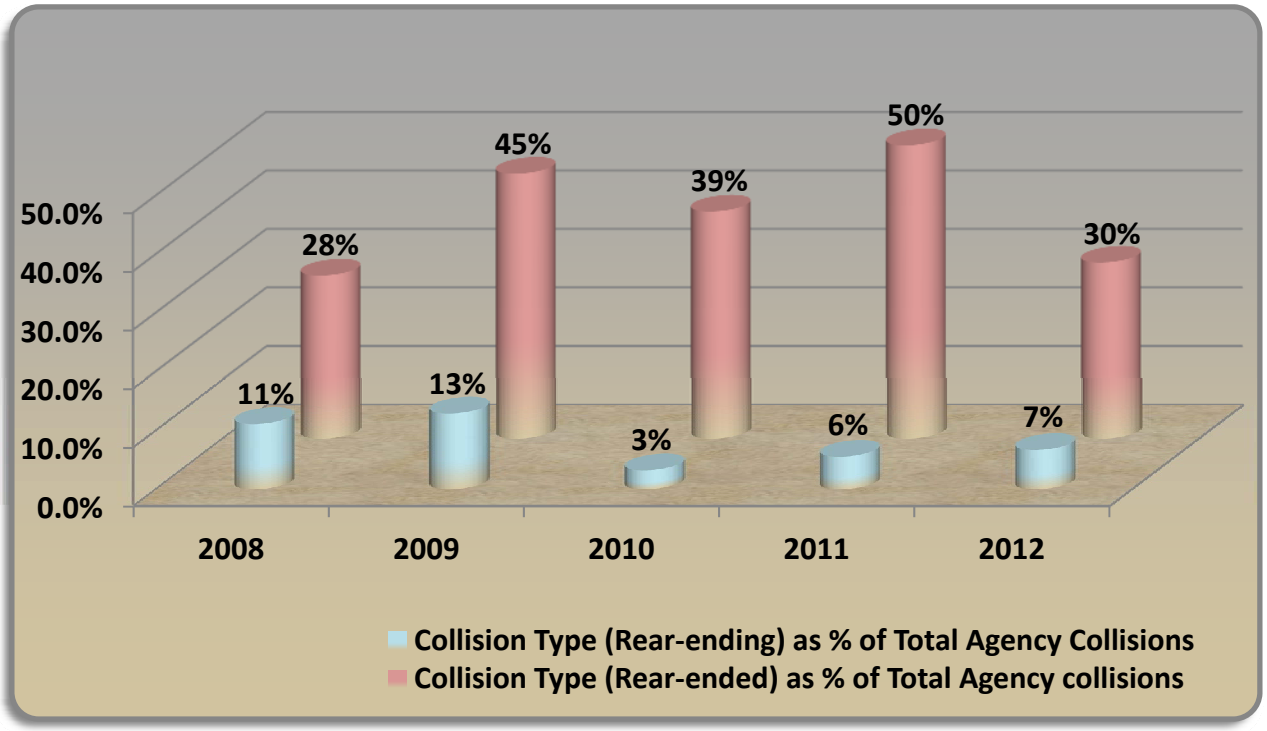

Figure 2-68. Pinellas Suncoast Transit Authority: Motorbus Collision Types as a Percentage of Total Agency Collisions, 2008-2012

Total Annual Revenue Miles

Figure 2-69 below displays the total annual revenue miles to form the foundation for reporting collisions per 100,000 miles.

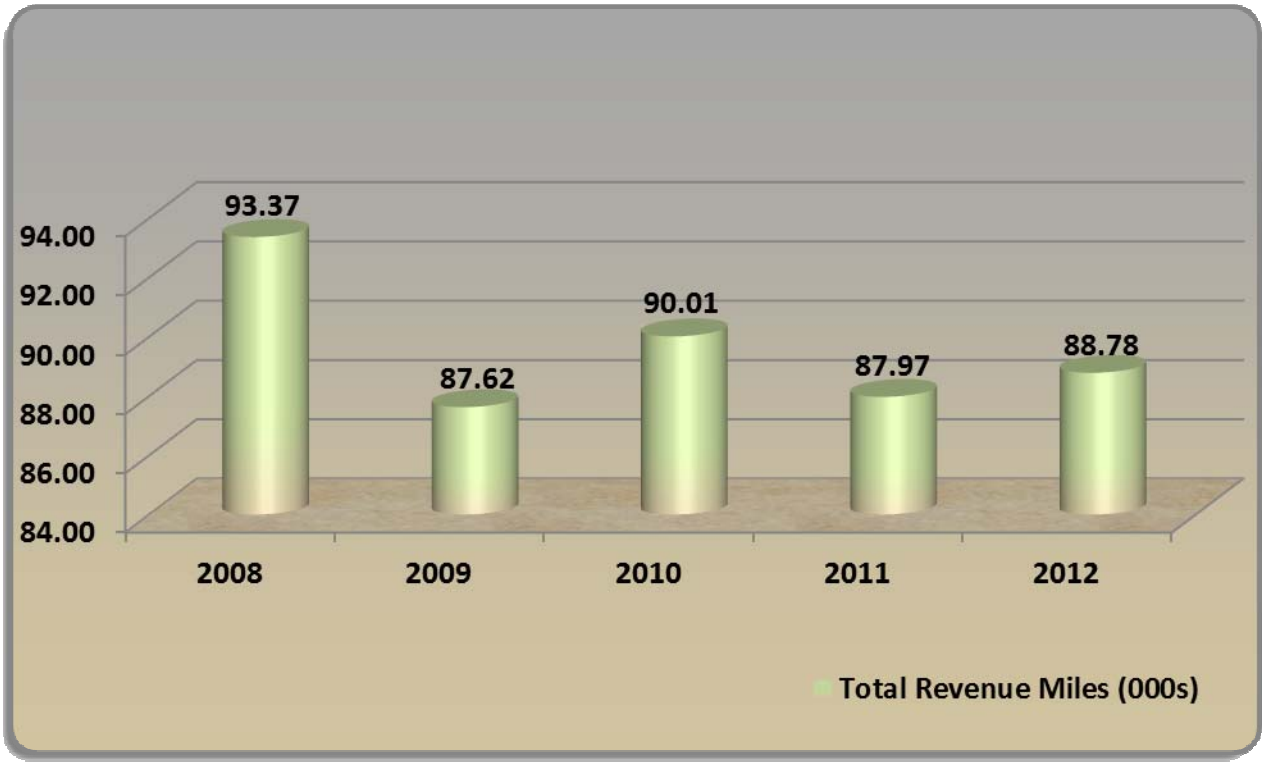

Figure 2-69. Pinellas Suncoast Transit Authority: Annual Total Revenue Miles (000s)

Collisions per 100,000 Miles

As with HART, total collisions are higher than the Florida aggregate rates per 100,000 miles. Total collisions per 100,000 miles ranged from 0.34 in 2012 to 0.41 in 2011, with 0.34 in 2010, 0.35 in 2009 and 0.39 in 2008. Rear-ended collisions peaked in 2011 at 0.20 and were at the lowest in 2012 at 0.10. In 2008, rear-ended collisions per 100,000 miles was 0.11, in 2009, 0.16 and in 2010, 0.13. Rear-end collisions showed a downward trend for the five year period. Figure 2-70 below displays motorbus collisions per 100,000 miles.

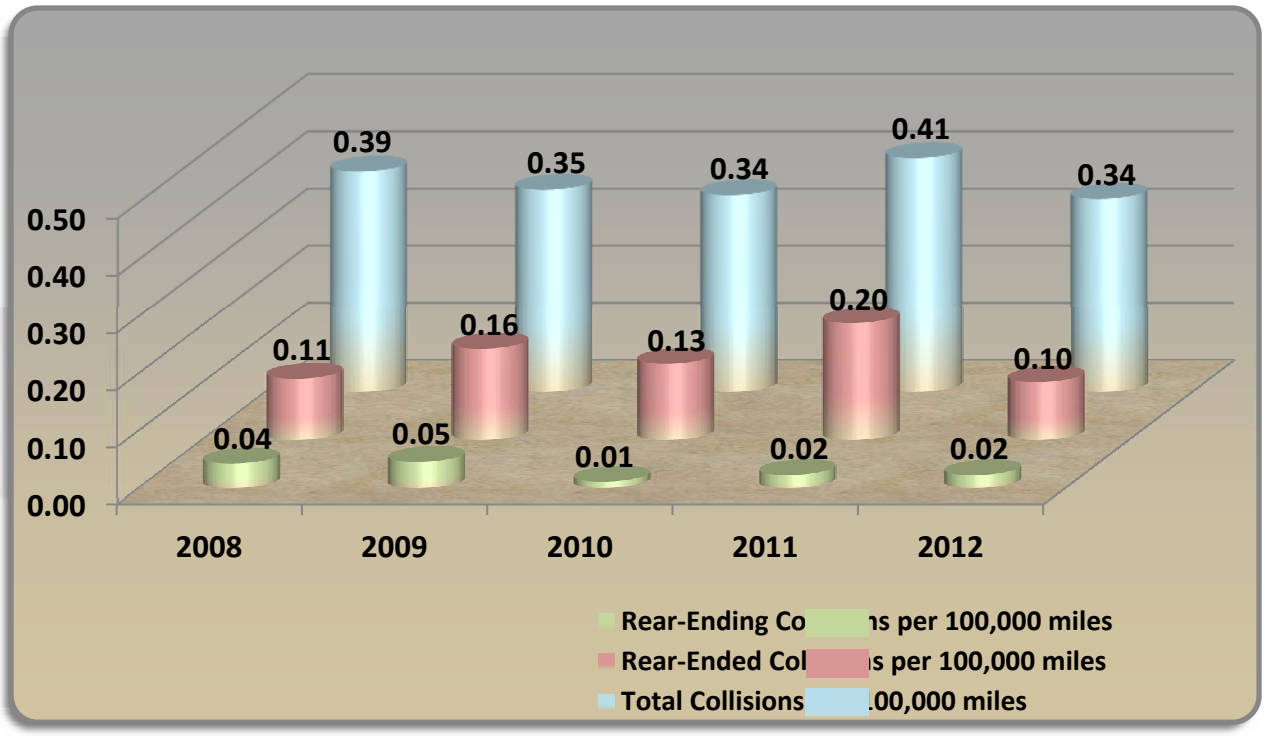

Figure 2-70. Pinellas Suncoast Transit Authority: Motorbus Collisions per Mileage, 2008-2012

Space Coast Area Transit

Reported collisions for Space Coast are very low with only 12 total collisions for the entire five year period. However, 9 of those 12 were rear-ended and one was rear-ending. Figure 2-71 below displays total annual motorbus collisions for years 2008-2012.

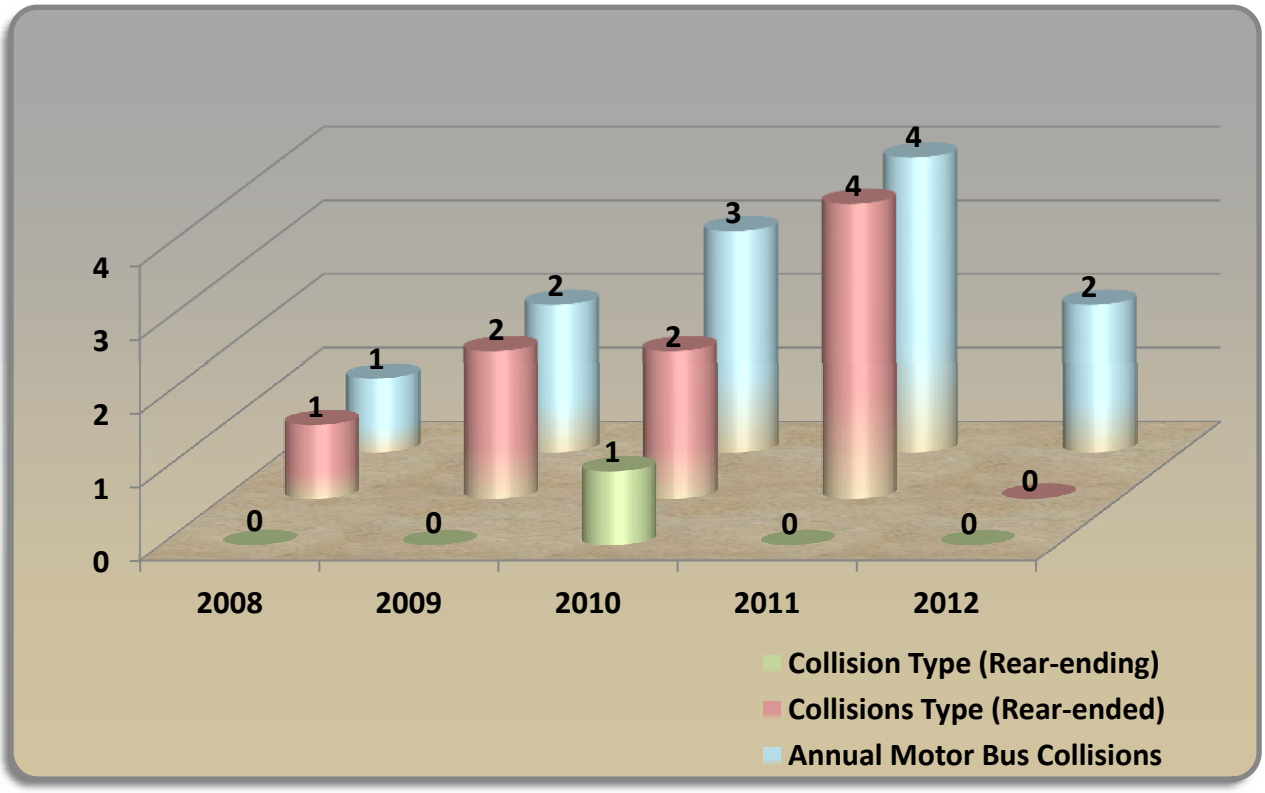

Figure 2-71. Space Coast Area Transit: Annual Motorbus Collisions, 2008-2012

Rear-ended and Rear-ending Collisions as a Percentage of Total Collisions

Rear-ended collisions were at 100 percent in 2008, 2009 and 2011. In 2020, rear-ended was 67 percent and rear-ending 33 percent of all collisions. Figure 2-72 below shows total motorbus collisions by type rear-ended and rear-ending as a percentage of total collisions.

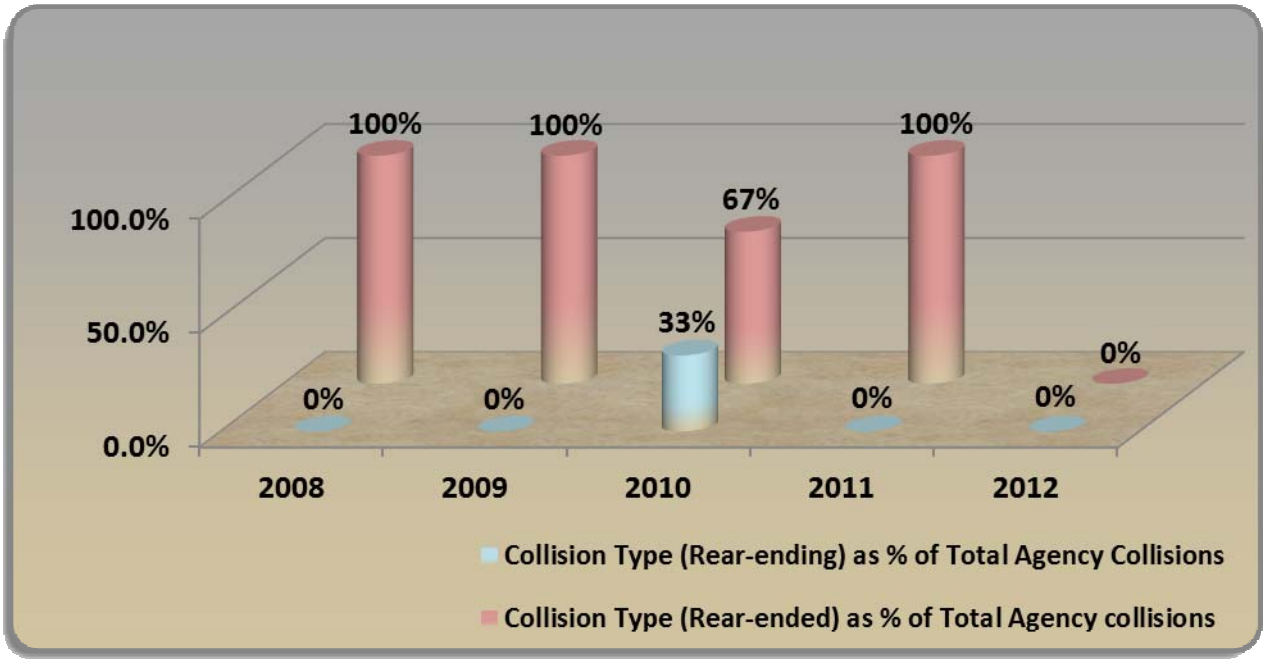

Figure 2-72. Space Coast Area Transit: Motorbus Collision Types as Percentage of Total Agency Collisions, 2008 - 2012

Total Annual Revenue Miles

Total annual revenue miles are presented below in Figure 2-73 to form the foundation for reporting collisions per 100,000 miles.

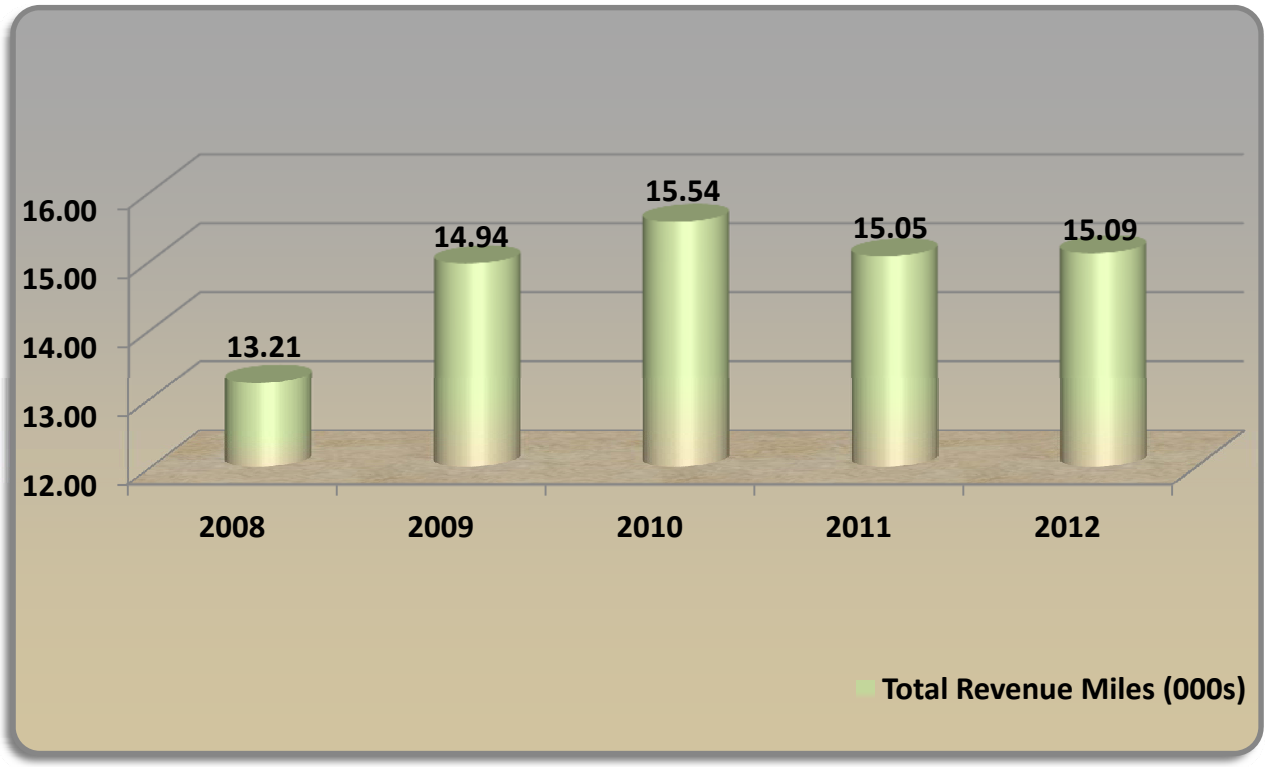

Figure 2-73. Space Coast Area Transit: Annual Total Revenue Miles (000s)

Collisions per 100,000 Miles

Both total and rear-ended collisions per 100,000 miles peaked in 2011 at 0.27 with 2008 as the lowest, 0.08. In 2009, the total and rear-ended was 0.13, in 2010, the total was at 0.19 with rear-ended at 0.13 and rear-ending at 0.06. In 2012, total collisions per 100,000 miles was 0.13 with no rear-ended or rear-ending collisions. Figure 2-74 below displays motorbus collisions per 100,000 miles.

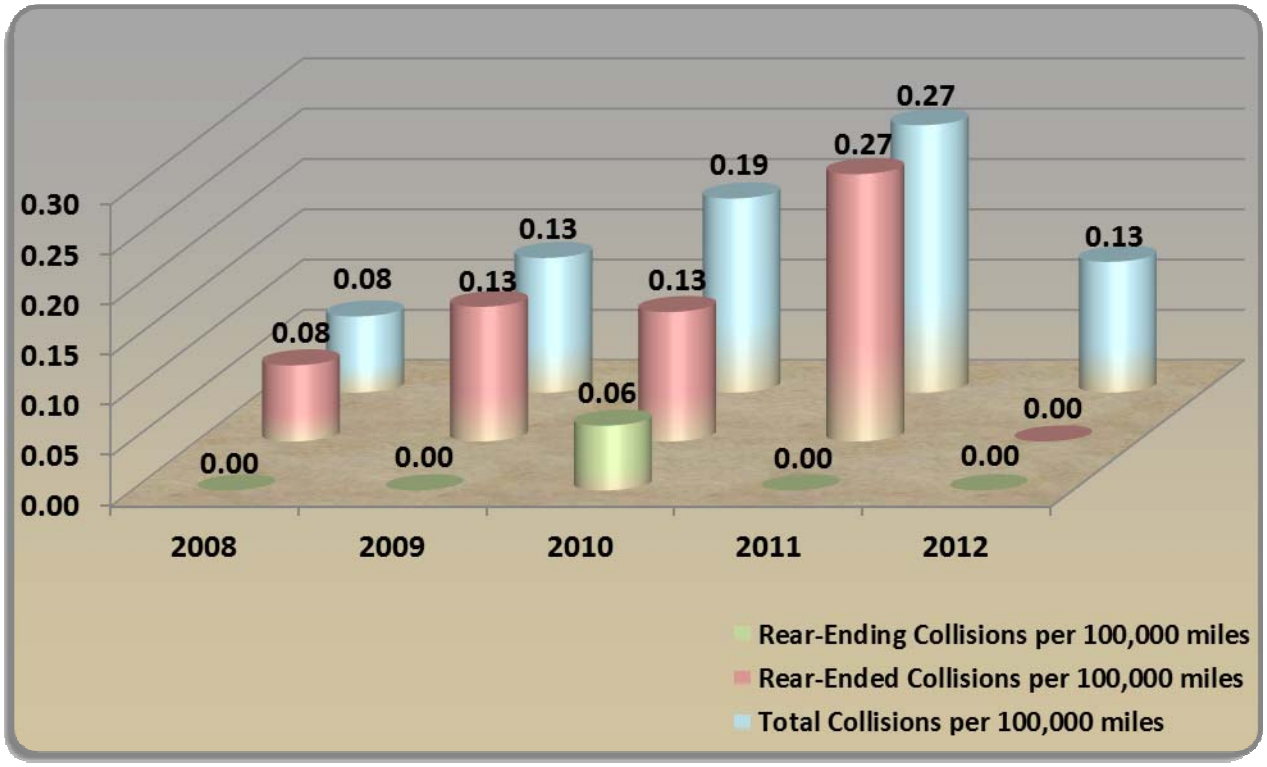

Figure 2-74. Space Coast Area Transit: Motorbus Collisions per Mileage, 2008-2012

Discussion

One of the primary objectives of this study was to ascertain the prevalence of rear-end collisions, the severity, and whether or not there is a real growth rate in rear-end collisions in Florida. By aggregating national, FTA region, Florida, and Florida transit agency, a solid presentation of data leads to significant insights. First, data were aggregated for total collisions per 100,000 miles for Florida, Region 4 and the U.S. plus territories. Figure 2-75 below displays this data for the years 2008-2012. The results in this graphic are quite striking. The data showed that total aggregate collisions per 100,000 miles for the United States is between 60 and 70 percent of the Florida aggregate data. Florida total collisions per 100,000 miles are slightly greater than double the Region 4 aggregate.

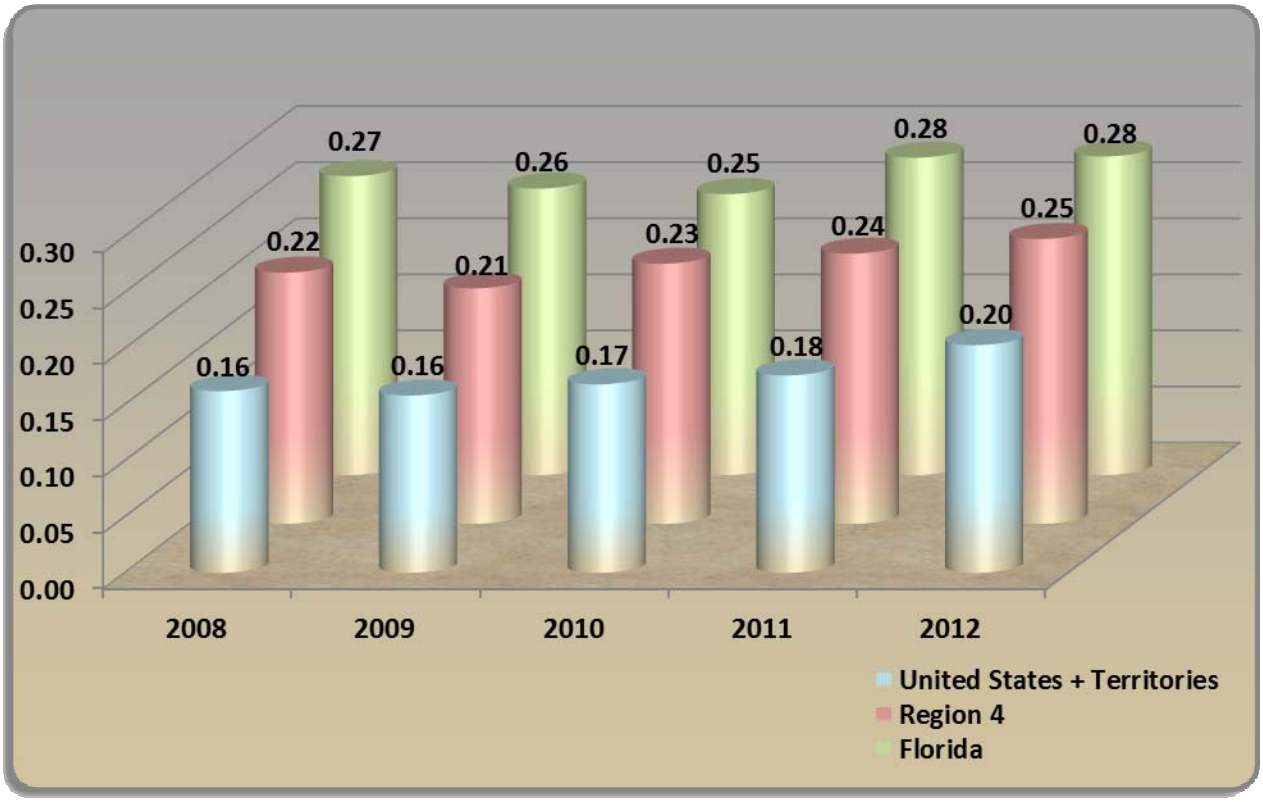

Figure 2-75. Aggregate Total Collisions per 100,000 miles for Florida, Region 4, and the United States plus Territories for the years 2008-2012

Further the data shows that Florida aggregate rear-ended collisions per 100,000 miles is triple the national aggregate and greater than the Region 4 aggregate. Once this graphic was prepared, the project team knew there would be more questions than answers. For instance, when the FTA region data was presented, Region 4 always had the highest rear-ended collisions per 100,000 miles. Was Florida the major contributor to Region 4 collision data? Figure 2-76 displays aggregate total rear-ended collisions per 100,000 miles for Florida, Region 4 and the U.S. plus Territories.

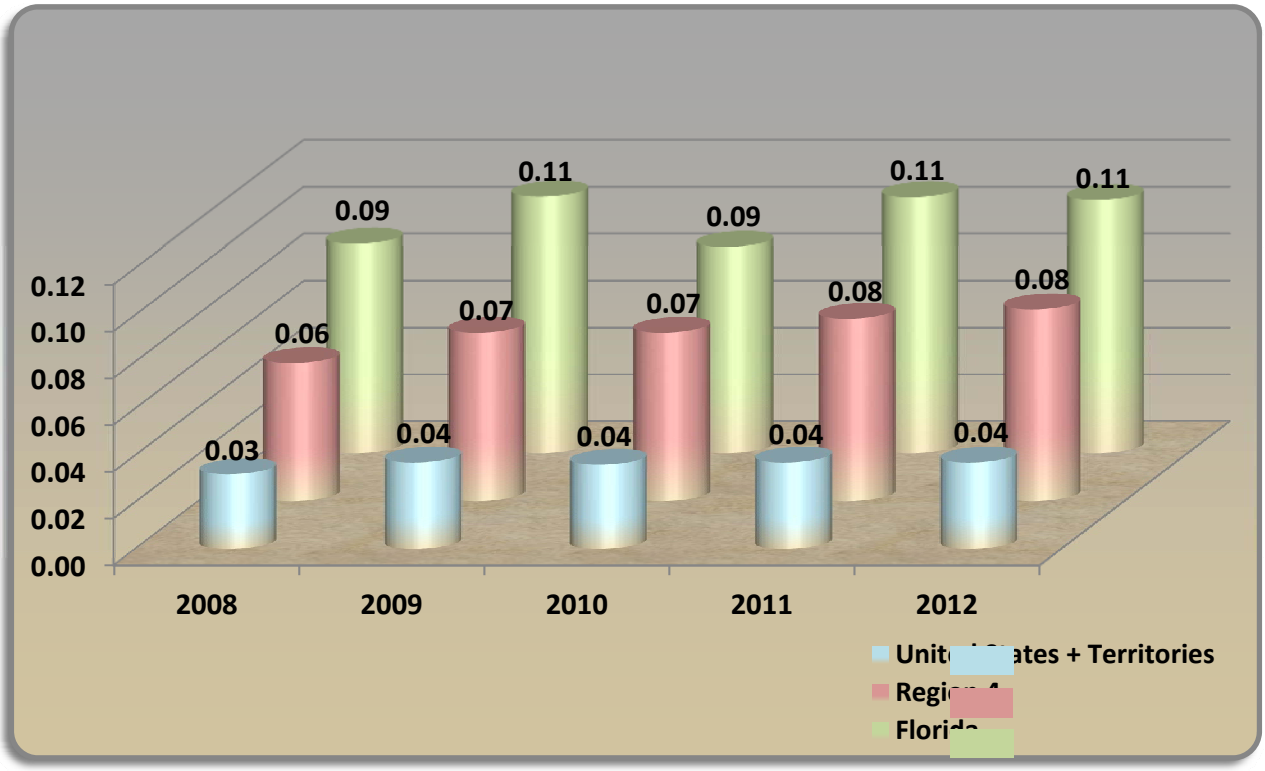

Figure 2-76. Aggregate Total Rear-ended Collisions per 100,000 miles for Florida, Region 4, and the United States plus Territories for the years 2008-2012

Finally, data for rear-ending collisions was aggregated for Florida, Region 4 and the U.S. plus Territories. This data shows that after 2008 and 2009, Florida data was commensurate with both U.S. and Region 4 collisions. This indicated that rear-ending collisions are not of the same severity and significance as rear-ended collisions. Figure 2-77 below displays aggregate data on rear-ending collisions.

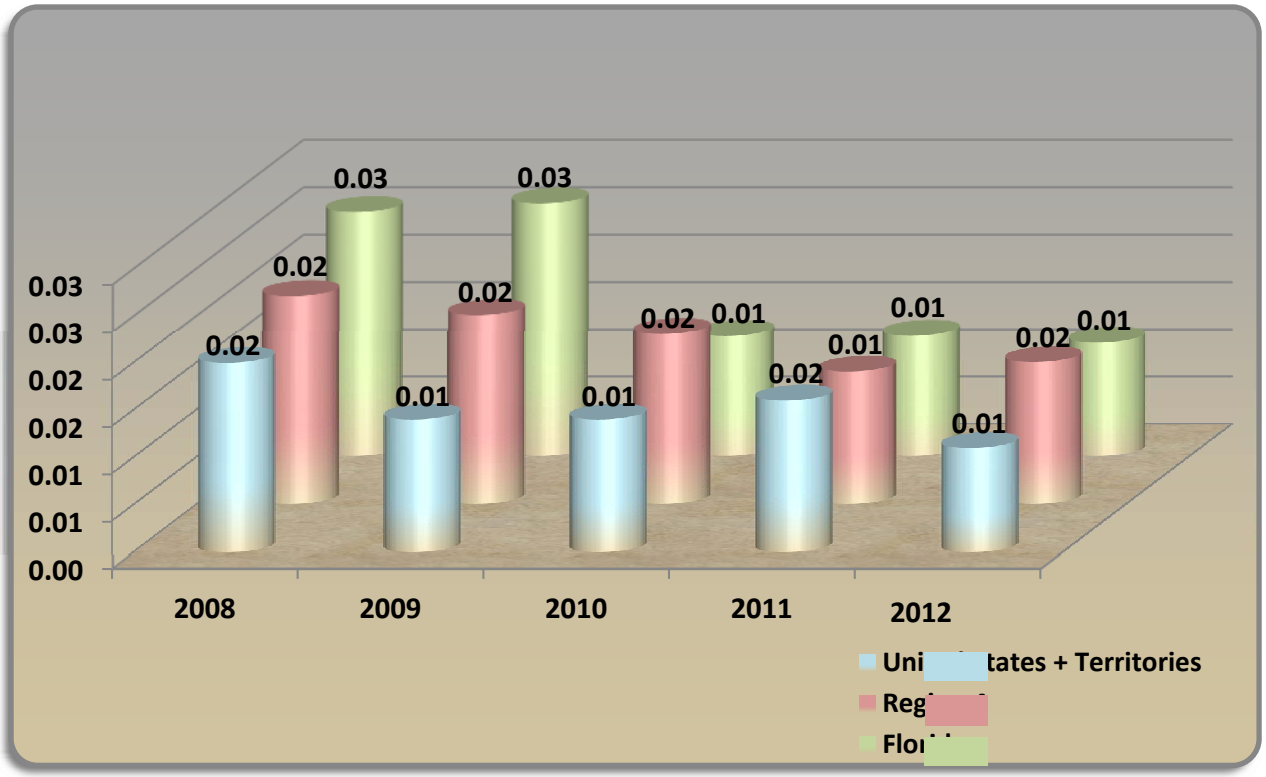

Figure 2-77. Aggregate Total Rear-ending Collisions per 100,000 miles for Florida, Region 4, and the United States plus Territories for the years 2008-2012.

Florida Compared to Six Most Populous States

Once the comparisons to Region 4 and the U.S. plus Territories was conducted, the question became whether Region 4 was the best comparison benchmark. Since Florida is one of the six most populous states, the project team decided to compare Florida to the states of California, Texas, New York, Pennsylvania and Illinois. Figure 2-78 below displays the total collisions for the six states for 2012. In this case, California, New York and Illinois had more total annual collisions than Florida. Only Pennsylvania posted total collision numbers not in alignment with the other five states. However, for rear-ended collisions, Florida's 128 rear-ended collisions was double that of Illinois at 64, and 2.5 times the rear-ended collisions reported by California (55) and Texas (48).

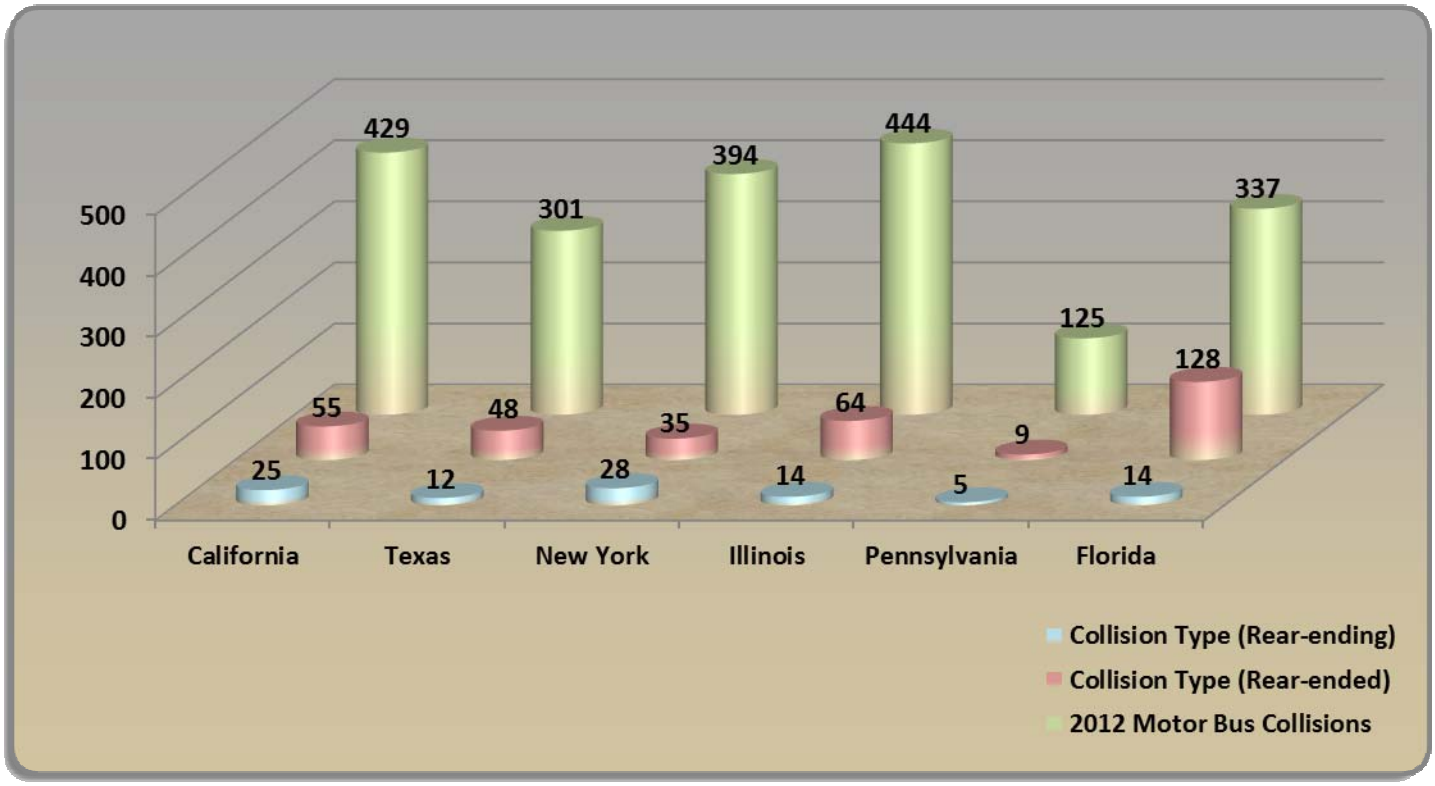

Figure 2-78. Total Motorbus Collisions - Six Most Populous States - 2012

Figure 2-79 below displays rear-ended and rear-ending collisions as a percentage of total collisions in 2012 for the six most populous states. This result is quite striking as Florida reports 38 percent of all collision is a rear-ended collision while Texas reports 15.9 percent, Illinois at 14.4 percent, and California at 12.8 percent.

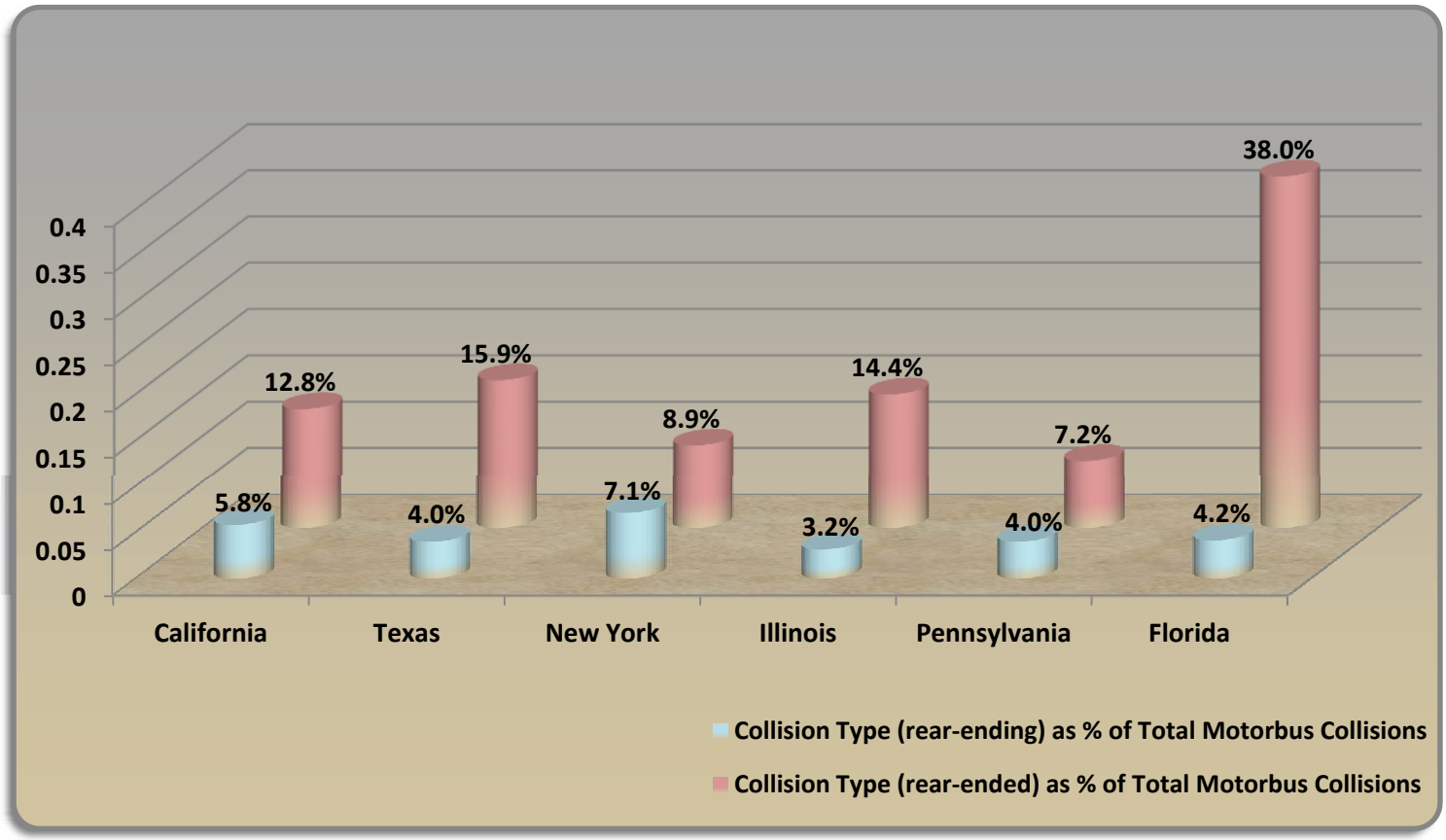

Figure 2-79. Rear-ended and Rear-ending as a Percentage of Total Collisions - Six Most Populous States - 2012

Finally, Figure 2-80 shows total collisions, rear-ended, and rear-ending collisions were aggregated in collisions per 100,000 miles. Illinois had the highest overall rate with 0.48 total collisions per 100,000 miles compared to Florida's 0.28. However, Florida had the highest rate of rear-ended collisions per 100,000 miles at 0.108, with Illinois next reporting 0.069 rear-ended collisions per 100,000 miles.

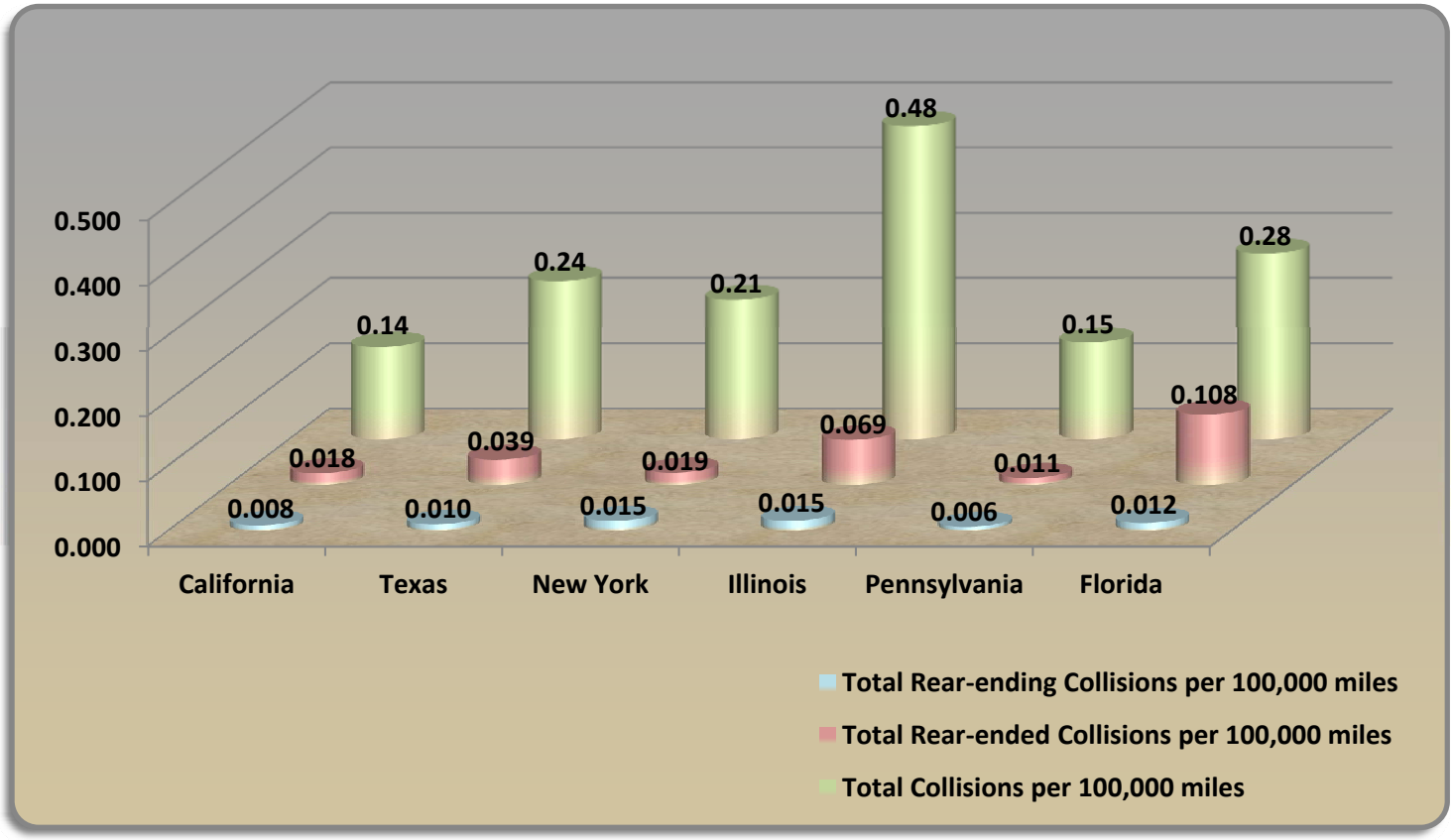

Figure 2-80. Collisions per 100,000 Miles - Six Most Populous States

Florida Transit Agencies

It is clear that Florida larger transit agencies in larger metro areas have the highest number of raw collisions (except for Miami-Dade after 2010). In Figure 2-81 below for 2008, the larger systems all have greater numbers of all three collision types than the smaller properties. It is likely that this is attributable to the size of the population, the number of buses operated, volumes of traffic, and/or the miles driven. In the next section, CUTR examined two years of collision files for rear-ended collisions at LYNX, the Central Florida Regional Transportation Authority and Broward County Transit.

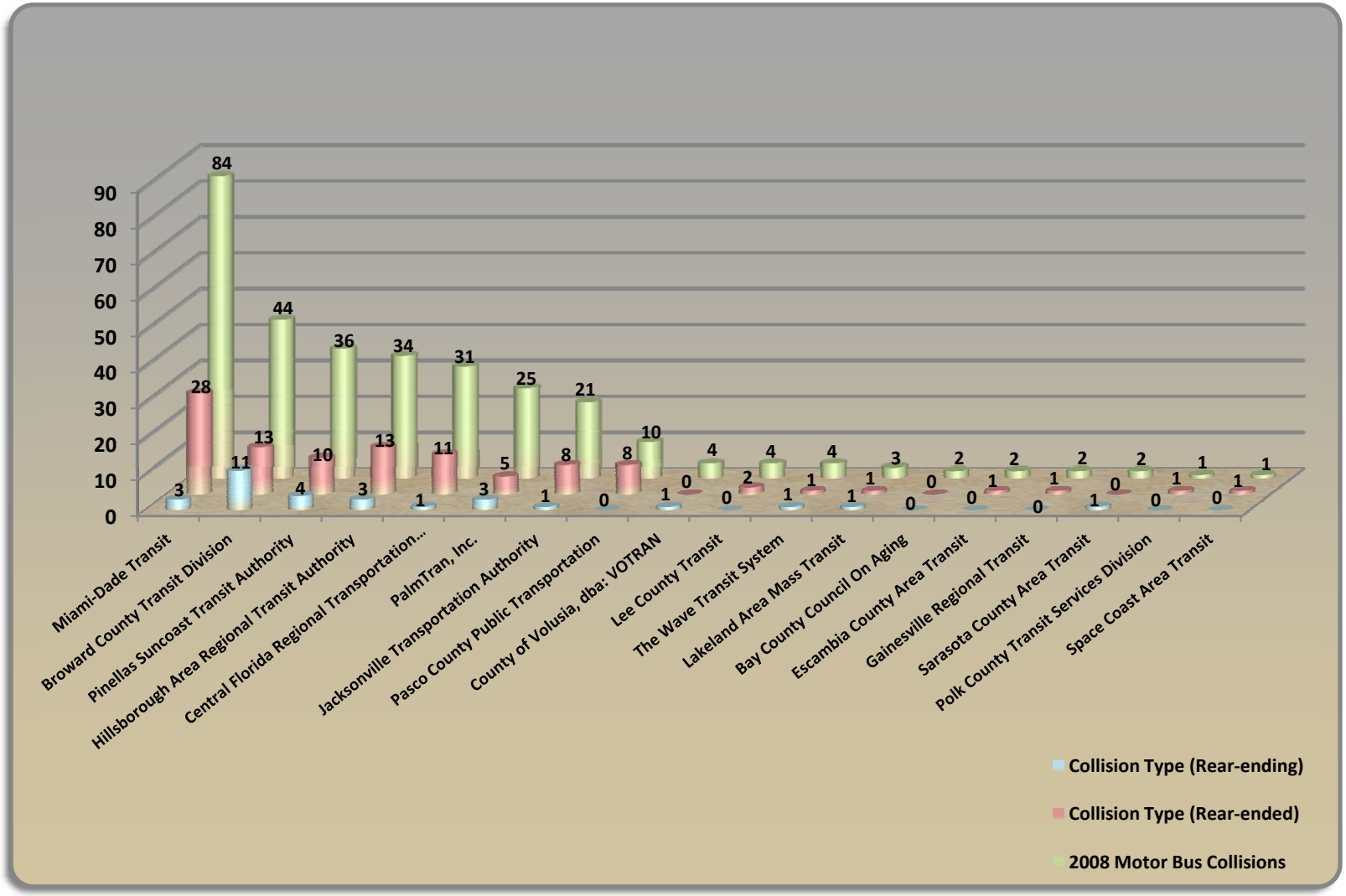

Figure 2-81. 2008 Motorbus Collisions by Transportation Agency (FL)

Chapter 3
Examination of Collision Files

Introduction

From the outset, two transit properties in Florida were selected for examinations of collision files: LYNX (The Central Florida Regional Transportation Authority) and Broward County Transit (BCT). In the case of LYNX, Orange, Seminole and Osceola Counties comprise a 2,700 square mile service area that contains every type of road facility in existence. Broward County has the most bus bays in Florida, which was a consideration regarding whether bus bays prevent or contribute to collisions. LYNX and Broward also had the factor of posting upward trends in rear-ended collisions; however, this was not known until later in the research effort.

The NTD collision database was used to extract rear-ended collisions and the list was supplied to LYNX and BCT prior to the site visit. This chapter will display the data that was harvested from the examination of collision files over two years. In the case of LYNX, the years were 2011 and 2012. In the case of BCT, the years were 2012 and 2013 because 2011 files had been sent to a County archive. The research team, though having previous transit operations experience, had never seen an agency collision file. Therefore, the NTD Major Incident database was used to start the process of examining data.

LYNX Collision Files

The project team reviewed a total of 55 files of rear-ended collisions from January 2011 through December 2012. The LYNX Files consist of three primary reports:

- The Operator Report;
- The Supervisor Report;
- Courtesy Report Forms distributed to customers immediately following a collision; and
- Thumbnail photos from the scene which are stored on CDs.

Only one file had a complete FHP crash report. In some files, there was information on vehicle damage and repair, and some included claims to insurance companies for LYNX vehicle damage. Only on rare occasions was there information on passenger claims or litigation.

The operator and the supervisor reports are virtually identical in structure and are divided into eight sections:

- Date/time/location/weather conditions
- LYNX operator information
- Other Vehicles Involved information
- Estimated damage to other vehicles
- Witnesses

- Police information
- Diagram for drawing collision; and
- Narrative description of the incident.

The Courtesy Report Form, issued to customers after a collision provides an opportunity for the customer to provide name, address, phone, etc. and to describe what happened in the collisions. Some passengers indicate injury while others do not, and some provide no information about injury at all. The LYNX Operator, Supervisor and Courtesy Report Forms are attached as Appendix A.

Broward Collision Files

The project team a total of 51 rear-ended collision files from October 2011 to September 2013. Similar to LYNX, BCT also has Operator and Supervisor reports, as well as customer courtesy cards. The Employee Report of Accident or Incident is divided into eight sections as follows:

- Basic Information;
- Reporting at time of the occurrence (responding officer, supervisor, etc.);
- Injuries;
- Other vehicle number 1 info;
- Other vehicle number 2 info;
- Diagram of bus interior to identify location of injured passengers;
- Diagram of bus and passenger vehicles to identify damaged areas;
- Passenger accident/incident; and
- Diagram with narrative description.

The supervisor report includes a more limited set of information including:

- Basic information;
- Bus Damage Description;
- Info on Vehicle Number 1 and 2;
- Citation information;
- Narrative description; and
- Diagram.

BCT files do not contain photos from the scene; however every BCT file contains a full and complete FHP Long Form Crash Report. Because of this, the project team was able to code additional data to inform this report. The Employee, Supervisor, and Courtesy card forms are attached as Appendix B.

Narrative Descriptions

The bus operator and descriptions for rear-ended collisions were generally identical and consisted of the following:

- The operator was stopped at a bus stop boarding and letting off passengers;
- The operator then heard a loud bang and/or felt an impact;
- The operator got off the bus to ask the people in the other vehicle were okay;
- The operator then asked the passengers if they were injured;
- Courtesy cards were handed out.
- In the case of Broward, operators were usually thorough in taking down information on passengers who were injured and were transported for medical treatment.

Supervisor descriptions were the same as operator descriptions except the supervisor would usually indicate the time he/she arrived on scene.

Organization of Collision Factors

Data from files was coded with neither pre-knowledge nor pre-discernment as to whether factors would ultimately prove to have impacts on collisions. Therefore, the data presented below is organized into the following sections:

- **Route Direction,** direction the bus was traveling when the collision occurred;
- **Roadway surface conditions,** expressed as dry or wet;
- **Lighting conditions,** expressed as light, dark (lighting and no-lighting), dawn and dusk;
- **Weather conditions,** expressed as clear, cloudy or raining;
- **Time factors,** including day of week and time of day;
- **Roadway factors**, which include prevalent rear-ended collision corridors, roadway classifications, ownership, lanes, divided/undivided, jurisdiction, and posted speed limits;
- **Transit factors,** including stop location (near side, far side and mid-block), bus movement at rear-ended collision location, passenger injuries, and estimated damage; and
- **Other vehicle factors,** reported for Broward only and including estimated speed of vehicle rear-ending the bus, distraction, obstructed vision, suspicion of drug and/or alcohol use, and whether the driver of the vehicle was transported for medical treatment.

Route Direction

For each collision, records were coded to capture whether the bus was going in the eastbound, northbound, southbound, or westbound directions. Figure 3-1 below shows there was no clear direction that was impacted by rear-ended collisions, with both Broward and LYNX having the fewest rear-ended collisions in the southbound direction at 17.6 percent and 20 percent, respectively (Figure 3-2 below).

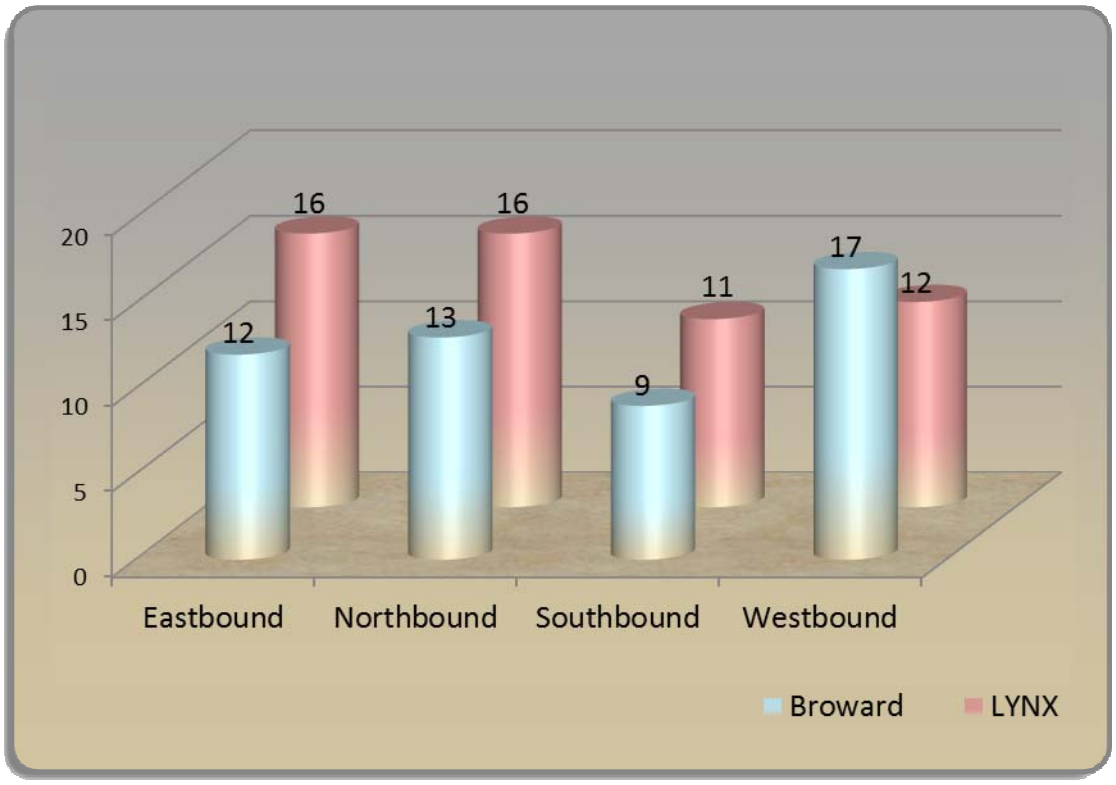

Figure 3-1. Route Direction

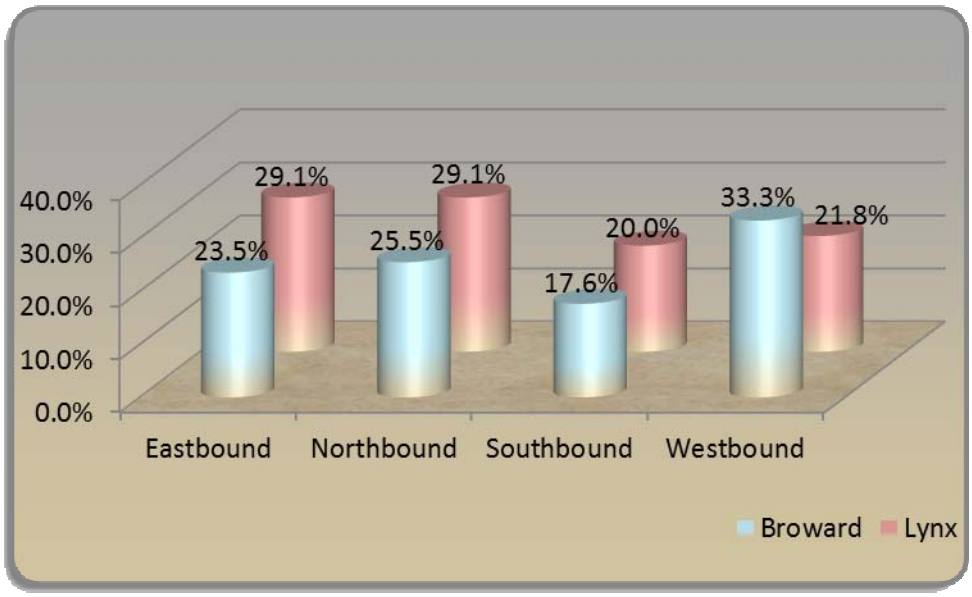

Figure 3-2. Route Directions Percentages

Roadway Surface Conditions

"Dry" roadway surface conditions are considered the most optimal. In the case of LYNX, Figure 3-3 shows a total of 53 rear-ended collisions occurred in dry conditions where as 40 of 50 Broward collisions occurred in dry conditions, or 20 percent of all collisions occurring under wet conditions (Figure 3-4 below).

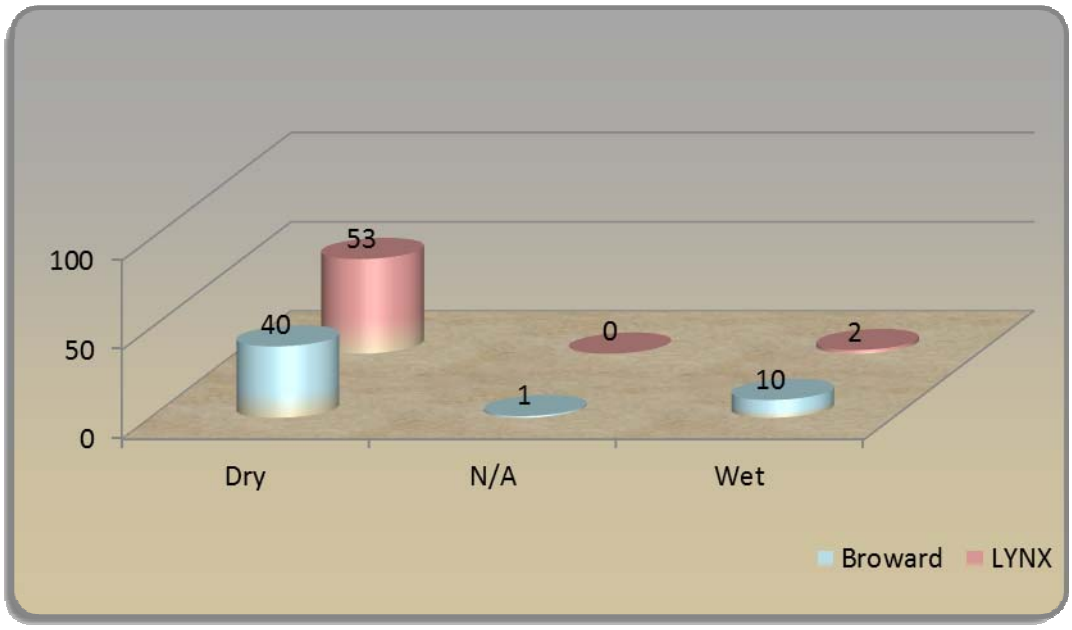

Figure 3-3. Roadway Surface Condition at Rear-ended Collision Location

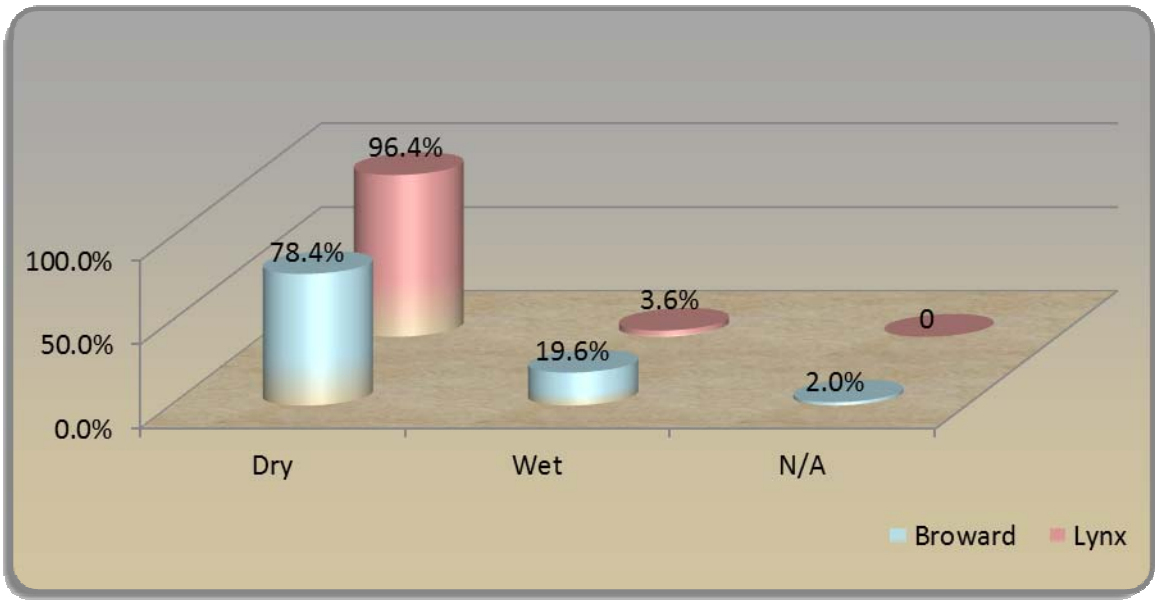

Figure 3-4. Roadway Surface Condition at Rear-ended Collision Location Percentages

Lighting Conditions

Daylight is the optimal condition, thus Figure 3-5 below shows that 44 of Broward's rear-ended collisions and 39 LYNX collisions occurred in daylight, or 86.3 percent and 79 percent respectively (Figure 3-6 below).

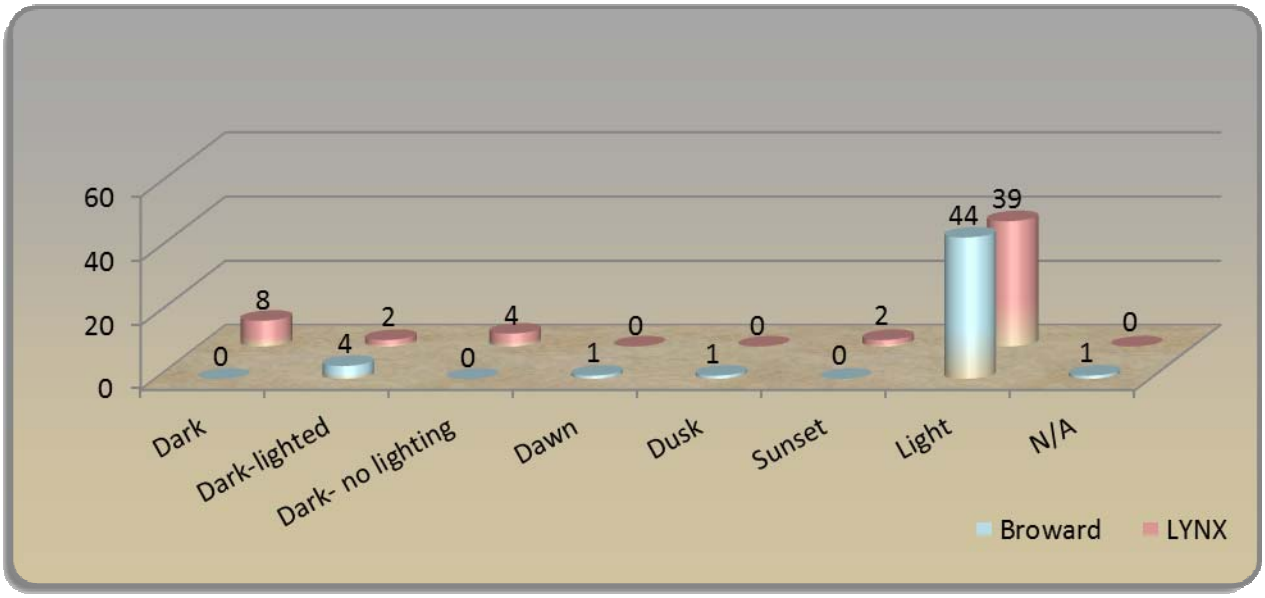

Figure 3-5. Lighting Conditions at Time of Rear-ended Collision

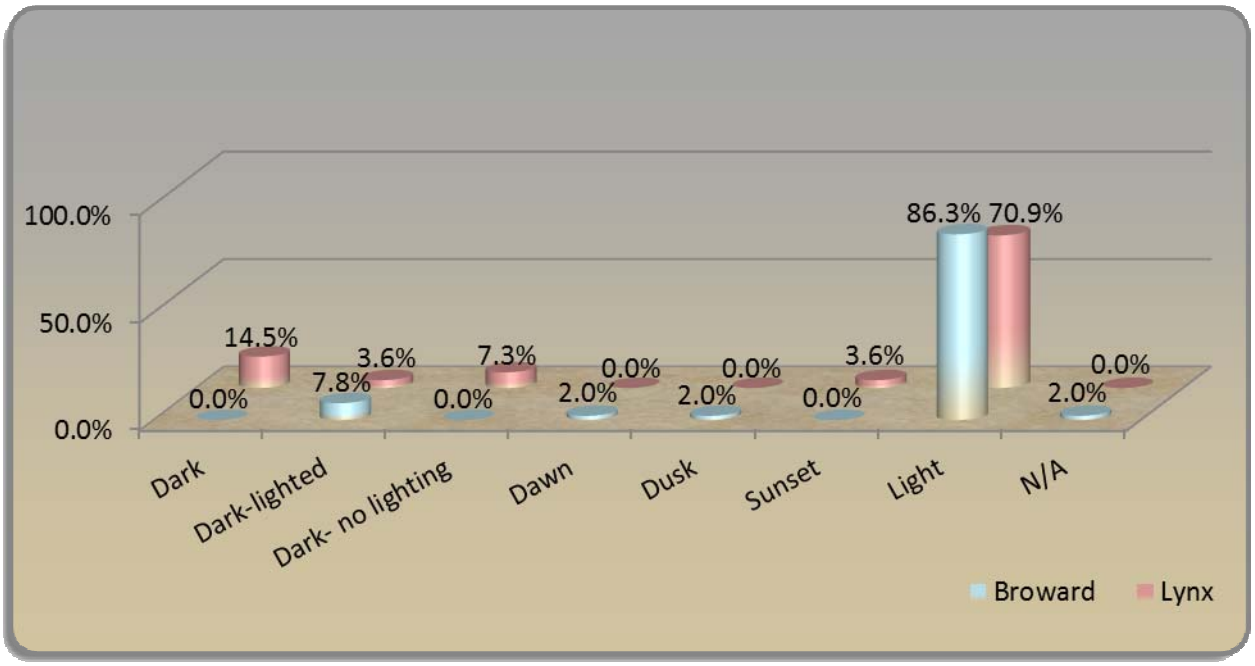

Figure 3-6. Lighting Conditions at Time of Rear-ended Collision: Percentages

Weather Conditions

Clear weather conditions are optimal, thus Figure 3-7 below shows 34 of Broward's rear-ended collisions and 48 of LYNX collisions occurred in clear weather conditions, or 66.7 percent and 83.7 percent, respectively (Figure 3-8 below). In only 6 cases in Broward and 2 cases with LYNX was it raining at the time of the collision.

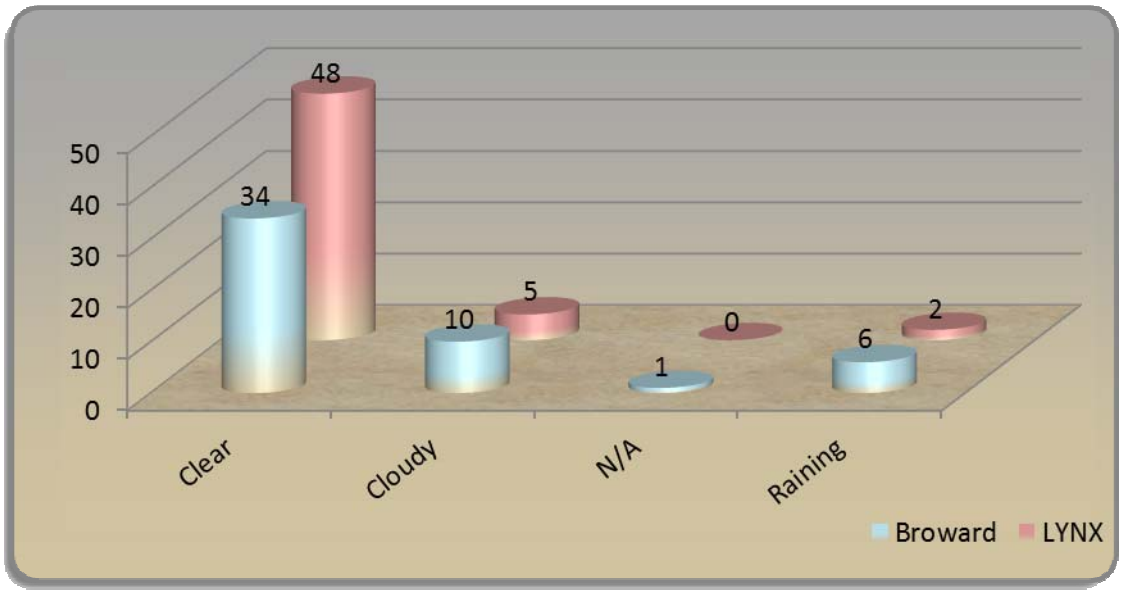

Figure 3-7. Weather Conditions at Rear-ended Collision Location

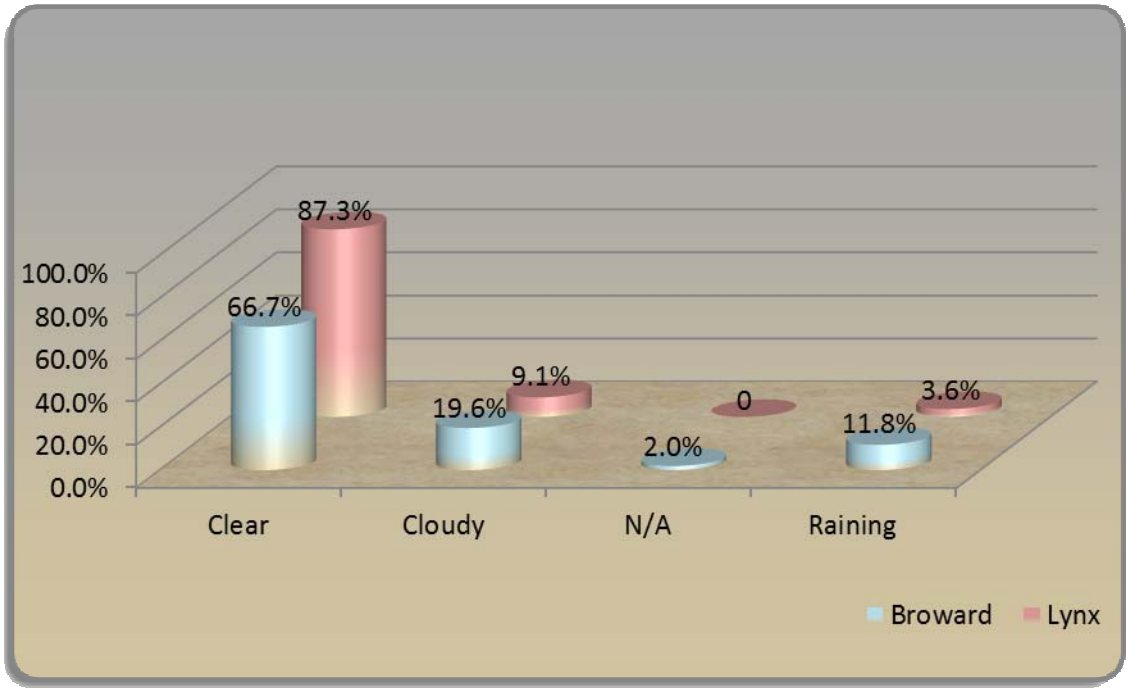

Figure 3-8. Weather Conditions at Rear-ended Collision Location: Percentages

Rear-ended Collisions by Day of Week

No clear day of the week was most conducive to rear-ended collisions, with LYNX peaking with 16 on a Monday and Broward peaking at 12 collisions occurring on a Tuesday, or 29.1 percent and 23.5 percent, respectively (Figure 3-9 below). At Broward, there were as many collisions on Saturday and Sunday as Wednesday (5 each) and for LYNX there were as many collisions on Saturday as Tuesday (7 each).

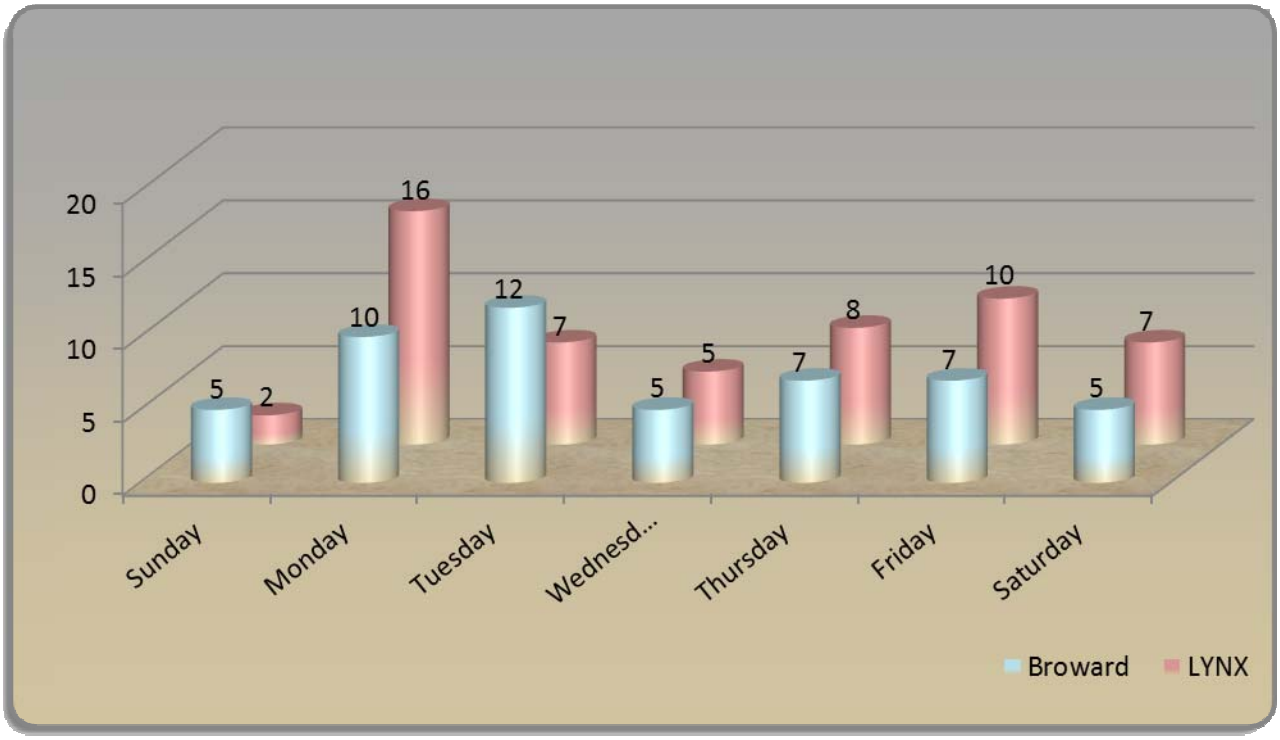

Figure 3-9. Rear-ended Collisions by Day of Week

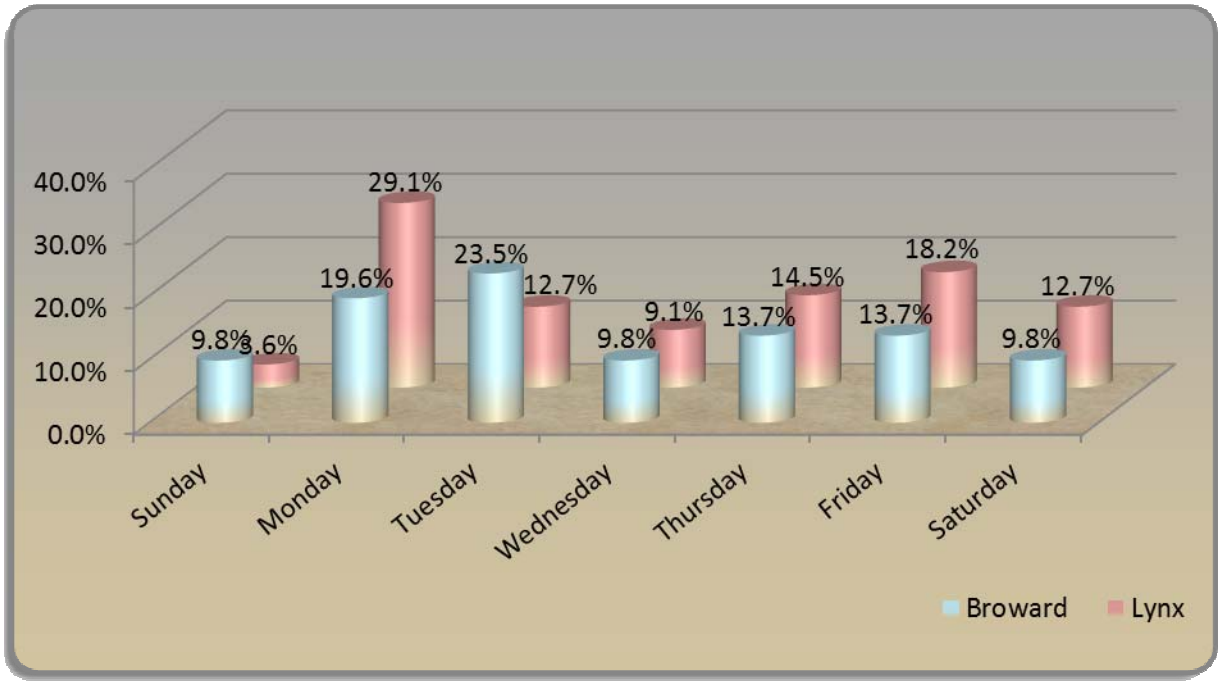

Figure 3-10. Rear-ended Collisions by Day of Week: Percentages

Rear-ended Collisions by Hour of Day

There was no clear prevalent hour of the day in which rear-ended collisions occurred. Broward peaked at 10 collisions that occurred between 4:00 and 4:59 p.m. while LYNX peaked at 7 collisions between 8:00 – 8:59 a.m. Broward had 10 consecutive hours of the day with at least one collision from 6:00 a.m. to 5:00 p.m. LYNX had 8 consecutive hours with at least one collision from 10:00 a.m. to 6:00 p.m. Figure 3-11 below displays collisions by hour of day; percentages are not displayed.

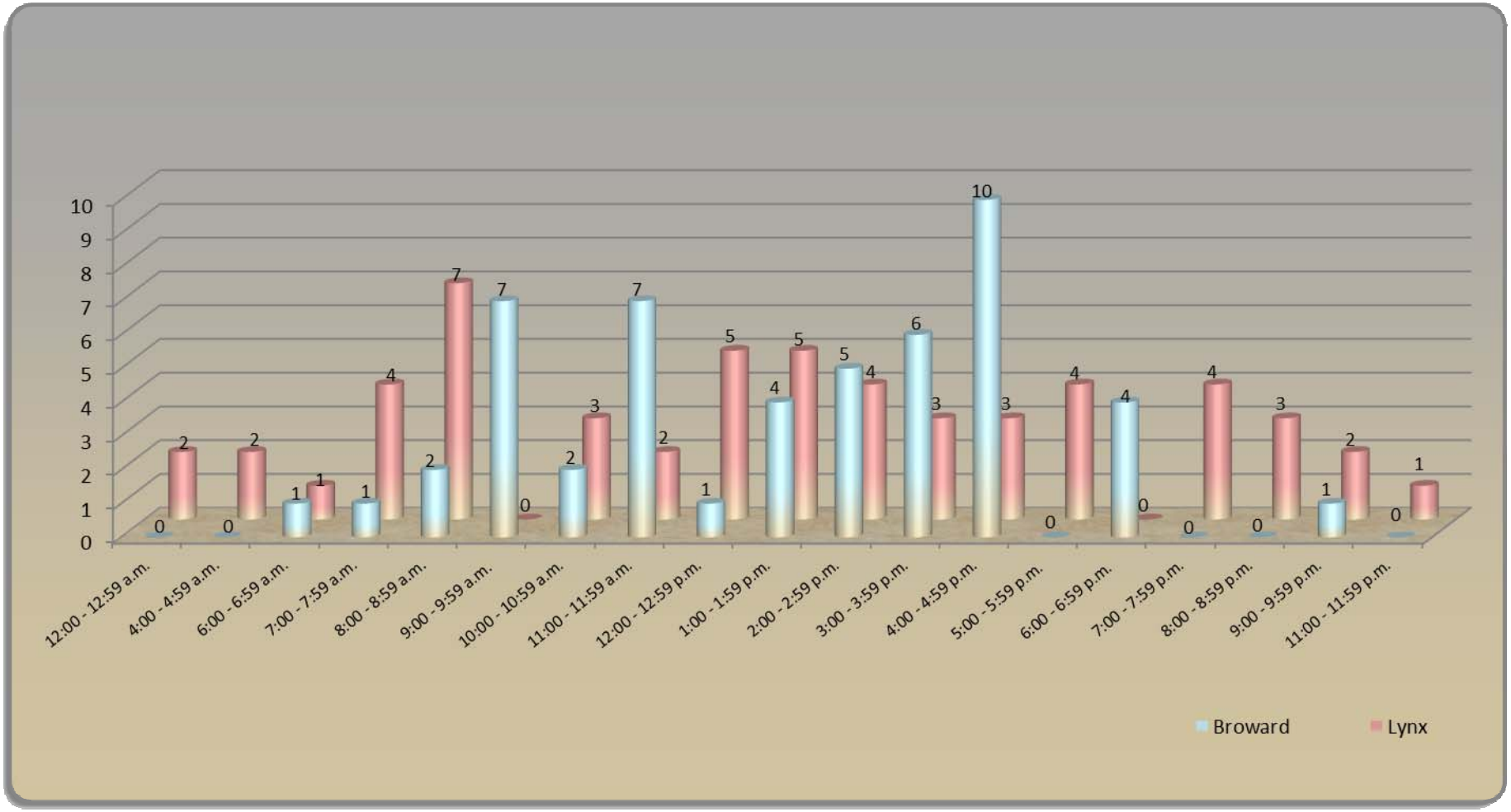

Figure 3-11. Rear-ended Collision by Hour of Day

Roadway Factors

Principal Collision Facilities with >1 Rear-ended Collision

There are a number of roadway factors that influence rear-ended collisions. First, the project team categorized every corridor that had more than one collision over the two year period. Both LYNX and Broward have a clear corridor that is problematic. For Broward, it is U.S. 441 with 8 collisions in two years and for LYNX, it was Orange Blossom Trail (north, central and south) with 11 collisions over the two year period. Rounding out the list for Broward (Figure 3-12 below) was Broward Boulevard with 6 rear-ended collisions, University Drive with 5, Sunrise Boulevard with 4, Davie Road with 3 and Coconut Creek Parkway with 2 collisions in two years. U.S. 441, Broward Boulevard, University Drive and Sunrise Boulevard are all 6 lane divided arterials; Davie Road and Coconut Creek Parkway are 4 lane divided arterials. Figure 3-12 below shows the principal collision facilities for Broward and Figure 3-13 below displays the percentages of total for each.

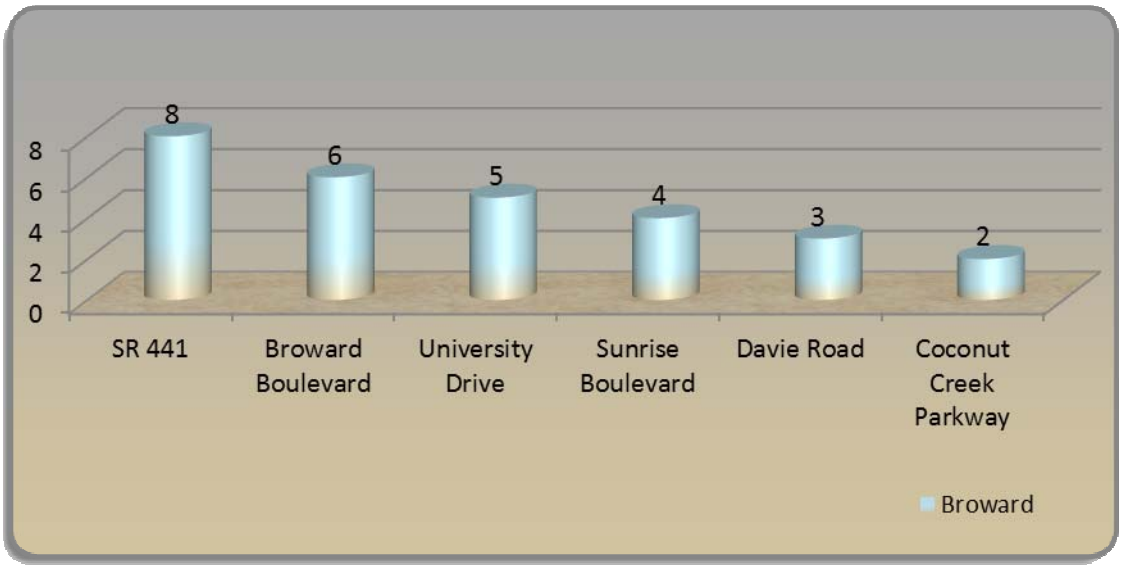

Figure 3-12. Principal Collision Facilities with >1 Rear-ended Collision

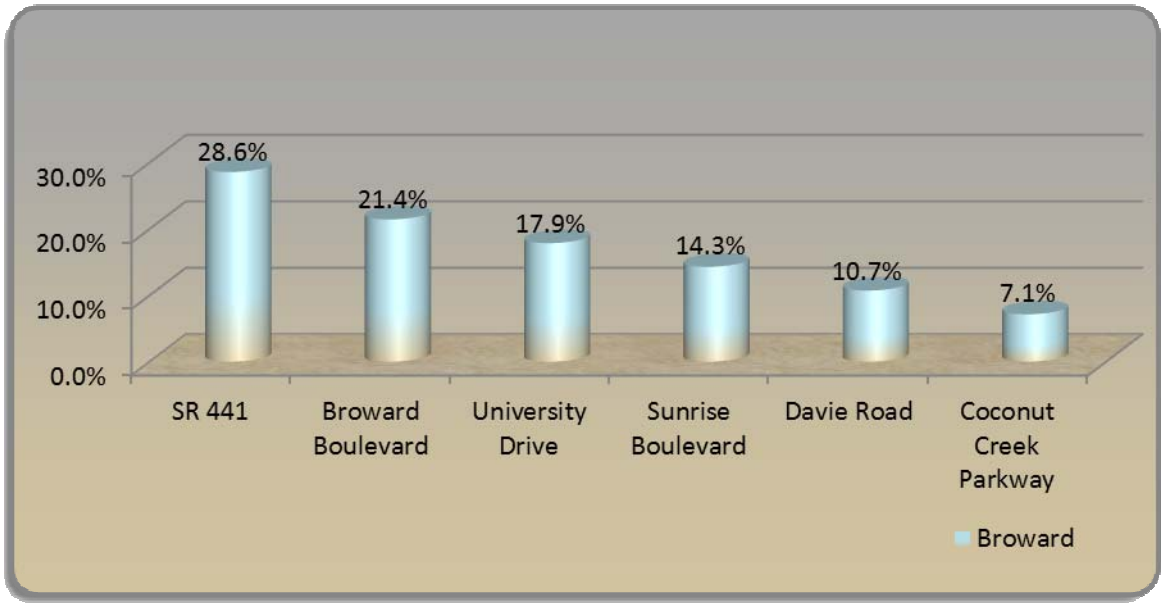

Figure 3-13. Principal Collision Facilities with >1 Rear-ended Collision: Percentages

For LYNX, after Orange Blossom Trail there was one facility with 4 collisions, three facilities with 3 each, and four facilities with 2 each. All of the facilities shown in Figure 3-14 below are 6 lane divided arterials except Curry Ford Road, which is 4 lane undivided and Orange Center Boulevard, which is 4 lane divided. Figure 3-15 below displays the percentages for each.

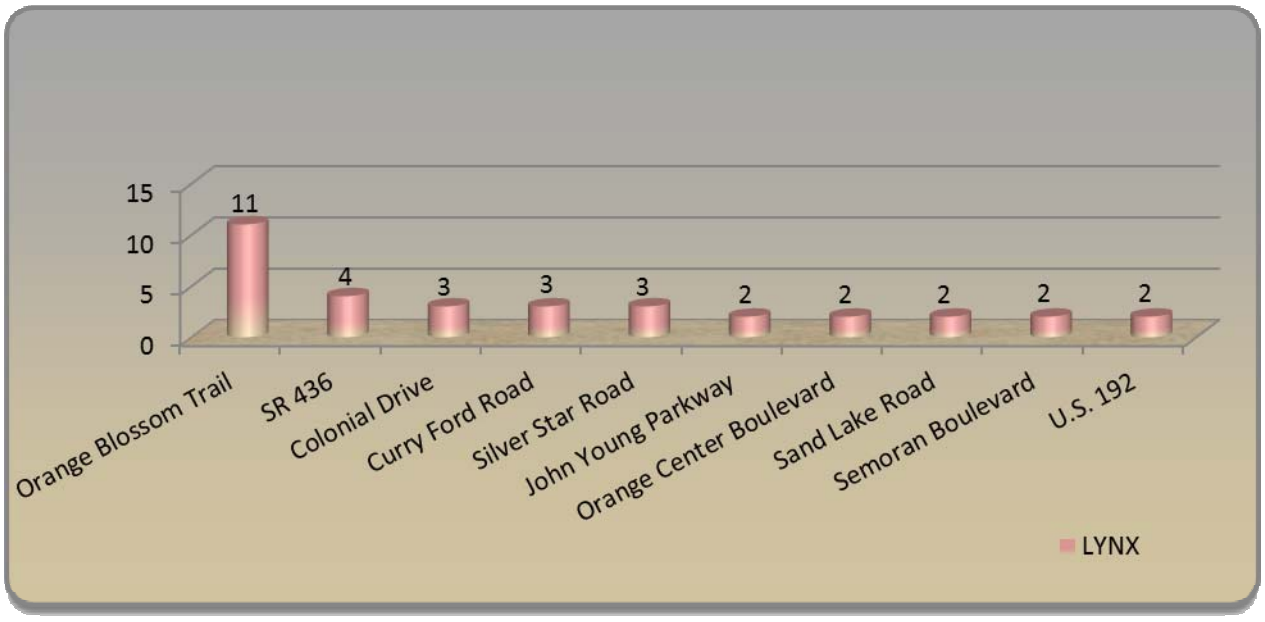

Figure 3-14. Principal Collision Facilities with >1 Rear-ended Collisions

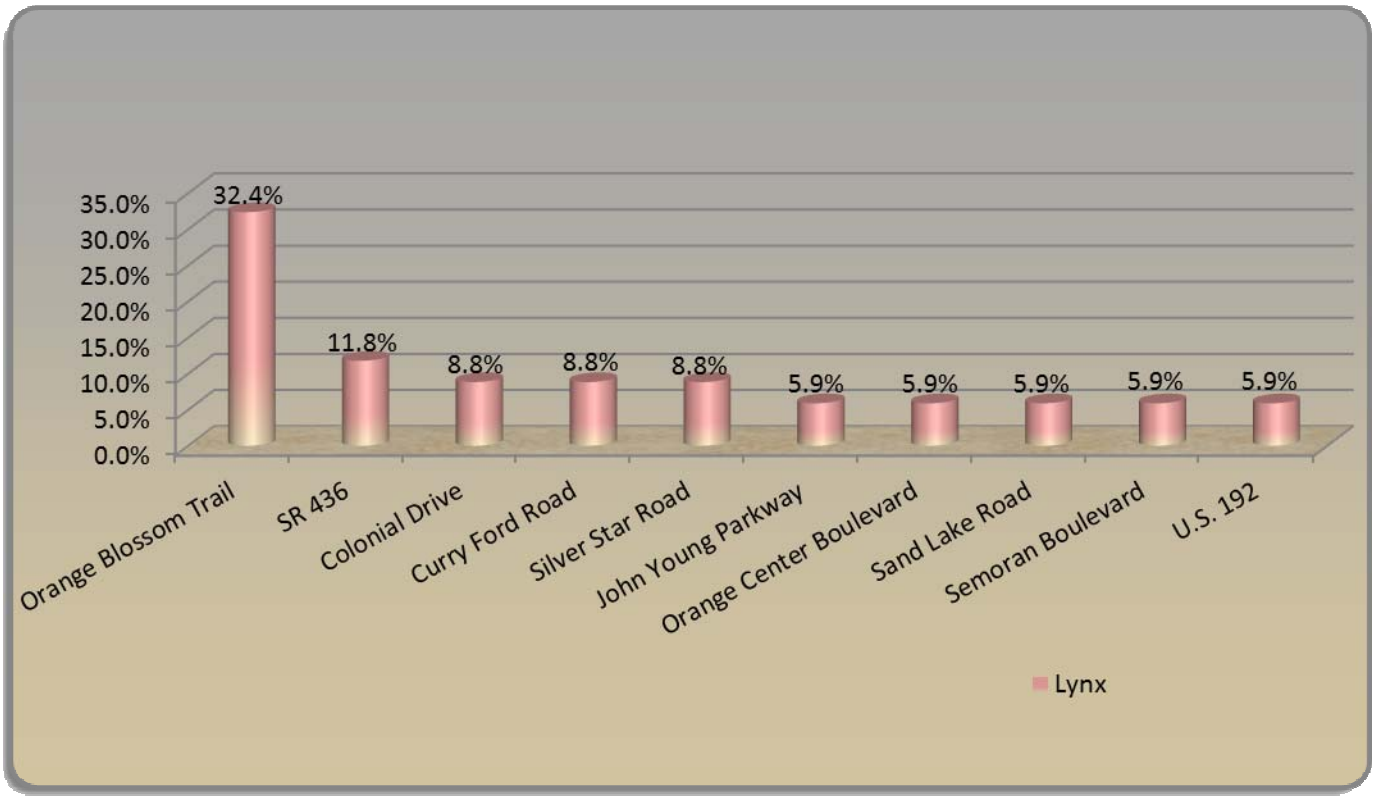

Figure 3-15. Principal Collision Facilities with >1 Rear-ended Collisions: Percentages

Roadway Classification

Most rear-ended collisions at both LYNX and Broward occur on arterials, either minor or principal. Figure 3-16 below shows that LYNX had 29 collisions on principal arterials and 18 on minor arterials while Broward had 35 collisions on principal arterials and 11 on minor arterials. Figure 3-17 below shows that LYNX did have 13 percent of collisions on an urban collector street.

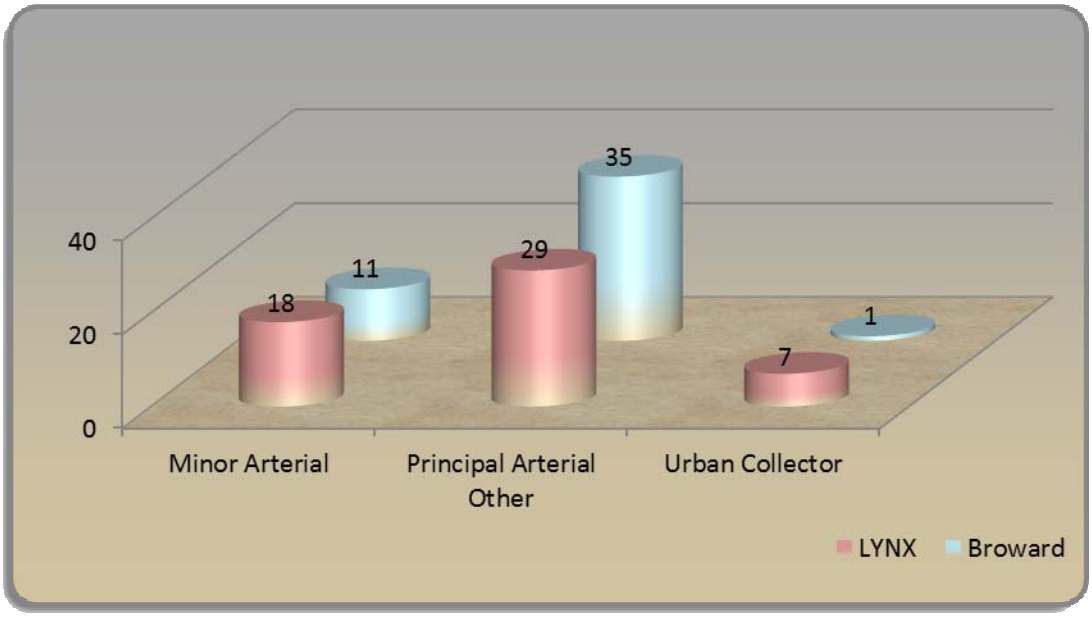

Figure 3-16. Roadway Classification

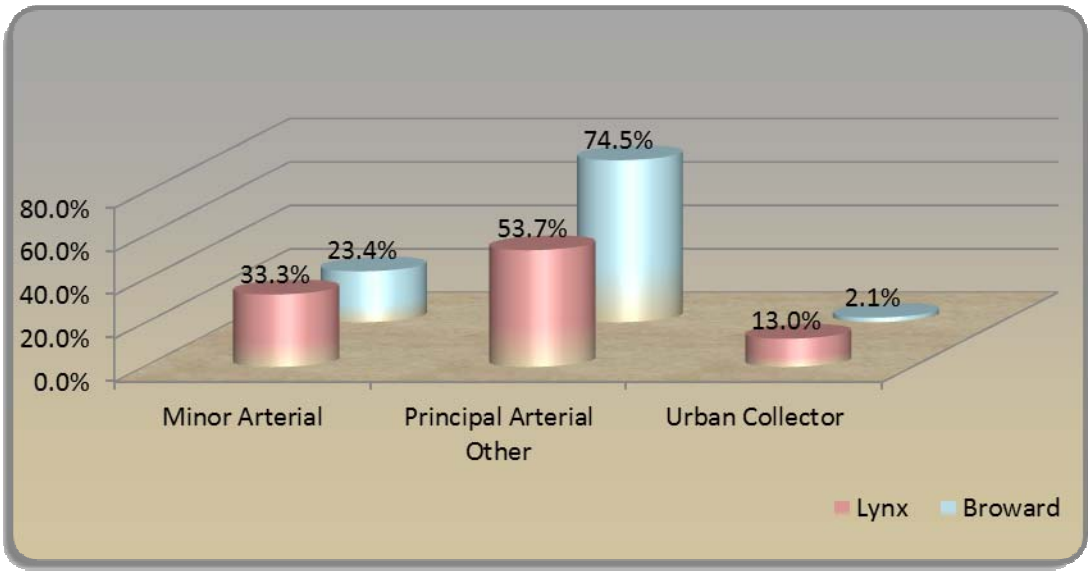

Figure 3-17. Roadway Classification: Percentages

Roadway Jurisdiction

Figure 3-18 below shows that Broward had a total of 37 rear-ended collisions on State roads while LYNX had 39 collisions on State Roads. Figure 3-19 below displays the percentages, with Broward having 14.3 percent of collisions on county roads and LYNX had 23.6 percent on local roads.

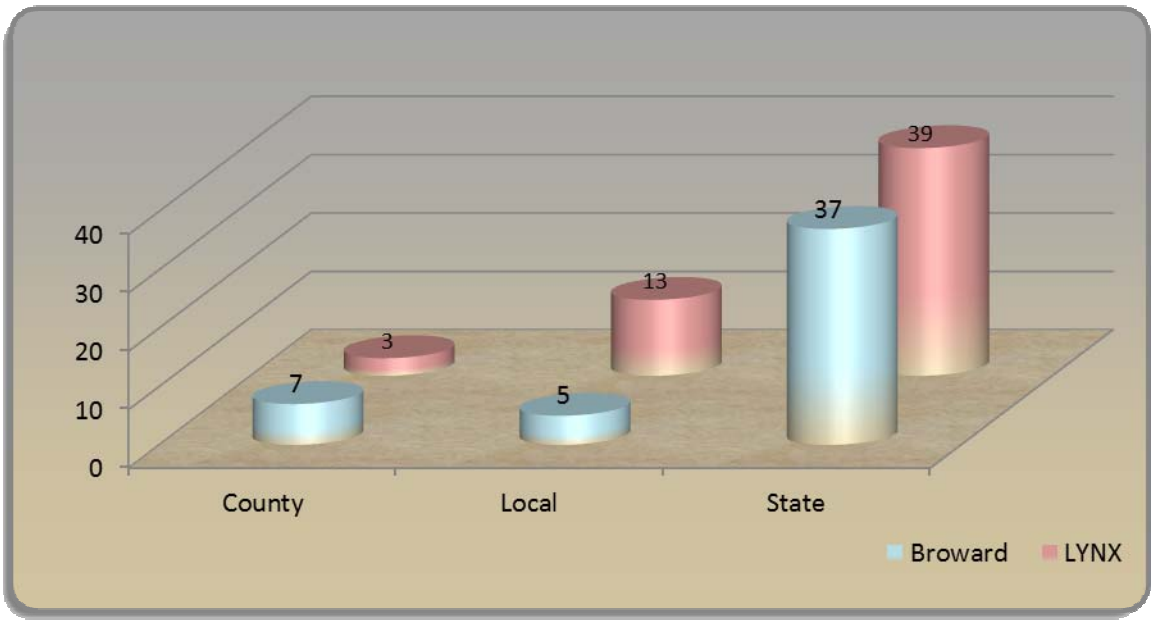

Figure 3-18. Roadway Jurisdiction at Rear-ended Collision Location

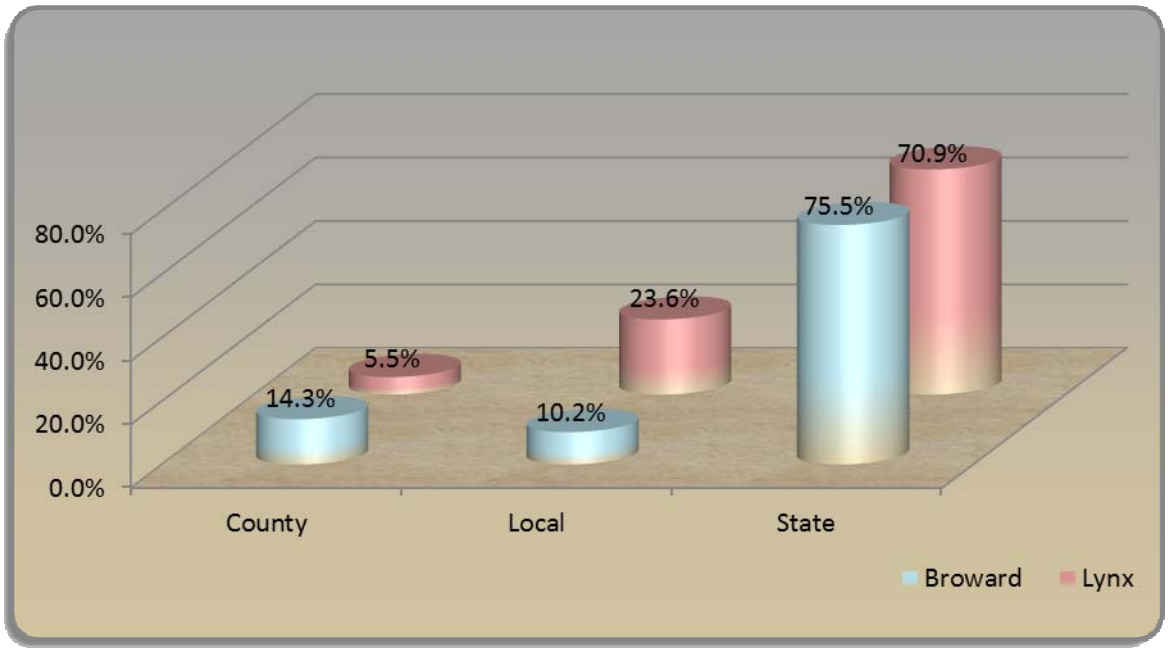

Figure 3-19. Roadway Jurisdiction at Rear-ended Collision Location: percentages

Number of Lanes and Divided/Undivided Roadways

Overall, LYNX had 42 collisions that occurred on a 4 lane divided or 6 lane divided roadway. Broward had 43 collisions on a 4 lane or 6 lane divided roadway (Figure 3-20). An additional 4 collisions occurred on 8 lane divided roadways. Figure 3-21 below shows that overall, LYNX had 69.1 percent of collisions on a 4 or 6 lane divided roadway while Broward had 86 percent of collisions on either type of roadway.

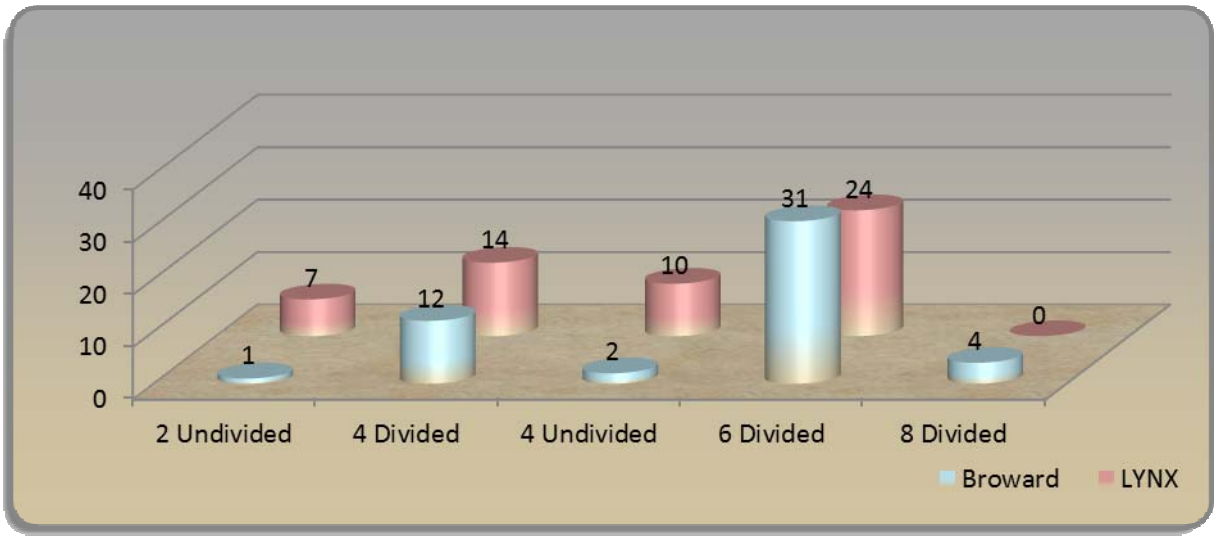

Figure 3-20. Number of Lanes and Divided/Undivided Roadways at Rear-ended Collision Location

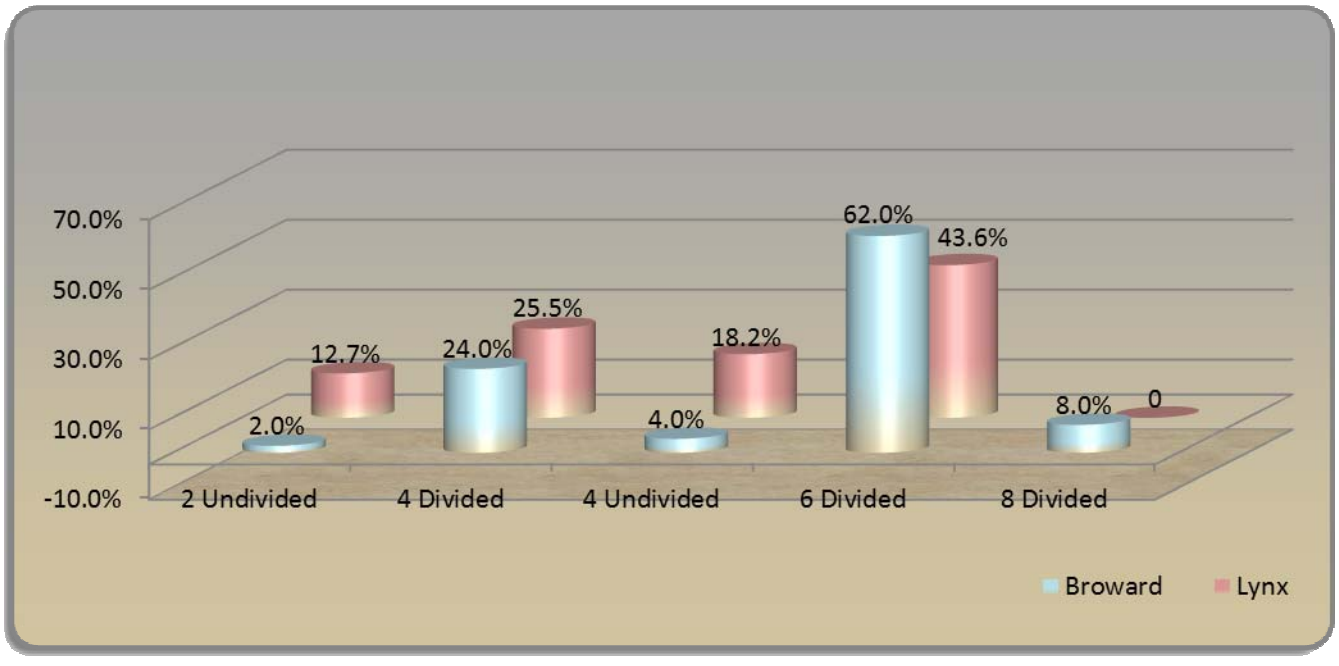

Figure 3-21. Number of Lanes and Divided/Undivided Roadways at Rear-ended Collision Location: Percentages

Vehicle Lanes with Jurisdiction

Finally, the lanes, divided/undivided, and jurisdiction were brought together to display what may be one of the most important graphics in the study. Figure 3-22 below shows that LYNX had 30 rear-ended collisions on a 4 or 6 lane divided State road. Broward had 35 rear-ended collisions on a 4 or 6 lane divided State road. These numbers represent 54.5 percent of all LYNX collisions and 68.6 percent of all Broward collisions (Figure 3-23 below).

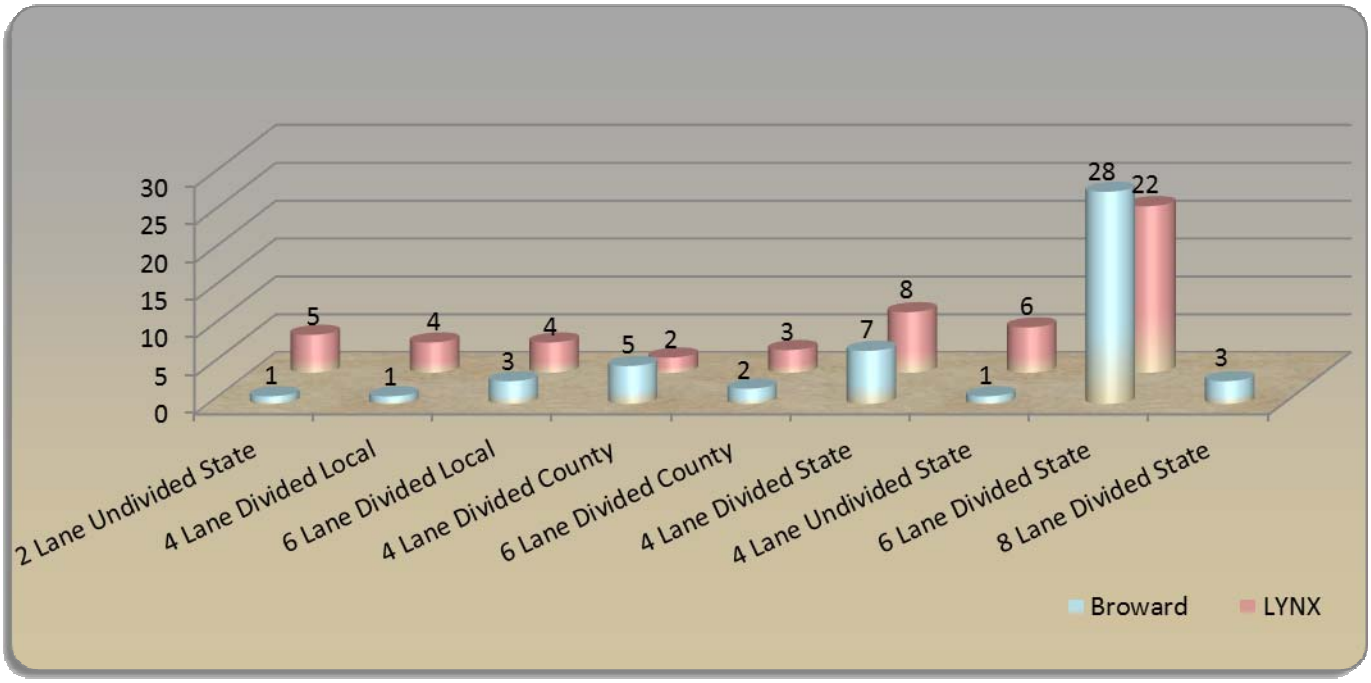

Figure 3-22. Vehicle Lanes and Jurisdiction

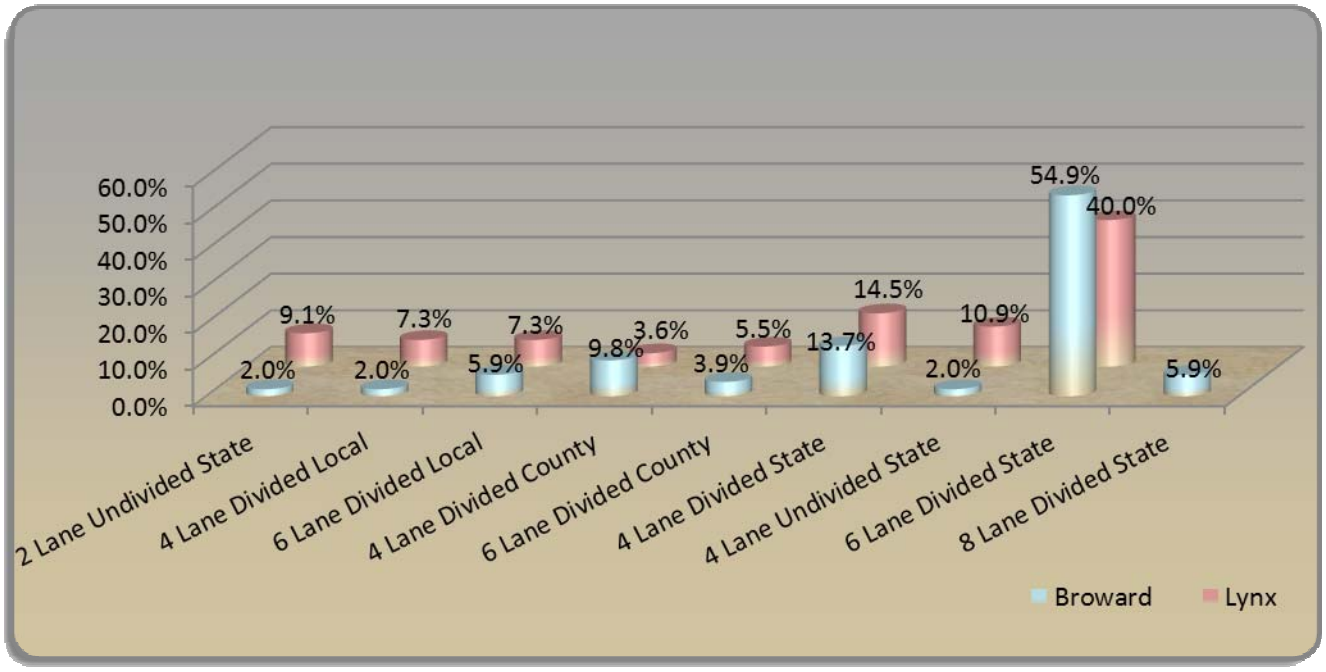

Figure 3-23. Vehicle Lanes and Jurisdiction: Percentages

Aerial Views of Typical Intersections

The project team identified the location of each collision using Google Earth and the diagrams provided in the collision files. The complete set of aerials is included as Appendix C for LYNX and Appendix D for Broward. The three aerial views presented below include a collision on a 6 lane divided State road at a near side bus stop (Figure 3-24).

November 18, 2011

NTD ID No. 52

LYNX Claim 1112-0215

Location: SR 434 east of SR 17-92 in Winter Springs

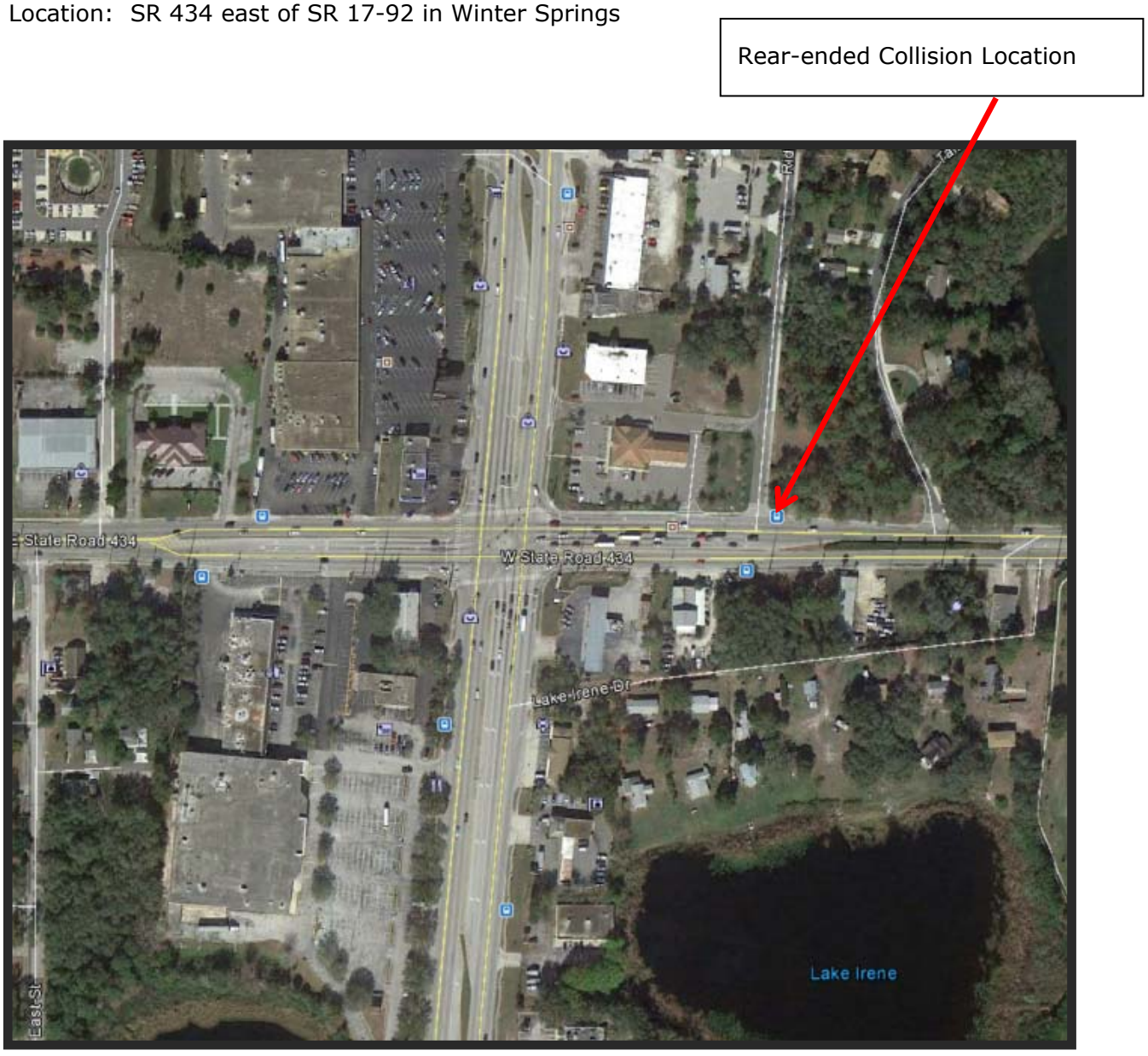

Figure 3-24. Rear-end Collision Location: SR 434 east of SR 17-92 in Winter Springs, FL

Figure 3-25 below displays a 4 lane divided State Road with a rear-ended collision at a mid-block stop in the LYNX service area.

June 30, 2011

NTD ID No 18

LYNX Claim 1011-1164

Location: North Orange Blossom Trail east of Sheeler Avenue in Apopka

Figure 3-25. Rear-end Collision Location: North Orange Blossom Trail East of Sheeler Avenue in Apopka, FL

Figure 3-26 below shows a 6 lane divided State road with a rear-ended collision at a far side bus stop.

January 21, 2012

NTD Incident No.

BCT Claim Number – A12012127C

Location: US 441 and Copans Rd.

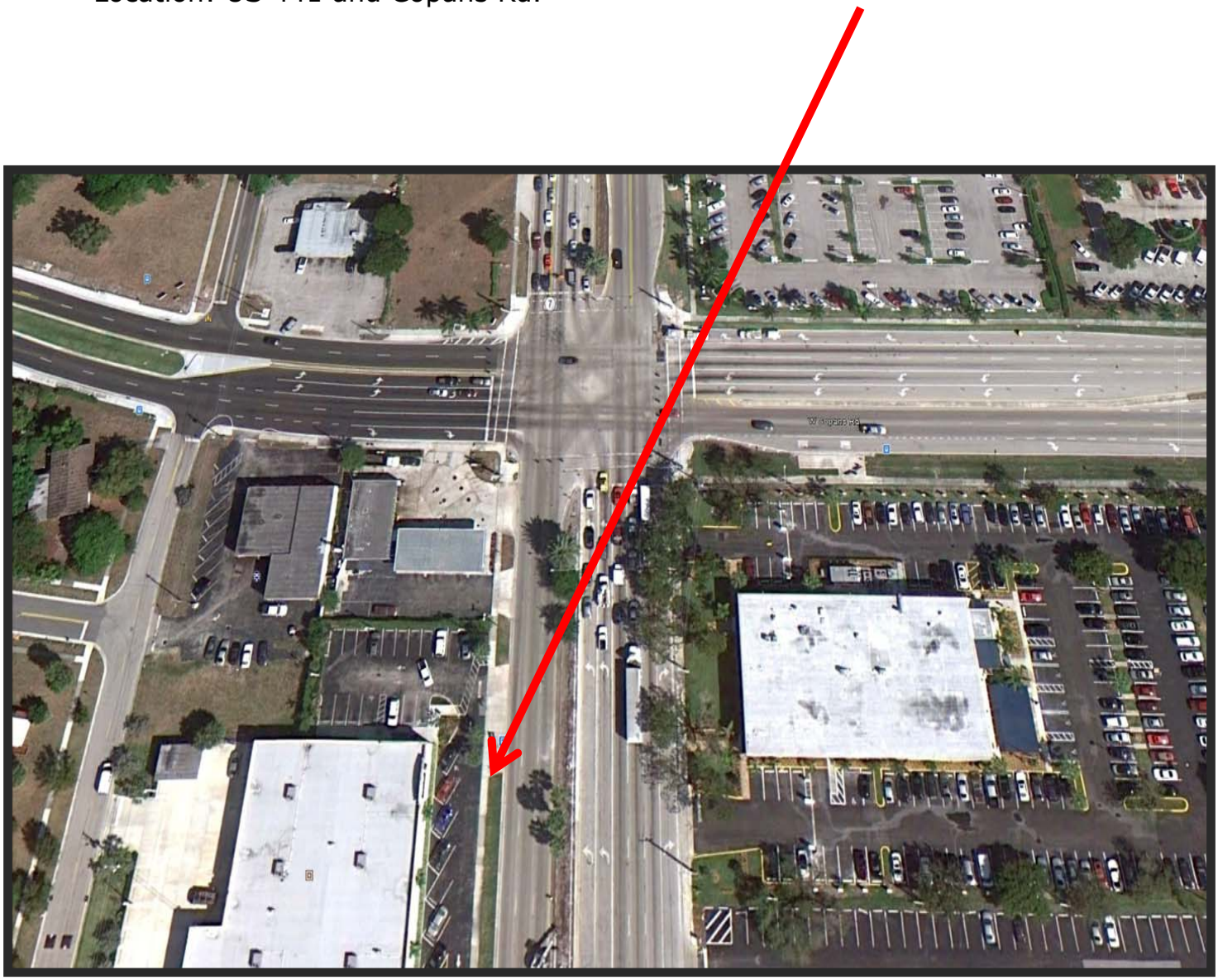

Figure 3-26. Rear-end Collision Location: US 441 and Copans Road

Transit Factors

Some of the transit factors, such as route direction and collisions by day of week, were included in the previous section of factors having no particular influence on rear-ended collisions. The primary transit factors are stop type, bus movement at time of collision, and passenger injuries.

Stop Type

Figures 3-27 and 3-28 show that Broward had 33 collisions (64.7 percent of all rear-ended collisions) at a far-side or mid-block bus stop while LYNX had 34 collisions (61.8 percent of all collisions) at a far-side or mid-block bus stop. Both properties had 27 percent of collisions at a near-side bus stop. This is of special note because bus stop placement is always a conundrum for transit agencies from the perspective of operations, bus operator satisfaction, customer satisfaction, safety, and right-of-way considerations. Officials at BCT indicated that in many instances a near-side bus stop cannot be placed on a 6 lane roadway if right turn queues are present. Therefore, a far side or mid-block stop is the only alternative. It is not likely that this data will solve the entire debate on the safest and most convenient bus stop placement. Broward had more mid-block collisions than LYNX and LYNX had more far-side stop collisions than Broward. Also, it could be argued that LYNX had an equal number of 15 collisions at a mid-block and 15 at a near-side bus stop. However, it was the observation of the project team when examining files that mid-block and far-side stops are more problematic when it comes to rear-ended collisions.

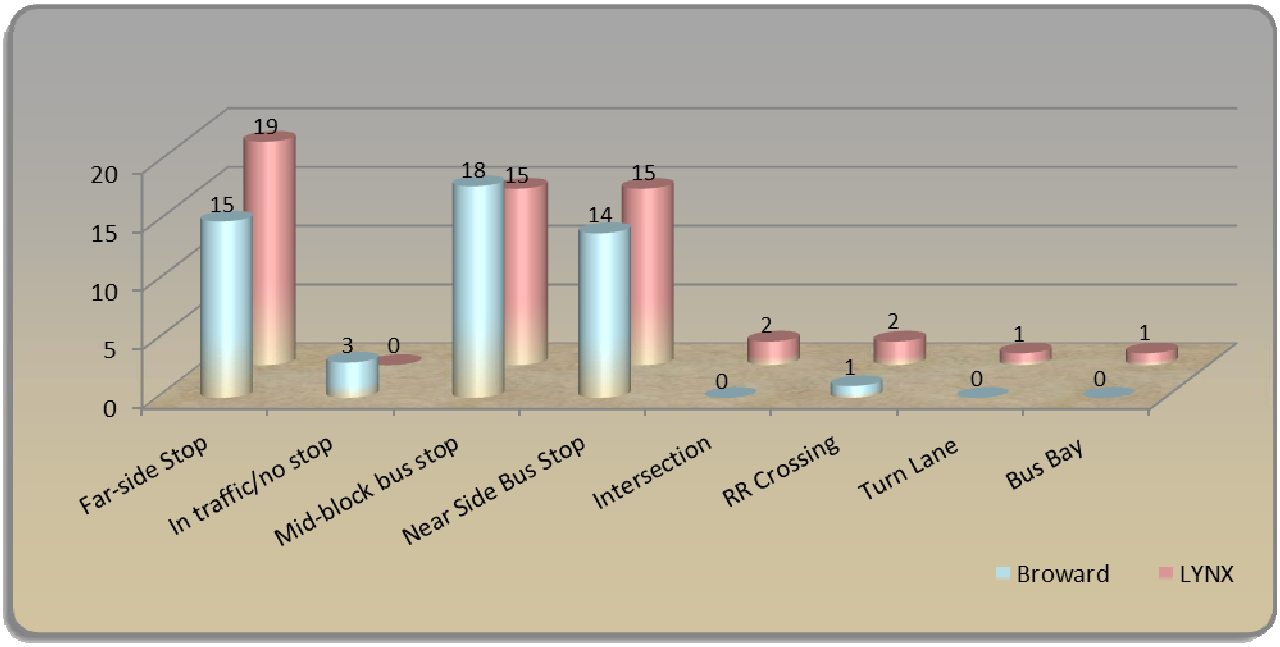

Figure 3-27. Stop Type

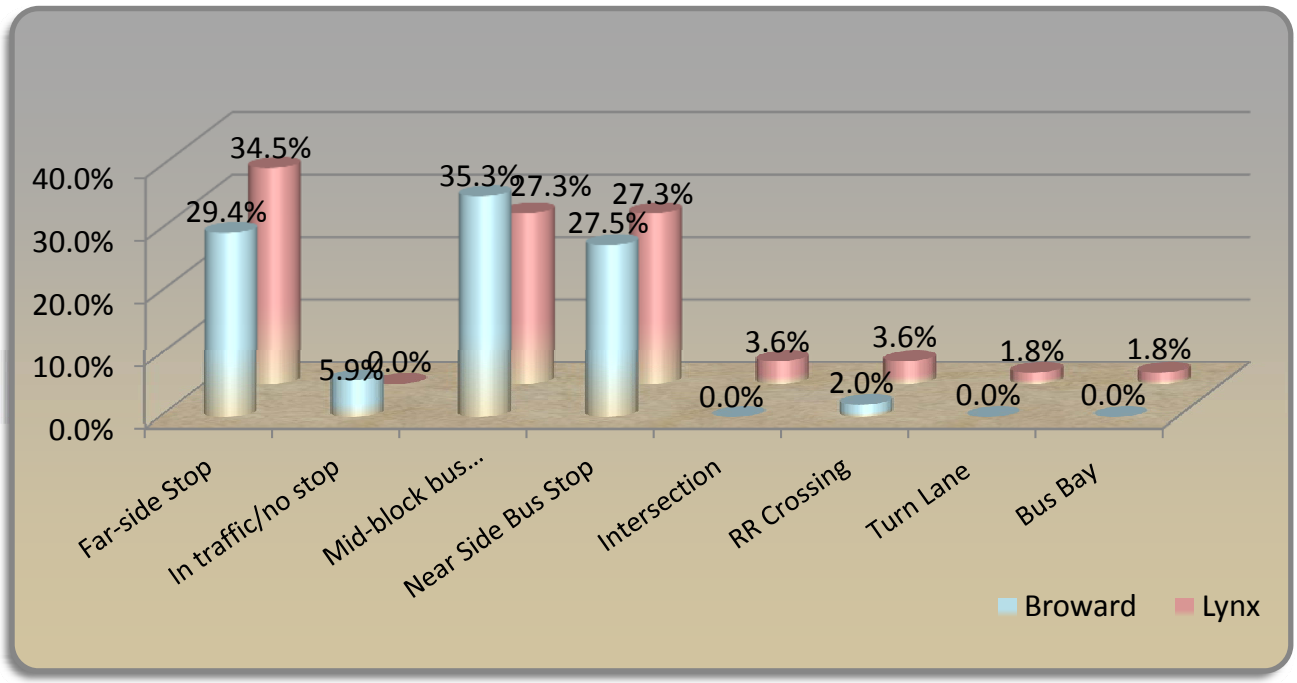

Figure 3-28. Stop Type: Percentages

Bus Movement at Time of Collision

Figures 3-29 and 3-30 below show that in most cases (86 percent for Broward and 93 percent for LYNX), rear-ended collisions occur when the bus is stopped at a bus stop in a lane of traffic. In the examination of files, only one collision occurred while a bus was in a bus bay and it had nothing to do with the bus bay. A woman was trying to avert another collision and collided instead into the back of the bus. The obvious note is that transit must function by stopping at fixed bus stops to serve passengers. From the perspective of the operator, when stopped, the bus is a "sitting duck." Even if there was a defensive driving technique, or a means by which the operator could spot the collision about to occur, averting the collision would likely cause greater harm and injury to passengers than the actual impact of the rear-ended collision. Also, it is not known whether there are any specific treatments of a bus to make it more visible that prevents collisions. No one ever knows about the close-calls, the collisions that did not occur. Therefore, even if treated there still is the occurrence of rear-ended collisions. This will be discussed in the next section under other vehicle factors.

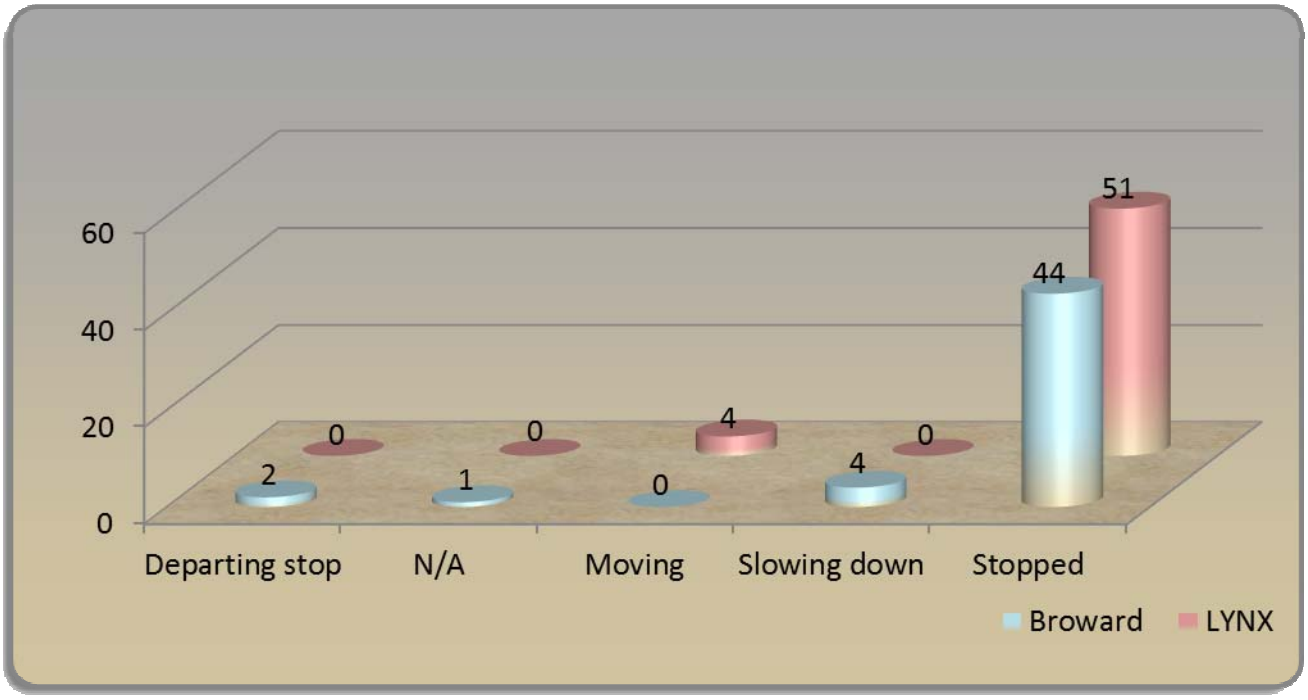

Figure 3-29. Bus Movement Status at Rear-ended Collision Location

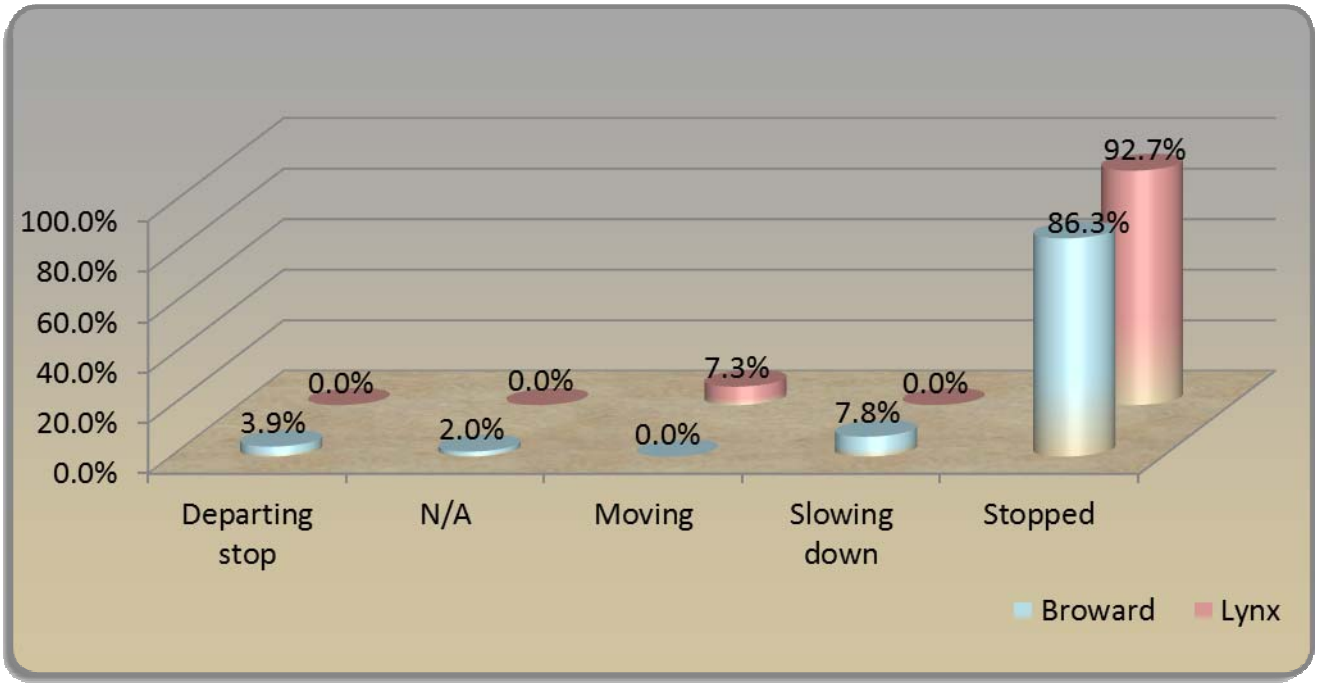

Figure 3-30. Bus Movement Status at Rear-ended Collision Location: Percentages

Passengers Reporting Injury

In the case of LYNX, there was evidence found in the files that passengers did or did not report being injured as a result of a rear-ended collision. However, LYNX files did not always contain information on whether passengers were transported for medical treatment. In the case of Broward, because the FHP long form collision report was present for every collision, there was documentation when passengers were transported for medical. Therefore, this category was generalized to incorporate passengers reporting injury. Figures 3-31 and 3-32 below show that in virtually 8 of every 10 collisions (82 percent for Broward and 78 percent for LYNX), passengers did report being injured and in Broward, most were transported for medical treatment.

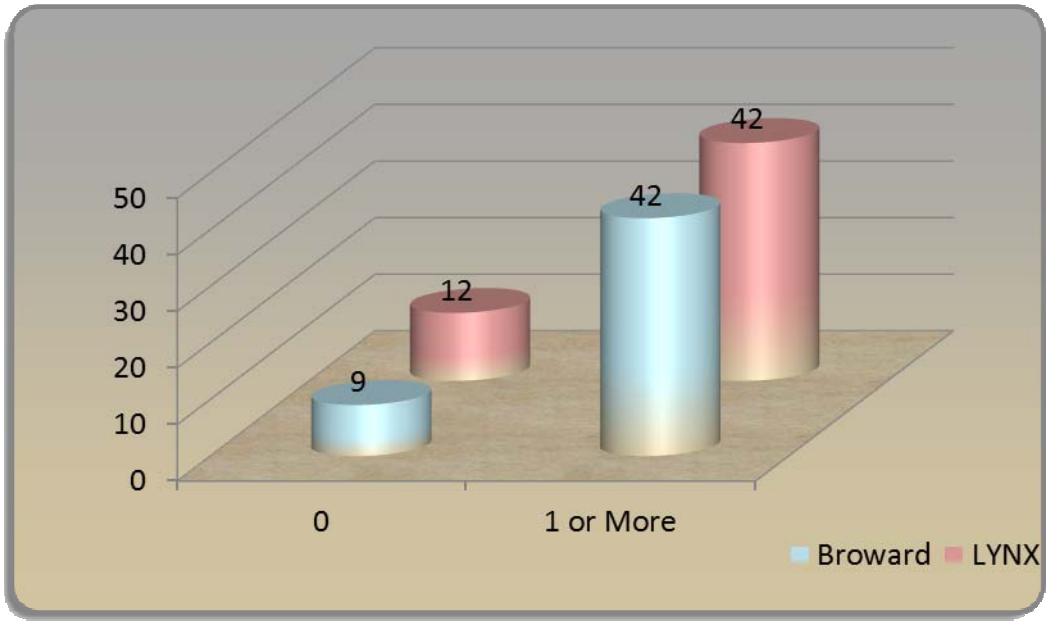

Figure 3-31. Passengers Reporting Injuries

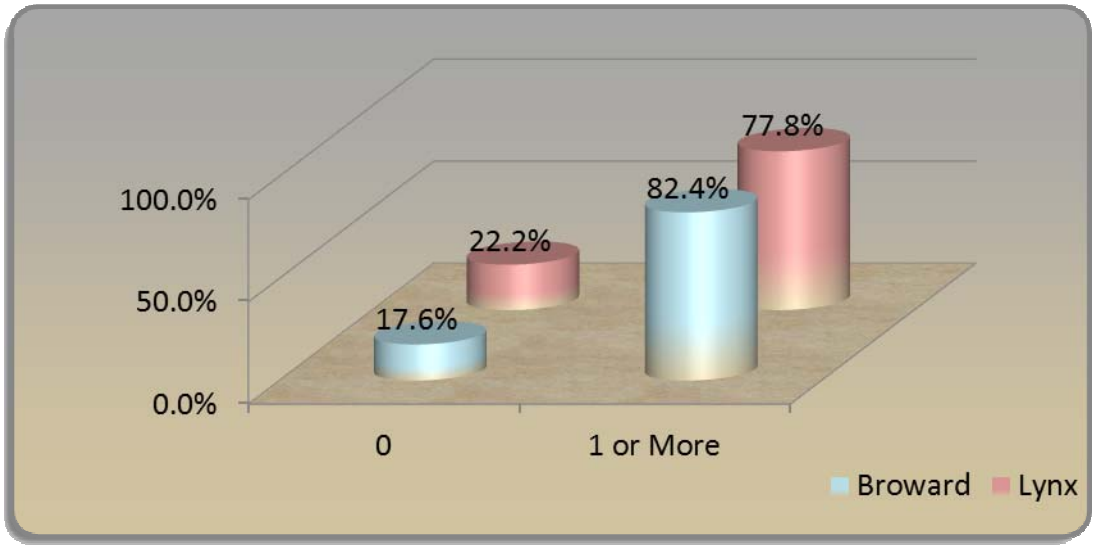

Figure 3-32. Passengers Reporting Injuries: Percentages

Other Vehicle Factors

As indicated earlier, the fact that Broward files contained the FHP long form collision report, it was possible for the project team to collect more information on rear-ended collisions. The first factor is the estimated speed of the vehicle rear-ending the bus. This estimated speed is garnered from the long form report; however, it is not known how the estimated speed is calculated. It may be through law enforcement investigation, it may be through the officer using experience to estimate speed, or it may come from interviewing the driver of the other vehicle and asking what speed they were traveling. Figure 3-33 and 34 below show that the most prevalent estimated speed was 30 miles per hour (23.5 percent), followed by 20 miles per hour (13.7 percent) and 45 miles per hour (13.7 percent).

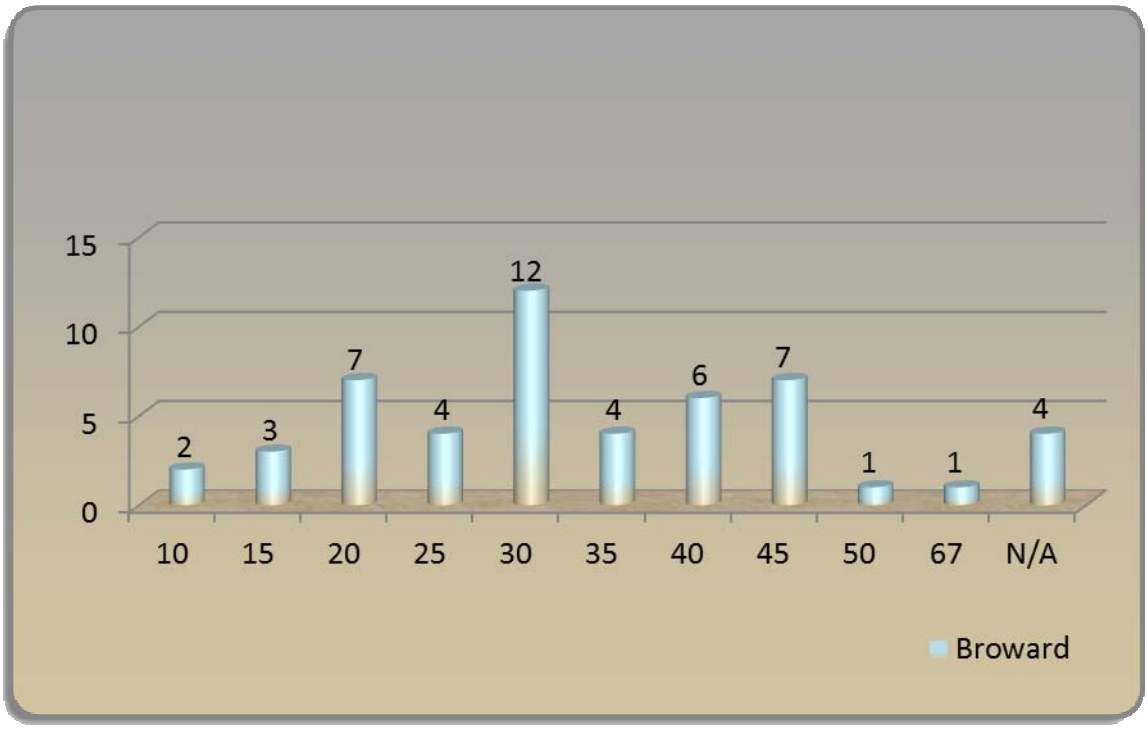

Figure 3-33. Estimated Speed of Vehicle Rear-ending Bus

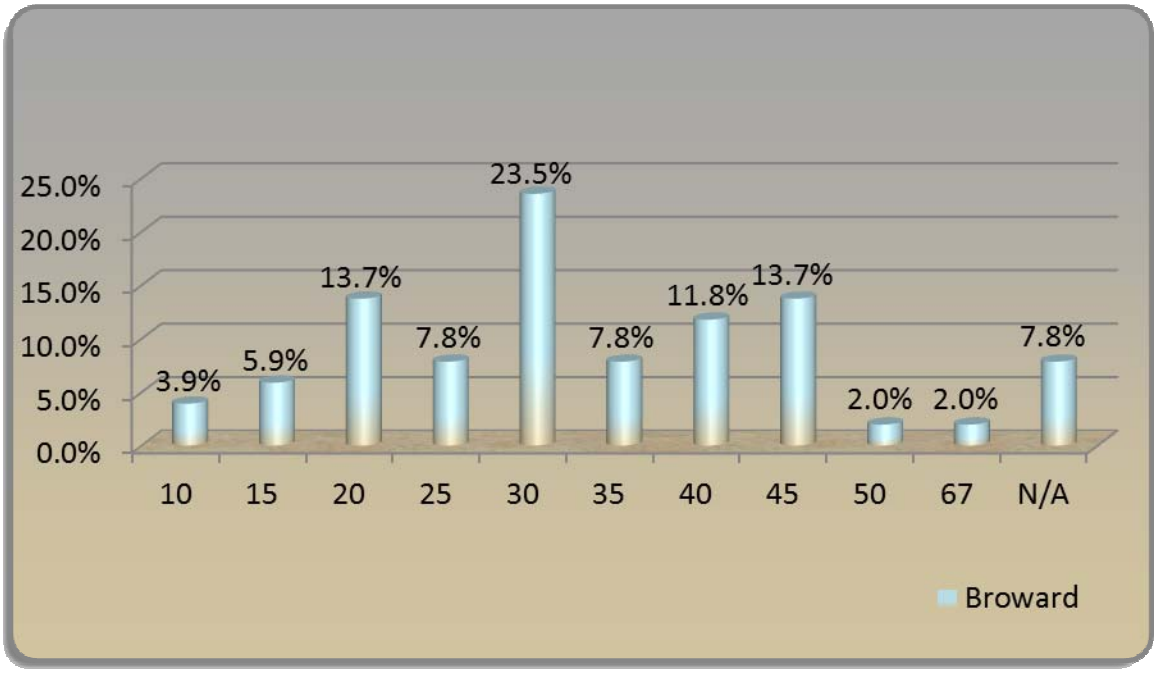

Figure 3-34. Estimated Speed of Vehicle Rear-ending Bus: Percentages

Posted Speed Limit at Rear-ended Collision Location

This particular factor may be more helpful in predicting locations ripe for rear-ended collisions. Figures 3-35 and 3-36 below show that the posted speed limit of 40 miles per hour and 45 miles per hour each accounted for 35 percent of total rear-ended collisions (70 percent of all collisions). Thus, higher speed limits may directly contribute to rear-ended collisions.

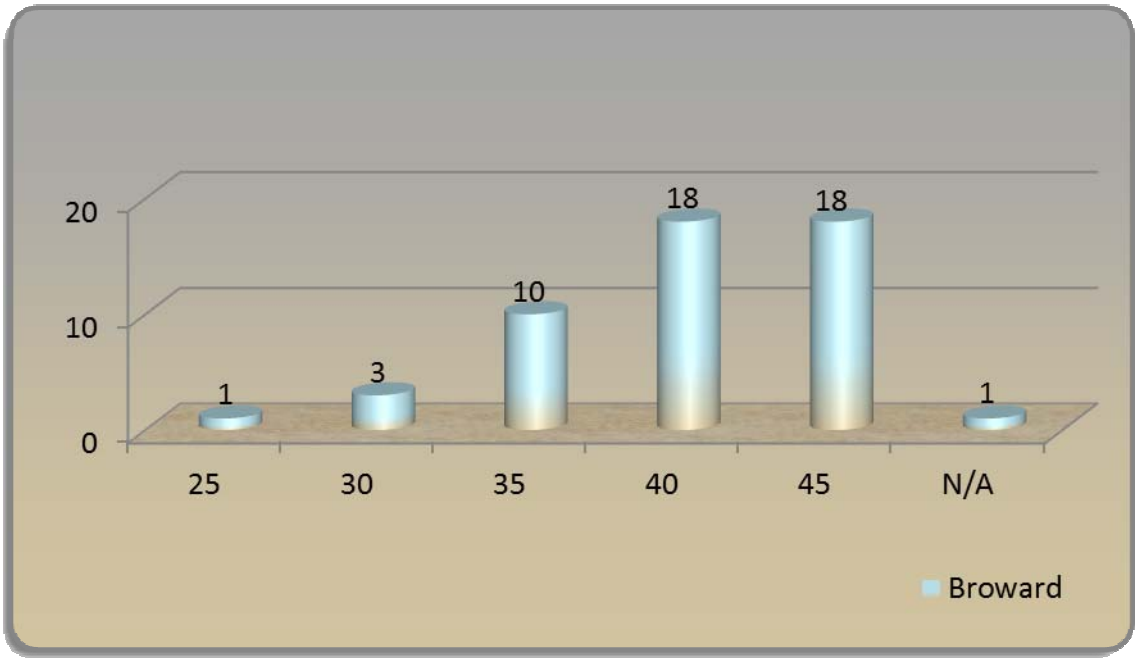

Figure 3-35. Posted Speed Limit at Rear-ended Collision Location

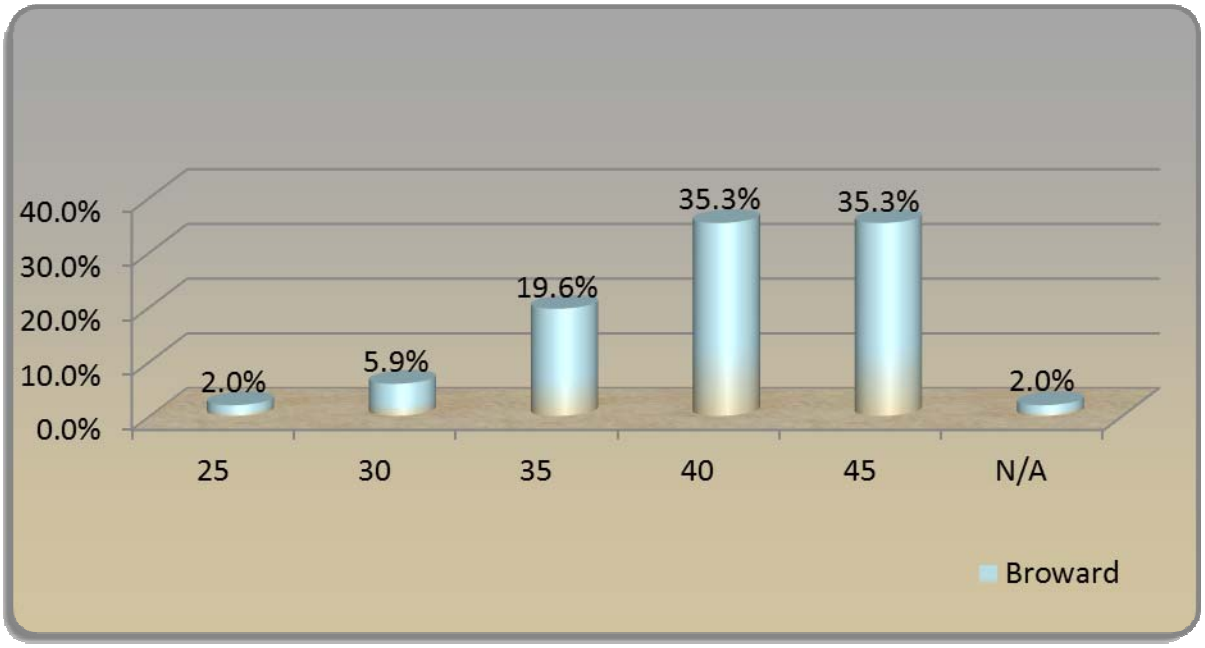

Figure 3-36. Posted Speed Limit at Rear-ended Collision Location: Percentages

Driver Distraction / Vision Obstructed / Suspicion of Drug or Alcohol Use

These next three factors must be examined together. Of initial note is that collisions are not a criminal offense unless they involve homicide, manslaughter or drug or alcohol use. Therefore, operators of other vehicles are not questioned in the same manner as a suspect in a crime. In a few anecdotal cases, the operators of other vehicles admitted to being distracted prior to the collision. One woman stated there was a bee in the car and she became distracted; another man had a small child in his truck and the passenger door came open and he became distracted. One person indicated outright that cell phone use contributed to the collision. However, Figures 3-37 through 3-42 show the long form indicating that 74.5 percent of other vehicle operators were not distracted, 94 percent did not experience vision obstruction and 76.3 percent there was no suspicion of drug or alcohol use. This appears to complete the probe to discover how the collision occurred. The narrative descriptions are euphemisms likely derived from statutory language: The other driver, "failed to use due caution," or "failed to use due care," and thus hit a 27,000 pound object directly in front of them. BCT describes it as, "the driver failed to yield to the bus and hit the rear-end."

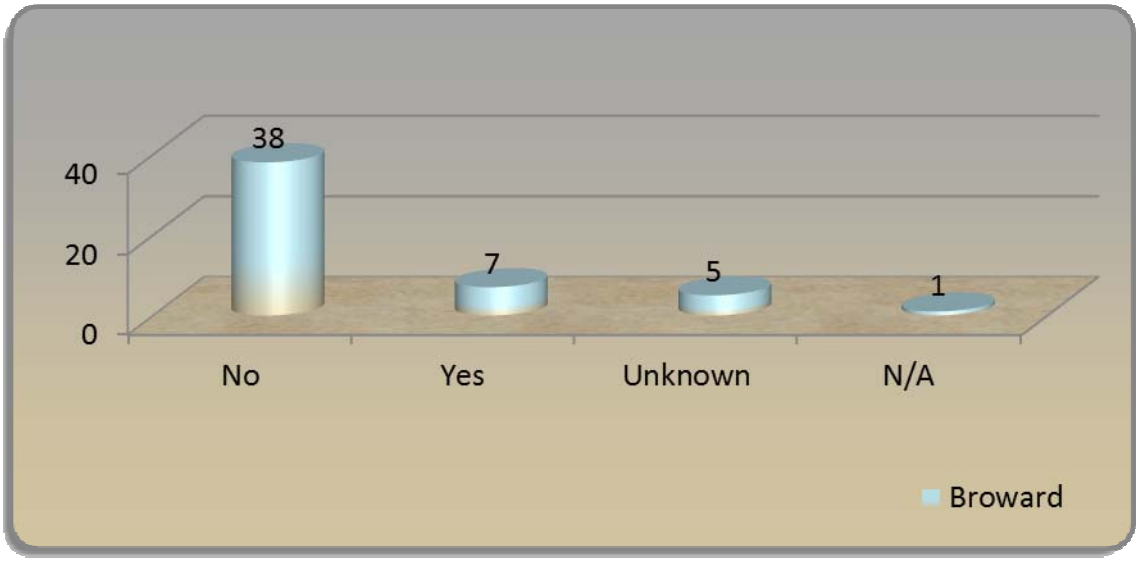

Figure 3-37. Operator of Colliding Vehicle Distracted

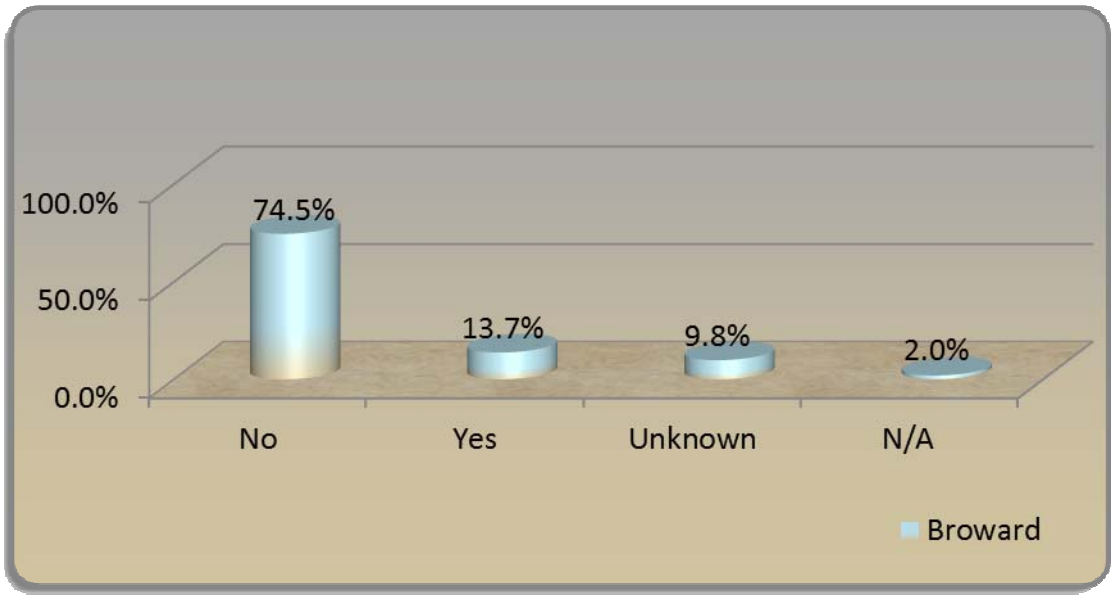

Figure 3-38. Operator of Colliding Vehicle Distracted: Percentages

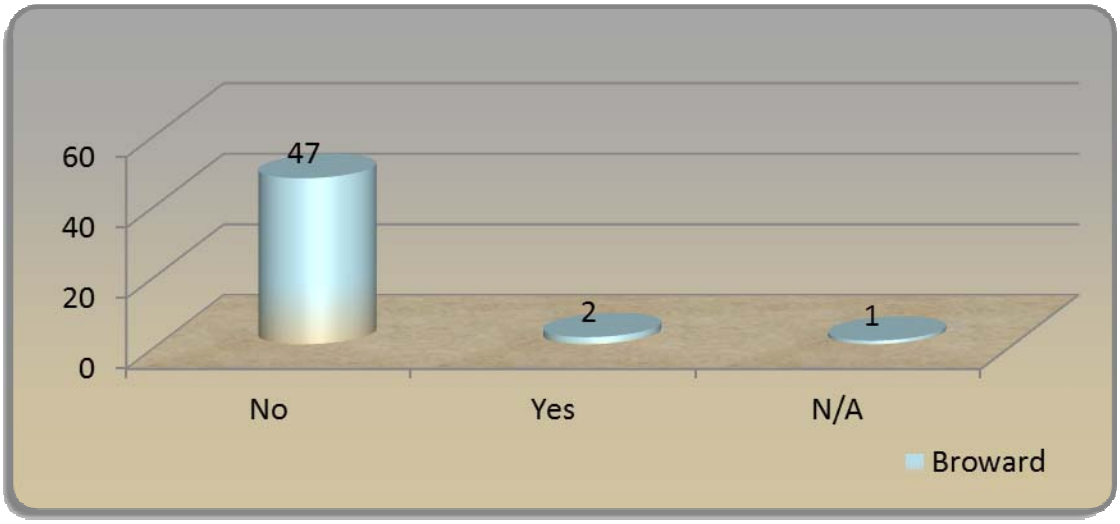

Figure 3-39. Vision of Colliding Vehicle Obstructed?

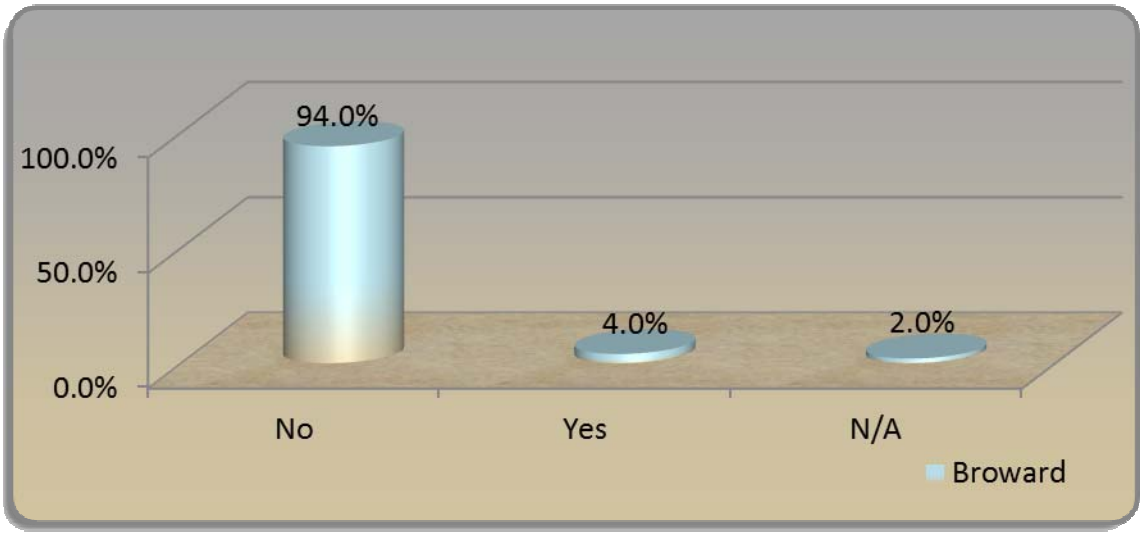

Figure 3-40. Vision of Colliding Vehicle Obstructed: Percentages

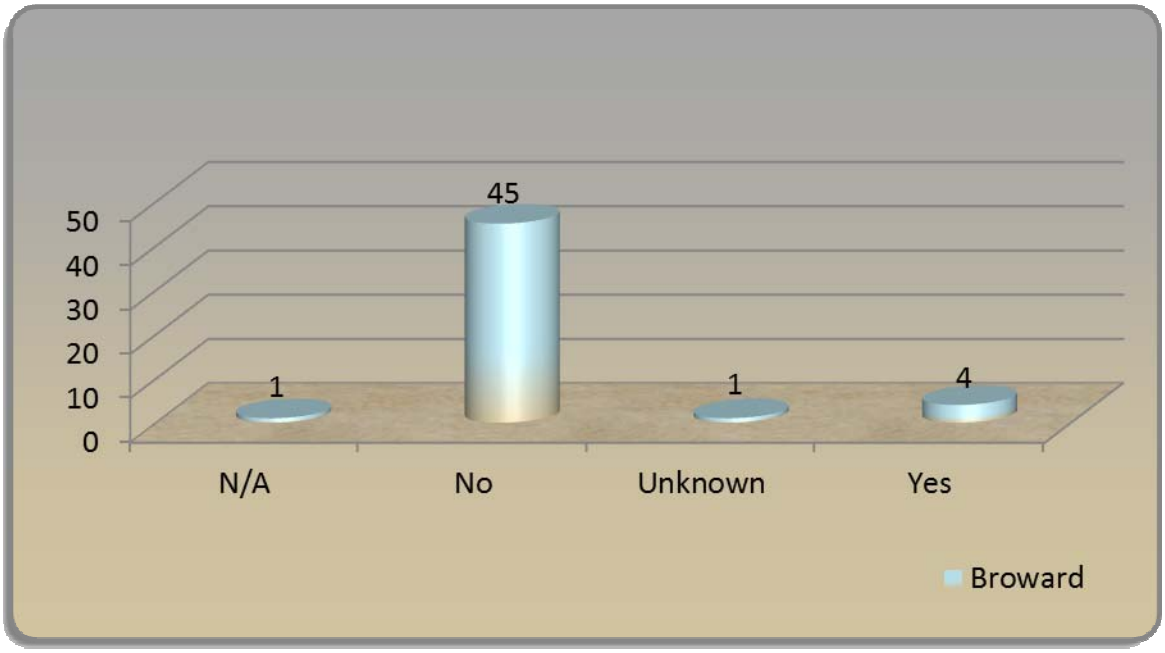

Figure 3-41. Drugs or Alcohol Suspected in Colliding Vehicle?

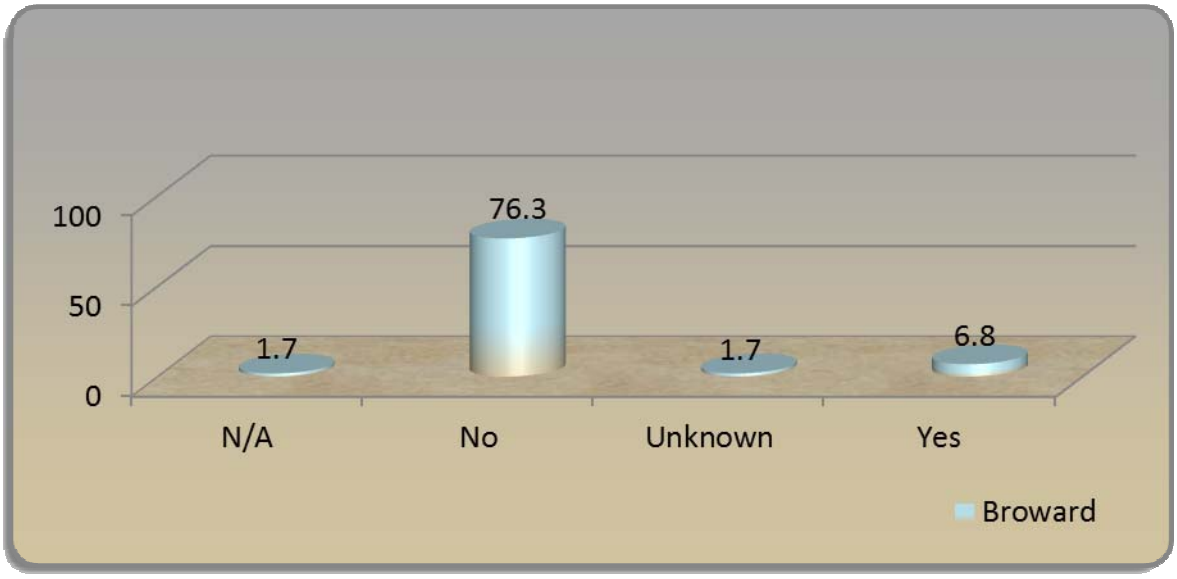

Figure 3-42. Drugs or Alcohol Suspected in Colliding Vehicle: Percentages

Operator of Colliding Vehicle Transported for Medical Treatment

Finally, the long form documents whether the operator of the colliding, and also any other occupants of the vehicle, are transported for medical. In the Broward collision files, Figures 3-43 and 3-44 show that 51 percent were transported for medical treatment and 47 percent were not.

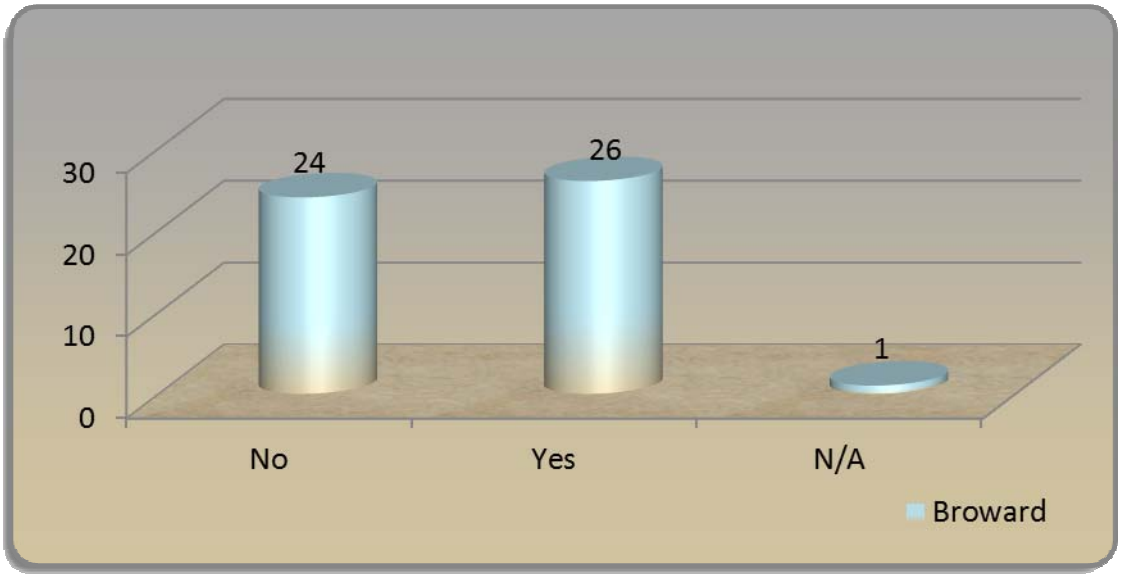

Figure 3-43. Operator of Colliding Vehicle Transported for Medical Treatment?

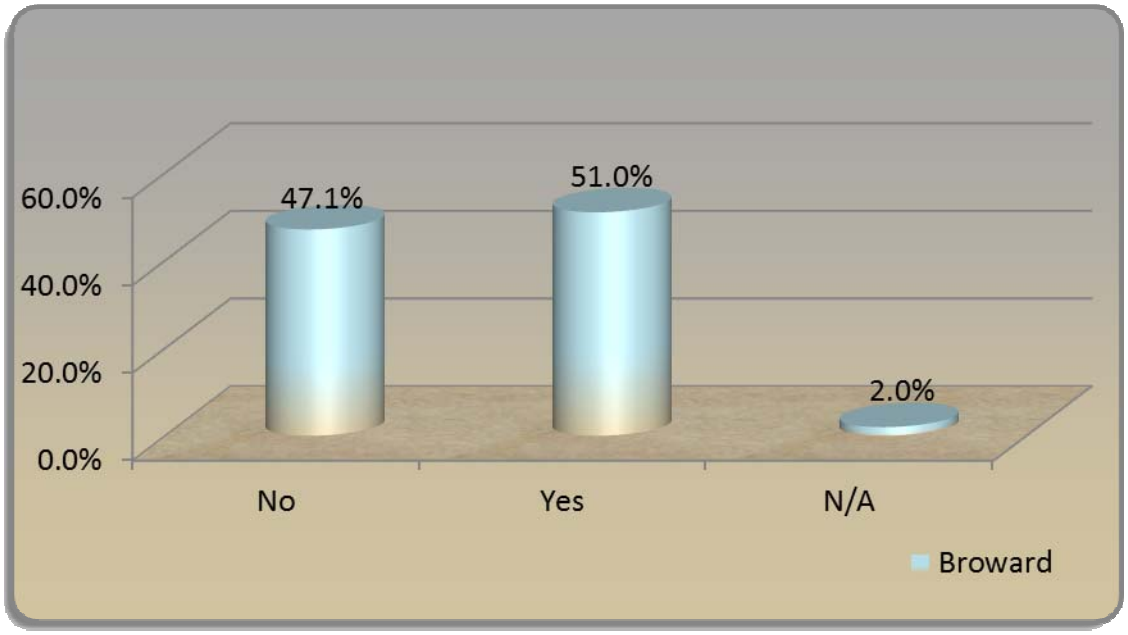

Figure 3-44. Operator of Colliding Vehicle Transported for Medical Treatment: Percentages

Chapter 4
Interviews with Transit Agencies

Introduction

Following the examination of collision files and assembling the associated data in Chapter 3, CUTR conducted a total of seven interviews with representatives of both larger and smaller transit agencies. Interviews were held with PSTA (Pinellas County), Lee County Transit, VOTRAN (Volusia County), PCPT (Pasco County), Spacecoast Area Transit (Brevard), Regional Transit System (Gainesville), and HART (Hillsborough County). Interviewees were selected from the database maintained by the Florida Transit Safety Network.

Interview Structure

The project team sent via e-mail to each interviewee the data that was obtained on their property from the NTD Major Incident database and a list of four topical areas to discuss with associated questions: Operations, Risk Management, Training, and Technology. The Interview Guide is attached as Appendix E. At the beginning of each interview, the project team explained how the transit agency's NTD data compared to Florida, FTA Region 4 and the national aggregate data. Each was asked if they wanted to reflect on the data and what it means for their respective systems.

PSTA indicated that their collisions are a result of being a high tourist traffic area with hundreds of thousands of people who do not know where they are going. The agency indicated that another problem is the number of driveways in Pinellas County and the fact that people make a right turn out of a driveway but don't realize there is a bus stopped there. PSTA indicated having issues with heavy traffic corridors such as U.S. 19 and Ulmerton Road.

VOTRAN indicated that training of drivers in regard to defensive driving in general contributed to their low collision numbers. Many operators have been with VOTRAN for many years and are experienced, skilled and competent. Most accidents occur with newer operators acclimating to operating a transit bus.

Pasco County Public Transit indicated that the source of most of their rear-ended collisions is the fact that they run service up and down U.S. 19 and there are no bus pull-out bays.

SCAT in Brevard County indicated that inattentive (or distracted) driving is especially prevalent in Florida. SCAT attempted to mitigate this by purchasing Gilligs with the maximum rear lighting package possible. Specifications included 4 inch brake lights, and red flashing "Stop" signs from HART. However, after a specific incident regarding the red flashing "Stop" signs, the agency switched away from this treatment and went with 4 LED flashing red lights and amber strobe lights surrounding the brake lights.

RTS indicated that much of their service is on the University of Florida campus where speed limits are 20 miles per hour which they feel keeps the number of rear-ended collisions low. Also, RTS places significant emphasis on training with every operator receiving 40 hours of in-service training every year. The agency discusses how the year progressed related to

safety issues, identify problems, and then work on strategies to increase safety and customer service.

HART indicated that supervisors do a good job of getting the driver of the vehicle who hit the bus to give a statement as to what happened. HART does not believe that the truth is told and that most often drivers are distracted which contributes to rear-ended collisions.

Operations

Reporting and Documentation

The project team asked interviewees to walk through the forms that are used to document collisions. They were also asked if they have a checklist to indicate all of the documentation that must be in a file before the file is considered complete. When the project team examined files at Broward County Transit and LYNX, the primary documentation forms included the Operator Report, the Supervisor Report, Courtesy cards for passengers, and the FHP long or short crash report. Virtually every system uses the Operator Report and the Supervisor Report with the exception of LeeTran, which uses a master Supervisor Packet that includes the statement of narrative from the Operator. Some systems use Courtesy cards while others say they have eliminated those in favor of a form in the Supervisor Report that documents the witnesses and witness statements.

Most systems say they either have access to the FHP crash reports or only get them if requested. A few have a standard practice of obtaining the report in weeks following the collision.

For the systems equipped with cameras, most keep a CD of all video associated with the collision and digital photos taken at the scene.

HART indicated that in the instance of fatalities, there is a supplemental investigation to revise measurements, establish speed of other vehicle and bus, and even work with traffic homicide departments of law enforcement when necessary. Finally, a few systems keep a report regarding estimates of bus damage and repair records once the bus has been repaired.

Roadway Facilities Associated with Rear-ended Collisions

Interviewees were then asked the types of road facilities in which rear-ended collisions occur with the designation of 2-, 4-, 6-, 8-lanes or interstate/toll facility. Most named the corridors of greatest risk. Brevard County mentioned U.S. 1 and A1A, both of which are 4 lane facilities. PSTA indicated that 6 lane facilities are of greatest concern including U.S. 19 and Ulmerton Road. Lee County indicated that 4 lane divided facilities are where most of their rear-ended collisions occur. VOTRAN indicated that it is a toss up between 2 lane and 4 lane facilities; however, collisions are more serious on 4 lane facilities because speed limits are higher. Pasco County Public Transit indicated that their main U.S. 19 facility is 6 lanes and where most rear-ended collisions occur. HART indicated that 4 lane facilities are most problematic where there are higher speeds and people pay less attention. The two major 6 lane facilities are Dale Mabry, Highway 60 in Brandon, and Hillsborough Avenue, but the HART representative did not recall a collision on any of these facilities in the last few years. RTS indicated that their main 4 and 6 lane facilities are where most rear-ended collisions

occur, including Archer Road (SR 24), 13th Street (U.S. 441), University Avenue (S.R. 26), and 34th Street.

Bus Stop Types Associated with Rear-ended Collisions

In examining the collision files at Broward County Transit and LYNX, the project team noted that far-side and mid-block stops are more problematic at these two transit agencies. Among interviewees, there was no significant agreement about bus stop locations where collisions occur and some agencies even admitted to having internal debates about bus stop placement. SCAT in Brevard, PSTA, VOTRAN, and Pasco all indicated that neither near-side, far-side nor mid-block bus stops stood out as a primary stop type where collisions occur. RTS indicated that their collisions occur at near-side and mid-block stops; however, they also indicated that every stop where a collision occurs undergoes a thorough review after the collision to determine whether it should be moved. VOTRAN maintains criteria for bus stop placement and has a preference for locating far-side stops. HART indicated that far-side stops are problematic and was the only agency to mention railroad crossings as a major problematic stop for rear-ended collisions. Finally, LeeTran indicated that near-side and mid-block stops are problematic for rear-ended collisions.

Risk Management

The project team explained to interviewees that the cost of rear-ended collisions is an important element of the overall issue but one for which this research project gained the least amount of data. For that reason, costs were categorized as:

- Damage to the other vehicle
- Injury(ies) to occupants of other vehicle
- Damage to the transit coach
- Injury(ies) to bus passengers
- Paid claims (all parties)
- Litigation

Actually, many interviewees indicated there are other cost categories such as lost time and lost use. Interviewees were asked to provide the process of liability and recovery management at their agency. Specifically, agencies were asked to describe how aggressive is their program to recover costs for injured passengers when the transit agency is not at fault in the collision.

First and foremost, virtually every system has an in-house risk management function or a risk-management function in the city or county where the transit agency is owned and governed. Many transit agencies including VOTRAN, LeeTran, RTS, SCAT in Brevard, and HART indicate their risk managers have a very aggressive program for recovering every possible loss when the agency is not at fault. Other agencies explained that their risk management is responsible for recovery but had less familiarity with outcomes.

Training

There is little variation between transit agencies regarding how transit operators, transit supervisors, and dispatchers are trained in the event of a rear-ended collision. The basic flow of the functions of each is summarized below:

Operators are trained to:

- Keep a calm demeanor.
- Notify dispatch of the collision.
- Leave the bus to ask about condition of occupants of other vehicle.
- Return to the bus and ask about the condition of the bus passengers.
- Pass out Courtesy cards if applicable.

Supervisors are trained to:

- Respond to the scene.
- Interface with law enforcement and the bus operator.
- Arrange for passengers to be transported either for medical or their destinations.
- Determine if drug or alcohol testing is mandatory under the circumstances.
- Take photos and employ other investigative techniques as warranted.
- Take statements from witnesses.

Dispatchers are trained to:

- Contact 9-1-1 for medical and law enforcement assistance.
- Support supervisors as necessary.

Technology

In the final section of the interview, interviewees were asked about strategies and/or technological improvements to bus rear exteriors that have been employed as a means of mitigating rear-ended collisions.

Operators

Many of the interviewees indicated that a rear-ended collision is not automatically determined to be a non-preventable collision. Operators can either do something that contributes to a collision or fail to do something that would have prevented the collision. As a result, all systems that have video recordings go back and investigate every action taken by the bus operator prior to a collision. They examine when the operator engaged the turn signal, when the 4-way lights were turned on, and the operator's approach to the bus stop. These facts are in contrast to the project team's assertion in Chapter 3 that from the bus operator's perspective, the bus is a "sitting duck" when it comes to rear-ended collisions. If the operator did everything properly, the collision is then considered a non-preventable collision.

HART indicated that strong training in stressing that operators should remain calm after a collision is key to the management process. If operators panic, customers are more likely to claim injury; however, when they remain calm the customers have a tendency to do the same.

RTS has banners at its Operations facility reminding operators to be safe and their Talking Bus technology issues safety messages at regular intervals.

Technology Improvements

Interviewees were then asked about technology improvements and treatments to the rear exteriors of buses. Regarding treatments to the rear exterior of the bus, interviews revealed that not all are sold. Some interviewees said that there is such a thing as overkill in rear treatments such that they can confuse other motorists more than indicate that the bus is stopping. The following improvements and treatments to buses have been tried under experiment, implemented on certain buses, implemented on the entire fleet, and/or were tried and then abandoned for other treatments:

- Reflective Striping - PSTA, LeeTran, HART, RTS
- LED lights – HART, SCAT in Brevard, LeeTran
- Flashing "Stop" signs (Red) – HART, PSTA, LeeTran
- Yield to Bus – Illuminated - LeeTran
- Yield to Bus – Non-illuminated – Pasco County Public Transit
- Cameras/Video – SCAT in Brevard, RTS, HART, PSTA, VOTRAN, LeeTran, Pasco County Public Transit
- Audio (Bus interior) - VOTRAN
- 4 red bars to indicate bus is stopping – SCAT in Brevard
- 2nd Yield to Bus Sign - LeeTran
- Fluorescent lights – Pasco County Public Transit
- Red strobe and amber strobe lights – SCAT in Brevard

Figure 4-1 below is a photo of a LeeTran bus with all of their rear exterior treatments.

Figure 4-1. Rear Exterior Treatments – LeeTran Bus

Meeting Summary

The Florida Transit Safety Network (FTSN) met on February 11, 2014 with rear-ended collisions as a primary topic for the meeting. The following is summary of that meeting.

FTSN Workshop Activities – An interactive workshop was held focused on rear-end collisions using the graphic below, dividing the workshop into the topical areas of Operations, Risk Management, Training and Technology.

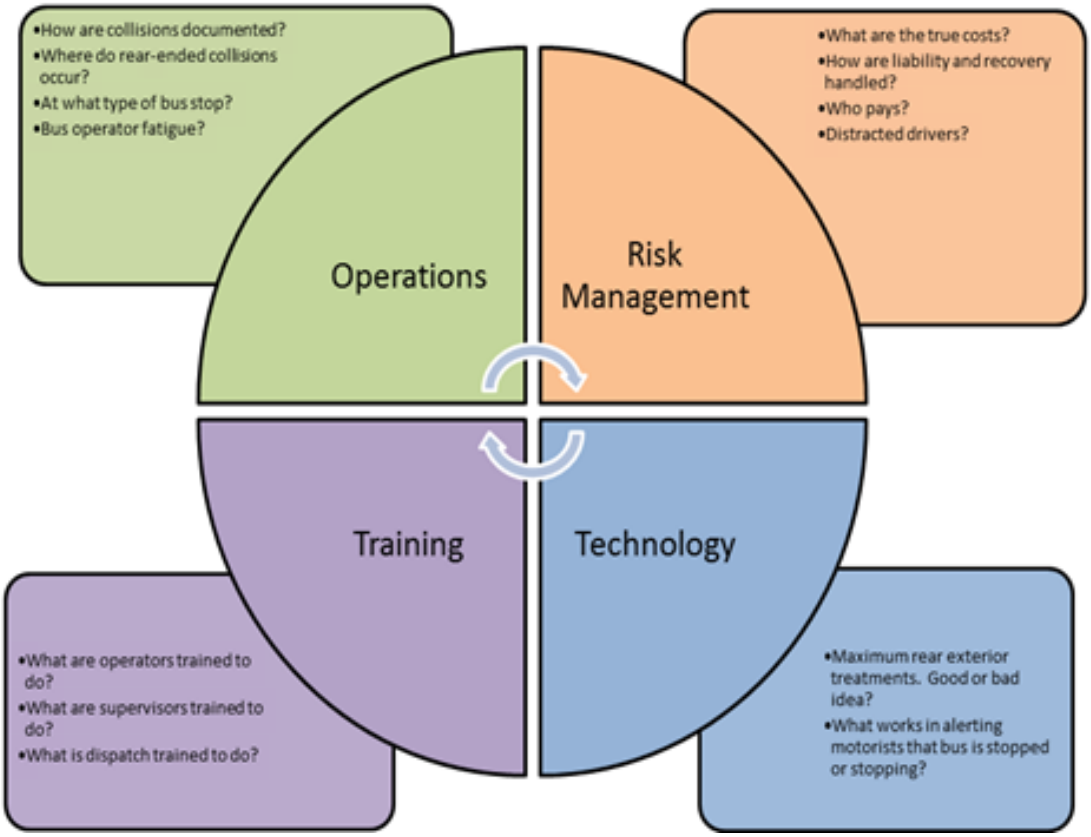

Figure 4-2. FTSN Workshop Activity

A vibrant discussion took place among FTSN members that rotated in and out of the committee meetings. The conversation revolved around how transit agencies are managing technology, training, operations and risk management related to rear-end collisions.

The discussion kicked off with a view of two different rear bus panels from transit agencies. One had a distinctive paint graphic and the other was a basic blue color. The group generally agreed that lighter colors were easier to see than darker colors, potentially leading to fewer collisions. A lighted "STOP" sign was seen as preferable to other lighting treatments such as stop bars or excessive dome lighting (although PSTA found no lighted stop treatment was particularly helpful). Where stop lights are used on Gillig buses, the larger 7" lights are preferable to the smaller specifications that are found on the more recent series.

Technology was found useful particularly with respect to cameras, although not on the rear of the bus. Additionally, participants stated that G-force sensors can give some indication as

to whether the bus operator braked hard before the collision. LAMTD is looking forward to the new ITS system it is installing to assist in safety.

Most participants expressed a similar training and protocol for operators when experiencing rear-ended accidents: Operators notify supervisor and/or dispatch, check on bus occupants, and get a manifest of passengers. When supervisors arrive they typically interact with law enforcement and initiate reporting. Space Coast Area Transit indicated they train operators to get info from the other vehicle.

Issues that were explored included:

- Operators using signals vs. 4-way stop signals when stopping
- Operators feeling rushed to keep schedule may lead to abrupt stopping
- Training operators for road conditions, including "seasonal" impact of snow birds and/or tourists to the state

A discussion followed about what happens if operators do not follow policy – most indicated corrective action would be taken, and the review of the incident with supervisors, and possible consequences if the operator was found at fault. There was a debate over stop placement and how that may influence rear-end collisions. Far-side stops to the intersection have traditionally been preferred, yet may lead to some rear-end collisions where motorists behind the bus may be accelerating to beat a red light.

A variety of risk management procedures were discussed. In Gainesville, RTS-Risk Department responds to the scene of accident and in Collier County, the Safety manager responds to scene of accident. Agencies use the standard forms for incidents/accidents which include operator, supervisor, and customer forms, as well as video and digital photos. If possible, some agencies use videos from adjacent area businesses (when available).

Agencies are also actively utilizing Accident Review Boards for investigations. When it comes to information regarding cost/loss of incidents/accidents, agencies can get the information if necessary.

LeeTran requests meetings with Risk Management and the county attorney to get a better understanding of cost/loss. It was noted that the transit agencies have a better understanding and the expertise to investigate bus incidents/accidents, sometimes better than the responding law enforcement.

Chapter 5
Synthesis and Conclusions

Introduction

As indicated in Chapter One of this report, the purpose of this project is to conduct a systematic study to examine rear-end collisions between motorists and public transit buses to achieve the following objectives:

- Determine if rear-end collisions are increasing;
- Conduct an assessment to ascertain the prevalence of rear-end collisions;
- Identify conditions that exist when rear-end collisions occur;
- Identify mitigation strategies for agencies that have identified rear-end collisions as a major issue; and
- Assess impact of Yield to Bus and pull out bays on rear-end collisions

The determination of increases in rear-ended collisions and the prevalence of those collisions came from the NTD Major Incident Database. The conditions when rear-ended collisions occur came from the examination of the files at Broward County Transit and LYNX. The examination also assessed the impact of pull-out bays on rear-ended collisions and found no impacts either to the positive or to the negative. Mitigation strategies for agencies to reduce rear-ended collisions were gained through interviews with the agencies and the meeting of the Florida Transit Safety Network on February 11, 2014.

This section will synthesize and draw conclusions, when appropriate, and will address the following topical areas:

- **Additional insights – NTD Major Incident Database –** Tata will be presented to assess prevalence and increases in rear-ended collisions by comparing agency data to National Aggregate, Region 4, six most populous states in 2012, and Florida. All Florida transit agency data was aggregated to establish total collisions per 100,000 miles, rear-ended collisions per 100,000 miles, and rear-ended collisions as a percentage of total collisions. Finally, data will be presented for the average days between collisions for total collisions and rear-ended collisions.
- **Collision reporting and documentation –** This section will provide agency examples of checklists to assure file completeness with all agency-gathered reporting and documentation included as an appendix to report.
- **Collisions from the operator's perspective –** This section will address the implications of rear-ended collisions on bus operators in terms of what they can, and cannot do in this particular type of collision in relation to defensive driving strategies that might be in place for other types of collisions.
- **Collisions from the other driver's perspective -** This section will demonstrate the insights that are gained, or not gained, from the data examined in Broward files.

- **Implications for law enforcement –** This section will provide law enforcement with potential opportunities to ascertain the root causes of rear-ended bus collisions in light of new laws that prohibit certain distractions for drivers.
- **Implications for operations managers –** Key to ascertaining the implications for operations managers comes largely from interviews and the Florida Transit Safety Network. This section will address training, procedures, and technology.
- **Future research –** This section will address the limitations of this study and areas that might greater inform this topic, especially in the areas of risk management, roadway facilities, and public awareness campaigns.

NTD Major Incident Database

Total Collisions per 100,000 Miles

In Chapter Two, data was presented on total collisions, rear-ended collision, and rear-ending collisions for the United States + Territories (National Aggregate), FTA regions, Florida, and Florida transit agencies from 2008-2012. Comparisons were drawn for the National Aggregate Data, Region 4 and Florida for total collisions per 100,000 miles, rear-ended collisions per 100,000 miles, and rear-ended collisions as a percentage of total collisions. In addition, Florida was compared to the six most populous states for 2012 only. Figure 5-1 below displays a comparison of PalmTran as an agency with comparatively high total collisions per 100,000 miles when compared to the National Aggregate, Region 4, six most populous states, and Florida for the period 2008-2012. This graphic shows that for the national aggregate data, the range was 0.16 to 0.20 total collisions per 100,000 miles. Florida data ranged from 0.16 to 0.28 collisions per 100,000 miles and PalmTran had a range of 0.35 to 0.41 total collisions per 100,000 miles

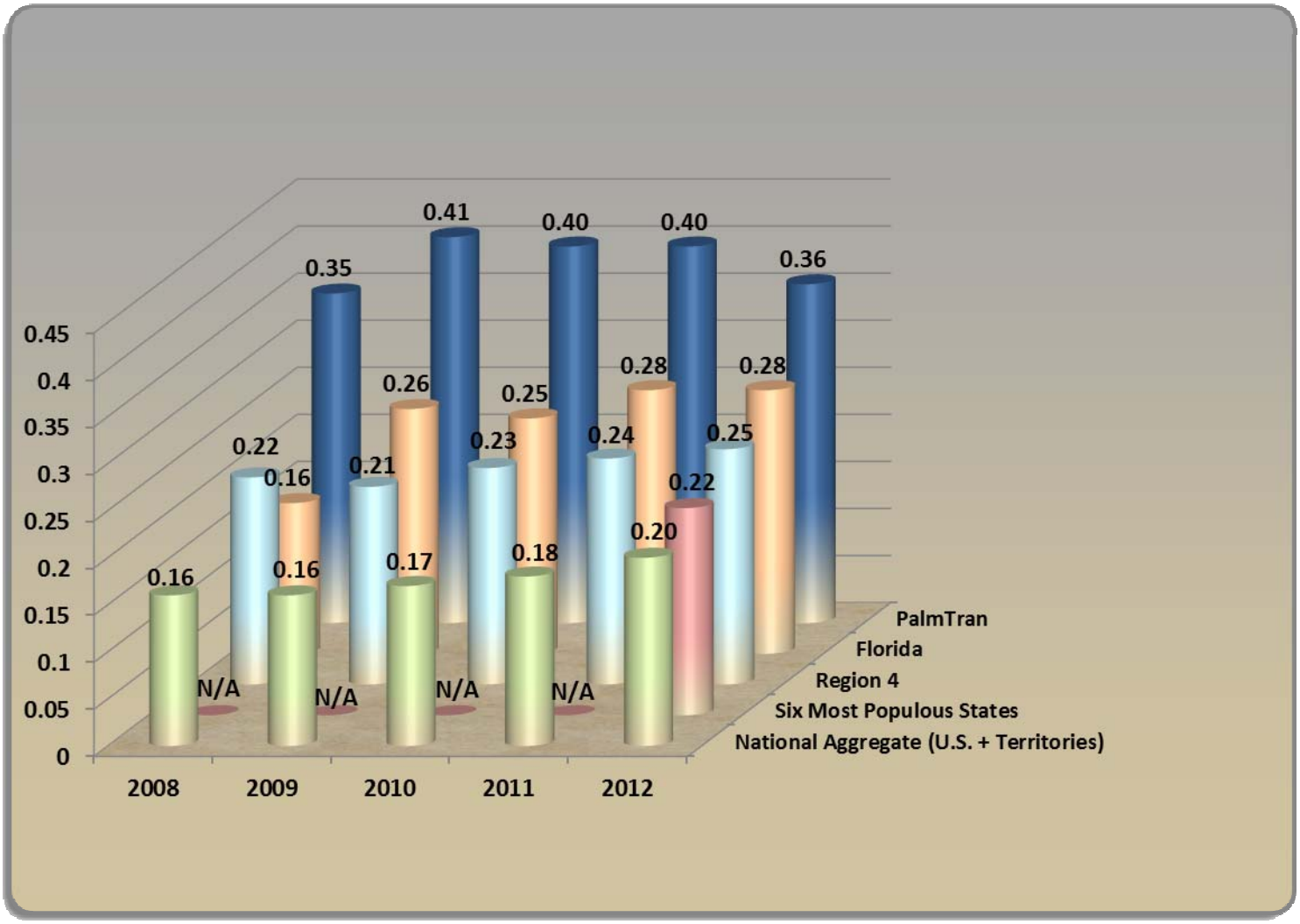

Figure 5-1. PalmTran - Agency with Comparatively High Total Collisions per 100,000 Miles

In addition, all transit agency collision data was aggregated for all five years from 2008-2012 for total collisions, rear-ended collisions, and miles, and then compared to the same aggregate for the State of Florida for the same period. Figure 5-2 below shows that the five year aggregate for Florida was 0.27 total collisions per 100,000 miles. There are 5 transit agencies with values greater than the Florida aggregate and six agencies with values less than the Florida aggregate. All agencies with greater values than the Florida aggregate are larger systems with the exception of Pasco County Public Transit. All agencies with values less than the Florida aggregate are small agencies with the exception of JTA in Jacksonville.

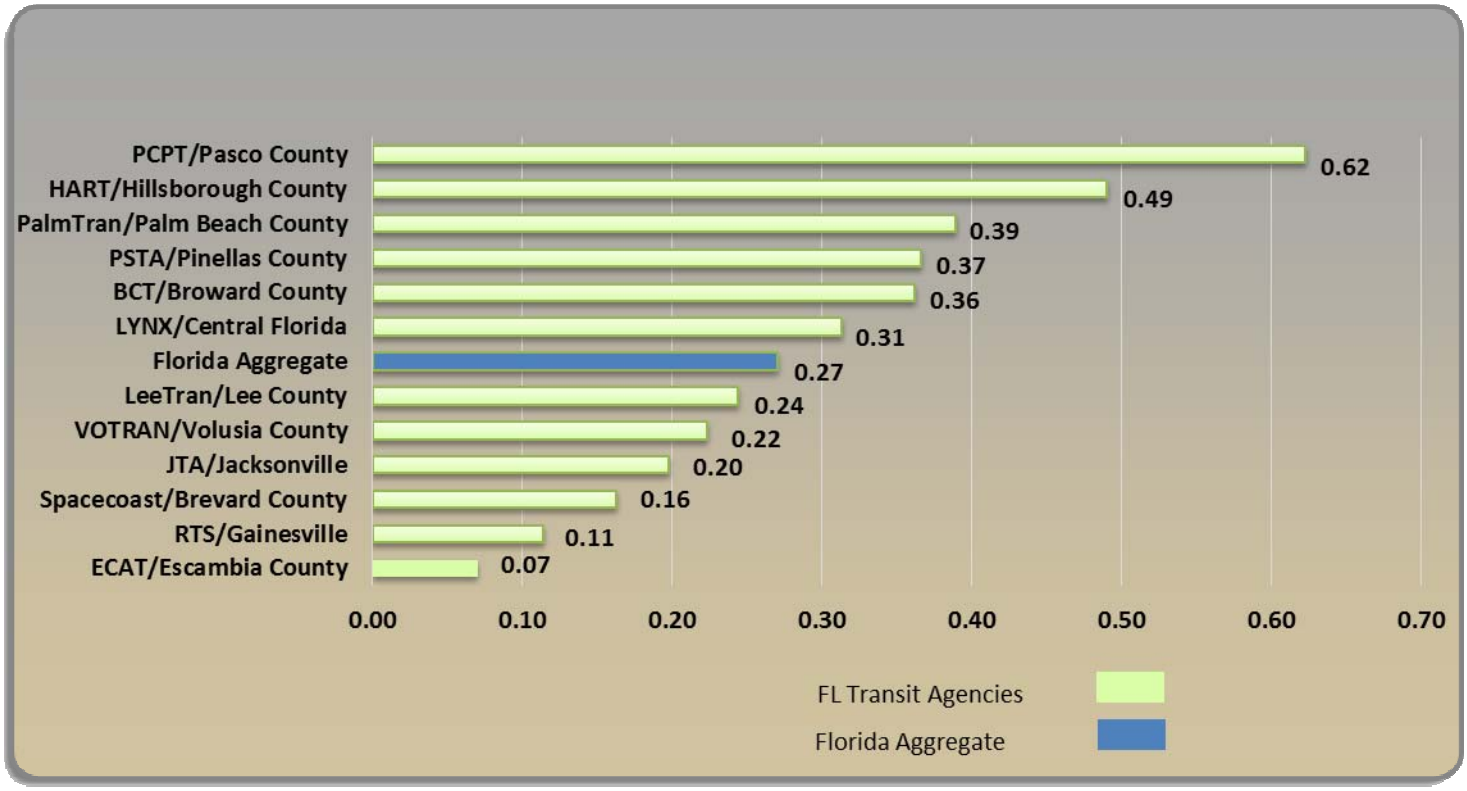

Figure 5-2. Total Collisions per 100,000 Miles – Comparison of Aggregate Five-year Agency Data to Florida Aggregate Data, 2008-2012

Rear-ended Collision per 100,000 Miles

Figure 5-3 below displays HART as an agency with comparatively high rear-ended collisions per 100,000 miles when compared to the National Aggregate, Region 4, six most populous states in 2012, and Florida aggregate data. While Florida aggregate values ranged from 0.09 to 0.11, HART's rear-ended collisions per 100,000 miles ranged from 0.16 to 0.22.

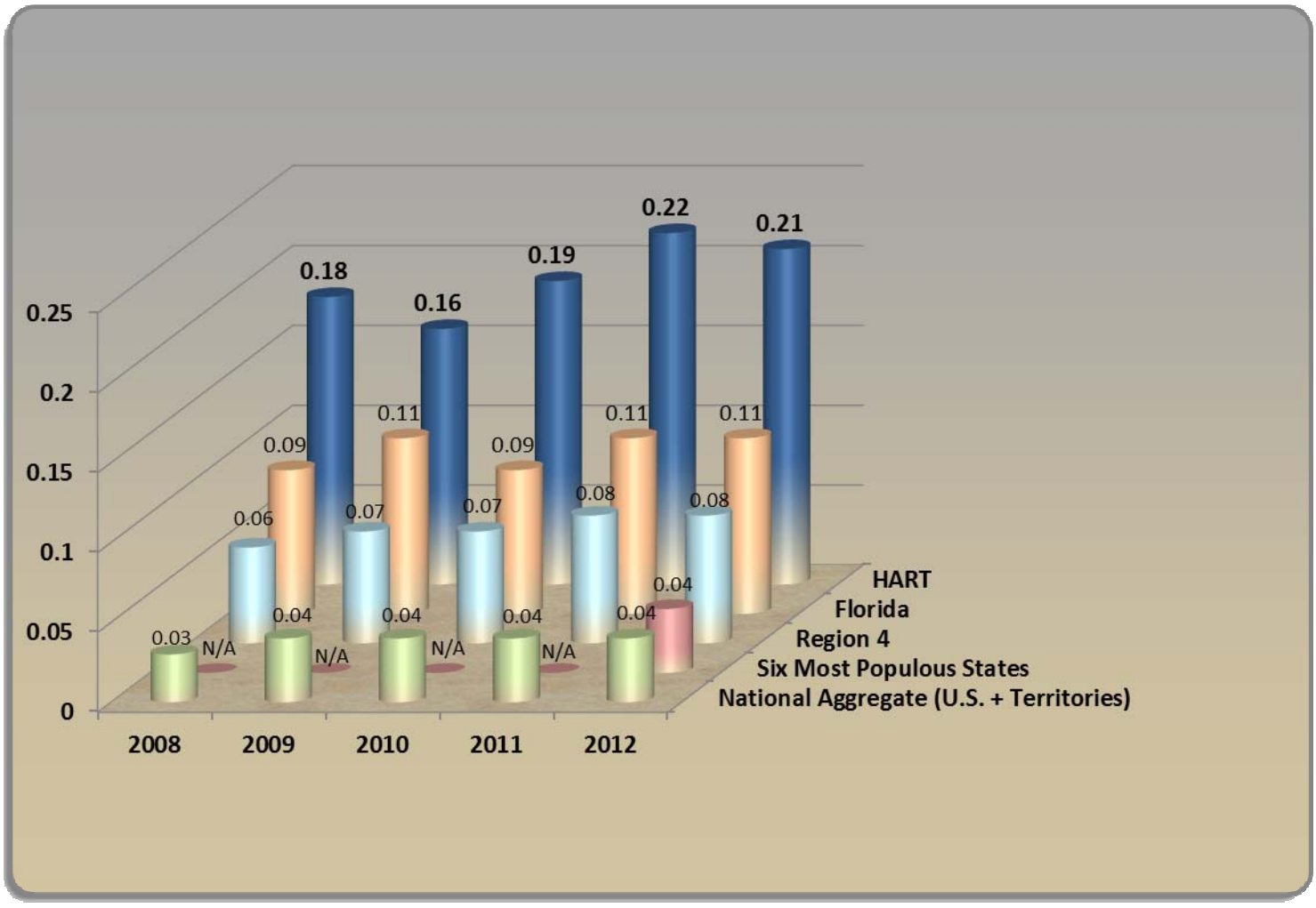

Figure 5-3. HART - Agency with Comparatively High Rear-ended Collisions per 100,000 Miles

Figure 5-4 below shows that the five year aggregate for Florida was 0.10 rear-ended collisions per 100,000 miles. There are 8 transit agencies with values greater than the Florida aggregate and four agencies with values less than the Florida aggregate. All agencies with greater values than the Florida aggregate are larger systems with the exception of Pasco County Public Transit, LeeTran, and Spacecoast in Brevard. All agencies with values less than the Florida aggregate are small agencies with the exception of JTA in Jacksonville.

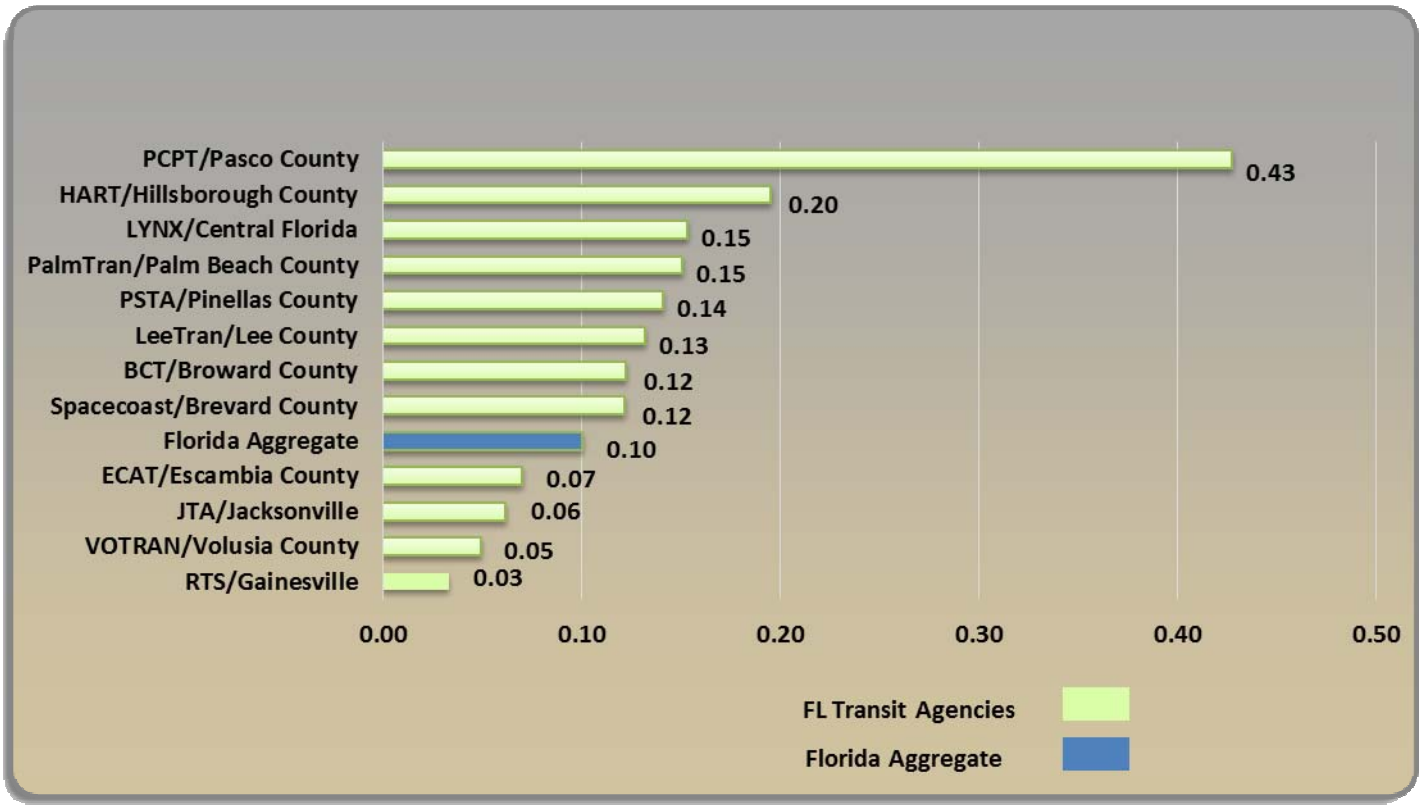

Figure 5-4. Rear-ended Collision per 100,000 Miles – Comparison of Aggregate Five-year Agency Data to Florida Aggregate Data, 2008-2012

Rear-ended Collisions as a Percentage of Total Collisions

Figure 5-5 below displays LYNX as an agency with comparatively high rear-ended collisions as a percentage of total collisions when compared to the National Aggregate, Region 4, six most populous states in 2012, and Florida aggregate data. While Florida aggregate values ranged from 34 to 43 percent, LYNX's rear-ended collisions as a percentage of total collisions ranged from 35 to 59 percent.

Figure 5-6 below shows that the five year aggregate for Florida was 38 percent rear-ended

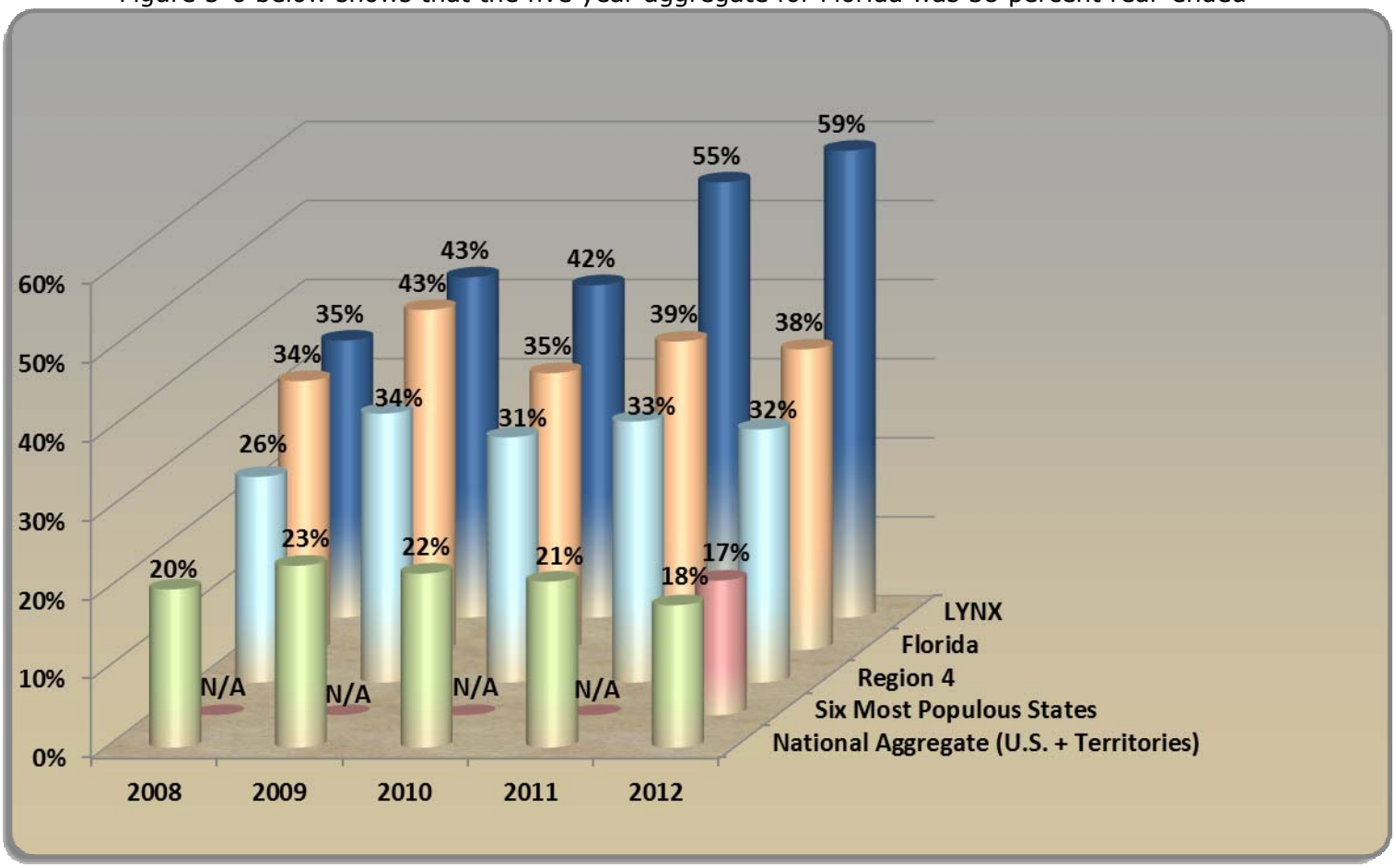

Figure 5-5. LYNX - Agency Comparatively High Percentage of Rear-ended Collisions to Total Collisions

collisions as a percentage of total collisions. There are 8 transit agencies with values greater than the Florida aggregate and four agencies with values less than the Florida aggregate. It must be noted that smaller transit systems have fewer accidents and many of those are rear-ended collisions. Therefore, percentages can skew higher for smaller agencies but overall collisions are low. All agencies with greater values than the Florida aggregate are smaller systems with the exception of LYNX, HART and PalmTran. Two agencies with values less than the Florida aggregate are small agencies and two are large agencies.

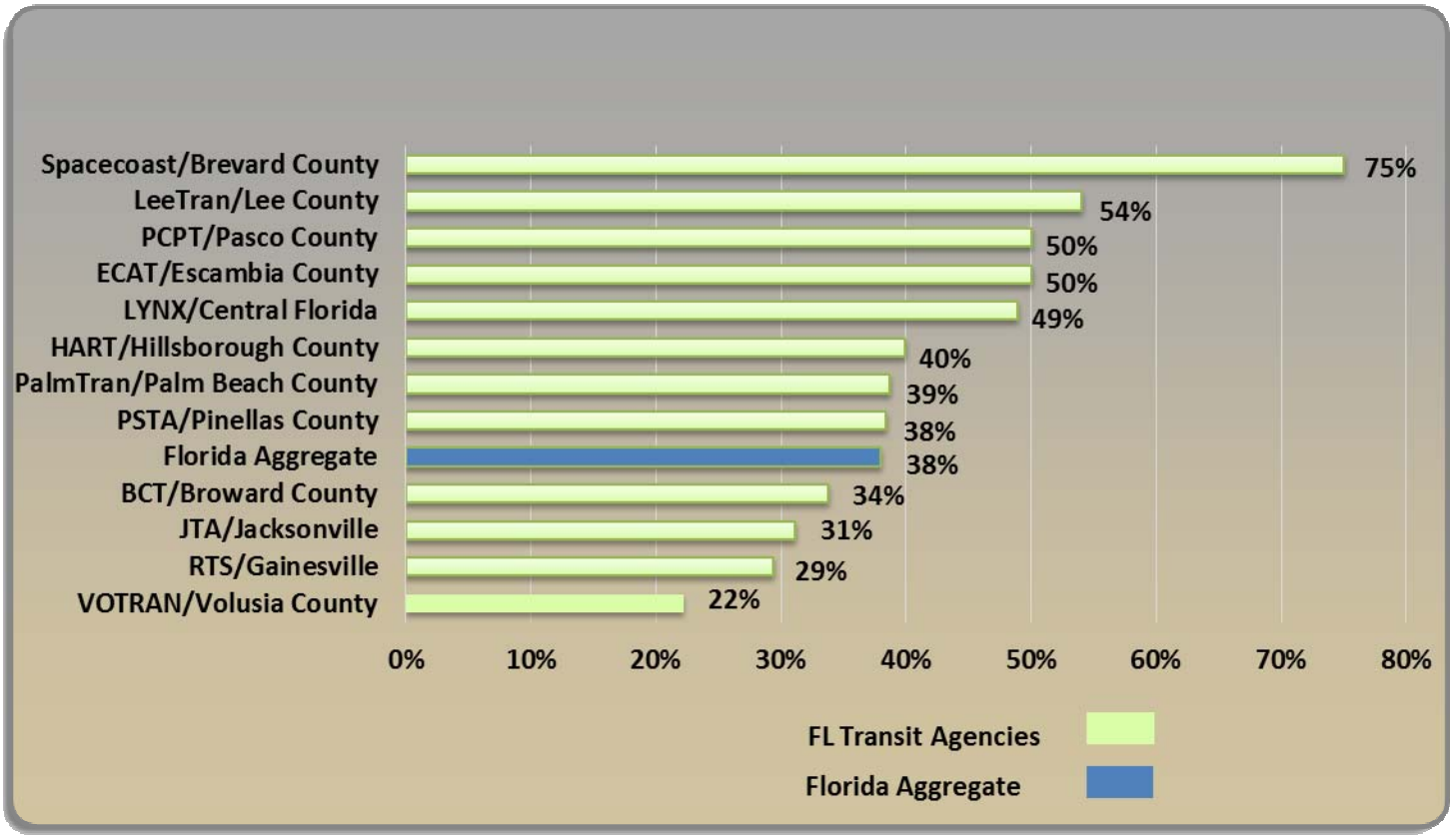

Figure 5-6. Rear-ended Collisions as a Percentage of Total Collisions – Comparison of Aggregate Five-year Agency Data to Florida Aggregate Data, 2008-2012

Average Collisions Over Five-Year Timeframe

To calculate the average collisions over the five years, data was aggregated for total collisions and rear-ended collisions for each transit agency and then was divided by 1,825 days (five years). For total collisions, Florida aggregate data revealed a value of 1 collision every 1.2 days and 1 rear-ended collisions every 3.19 days. All transit agencies had values greater than the Florida aggregate. Figure 5-7 below shows the average days between total collisions with Broward having a high of 1 collision every 6 days and Escambia having an average 1 collision every 183 days. All large agencies had on average 1 collision every 20 days or fewer.

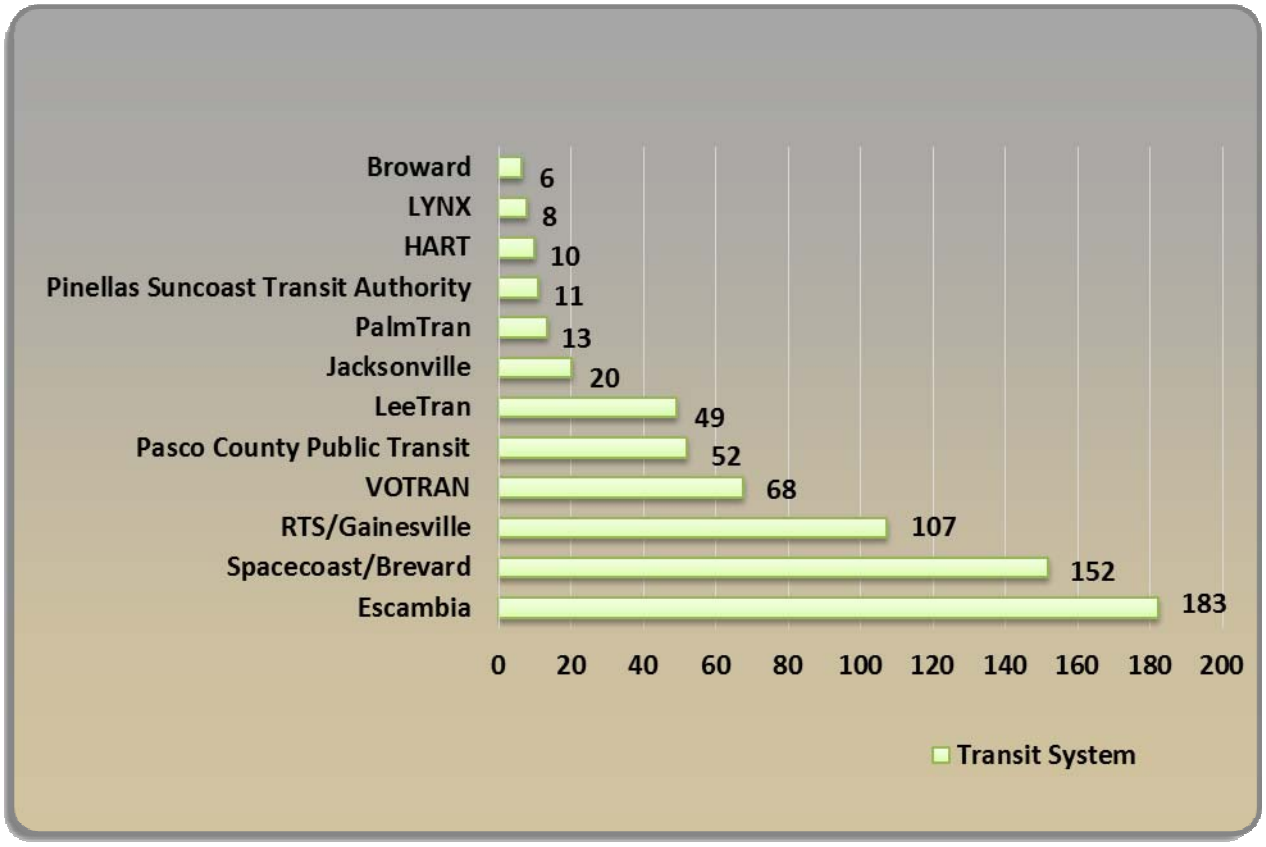

Figure 5-7. Average One (1) Total Collision Every "X" Days over Five-year Timeframe

Figure 5-8 below shows that on average, LYNX had a high of 1 rear-ended collision every 16 days while RTS and ECAT had an average 1 rear-ended collision every 365 days, or one per year.

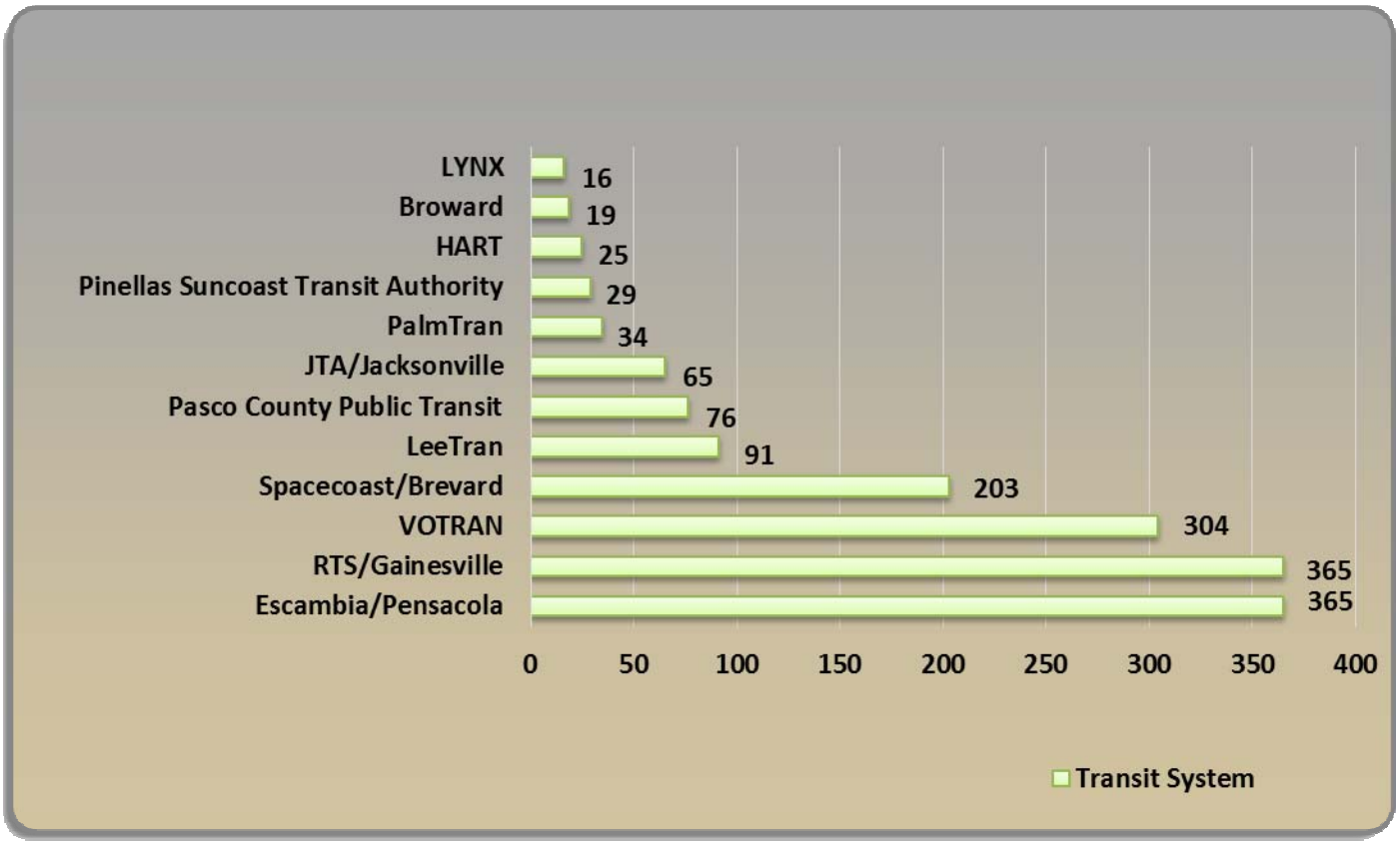

Figure 5-8. Average One (1) Rear-ended Collision Every "X" Days over Five-year Timeframe

Conclusions

Given the fact that Florida aggregate was always greater than the national aggregate, Region 4, the six most populous states (with the exception of Illinois on total collisions per 100,000 miles), and individual agency data often exceeded Florida aggregate, this study concludes that there is a strong prevalence of total and rear-ended collisions in Florida.

While increases on a year-over-year basis were found at LYNX and Broward, for most agencies the number of annual collisions fluctuates and does not display a clear trend line. Statisticians have informed the project team that several years of past data would be necessary to perform a regression analysis that would show real increases or declines from the past to the present and as predictors for future increases or declines.

Reporting and Documentation

FDOT expressed a desire for this research to explore the prospect of providing guidelines for transit agencies to standardize reporting and documentation for collisions if agencies found this to be useful. During the FTSN session in February, 2014, the project team determined that there may be more than one master collision file kept internally for collisions. Operations may house one set of reporting and documentation while risk management function house other sets of documentation. From this research, the project team identified the following list of reports and documents for collision files.

- Operator Report
- Supervisor Report
- Drug and Alcohol Determination
- Courtesy Cards/witness information
- Crash Report – FHP and/or local law enforcement
- Photos
- Video
- Other investigation forms (follow-up)
- Subrogation Reports for bus damage
- Passenger Claims

Figures 5-9 to 5-11 display the checklist forms for Pasco County Public Transit, LeeTran and Spacecoast in Brevard, respectively. The complete investigation packets for PCPT, LeeTran, and RTS are included as Appendices F, G, and H.

SUPERVISORY CHECKLIST FOR ACCIDENTS

Action	Date/Time	Supervisor Initials
Notify Law Enforcement of location, road blockage, and injuries. This is done through dispatch and annotated in the Service Interruption Log.		
Contact the Following: a. Mike Carroll		
b. Joe DeGeorge		
c. Risk Management. Give time/location, vehicle number, driver name, how many on board, injuries, and if workers' compensation.		
Investigate Accident		
Notify Fleet Management if vehicle is disabled.		
Complete Immediate Notification of Vehicle Accident Form		
Notify Office Staff and 511, if Route Delay		
Complete Paperwork in Accident Packet and Submit to Transportation Operations Manager: a. Operator's Report of Motor Vehicle Accident		
b. Law Enforcement Traffic Report		
c. Supervisor Documentation Drug/Alcohol Testing - Drug Testing, if Necessary.		
d. Supervisory Follow-Up		
e. Supervisor Recommendation Form		
f. Operator's Post-Accident Survey		
Complete Workers' Compensation Paperwork, if Necessary a. Supervisor Investigation Report		
b. Give Photo Copy to Employee		
Notify Thelma Williams. Give time/location, vehicle number, driver name, how many on board, injuries, and if workers' compensation.		

Attach this checklist to package when processing.

Figure 5-9. Pasco County Public Transit – Supervisory Checklist for Accidents

LEE COUNTY
SOUTHWEST FLORIDA

ACCIDENT-INCIDENT COVERSHEET

lee tran
Your Ride Is Here.

Accident Date & Time _____ **AM/PM** **Bus No:** _____

Type: _____ Vehicle _____ Object _____ Non-Injury _____ Injury _____ Injury Transport

Incident Date & Time _____ **AM/PM** **Bus No:** _____

Type: _____ Off Vehicle _____ On Vehicle _____ Incident

Location: _____

Accident / Incident (Circle One)	Yes	No		Yes	No
EMS Contacted			CTR (If Necessary)		
Transported from Scene			Reporting Supervisor Name		
Vehicle has Disabling Damage (If Yes, Update Damage Book)			Assisting Supervisor Name		
Vehicle has Damage (If Yes, Update Damage Book)			Driver Reporting Name		
Vehicle Towed			Driver Witness/Assist. Name		
Meets FTA Criteria (If Yes, Complete FTA Post Accident Drug/Alcohol Form)			Law Enforcement Reporting: CCPD FMPD LCSO FHP		
Photos Downloaded			Officer/Trooper Name:		
Witness Form					

Date Accident/Incident Driver Name Bus No.

Figure 5-10. Lee County – Accident/Incident Coversheet

	Accident/Incident Check List
	Bus #
	Date
	Supervisors Report
	Operators Report
	Courtesy Cards
	Video
	Photos
	PC
	Property Casualty Auto Claim
	Law Enforcement Report
	Law Enforcement Collision Report
	Case Number
	FVS Estimate
	CC: Scott Nelson
	CC: C. Hibbard
	Comments:

Figure 5-11. Brevard County – Accident and Incident Check List

Collisions from the Operator's Perspective

From the operator's perspective, if a bus is stopped at a service stop (which is in almost all cases with rear-ended collisions), there are virtually no defensive driving techniques that could avoid a rear-ended collision. If passengers are boarding and alighting the bus, and the doors are open, the bus is immobilized.

From the transit agency's perspective, the primary defensive driving techniques operators can employ are in the moments leading up to a rear-ended collision. These would include turning on signals, turning on 4-way stop lights, maintaining a safe following distance, and appropriately pulling up to the stop. In essence, operators can give drivers behind them as much warning as possible that the bus is coming to a stop.

Collisions from the Other Driver's Perspective

Many members of the FTSN theorize that one major cause of rear-ended collisions is the influx of tourists and seasonal residents who are traveling in areas in which they are unfamiliar. The data from this research could not shed light on this theory. In the case of LYNX, there usually was not information on the other driver except for a name. In the case of Broward, the project team was able to see the addresses of other drivers in the FHP long form. Only one record showed an out-of-state resident as the other vehicle involved in the collision.

The data from the report shows that a majority of collisions occur in daylight, with clear weather conditions and dry roadway surface conditions. Correspondingly, the FHP long

report showed that a majority of drivers were not distracted, their vision was not obstructed and they were not suspected of using drugs or alcohol. Therefore, the conclusion of this report is that there is little evidence to suggest why, from the other driver's perspective, these types of collisions occur with greater frequency than other states or regions.

Implications for Law Enforcement

The Florida legislature recently enacted a law that prohibits driving with certain distractions, including texting on mobile devices. The project team is not aware of whether Florida Department of Law Enforcement (FDLE) or Florida Highway Patrol (FHP) issued guidelines to their agencies regarding enforcement of this law. However, there may be opportunities to modify procedures to include greater probes into how rear-ended bus collisions occur. Current language in reports indicate that other drivers, "failed to use due caution," or "failed to use due care," thus hitting the rear of the bus. Unfortunately, there is little insight into what caused the failure that is cited.

Implications for Operations Managers

For purposes of this section, Operations Managers refer to all personnel within a transit agency responsible for operations, supervision, safety, security, and training. At the FTSN meeting in February 2014, it was clear that members at the agency level all have clear standards, procedures, training, and treatments on the rear of buses. However, not all members agree on the effectiveness of these elements. For instance, one agency absolutely requires operators to turn on blinkers and four-ways. However, other members questioned entirely the use of four-way lights in the process of stopping. The same was true for the red flashing, "Stop" signs. Some members believe they are effective while others believe they do not make a difference in deterring or preventing rear-ended collisions.

One major area of agreement among FTSN members is that every incident requires a thorough investigation using photos, video and audio when applicable. Rear-ended collisions are not automatically considered a non-preventable collision. Transit agencies report that there are things an operator can do to contribute, or fail to do to prevent rear-ended collisions. This may provide some insight into why operator reports contain minimal narrative as was found at Broward and LYNX.

The FTSN agreed that this research should include concrete actions and strategies that can be completed in the short term with little cost. The following is a compilation of actions and strategies that are achievable:

- **Move, Improve, or Remove –** Following every collision, conduct a thorough investigation of the bus stop to determine if any factors related to location, placement, or environment may have impacted the incidence of the collision. Following the investigation, either make stop improvements, move the stop or remove the stop altogether. In the case of Broward and LYNX, the agencies could conduct a major review on the two most problematic facilities: Orange Blossom Trail for LYNX and U.S. 441 for Broward. Figure 5-12 below displays the seven collisions that occurred along U.S. 441 over the two year period. Figure 5-13 below displays the three collisions on Orange Blossom Trail that occurred in northwest Orange County over the two year period. Figure 5-14 displays eight collisions that occurred on Orange Blossom Trail in central Orange County over the two year period.

- Change current bus specifications to include larger LED lights from the current 7-inch lights that are available. Spacecoast in Brevard indicated using strobe lights on their amber lights and the agency believes strobe lights have produced positive results in reducing rear-ended collisions.
- Inspect rear bus exteriors to ensure that paint schemes and graphics do not create visual distractions that take away from the treatments that are designed to warn drivers that buses are stopping.
- When flashing red, "Stop" signs are used, train the operator to depress the break upon initial deceleration to provide the maximum warning to vehicles behind the bus that it will be coming to a stop.
- Following a full investigation, conduct a thorough de-briefing with the operator and explain everything the operator did right and wrong in the moments leading up to and following the collision. Train the operator on how to correct the things they did wrong.
- Conduct in-service training at least once each year for all operators and go over the specific issues that faced the agency over that past year. Discuss strategies on how to address the primary issues.
- When possible, employ Accident Review Boards to review all collisions to identify possible future strategies.

Figure 5-12. US 441 in Broward County

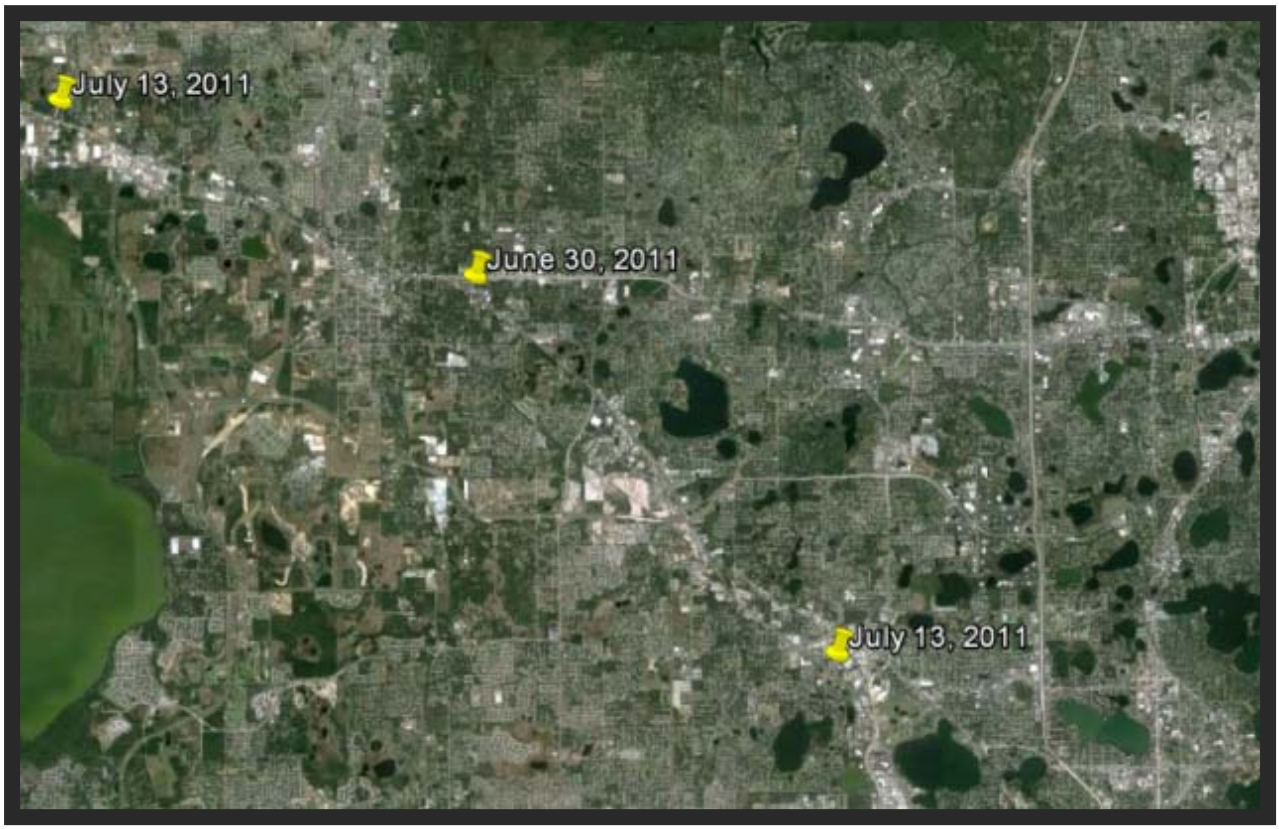

Figure 5-13. Orange Blossom Trail in Northwest Orange County

Figure 5-14. Orange Blossom Trail in Central Orange County

Future Research

One overall element that is important to the topic of rear-ended collisions is the overall cost. This was the one area in which this research was able to glean the least amount of information, largely because the responsibility for liability and recovery is managed by the risk management function, either within a transit agency or within a local government. Future research should focus not only on processes for managing liability and recovery, but also to determine the different methods by which agencies maximize recovery and minimize liability.

Another implication for future research includes the finding in this study that almost 2/3 of all rear-ended collisions occur on 4 lane and 6 lane State facilities. There are two schools of thought among safety researchers at CUTR. The first line of thought is that the design of the roadways may have elements and/or components that are conducive to collisions. The other school of thought is that there may be more transit service, in terms of overall hours of service, on 4 lane and 6 lane facilities than other facility types. Future research should be designed to explore these and other possible contributing factors to explain why Florida's prevalence of rear-ended collisions is so much greater than other regions and states.

Finally, future research should explore the development of public awareness campaigns similar to the, "Watch out for Motorcycles" campaign which has been effective in making the public more aware of motorcycles. Such development would explore messages that are effective and the various means for defining partners and strategies to make such a campaign successful.

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Appendices

Appendix A

Complete Operator and Supervisor Report Plus Courtesy Cards – LYNX

Appendix B

Complete Operator and Supervisor Report Plus Courtesy Cards – Broward

Appendix C

Aerials of LYNX Collision Location

Appendix D

Aerials of Broward Collision Locations

Appendix E

Interview Guide

Appendix F

Lee County Supervisor Packet

Appendix G

Pasco County Collision Reporting Packet

Appendix H

RTS/Gainesville Collision Reporting Packet