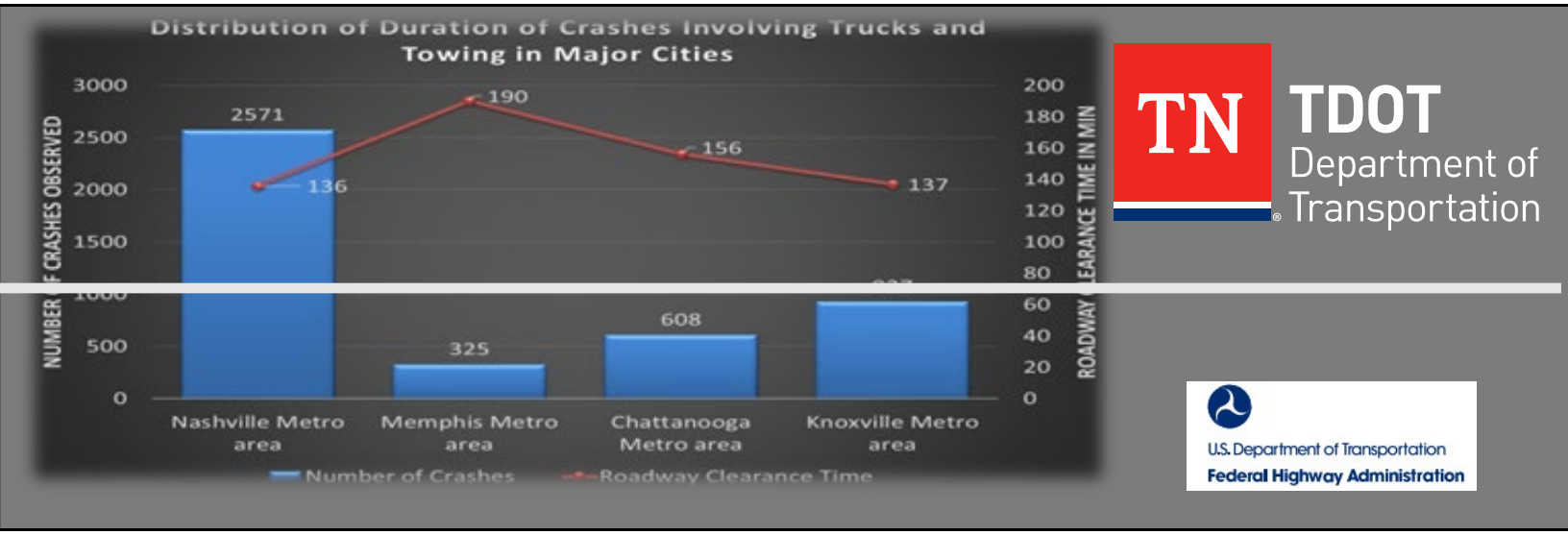


# Investigation into Towing Regulations in Tennessee

RES2023-21

Research Final Report from Tennessee State University

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TENNESSEE STATE UNIVERSITY

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**16. Abstract:** This research investigated the impact of towing regulations on incident clearance times for commercial motor vehicle (CMV) crashes in Tennessee, focusing on improving Traffic Incident Management (TIM). Sponsored by the Tennessee Department of Transportation (TDOT), the study evaluated current towing practices, analyzed innovative strategies adopted in other states, and provided evidence-based recommendations to enhance roadway safety and efficiency. Using data from the Tennessee Highway Patrol (THP) and Smart Way Central Software (SWCS), the research comprehensively examined the relationship between towing regulations, incident clearance times, and secondary crashes. The study draws on successful incentive-based towing programs such as Georgia's and Virginia's Towing and Recovery Incentive Program (TRIP), Florida's Rapid Incident Scene Clearance (RISC) and Washington DOT TIM. These programs demonstrated significant reductions in clearance times—through CMV towing financial incentives. Surveys and interviews with stakeholders in these states revealed key insights into policy development, funding mechanisms, and program benefits, including reduced secondary crashes and enhanced coordination among responders. For instance, Virginia and Georgia DOTs achieved average clearance times of 83 minutes under TRIP, compared to Tennessee's over 130 minutes. These findings highlighted the potential for similar implementations in Tennessee. Data analysis centered on THP incident records from 2015 to 2022, which provided detailed information on crash locations, clearance durations, towing requirements, and injury severities. The SWCS dataset served as a comparative reference. CMV-related crashes averaged 130 minutes for roadway clearance time (RCT), significantly longer than the 67-minute average for non-CMV incidents. Towing-related incidents required 149 minutes on average, compared to 88 minutes for non-towing incidents. The disparity was more pronounced in rural counties, where RCTs often exceeded 200 minutes in some cases, compared to urban areas like Nashville, where the average was 68 minutes. The analysis revealed notable urban-rural disparities in incident management efficiency. Urban centers like Nashville benefitted from stringent towing regulations and robust infrastructure, resulting in faster clearance times. Conversely, rural areas faced logistical challenges, including limited access to specialized towing services, leading to prolonged durations. Statistical analysis identified average time and distance gaps of 45 minutes and 1.5 miles, respectively, between primary and secondary incidents. Prolonged RCTs correlated with increased secondary crash risks, emphasizing the importance of rapid clearance. Secondary crashes involving large trucks often required towing services, with 94% of such incidents necessitating professional assistance. The clearance times for towing-involved secondary crashes varied widely, with 55% resolved after 91 minutes. The research found inconsistencies in towing regulations across Tennessee's jurisdictions. Urban areas like Nashville had stricter policies, including mandated response times, while rural areas lacked uniform enforcement. Comparative analysis with neighboring states underscored the effectiveness of incentive-based programs in reducing clearance times and improving traffic flow. For example, Tennessee's RCTs were notably higher than Virginia's and Georgia's. Key recommendations for TDOT include adopting statewide incentive-based towing programs to align towing company incentives with rapid incident clearance. Developing a uniform towing manual and enhancing rural towing capabilities through investment in equipment are also critical. Strengthening collaboration among stakeholders is recommended.

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We would also like to extend our heartfelt thanks to the graduate research students who contributed tirelessly to this project. We express our gratitude to Mr. Bryson Mgani, Masanja Madalo and Aaron Lamson for their exceptional work, dedication, and enthusiasm throughout this project. Their insights, expertise, and unwavering commitment to the project were invaluable, and we owe them a debt of gratitude for their contributions.

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# Executive Summary

Efficient Traffic Incident Management (TIM) is critical to ensuring safety and mobility on Tennessee's roadways, especially for crashes involving commercial motor vehicles (CMVs). These incidents often result in prolonged roadway clearance times (RCTs), traffic congestion, and an increased risk of secondary crashes. The Tennessee Department of Transportation (TDOT) sponsored this research to investigate the role of towing regulations in influencing CMV crash clearance times and to evaluate the potential benefits of adopting innovative towing practices. Drawing on extensive data from Tennessee Highway Patrol (THP), Smart Way Central Software (SWCS), and case studies from other states, the study aimed to recommend evidence-based policies to enhance towing efficiency and incident management in Tennessee.

The literature review highlighted best practices in towing and recovery operations from other states, focusing on programs like Georgia's Towing and Recovery Incentive Program (TRIP), Florida's Rapid Incident Scene Clearance (RISC), and Virginia's TRIP. These programs incentivize towing companies to invest in advanced equipment and training by offering performance-based bonuses for rapid incident clearance. Virginia's and Georgia's TRIP program, for instance, reduced average incident clearance times to 87 and 79 minutes respectively by providing bonuses of up to $3,500 for clearing major incidents. Similarly, Florida's RISC program achieved clearance times under 90 minutes for complex incidents through strict response time requirements and financial incentives. These findings underline the potential for Tennessee to adopt similar programs to enhance CMV crash management. A notable practice in some states is the "pay-by-the-pound" model, which charges towing fees based on vehicle weight rather than time spent at the scene. This approach discourages delays and aligns towing company incentives with faster clearance.

Surveys and interviews were conducted with towing managers and TIM stakeholders in Virginia (TRIP, Florida (RISC), Washington State (MIT) and Georgia (TRIP) to understand the implementation and outcomes of their incentive-based programs. Interview questions included in the Appendix C). The lessons learned from these interviews emphasize the importance of stakeholder collaboration and financial incentives in achieving program success. Key insights include:

1. **Policy Development**: All four states required collaboration between transportation agencies, law enforcement, and towing companies to design and implement programs tailored to their needs.
2. **Initial Costs and Funding**: Incentive programs required upfront investments for training and equipment upgrades. Funding was secured through state budgets and partnerships with private towing companies.
3. **Program Benefits**: Respondents unanimously highlighted reduced clearance times, fewer secondary crashes, and improved coordination among responders as key benefits.
4. **Challenges**: Initial resistance from towing companies was overcome by clear communication of program benefits and ensuring financial sustainability.

The research utilized two primary data sources: Tennessee Highway Patrol (THP) incident data and Smart Way Central Software (SWCS) data to evaluate incident durations related to CMVs

across Tennessee. The THP data, provided by the Tennessee Department of Safety and Homeland Security, covered a comprehensive record of crash incidents across the state from 2015 to 2022. This dataset included detailed variables such as crash location, time of occurrence, roadway clearance times (RCT), incident clearance times (ICT), vehicle types involved, towing requirements, and injury severities. Rigorous screening processes were applied to isolate incidents involving commercial motor vehicles (CMVs) and those requiring towing services, ensuring targeted analysis of towing-related impacts on incident durations and secondary crashes. Additionally, SWCS data, obtained from Gannett Fleming Inc., the TDOT consultant, served as a secondary dataset for comparative purposes (Included in Appendix A). This data spanned multiple years and included variables like crash types, clearance durations, and geographic distribution. While the primary findings were derived from the THP data, the analysis of SWCS data yielded equivalent and comparable results, validating the robustness of the conclusions. Together, these datasets provided a comprehensive foundation for evaluating towing regulations, incident management efficiency, and their implications for roadway safety in Tennessee. Key findings include:

1. **CMV Incident Durations**:
    - CMV crashes averaged 130 minutes for RCT, significantly longer than the 67-minute average for non-CMV incidents.
    - Incidents involving towing required 149 minutes on average, compared to 88 minutes for those without towing.
2. **Rural vs. Urban Disparities**:
    - Rural counties reported longer RCTs, in contrast, urban areas averaged relatively shorter RCTs.
3. **Major Cities Comparison**:
    - Nashville had the highest number of CMV-related incidents but managed to maintain shorter clearance times compared to other cities.
    - Memphis and Chattanooga reported longer clearance times.

Prolonged RCTs for CMV incidents were found to significantly increase the likelihood of secondary crashes. The study identified 17% of secondary crashes as resulting from primary CMV crashes, with a notable correlation between longer clearance times and increased crash severity. Secondary crashes were characterized by:

1. **Time Gaps**: The average time between a primary incident and a secondary crash was 45 minutes, with longer RCTs leading to higher secondary crash risks.
2. **Distance Gaps**: Secondary crashes typically occurred within 1.5 miles of the primary incident location, underscoring the need for rapid clearance to mitigate cascading traffic effects.

The analysis of Tennessee's towing regulations revealed inconsistencies across jurisdictions, with urban areas like Nashville benefiting from stricter policies, while rural areas lacked uniform enforcement. Key findings include:

1. **Policy Variation**: Towing regulations in Nashville, Memphis, Chattanooga, and Knoxville varied significantly in terms of response time requirements and towing fees, leading to inconsistent TIM outcomes.

2. **Impact on Clearance Times**: Counties with stricter towing policies, such as Davidson, achieved shorter clearance times, while rural counties struggled with delays.
3. **Comparison with Neighboring States**: Virginia's, Georgia's TRIP, Florida's RISC incentive programs demonstrated a clear advantage in reducing clearance times compared to Tennessee's for similar incidents.

**Recommendations**

Based on the findings, the study provides the following recommendations for TDOT:

1. **Adopt Incentive-Based Programs**:
   - Implement a TRIP-like program statewide, offering financial incentives to towing companies for meeting strict clearance time targets.
2. **Standardize Towing Regulations**:
   - Harmonize policies across urban and rural areas to reduce disparities in TIM outcomes.
   - Develop a statewide towing manual incorporating best practices from other states.
3. **Enhance Rural Towing Capabilities**:
   - Invest in specialized towing equipment and training for rural areas.
   - Establish regional towing hubs to improve response times in remote locations.
4. **Strengthen Stakeholder Collaboration**:
   - Engage towing companies, law enforcement, and TIM managers in program design and implementation.
   - Provide training and public awareness campaigns to support policy changes.

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## Glossary of Key Terms and Acronyms

TDOT—Tennessee Department of Transportation
THP—Tennessee Highway Patrol
SWCS—Smart Way Central Software
CMV—Commercial Motor Vehicle
RCT—Roadway Clearance Time
ICT—Incident Clearance Time
TRIP—Towing and Recovery Incentive Program
RISC—Rapid Incident Scene Clearance
TMC—Traffic Management Center
e-TRIMS—Enhanced Tennessee Roadway Information Management System
TIM—Traffic Incident Management
MIT—Major Incident Tow
RITIS—Regional Integrated Transportation Information System
VDOT—Virginial Department of Transportation
GDOT—Georgia Department of Transportation
FDOT—Florida Department of Transportation
TSU—Tennessee State University

# Chapter 1 Introduction

## 1.1 Background of the Project

Traffic Incident Management (TIM) is an essential aspect of modern transportation systems, designed to ensure the safety and efficiency of roadway operations. Towing and recovery services are a critical component of TIM, as they facilitate the rapid clearance of roadway blockages caused by vehicle crashes, particularly those involving commercial motor vehicles (CMVs). In Tennessee (TN), towing operations for complex crash scenes involving CMVs typically charge by the hour, a practice that may inadvertently disincentivize quick clearance. The delays in clearing incidents not only disrupt traffic flow but also increase the risk of secondary crashes, traffic congestion, and economic losses. While Tennessee faces challenges in its towing and recovery processes, other states, such as Washington, Georgia, Florida, and Virginia, have successfully implemented innovative towing strategies. These include pay-by-the-pound pricing, zone-based towing coverage, and time-based incentive-disincentive payments. These strategies have been shown to significantly reduce incident clearance times and improve overall TIM outcomes. However, Tennessee's towing regulations have not yet evolved to incorporate such innovative measures consistently across the state. This creates variability in incident response times and limits the efficiency of TIM programs, particularly for incidents involving large vehicles. Given the economic and safety implications of delayed incident clearances, this research focuses on understanding the relationship between towing regulations and incident clearance times in Tennessee. By analyzing current practices, evaluating innovative strategies from other states, and identifying areas for improvement, the study aims to provide actionable recommendations for optimizing towing policies and practices in Tennessee to enhance TIM effectiveness.

## 1.2 Problem Statement

Towing and recovery operations are a cornerstone of TIM, yet existing practices in Tennessee may not adequately incentivize rapid incident clearance. The practice of charging by the hour for towing services in complex incidents involving CMVs can lead to extended clearance times, which exacerbate traffic congestion, increase the risk of secondary crashes, and negatively impact supply chain operations. Additionally, Tennessee lacks a standardized approach to towing regulations across its jurisdictions, resulting in inconsistent incident response outcomes. The challenges are particularly acute for CMV-related incidents, which often result in prolonged roadway blockages and secondary crashes. Secondary incidents, such as rear-end, angle, or sideswipe collisions, frequently occur due to traffic slowdowns, reduced visibility, and erratic driving behaviors triggered by the initial CMV crash. These cascading effects compound traffic safety issues and create enforcement and operational challenges for emergency responders. The absence of innovative towing policies, such as those adopted by Washington (MIT), Georgia (TRIP), Florida (RISC), and Virginia (TRIP), limits Tennessee's ability to address these challenges effectively. Such programs incentivize towing companies to invest in better equipment and training, enabling quicker response times and more efficient clearance of CMV crashes. This research aims to fill the knowledge gap by evaluating the efficacy of innovative towing strategies

and determining their potential applicability in Tennessee. The findings will provide evidence-based recommendations to improve towing regulations, reduce incident clearance times, and enhance roadway safety across the state.

## 1.3 Research Objectives

The issue of towing and recovery for CMV-related incidents in Tennessee presents a significant challenge for TIM, with implications for traffic safety, congestion management, and economic productivity. This research seeks to provide TDOT with a comprehensive understanding of the relationship between towing regulations, incident clearance times, and secondary crashes. Leveraging insights from other states and employing robust analytical methods, the study aims to deliver evidence-based recommendations for optimizing towing policies and practices in Tennessee. The findings will contribute to safer and more efficient roadway operations, benefiting road users, emergency responders, and transportation agencies alike. The overarching goal of this research is to assess the impact of advanced commercial vehicle towing regulations on incident clearance times and roadway safety in Tennessee. The specific objectives are as follows:

- **Evaluate Current Practices**: Assess the impact of Tennessee's existing towing regulations on incident durations, clearance times, and secondary crashes.
- **Analyze Innovative Strategies**: Investigate the effectiveness of advanced towing strategies, such as time-based incentive-disincentive payments, pay-by-the-pound pricing, zone-based coverage, and implemented in other states.
- **Quantify Relationships**: Establish correlations between towing response times, incident clearance durations, and the occurrence of secondary crashes.
- **Recommend Policy Improvements**: Develop actionable recommendations for refining Tennessee's towing regulations to improve TIM outcomes and ensure roadway safety.
- **Engage Stakeholders**: Gather insights from TDOT, TMC managers, and other stakeholders to contextualize findings and ensure practical applicability of recommendations.

## 1.4 Scope of Work

The scope of this study encompasses a series of interconnected tasks designed to address the research objectives. These tasks include:

- **Literature Review**: A thorough review of towing regulations and policies from Tennessee and other states, with a focus on best practices and innovative strategies.
- **Regulation Analysis**: Examination of towing statutes in Tennessee's largest cities (Nashville, Chattanooga, Knoxville, and Memphis) and comparative analysis with neighboring states.

- **Incident Data Analysis**: Analysis of crash and incident data from the Tennessee Highway Patrol (THP) and Smart Way Central Software (SWCS) to identify trends and patterns in roadway clearance times specifically those involving CMVs.
- **Surveys and Interviews**: Distribution of surveys to traffic management agencies, safety engineers, and other stakeholders in Tennessee and states to gather insights into towing practices and their impact.
- **Statistical Analysis**: Application of descriptive and inferential statistical techniques to evaluate the relationship between towing practices, incident durations, and secondary crashes.
- **Secondary Crash Analysis**: Identification and characterization of secondary crashes linked to towing delays and primary incidents, with a focus on time and distance gaps.
- **Policy Recommendations**: Development of a report summarizing findings and providing evidence-based recommendations for updating towing regulations in Tennessee.

## 1.5 Methodologies

To achieve the study objectives, a comprehensive mixed-methods approach is adopted, combining qualitative and quantitative analyses. The methodologies include:

- **Literature Review**: Examining innovative towing strategies and regulations from other states, such as Washington MIT, Virginia's and Georgia's TRIP and Florida's RISC programs.
- **Incident Data Collection**: Compiling detailed spatial, temporal, and operational attributes of incidents involving CMVs in Tennessee.
- **Descriptive Analysis**: Mapping and visualizing Roadway Clearance Time (RCT) and Incident Clearance Time (ICT) to identify regional and temporal patterns.
- **Statistical Testing**: Using regression models, Safety Performance Functions (SPFs), and comparative tests to evaluate the impact of towing practices on incident durations and secondary crashes.
- **Stakeholder Engagement**: Conducting surveys and interviews with TDOT, TMC managers, law enforcement agencies, and other stakeholders to gather practical insights.
- **Secondary Crash Analysis**: Evaluating the time and distance gaps between primary incidents and secondary crashes to understand cascading effects.
- **Policy Evaluation**: Assessing the alignment of Tennessee's towing regulations with best practices from other states to identify opportunities for improvement.

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# Chapter 2 Literature Review

## 2.1. Overview

A comprehensive search of literature was undertaken to uncover both published and unpublished reports on previous efforts on towing. The purpose of the review is to determine highway sections, jurisdictions, and regions, as well as types of incidents and traffic variables, which are relevant for assessment, and what data needed to be acquired in the field. In recent years, traffic crash towing has emerged as a critical component of incident clearance, particularly in the context of large truck and commercial vehicle crashes. Several studies have emphasized the importance of efficient towing practices in mitigating traffic congestion, reducing secondary accidents, and minimizing the economic and environmental impacts of these incidents. It has been demonstrated that the time taken to clear incidents involving large trucks is significantly longer than for passenger vehicles, making effective towing practices paramount in these situations. Moreover, research highlights the need for standardized procedures and collaboration among various stakeholders, including law enforcement, towing service providers, and transportation agencies, to ensure a rapid and coordinated response [19].

Related to towing, Chimba et al. [1-5] completed a study for TDOT in 2013 which focused on disabled and abandoned vehicles in general without narrowing it to towing impacts in detail. The study evaluated primary incidents and secondary crashes occurring because of disabled and abandoned vehicles in Tennessee. It evaluated the impact of these incidents with respect to experience from other states: Roadway Clearance Time, secondary crashes, roadway location, queue lengths, weather conditions, towing times, lane closures, and the source of incident notifications, among other comparative factors. The study found that abandoned and disabled vehicle incidents were problematic in other states, and not only in Tennessee. The average Roadway Clearance Times in many states for all types of vehicles ranged from 30-60 minutes, compared to Tennessee's 57 minutes [1-4]. The study revealed that apply to minor things like a flat tire on a personal car that are related to disabled and abandoned vehicles were most found on the shoulder compared to other locations on the roadway [1-2]. A hazard-based log-logistic model was applied in the study to determine the factors affecting Roadway Clearance Times. The time and distance gap analysis indicated that a large portion of secondary crashes in Tennessee occurred within 20 minutes after the primary incidents and within 0.5 miles upstream [2-3]. While 76% of incidents involved the shoulder, most secondary crashes were related to the closing of right lanes [3]. Further, the study found that most of the incidents involving towing, and which caused secondary crashes were towed or removed out of the travel way within 60 minutes from the time of occurrence [1]. Roadway segments with wider medians, shoulders, and multi-lanes were found to decrease the likelihood of secondary crashes caused by abandoned and disabled vehicles as the primary incidents [1-5].

Traffic crash towing plays a critical role in mitigating the impact of accidents on road networks. Recent research highlights the importance of efficient and effective towing services in incident management, addressing challenges through collaboration and resource allocation, and leveraging technological advancements to improve detection and response. Further research is

needed to continue refining towing practices and technologies to enhance overall traffic safety and mobility. Yang and Ozbay examined the efficiency of incident management programs and their role in traffic crash towing. The study found that the implementation of effective incident management programs could significantly reduce traffic congestion and accident-related costs [6]. Wang and Guo [7] provide review on evaluation of tow truck performance in incident management. They highlight the importance of response time, clearance time, and towing capacity in determining the efficiency of tow trucks. The authors emphasize that real-time monitoring and adaptive dispatch strategies could improve the effectiveness of towing services. Hadjidemetriou and Karsanidis [8] conducted a review of critical factors and decision-making in traffic incident management, focusing on the role of towing services. They identified several challenges, including the coordination between responders, the availability of towing resources, and the decision-making process for allocating these resources. Çelik and Topçu [9] proposed an integrated approach for traffic incident management that involves collaboration between traffic police and towing services. The authors argue that such an approach can help overcome challenges associated with traffic crash towing, including resource allocation, communication, and response time. Meng and Weng [10] explored the potential of real-time traffic routing strategies to improve towing services during traffic incidents. Their findings suggest that incorporating advanced technologies such as GPS, traffic sensors, and communication systems can enhance towing efficiency and response time. Alluoch et al [11] demonstrates the potential of connected vehicle technologies for improving traffic incident detection and response, including towing services. The authors found that such technologies can help dispatch towing resources more effectively and reduce response times.

## 2.2. Improving Towing in Florida, Washington State and Georgia

In recent years, various states across the United States have recognized the need for efficient towing and incident clearance practices, particularly in response to crashes involving heavy vehicles such as large trucks and commercial vehicles. As a result, several states have implemented innovative measures and incentive programs to promote efficient towing operations. To encourage towing companies to invest in specialized equipment and staff training, others have introduced incentive programs that provide financial rewards for towing operators who meet specific performance criteria. In addition, other states have focused on developing collaborative frameworks among various stakeholders, including transportation agencies, law enforcement, and towing service providers, to enhance communication and coordination during incident clearance operations. These state-level initiatives demonstrate a growing awareness of the importance of efficient towing practices in managing heavy vehicle crashes and their associated impacts on traffic flow, safety, and the environment. They also highlight the role of incentive programs and stakeholder collaboration in driving improvements in incident clearance practices across the nation.

Florida's Open Roads Policy has introduced the Rapid Incident Scene Clearance (RISC) program to expedite the clearance of accidents and improve the safety and mobility of Florida's roadways. The RISC program focuses on heavy-duty towing and recovery, with the objective of clearing crashes within 90 minutes or less. Participating in towing companies that meet the quick clearance goals for more complex traffic incidents receive monetary incentive bonuses [12].

Certified towing companies are required to arrive at the scene within 60 minutes of receiving the call from the responder. Regardless of whether their services are used, these companies receive a flat rate of $600 if they meet the arrival time requirement. If additional equipment is requested at the crash scene but not used in the recovery process, a $600 award is given. If the requested additional equipment is used, an extra $400 is added, bringing the total to $1000. Towing companies are eligible for a $2500 incentive bonus if they meet the clearance goals. If they fail to meet the goals but do not exceed 180 minutes, no bonus is given. However, if the clearance time exceeds 180 minutes, the towing company is penalized at a rate of $10 per minute, amounting to $600 per hour [13]. According to the 2017 Rapid Incident Scene Clearance program report [13], there were a total of 233 activations, with 43 percent stemming from roads managed by the Florida Turnpike Enterprise, covering 460 miles. Additionally, the data indicates that 64 percent of activations occurred predominantly between 3 am and 3 pm. In pursuit of its primary goal of quick clearance, the program achieved an 82 percent success rate in clearing crashes with incentive bonuses for 2017, which was a 7 percent decrease from the previous year.

The focus is not only on major accidents; minor crashes are also addressed by road safety patrol services in collaboration with Road Rangers. These service teams employ strategies designed to mitigate the effects of traffic crashes through quick clearance, offering assistance such as changing flat tires, jump-starting vehicles, making minor repairs, providing stranded motorists with two free local calls, clearing disabled vehicles and debris from travel lanes, supplying emergency gasoline, diesel, and water, monitoring abandoned vehicles and notifying the Florida Highway Patrol (FHP), as well as providing maintenance-of-traffic (MOT) services during incidents. According to a police survey in Florida, 93% of towing responders agreed that Road Rangers improve road safety [14].

In 2002, Washington state introduced the Major Incident Towing (MIT) program to maintain efficient incident response and safe crash clearance, specifically targeting traffic congestion resulting from Class C crashes (commercial vehicles) [15]. The program, created by the Washington State Patrol (WSP) and the Washington State Department of Transportation (WSDOT), aims to clear traffic crashes within 90 minutes or less, offering certified towing companies an additional incentive bonus of $2,500 for clearing Class C and S crashes within the specified time frame. The program stipulates that collisions or crashes blocking one or more lanes, on or off ramps, and interchanges are all eligible for MIT assistance. The program measures its effectiveness by reporting the quarterly number of incident responses by geographical location and average clearance time. According to the 2022 second quarter report [16], the incident program responded to 11,108 incidents, which is 7.1% fewer (851 incidents) than during the same quarter in 2021. The report states that 71.9% of the total crashes responded to were cleared within or less than 15 minutes as an average clearance time, which was the same as 2021 in same quarter. Approximately 26.3% of responses were cleared between 15-90 minutes, while only 1.8% took over 90 minutes. Reduced crash clearance time provided economic advantages by decreasing vehicle operating costs, particularly fuel consumption that would have increased due to lane blockages. The report estimates that the economic benefit resulting from the impact of the reduced incident on drivers was $21.0 million. For every $1 spent on WSDOT's Incident Response program, the traveling public received $14.02 in economic benefits [16].

In 2008, the Georgia Department of Transportation (GDOT), in collaboration with the Georgia Regional Transportation Authority (GRTA) and the Federal Highway Administration (FHWA), introduced the Towing Recovery Incentive Program (TRIP) with the main goals of clearing major crashes, complicated debris, or hazardous materials in 90 minutes or less by offering an incentive program-based bonus to the towing companies involved in the recovery process [17, 18]. The program had specific criteria for TRIP activation and rules for towing companies. Supervisors of certified towing companies were required to be at the scene within 30 minutes from the time of notification and basic equipment for recovery should arrive within 45 minutes. Towing companies were to remain at the scene until they received an official notification to start the recovery process. If they tried to influence the activation of the program by persuading any police or responder at the scene to activate the official Notice to Proceed, penalties were deployed, including the company not receiving any payment, including flat-rate service charges or emergency response and mobilization incentives, suspension of the company from the program for three months, or removal from the program [17]. TRIP program performance measures include reductions in response times, improvements in roadway clearance times, reductions in travel-lane blockage, reductions in incident clearance times, and dollar savings from reduced congestion. According to a report evaluating the TRIP program, data showed that in 2008 and 2009, incentive bonuses totaling $284,000 were given to towing companies for clearing crashes within the stated time. The cost of incidents, based on incident location, traffic volume during the incident, and geometry, was found to be $186,684 due to delays, wasted fuel, and excess emissions. The report also stated that the cost-benefit ratio of the program was calculated by comparing the cost of each TRIP incident to the cost of the same incident if it had taken an additional 60 minutes to clear. The difference represents the cost savings of having the program in place. By the end of 2009, the benefits of TRIP were calculated to be $9,154,431 in avoided delays, wasted fuel, and excess emissions. With a benefit-to-cost ratio of 10.96 to 1, TRIP is saving almost eleven dollars for every dollar invested [18].

## 2.3. TRIP program in Virginia—Case Experience Expanded Details

Virginia's Towing and Recovery Incentive Program (TRIP) is designed to provide quick responses to towing commercial vehicles involved in crashes. The program primarily focuses on the safe and quick clearance of commercial vehicles, reducing congestion, and eliminating secondary crashes that may result from primary crashes. Qualified heavy-duty towing companies participating in the recovery process are eligible for monetary incentive bonuses for clearing commercial vehicle crashes within the stated time. The program serves as a tool for developing local towing companies, as invitations to join this voluntary program are open to all locally based towing and recovery businesses. Once a company meets the outlined qualifications, it may be added to the program and become eligible for the bonus.

The program benefits all parties concerned with traffic incidents, including emergency responders, and traveling motorists in specific areas, by clearing major crashes in less time, thus reducing congestion and the occurrence of secondary crashes. The program ensures motorist

safety at incident scenes by reducing time and exposure to dangers on the interstate during crash clearance. It also benefits motorists by saving time, reducing fuel consumption, and enhancing safety liability on the interstate. Towing and recovery companies also benefit from the program through the development of skills provided by comprehensive training and the opportunity to receive incentive bonuses for meeting performance goals. The program's effectiveness is measured in several ways to validate its improvements and benefits. TRIP performance is assessed by examining response times to the scene, roadway clearance times, travel-lane blockages, and incident clearance times within given boundaries. The program does not recruit any towing company; instead, companies must agree to the terms and conditions laid out by the Virginia Department of Transportation (VDOT). Towing and recovery companies shall agree to provide professional vehicle recovery services in accordance with the terms and conditions predetermined by the Virginia State Police and VDOT rules and regulations. Companies are required to have specialized personnel and equipment for the recovery process. The program may sometimes require companies to have special tools for recovery processes in specialized areas like corridors with unique challenges in geography, terrain, and road design to meet TRIP program goals. For example, the I-80 corridor requires at least a 40-ton rotator (minimum) as per given specifications. The program also lists tools and equipment required for response, lane, and scene clearance.

VDOT has the right to immediately suspend or terminate a towing and recovery program with or without prior information if the company violates the terms and conditions. VDOT also reserves the right to penalize towing and recovery companies based on various offenses. For example, if a towing company is contacted by the vehicle owner, other agencies, or any unauthorized personnel other than VDOT to provide towing and recovery service, the company is required to contact VDOT Traffic Management Centre (TMC) immediately for coordination and to avoid confusion. If the company decides to provide heavy-duty towing without notifying VDOT, they will be penalized $2,000 or $3,000 and could be removed from the program. Additionally, any company that tries to persuade the scene commander to provide an official notice to proceed will be subjected to offenses that may result in the company not receiving any payment, including the flat rate, being suspended from the program for three months, or being removed from the program. The program does not limit the location of the company regardless of the given recovery zone. The company is required to prove its ability to respond within a specified time from when the call is received. The towing and recovery company must be able to arrive at the scene within 45 to 60 minutes from the time of receiving the call and be able to perform quick clearance within 90 minutes. To improve the level of service, VDOT reviews recovery zones every two years, depending on the number of applications received and the outcome of the route review with each company. VDOT is not responsible for providing the actual compensation for towing and recovery services performed. Instead, the company agrees to seek all actual compensation from the vehicle owner or their insurance company. VDOT agrees to pay a mobilization fee of $600 to the towing and recovery company that receives TRIP activation from the VDOT if the company arrives at the crash scene with two wreckers and a support vehicle within 45 minutes between the hours of 5:30 am and 7:00 pm, Monday through Friday, and within 60 minutes during other times. VDOT agrees to pay an incentive bonus of $2,500 to two wreckers and a support vehicle if they arrive at the crash scene with the required equipment and personnel

within the specified timeframes and complete clearance and debris removal within 90 minutes after receiving the official notice to proceed. All TRIP personnel are required to wear PPE Class 3 safety vests. VDOT's on-scene incident manager must approve the conditions above if they are met. An additional $1,000, up to a maximum of $3,500 in TRIP incentives, is offered for any special equipment that arrives on the scene within the required response time.

Incentive payments are not to be made if the required personnel and equipment fail to arrive at the scene within the established time, if the company fails to complete all work required to open travel lanes, if travel lanes are not opened within 90 minutes from the official notice to proceed, or if TRIP personnel and their agents fail to wear a Class 3 safety vest. If a company fails to remove spilled road debris, clear traffic, and vehicle fluids within three hours, a flat rate of $600 from the next incentive payment will be assessed against the company and paid to the VDOT TRIP Program Manager. If the company fails to clear the crash within four hours, a flat rate of $10 per minute will be added to the original flat rate of $600 until the lane is restored to normal traffic operation. Under special conditions, such as crashes involving hazardous materials cargo that require special precautions, incidents that involve infrastructure damage and do not allow for the reopening of travel lanes, or under any direction from the VDOT TRIP Management Review Team, disincentives become inactive. TRIP is activated by an authorized person for any commercial vehicle crash that impacts travel lanes, exit ramps, or interchanges. The authorized person may also activate the program for commercial vehicle crashes that have left the roadway but require responders to block lanes of travel during the recovery process. Not all vehicles are eligible for TRIP activation. However, Truck Tractor Semi-Trailer Combinations (DOT Class 8), Trucks over 26,000 lbs. and 'Bobtail' Tractors (DOT Class 7 or 8), Large Motor Homes (40ft plus) and Motor Coaches (DOT Class 5 and 6), Buses (16 passengers or more, DOT Class 6, 7 & 8), major impacts with a guard rail, bridge support, or structure on top of a barrier wall, trucks towing loaded equipment trailers or cargo trailers, and aircraft are all eligible for activation.

## 2.4. Charge By Pound Towing Practices

Charging by the pound is a prevalent practice in the towing industry, where the cost of towing a vehicle is determined by its weight. In essence, the heavier the vehicle, the more it costs to tow. This pricing method is particularly common for large commercial vehicles and heavy equipment. However, not all towing companies adopt this pricing model. The cost of towing services can vary based on several factors, including location, type of vehicle, distance traveled, and the purpose of the tow. In Colorado there is regulations concerning the maximum rates towing companies can charge for nonconsensual tows within the state. According to 4 Colo. Code Regs. § 723-6-6511 [20], no additional fees, charges, or surcharges are permissible. Instead, the maximum towing costs for recovery operations and law enforcement-authorized tows are calculated on an hourly basis, per required tow truck, as outlined [20]:

- $232.52 per hour for vehicles with a GVWR up to 10,000 pounds.
- $277.89 per hour for vehicles with a GVWR over 10,000 pounds but up to 19,000 pounds.
- $362.96 per hour for vehicles with a GVWR over 19,001 pounds but up to 33,000 pounds.

- $419.67 per hour for vehicles with a GVWR over 33,000 pounds.
- For the recovery of vehicles requiring a Heavy Rotator (60+ tons), the charge shall not exceed $663.53 per hour.

These rates are subject to annual inflation adjustments and were last updated on March 15, 2022. Towing carriers that bill for more than one hour for a tow truck on a single tow must adhere to the following requirements [20]:

- In addition to meeting the criteria of rule 6509, the tow record or invoice must specify times for dispatch, departure from the staging area or yard, arrival at the site, departure from the scene, and when the towed vehicle is detached from the tow truck.
- The tow record/invoice should notify the customer that documentation of charges exceeding one hour for a tow truck is available upon request.
- Towing carriers can only bill for the time reasonably needed to complete the tow, which includes hourly rates for one tow truck and driver. They can also charge actual and reasonable costs for recovery equipment and labor, plus an extra 25% of those costs, but no more.
- Upon request, towing carriers must provide a detailed breakdown of costs that exceed one hour for a tow truck and driver to the vehicle's owner, operator, or their authorized agent.

Lastly, the code specifies the maximum 24-hour storage rates for nonconsensual tows based on the following classifications:

- $39.18 for vehicles with a GVWR less than 10,000 pounds.
- $48.32 for vehicles with a GVWR of 10,000 pounds or more.

# Chapter 3 Survey and Interview with TRIP and RISC Managers

## 3.1. Current practice in TN

The Tennessee Department of Transportation (TDOT) oversees the development and execution of towing policies and procedures for state highways and interstates. These towing services come into play during vehicle accidents, breakdowns, or other incidents necessitating the removal of vehicles from roadways. Over recent years, TDOT has launched several initiatives to enhance towing practices, ensuring the safety of both drivers and towing professionals. For instance, TDOT has created a statewide roster of towing companies that adhere to specific safety and insurance criteria. Furthermore, they have formulated standardized protocols for towing and recovery operations, encompassing incident management and traffic regulation. Recognizing the evident enhancements in traffic management and safety in other states, TDOT has commissioned a research project to evaluate the potential impact of advanced towing strategies within Tennessee.

## 3.2. Overview from other states

To reduce Roadway Clearance Time, especially for large commercial vehicle accidents, states like Georgia, Florida, and Virginia have special programs for the recovery process. In getting the information, interviews were conducted with program representatives from existing towing programs in Virginia (TRIP by VDOT), Georgia (TRIP by GDOT), and Florida (RISC by Florida Turnpike). This chapter summarizes the findings and highlights the key factors that led to the implementation of these programs. Before the introduction of towing incentive programs, all three states relied on traditional towing rotation programs. In Georgia, the TRIP program was implemented to address the contradiction between state patrol and law enforcement agency towing rotations. This program streamlined the process by establishing clear criteria and reducing confusion about which towing company would respond to incidents. Similarly, Virginia employed a traditional towing rotation program without any specific policies governing it. In addition, in Virginia, the TRIP program was established due to inconsistent performance from towing companies, varying levels of oversight in rotation application, and a need for appropriate incident response equipment. These issues led to the creation of a program that ensured quicker clearance for commercial truck towing. Florida Turnpike's RISC program was introduced in 2004, as they relied on a typical rotation process involving the Florida Highway Patrol's communication center. In Florida, the RISC program was prompted by the expansion of turnpike systems around cities such as Tampa, which required a specialized program to expedite response times, provide suitable equipment, and ensure experienced personnel were available. Furthermore, the Turnpike was experiencing excessive shutdown times (5-10 hours) for commercial vehicle crashes, which highlighted the need for a more efficient system.

## 3.3. Towing Incentive Incident Clearance Bonus

The Florida Turnpike, Virginia DOT, and Georgia DOT all have similar towing incentive programs, with variations in the structure of incentives and disincentives. In Florida, the cost to the department is based on the number of activations and the incentive payment is $5,500 for maximum performance if the towing company responds in under 45 minutes to a scene and clears under 30 minutes. Currently, if the towing company responds from 45 minutes to 60 minutes, they will get an additional $500 that is tiered by 15-minute type intervals from 30 to 45 and then 60. Virginia's base incentive is $2,500, with an additional $1,000 for using extra equipment and a maximum bonus of $3,500. Disincentives kick in at the three-hour mark and include $600, and $10 per minute for every minute beyond four hours. In Georgia, the TRIP tow company receives a bonus for clearing the crash within 90 minutes or less, and they invoice the insurance or trucking company separately for their services. Georgia's incentive structure is nearly identical to Virginia's, with a $600 disincentive at the three-hour mark and a $10 disincentive added immediately beyond that. The Georgia program has not changed since 2008 and there are discussions on raising the incentives.

| FLORIDA TURNPIKE INCENTIVES SUMMARY | | | |
|---|---|---|---|
| Response time | Incentive bonus | Clearance time | Incentive bonus |
| 45 min or less | $1000 | 30 min or less | $4,500 |
| 60 min or less | $500 | 90 min or less | $3,000 |

| VIRGINIA AND GEORGIA INCENTIVES SUMMARY | | | |
|---|---|---|---|
| Response time | Extra Equipment | Clearance time | Incentive bonus |
| Within 60 min | $1000 | Less than 90 min | $2,500 |
| | | Less than 180 min | 0 |
| | | 3 hours | -$600 |
| | | Beyond 3 hours | -$10 per min |

It should be noted that the incentive programs are bonuses paid out by the DOT or Turnpike, but then the actual tow bills are still between the wreckers and customers, DOTs are not involved. In Virginia, there is no legislative oversight regarding what a towing company can charge. VDOT does not set towing rates for the TRIP program, but they do promote ethical behavior and transparency. Recent legislation requires that any towing and recovery bill over $10,000 must include the Attorney General's Office contact information in case of complaints or questions. In Florida, the Turnpike does not involve itself in the billing process between the tow companies and the customer. Individual counties in Florida set their towing rates, and the contract cites the county rates for companies participating in the program. In Georgia, there is no legislation overseeing the TRIP program; it is purely a DOT-managed program. In Virginia, there is no specific legislation that empowers VDOT to manage the program, but there is some legislation that allows the TRIP program to exist, such as the authority to remove vehicles and hold harmless legislation that protects tow companies from additional liabilities. The program is voluntary for towers. In Florida, the RISC program was established as a department program with the Turnpike, with both the DOT and the Florida Highway Patrol having the authority for

removal and clearance of the roadway. An open roads policy was signed by the Highway Patrol and the department, committing to quick response and clearance efforts with a goal of 90 minutes or less for all crashes. Overall, the billing processes for towing incentive programs vary by state, with tow companies receiving bonuses for timely clearance and billing the insurance or trucking companies separately. Legislation related to these programs also varies, with some states having DOT or Turnpike-managed programs, while others have supporting legislation that allows the programs to exist and operate effectively.

## 3.4. Towing Incentive Programs Policy Writing

The towing incentive white paper policy was written by different entities in different states, reflecting the unique requirements and considerations of each region. In Virginia, the initial white paper draft was prepared by Parsons Corporation on behalf of VDOT. The draft was then reviewed and modified by VDOT's legal team. In Georgia, the white paper was created by a consultant in 2007-2008 and subsequently reviewed by the state legal department, without the involvement of any external law firms. The program in Virginia is voluntary, meaning that towing companies can choose whether or not to participate based on their equipment and capabilities. The TRIP (Towing and Recovery Incentive Program) has been designed to set a benchmark for the industry in terms of equipment, training, and performance standards. Although the program aims to elevate the overall quality of towing services, it is not intended to be suitable for every towing company, recognizing that companies have varying resources and expertise. In Florida, the program started with a reduced requirement of 20-ton and 35-ton tow trucks to encourage participation. Over time, the program evolved to require trucks with additional equipment as the industry adapted to the new standards. The industry itself has raised its own standards as more companies have joined the program and invested in the necessary equipment. This growth has led to an improvement in industry standards and a more consistent level of service across participating companies.

In Virginia, the incentive program started with months of outreach that included town hall meetings, high-level stakeholder leadership decision-maker meetings, and boots-on-the-ground stakeholder meetings. This top-to-bottom approach was found to be necessary for securing the buy-in, understanding, and cooperation needed to launch the program. Similarly, in Georgia, a top-to-bottom approach was taken. A third-party engineering firm conducted data collection and analysis on crashes, which led to the consideration of expanding the program to other parts of the state. In Macon County, Georgia, they communicated with law enforcement and existing rotational heavy towers to ensure buy-in from all parties. However, in Savannah, the lack of buy-in from law enforcement agencies and agreements with towers caused the program to be put on hold. In Florida, the Turnpike followed a similar approach, working closely with the Towing Association and Traffic Incident Management (TIM) partners. They made special trips to influencers in the tow industry and initially started the program with lower requirements to encourage participation. Over time, the industry raised its own standards, and now the program has complete coverage throughout the state. In all three states, obtaining buy-in and cooperation from various stakeholders, including law enforcement agencies, towing companies, and other key partners, was crucial for the successful implementation and expansion of the towing incentive program.

## 3.5. Towing Incentive Programs Initial Costs

A review revealed that the starting expenses of the towing incentive program fluctuated based on the program's breadth. In 2016, Virginia's pilot program, which spanned 200 centerline miles in the Richmond area, had an initial cost of approximately $300,000. It's essential to contextualize these figures, considering inflation since 2016. The state's ongoing support for the program, despite its inception several years ago, underscores its commitment to its continuity. This cost did not include incentives and was focused on the mobilization phase. In Georgia, the initial startup cost was like Virginia, and the incentives alone reached nearly a million dollars. With an average of 30 TRIP incidents per month in the metro Atlanta area, the program covers about 471 centerline miles of interstate and state highway. In Florida, the Turnpike relied on a team of four or five individuals to manage the contract, and the primary cost was the incentive payment to the towing companies. The first year (2004) saw around $120,000 in incentives for 40+ activations, and the cost in 2023 increased to over $700,000 as the number of activations grew. The incentive structures differ across the three states but generally include a base incentive for timely arrival, proper use of Personal Protective Equipment (PPE), and clearing the scene within a set timeframe. Additional incentives may be offered for using extra equipment or meeting stricter response and clearance times. Disincentives are also applied if the towing companies do not meet the set response and clearance time requirements.

## 3.6. Building Relationship with Towing Companies

A critical aspect of the program's success is building relationships between towing companies and first responders. Initially, towing companies may be resistant to the program, but over time, as relationships are established and trust is built, they tend to prioritize clearing incidents more efficiently. They start to behave more like first responders, focusing on reopening roadways and reducing the impact of incidents on traffic flow. From the review, it was observed that one challenge faced in implementing the program is getting towing companies to buy into the program and adopt a more first responder-focused mindset. Initially, there may be some pushbacks from towing companies, but as the program progresses and relationships are built, they are more likely to cooperate and prioritize clearing incidents more efficiently. Overall, incentive programs have shown significant benefits in reducing response and clearance times for incidents involving commercial vehicles. These programs can be customized to meet the needs of different regions and help build better relationships between towing companies and first responders. By demonstrating the advantages of incentives, it becomes easier to make a case for their adoption to policymakers and stakeholders, ultimately improving traffic safety and congestion in both urban and rural areas. This can be useful for Tennessee's unique urban-rural divide that presents an opportunity to assess how incentives can be tailored to suit different regions. The program's flexibility allows for customization, addressing specific needs and challenges in each area. By demonstrating the benefits of implementing incentives, it becomes easier to make a case for their adoption to policymakers and stakeholders.

## 3.7. Funding Towing Incentive Programs

The source of funds for the towing incentives varies depending on the state and the specific program. In general, these funds come from a combination of state and federal budgets. In the case of Virginia, the pilot program was initially funded by the Virginia Transportation Research Council in cooperation with the Virginia Department of Transportation (VDOT). As the program expanded, funding sources shifted to include VDOT's budget, corridor funding, federal corridor funding, and I-81 corridor funding. The individual regional and district budgets also support the effort. Similarly, in Georgia, state and federal funds are used to finance the program. Additionally, the Environmental Protection Agency (EPA) contributes to the program's funding, as it benefits from reduced emissions when trucks are not idling during traffic incidents. However, not all states receive funding from sister agencies like the EPA. In Virginia, while the EPA is a partner in the program, it does not provide any financial support. In Florida, the program is funded through roadway maintenance department funds as a toll facility. It is important to note that the financial support and funding mechanisms for these programs can differ across states and may be subject to change over time.

## 3.8. Selecting Towing Companies for Incentive Programs

Selecting towing companies for the incentive program is shown to be through an open application process in these three states. In Virginia, the application occurs every two years, and towing companies must meet all equipment, support vehicle, and training requirements at the time of application. There is no grace period for achieving these requirements after being accepted into the program. Georgia follows a similar process, with a competitive application based on training, experience, and equipment. Recently, Georgia has implemented a scoring criterion for applications. A third-party engineering group scores the companies applying for a particular trip zone based on criteria like proximity, training, and years of experience. The recommendations are then presented to the TRIP managers group, who vote on the selection, with the Georgia Department of Transportation (GDOT) having the final say. As for the number of towing companies participating in these programs, Georgia currently has 17 towing companies, Virginia has 37 towing companies covering 633 miles, and Florida has 10 contracts covering approximately 480 centerline miles.

## 3.9. Coverage of Towing Companies for Incentive Programs

Coverage in the incentive programs is determined based on the towing companies' ability to cover a zone or area effectively within the time constraints. In Georgia, the development of coverage areas has been based on the towing companies that could cover the specific zones at a given time, while Virginia custom-designs the zones based on the approved participants. Virginia's zones range from 10 miles in more congested urban areas to a maximum of 45 miles, while Florida sets the zones based on county, intersection-to-intersection in rural areas, or as determined best by the program. Regarding equipment capacities, Georgia requires towing companies to have a minimum of a 30-ton, a 50-ton, and a support truck for traffic control and spill mitigation. In Virginia, the base response requires a minimum of a tandem axle 30-ton

wrecker and a 35-ton rotator or a 50-ton wrecker. Virginia has also evolved its requirements to match the towing industry's technological advancements. In Florida, towing companies must have two 50-ton wreckers, with one being a rotator, a support vehicle with an arrow board, and a skid steer. Many towing companies in the TRIP program use equipment manufactured by Miller Industries in Tennessee, as well as other brands and models of wreckers.

## 3.10. Benefits of Towing Incentives in Improving Clearance Times

For Georgia, in 2007, the average start-to-finish clearance time for commercial crashes was around 262 minutes. Since implementing the incentive program in 2008, this time has significantly reduced Incident Clearance Time (ICT), averaging around 110 minutes. The time savings for clearing the roadway were evident in the data, emphasizing the program's effectiveness. In addition to the improvements in response and clearance times, studies have been conducted to analyze the cost-benefit ratios of such programs. These studies considered factors such as lost productivity time for motorists, delayed freight deliveries, and other related costs. The data collected has been useful in presenting to policymakers and stakeholders the advantages of implementing the programs. The Virginia program began with a pilot program covering 200 miles of interstate in urban and suburban areas. The program was later expanded, covering a total of 633 miles, including the rural I-81 corridor. Despite the challenges faced in rural areas with limited resources, the program maintained an average response time of 37 minutes statewide. This demonstrates that the program can be customized to meet the needs of various regions, whether urban or rural, and can be adapted to address specific challenges. Both Virginia and Florida have seen benefits in terms of reduced clearance times, similar to Georgia. In Virginia, the program Roadway Clearance Time (RCT) within 90 minutes about 91% of the time. Over five years, they've had over 1,400 incidents with an average response time of 36 minutes and an average TRIP lane clearance time of 52 minutes. The biggest benefit has been the improved relationship between the responders and the towing community, which allows for more efficient operations and teamwork. Florida has seen similar improvements in clearance times and better teamwork between on-scene law enforcement and towing companies. The average time from the incident occurring to the travel lanes being cleared has been reduced by about half compared to before the program's implementation. The TRIP program has also helped to virtually eliminate the worst incidents, such as 10–18-hour events, which used to occur more frequently. By addressing these challenging incidents more effectively, the program makes overall incident management more manageable and efficient.

***Incident Clearance Time (ICT)**: Refers to the time taken from when an incident occurs to when all aspects of the incident, including any investigation, debris removal, and the involved vehicles' removal, are completely addressed, and cleared.*

***Roadway Clearance Time (RCT)**: Refers to the time taken from when an incident occurs (like a vehicle crash) until all lanes are cleared and open for traffic.*

## 3.11. Towing Billing Issues

Towing regulations for commercial vehicles that are not covered by insurance are not specific to states like Georgia or Virginia. The responsibility of billing the responsible party lies with the towing company, and they may have to resolve any disputes civilly. In addition, even if a vehicle is covered by insurance, the towing company is still responsible for billing them. DOT forms from those states practicing this program have nothing to do with billing issues.

## 3.12. Chapter Summary and Conclusions

In conclusion, the review showed that the towing incentive white paper policy was drafted by different entities in different states to address the specific needs and goals of each region. The program is voluntary and aims to set industry standards for equipment, training, and performance. The process of establishing the program and acquiring the necessary equipment can be time-consuming, but it has led to the improvement of industry standards and service quality in the long run. This collaborative approach has helped create a more efficient and effective towing industry, benefiting both service providers and the communities they serve. The review from these three programs also shows that establishing such an incentive program can be a lengthy process, with a nine-to-12-month outreach phase serving as just the beginning. Towing incentive programs have been found to be an effective solution for clearing incidents quickly and safely from roadways, improving traffic flow, and reducing secondary incidents. The programs have been implemented successfully in several states, including Georgia, Virginia, and Florida, with positive feedback from all involved agencies. Overall, towing incentive programs have proven to be a valuable tool for enhancing roadway safety and efficiency, and continued efforts to improve and expand these programs benefit both the public and emergency responders.

## 3.13. Recommendations to TDOT

The TRIP programs in Virginia and Georgia, as well as the RISC program in Florida, have shown a reduction in incident clearance times and secondary crashes. These programs could have a positive impact on traffic incident management in Tennessee. The reduction of incident clearance times in Florida, Georgia, and Virginia provides evidence of the effectiveness of such programs. By incentivizing prompt and efficient towing, TDOT can improve incident management, reduce congestion and delays, and enhance the safety of motorists and first responders. Further research is necessary to assess the feasibility and potential impact of implementing a towing incentive program for commercial vehicles in Tennessee.

# Chapter 4 Towing Regulations in Tennessee

## 4.1. Overview of Towing Regulations in Tennessee

Towing regulations in Tennessee and its major cities aim to protect vehicle owners from predatory towing practices while ensuring that towing companies follow proper procedures. Each jurisdiction has specific requirements for signage, notification, and fees. This chapter provides a detailed summary of towing regulations as outlined in specific city codes for Chattanooga (Code 35), Knoxville (Code 26), Nashville Metro (Code 5.80.452-620), and Memphis (Code 6-88). These codes govern the towing and storage of vehicles in the respective jurisdictions.

## 4.2. Chattanooga Code 35 Sec.150-171

Chattanooga City Code chapter 35 outlines the rules and regulations for non-consensual towing from private property and from highway within the city. It mandates that towing companies must obtain a license from the city to operate and perform non-consensual tows. Towing companies must also maintain a list of rates and fees for their services, which must be posted in a conspicuous location at their place of business. The code also sets maximum fees for towing, storage, and related services. In addition, it requires that towing companies notify local law enforcement about towed vehicles from private property within one hour of the tow. Vehicle owners have the right to retrieve their vehicles and personal property without being charged additional fees. This code governs emergency towing and storage procedures upon vehicles on streets or highways which constitutes hazard to the safe movement of traffic.

### *4.2.1. Towing Requirements*

- When vehicle disabled by an accident and constitute hazard to safe movement of traffic.
- A car is parked, stopped, or standing still to prevent a smooth flow of traffic.
- Signs must be posted on private property, indicating parking restrictions, the towing company's information, and contact details for the Chattanooga Police Department.
- Towing operators must obtain a permit from the Chattanooga Police Department and maintain a valid city business license.
- Within 30 minutes of completing the tow, the towing company must notify the Chattanooga Police Department with the vehicle and tow details.
- Any vehicle standing upon any street or highway constitutes a hazard to safe movement of traffic.

### *4.2.2. Towing Fees*

The code sets maximum fees for towing and storage, which are subject to change. As of the cutoff date on 31st March 2023, the maximum towing fee is $150 and $20 for storage from private property and for emergency towing by wrecker depend on class but for class C is $700/hour and the daily storage fee is $70. In addition to that this code mandates charges for large vehicles to be done by pound for trucks above 26,001 pounds.

## 4.3. Knoxville Code 26 Sec 226-414

Towing procedures in Knoxville are governed by Chapter 26 of the Knoxville City Code, encompassing both voluntary and involuntary towing. The code emphasizes the prompt removal of incapacitated vehicles from roads to avoid traffic disruptions and potential accidents. Furthermore, the code stipulates certain towing guidelines, including the upkeep of a towing registry and ensuring that only wreckers from the designated rotation list respond to incidents, barring unlicensed ones.

### *4.3.1. Towing Requirements*

- Vehicle disabled by an accident and constitute an obstruction to traffic.
- Vehicle is parked, stopped, or standing to obstruct the orderly flow of traffic.
- Towing operators must have a written contract with the property owner or lessee for non-consensual towing.
- Tow companies must maintain a valid city business license and carry liability insurance.
- Signs must be posted on private property, indicating parking restrictions, towing company information, and contact details for the Knoxville Police Department.
- The towing company must notify the Knoxville Police Department within one hour of completing the tow.

### *4.3.2. Towing Fees*

The code establishes maximum fees for wreckers on rotational list and fee for storage which is subject to change. The current maximum towing fee to be charged by wrecker on rotational list as per February 2023 is $682.50 hourly rate for vehicles being involved in collision under class C, and daily storage fee is $45.

### *4.3.3. Disputes and Penalties*

- Vehicle owners can file a complaint with the Knoxville Police Department if they believe the towing company violated the provisions of the code.
- Violations can result in fines or suspension of the towing company's license.

## 4.4. Nashville Metro Code 6.80.452-620

Nashville Metro Code governs the towing of vehicles from public and private property within the city. This code mandates no person shall engage in towing business without being certified/licensed. It sets maximum fees for towing, storage, and related services, and it requires towing companies to maintain a list of fees for their services for both consent and nonconsensual tows. For emergency situations this code gives authority and directives to the commission to divide the geographical jurisdictional territory of the metropolitan government into zone for emergency wrecker service. It mandates zone wrecker companies must respond to calls within thirty minutes when traffic and weather conditions are normal.

### *4.4.1. Towing Requirements*

- Vehicle disabled by an accident and constitute an obstruction to traffic.
- A vehicle is parked, stopped, or standing to obstruct the orderly flow of traffic.
- When a vehicle is parked, stopped, or standing in violation of any regulation or ordinance of the metropolitan government.
- Private property owners must post visible signs indicating parking restrictions and towing company information.
- Towing operators must have a valid Metropolitan Government license to perform non-consensual tows and maintain liability insurance.
- Within one hour of completing the tow, the towing company must notify the Nashville Metropolitan Police Department with the vehicle and tow details.

### *4.4.2. Towing Fees*

The code establishes cap limits on towing and storage fees, which can be revised. As per the information available until March 2023, vehicles under class C (over 7000 GVWR) towed from private premises have a maximum towing fee of $375, with a daily storage cost of $40. For involuntary towing on highways and freeways, fees are determined by specific service zones. However, labor costs can only be billed for the initial hour, capped at a rate of $150 per hour.

### *4.4.3. Disputes and Penalties*

- Vehicle owners can file a complaint with the Nashville Metropolitan Police if they believe the towing company violated the provisions of the code.
- Violations can result in fines, suspension, or revocation of the towing company's license.

## 4.5. Memphis Code 6-88

Memphis City Code 6-88 regulates the towing of vehicles from public and private property within the city. This code mandates any person who is engaged in the business of providing wrecker

services within a cooperated city limit should be certified/ licensed by city authorities. It sets maximum fees for towing, storage, and related services, and it requires towing companies to maintain a list of fees for their services. In addition to that this code gives guidelines for wrecker service engaged in clean-up of hazardous materials. It mandates wrecker service to be equipped with sufficient absorbents materials and tools to pick up all fluids associated with the vehicle they are towing.

### *4.5.1. Towing Requirements*

- Vehicle disabled by an accident and constitute an obstruction to traffic.
- A vehicle is parked, stopped, or standing to obstruct the orderly flow of traffic.
- Signs must be posted on private property, indicating parking restrictions, towing company information, and contact details for the Memphis Police Department.
- Towing operators must have a valid city business license and liability insurance.
- Within one hour of completing the tow, the towing company must notify the Memphis Police Department with the vehicle and tow details.

### *4.5.2. Towing Fees*

The code establishes maximum fees for towing and storage, subject to change. The current maximum towing fee for class C wrecker services is $350 per hour, and the daily storage fee is $30.

### *4.5.3. Disputes and Penalties*

- Vehicle owners can file a complaint with the Memphis Police Department if they believe the towing company violated the provisions of the code.
- Violations can result in fines or suspension of the towing company's license.

Table 4.1: Towing fee Summary

| City | City code | Towing rate | Storage rate |
|---|---|---|---|
| Chattanooga | 35 Sec.150-171 | $700/hour for Veh under class C | $70 per day |
| Knoxville | 26 Sec 226-414 | $682.50/hour | $45 per day |
| Nashville | Sec 6.80.550 | $375/hour | $40 per day |
| Memphis | Sec 6-88-6 | $350/hour | $30 per day |

## 4.6. Chapter Summary and Conclusions

Upon reviewing towing regulations in Tennessee's major cities, including Chattanooga, Knoxville, Nashville, and Memphis, there is a pronounced emphasis on establishing structured guidelines that ensure both vehicle owner protection and standardized towing practices. These regulations, which encompass private property towing, public roadway towing, signage, fees, and dispute

resolution, are essential for maintaining order and promoting responsible towing practices. These codes also set standards for notification, as well as imposing penalties for violations. As the Tennessee Department of Transportation (TDOT) is examining the benefits of current towing practices, it is crucial to examine the effectiveness of existing regulations and make improvements where necessary. Each city's code champions the prevention of predatory towing through clear mandates on signage, transparent fee structures, and timely notifications to local law enforcement. This harmonized approach across jurisdictions underscores Tennessee's commitment to maintaining roadway safety and efficient incident management. However, a noteworthy omission across all these cities' regulations is the absence of specific clauses addressing large commercial vehicles. Despite the comprehensive nature of the regulations, no reference was found pertaining to the towing of incidents involving such vehicles. This omission might indicate a potential gap in addressing the unique challenges and considerations that towing large commercial vehicles might present. Given the differing weight, size, and potential hazardous materials these vehicles might carry, their omission from specific regulatory guidelines is conspicuous. The licensing prerequisites and robust penalty mechanisms further indicate a city-wide aspiration to maintain a high level of service quality and integrity among towing service providers. However, without tailored provisions for large commercial vehicles, there might be ambiguity in handling incidents involving these vehicles. In summation, while Tennessee's major cities exhibit commendable dedication to safeguarding the interests of the general motoring public and ensuring streamlined towing operations, the absence of stipulations for large commercial vehicles in their codes suggests a potential area for future regulatory enhancement.

# Chapter 5 Incident Data Analysis (from THP)

## 5.1. Overview

Four sources of incident and crash data are used in this study including.

1. THP CAD connection data.
2. SWCS- custom report
3. eTRIMS with crash data
4. RITIS with incident data

The Tennessee Highway Patrol (THP) Incident data was obtained for incidents from 2015-2022 with several variables which are useful for the study. Some attributes included weather conditions, incident location, secondary collision, blockage occurrence, towing involvement, large truck involvement etc. The Smart Way Central Software - custom report incident data was obtained from Gannett Fleming Inc (a TDOT consultant leading the SWCS integration in the Traffic Management Center) which included incident data from 2017 to 2022. The SWCS incident data include key variables such as incident cause type, Roadway Clearance Time, secondary collision, blockage description, towing involvement, weather condition, hazmat involvement etc. The access to RITIS data was obtained, however this interim report does not include analysis of data downloaded from RITS. The eTRIMS crash data is used to support crash data obtained from THP and SWCS.

## 5.2. Tennessee Highway Patrol (THP) Incident Data

This section presents an analysis of crash data provided by the Tennessee Highway Patrol (THP)-TITAN Business Unit. The dataset contains several variables including:

- Crash Type
- Weather Condition
- Incident Location (County, Route, and Milepost)
- Secondary Collision (Y or N)
- Blockage Occurrence (Y or N)
- Towing Involvement (Y or N)
- Large Truck Involvement (Y or N)
- Blockage Start Date and Time
- Blockage End Start Date and Time
- Blockage Incident Start Date and Time
- Blockage Incident End Start Date and Time
- Collision Date and Time
- Notification Date and Time
- Officer Arrived Date and Time
- Roadway Clearance Time and Police Response Time

### 5.2.1. Analysis of the Overall total Crashes Provided by THP

A dataset comprising 1,579,465 crashes from 2015 to 2022 was provided. The top incident counties are as shown in Figure 5.1 whereby Nashville metropolitan area (Davidson, Rutherford, Williamson, Sumner, and Wilson counties), Shelby, Knox, and Hamilton counties recorded the highest number of incidents.

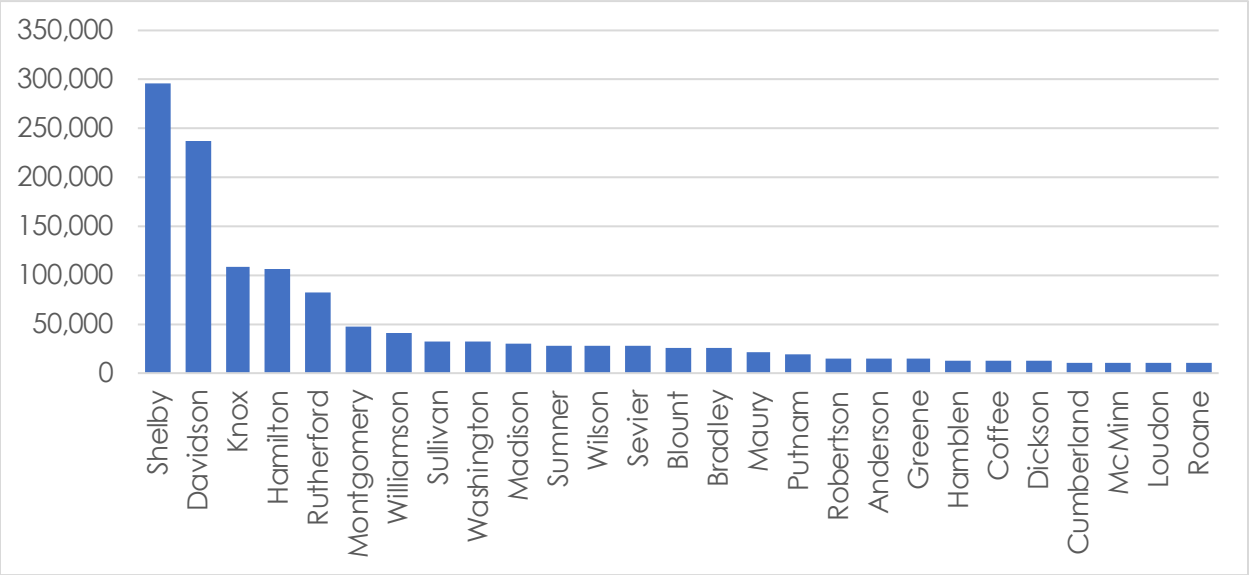


Figure 5.1: Frequency of Crashes by Top Counties

Accident data distribution across months was relatively consistent, with minor variations in the spring months (March to May). Crashes started to increase again in 2021 and 2022. Figure 5.2 shows most crashes (75%) resulted in property damage only (PDO). Out of 1,579,465 crashes from 2015 to 2022 provided, only 7% involved large trucks while 93% did not involve trucks. This 7% is of interest in this study as part of the evaluation of towing impacts.

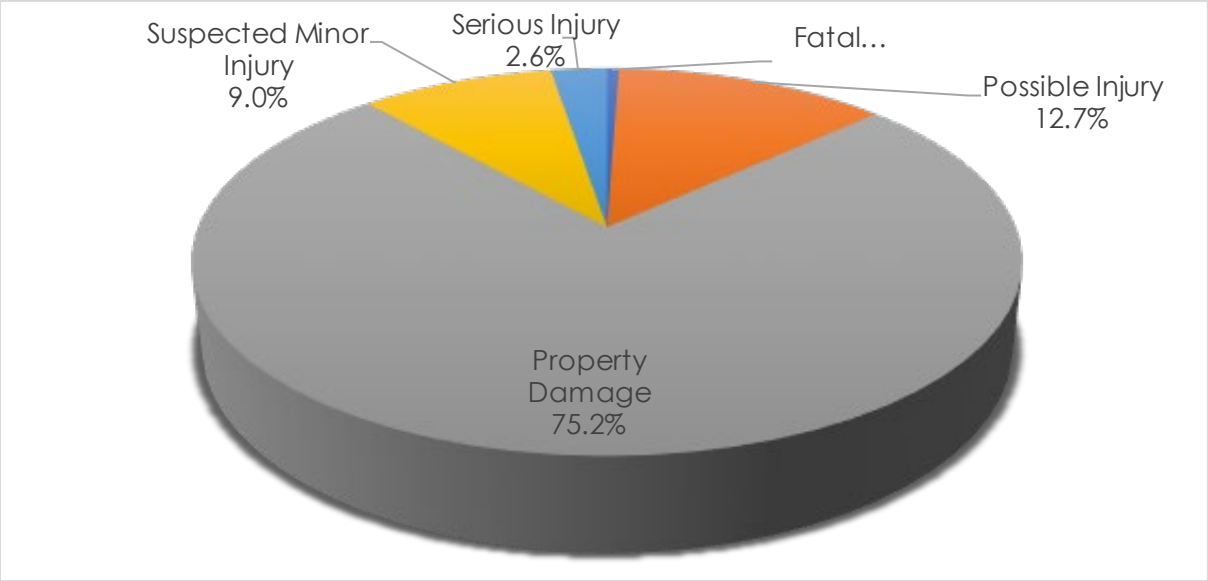


Figure 5.**2**: Distribution of Crashes by Injury severities

### 5.2.2. Crashes that Involved Trucks

Out of 7% that involved trucks, 86% involved towing and 14% did not involve towing, Figure 5.3. In addition, 32% of the crashes that involved trucks ended in lane blockage while 68% resulted with no lane blockage, Figure 5.4.

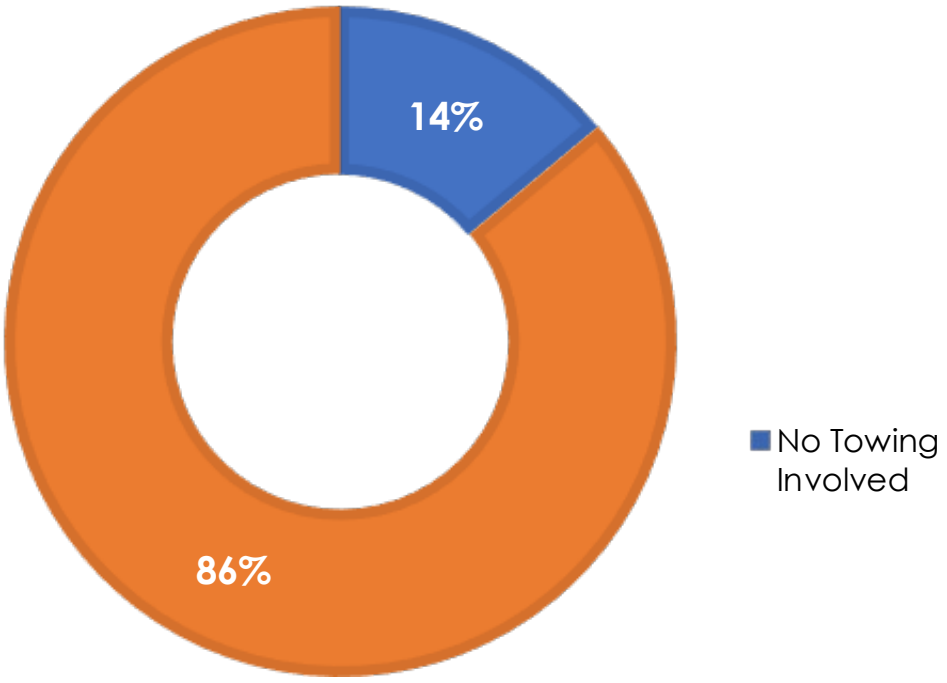


Figure 5.3: Towing Situations for Crashes that involved Trucks.

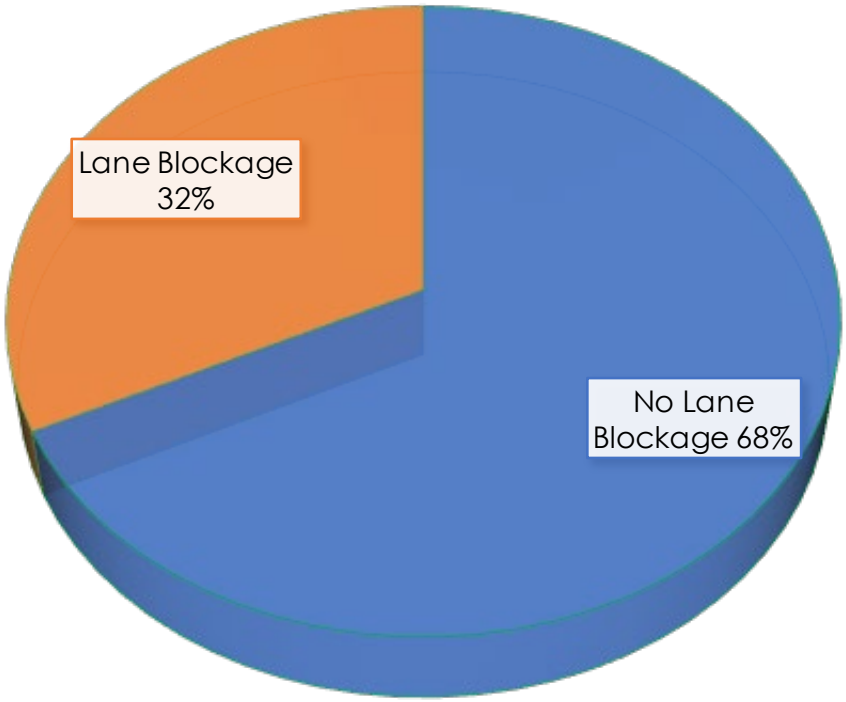


Figure 5.4: Lane Blockage Situations for Crashes that involved Trucks.

### 5.2.3. Distribution of Roadway Clearance Time by Road Functional Class

The analysis of average incident clearance times across various road functional classifications reveals notable differences in the time required to clear incidents involving large trucks versus those not involving large trucks. Interstate routes have the longest average clearance times, with large vehicle incidents taking up to 149 minutes and non-large vehicle incidents averaging 67 minutes, Figure 5.5. This data indicates that incidents on Interstate routes have higher clearance times compared to other road functional classes. State Routes show average clearance times of 121 minutes for large vehicle incidents and 77 minutes for non-large vehicle incidents. This reflects a difference in clearance times between large and non-large vehicle incidents on State Routes. Local Roads and unspecified road classifications exhibit shorter average clearance times, with large vehicle incidents cleared in 115 and 104 minutes, respectively. For non-large vehicle incidents, the clearance times are 66 minutes on Local Roads and 59 minutes for roads not specified in the dataset. These figures suggest variations in clearance times across road classifications, with Interstate and State Routes experiencing longer durations compared to Local Roads and unspecified classifications, Figure 5.5.

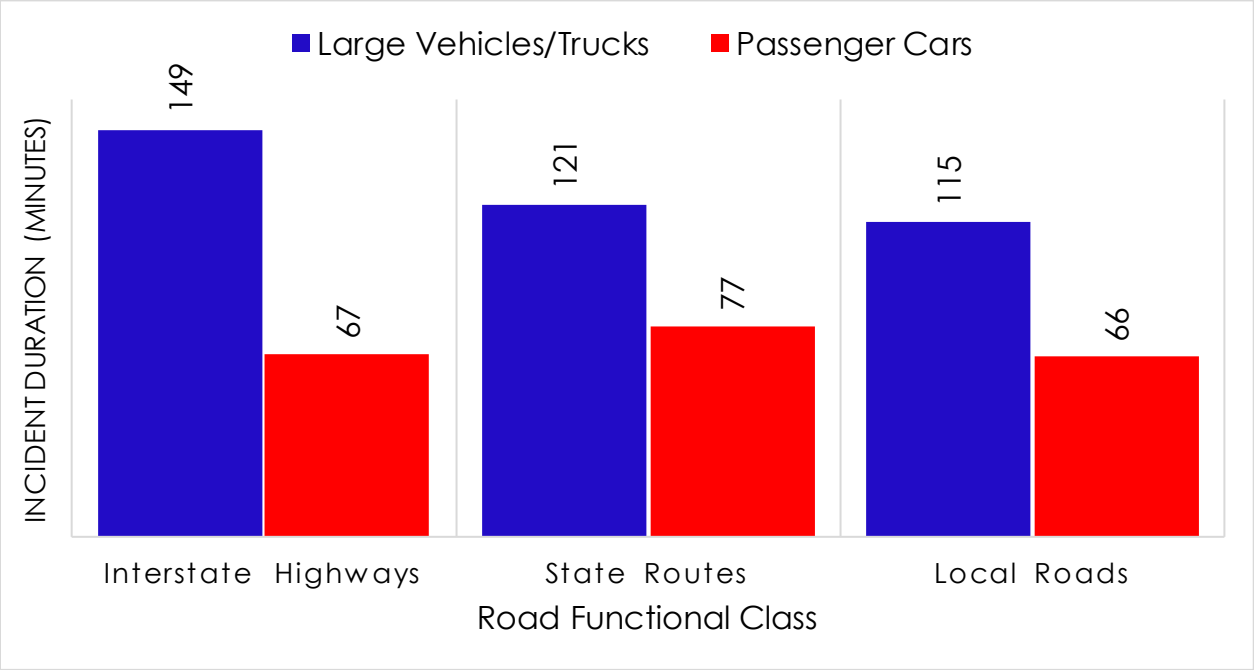


Figure 5.5: Distribution of Roadway Clearance Time based on Functional Class

### 5.2.4. Police Response Times

Table 5.1 summarizes police response time for different crash scenarios. The response is calculated by taking the difference of the time the officer was notified to the time the officer arrived at the crash site.

**Table 5.1: Average Police Response Time by Crash Scenario**

| | Crash Scenario | Police Response time (Minutes) |
|---|---|---|
| Towing involvement | Crashes Involving Towing | 12 |
| | Crashes Not Involving Towing | 8 |
| Large Truck Involvement | Crashes Involving Trucks | 10 |
| | Crashes Not Involving Trucks | 8 |
| Lane Blockage Involvement | Crashes resulting in lane blockage | 8 |
| | Crashes with no lane blockage | 8 |
| Crash Severity | Fatal Crashes | 14 |
| | Possible Injury Crashes | 7 |
| | Property Damage Only Crashes | 7 |
| | Suspected Minor Injury Crashes | 9 |
| | Suspected Serious Injury Crashes | 10 |
| | | |
| All Incident | All incident average response time | 9 |

## 5.3. THP Data Incident Response Duration

A total of 113,969 Crashes out of 1,579,465 incidents provided by THP had the following variables: blockage start date and time, blockage end date and time, blockage incident start date and time and blockage incident end date and time. These variables were therefore used to calculate the Roadway Clearance Time as follows;

$$\textbf{Roadway Clearance Time (RCT) (in Minutes)} = (\text{blockage start date and time}) - (\text{blockage end date time})$$

Among the 113,969 total crashes with recorded Roadway Clearance Time (RCT), nearly 99.94% resulted in lane blockages, with an average RCT of 74 minutes. For crashes involving trucks, the average RCT extended to 130 minutes, while incidents requiring towing had an RCT of 149 minutes, as detailed in Table 5.2.

Table 5.2: Average Roadway Clearance Times for Trucks and Towing Categories

| | Average Roadway Clearance Times (Minutes) |
|---|---|
| All Incidents Combined | 74 |
| | |
| Large Trucks Involved | 130 |
| Large Trucks Not Involved | 67 |
| | |
| Towing Involved | 149 |
| Towing Not Involved | 88 |

### *5.3.1. Variation of Roadway Clearance Times by Counties*

The distribution of Roadway Clearance Time (RCT) for incidents involving large vehicles across counties in Tennessee shows a notable trend where rural counties experience longer RCTs compared to their urban counterparts, Figure 5.6. Perry County ranks at the top with the highest RCT of 204 minutes. Other rural counties such as Hancock, Hickman, Van Buren, and Houston also report extended RCTs, ranging from 133 to 140 minutes. This pattern continues with

counties like Bledsoe, Humphreys, and Wayne, all exceeding an average RCT of 125 minutes. Even as we move lower in the ranking, rural counties maintain higher RCTs, with several counties like Montgomery, Clay, and Fayette observing RCTs well above 100 minutes. The trend persists down to Polk County, which still sees RCTs of 90 minutes, indicating that incidents in rural areas of Tennessee tend to result in longer traffic disruptions when large vehicles are involved. This data suggests that rural counties face unique challenges in incident clearance, possibly due to factors such as resource availability, response time, and logistical constraints. Figure 5.6 highlights counties with an average Roadway Clearance Time exceeding 90 minutes. This observation supports the idea of implementing an incentive program that assigns towing companies to specific geographical locations, as currently practiced in Virginia and Georgia under the TRIP program and in Florida under RISC program.

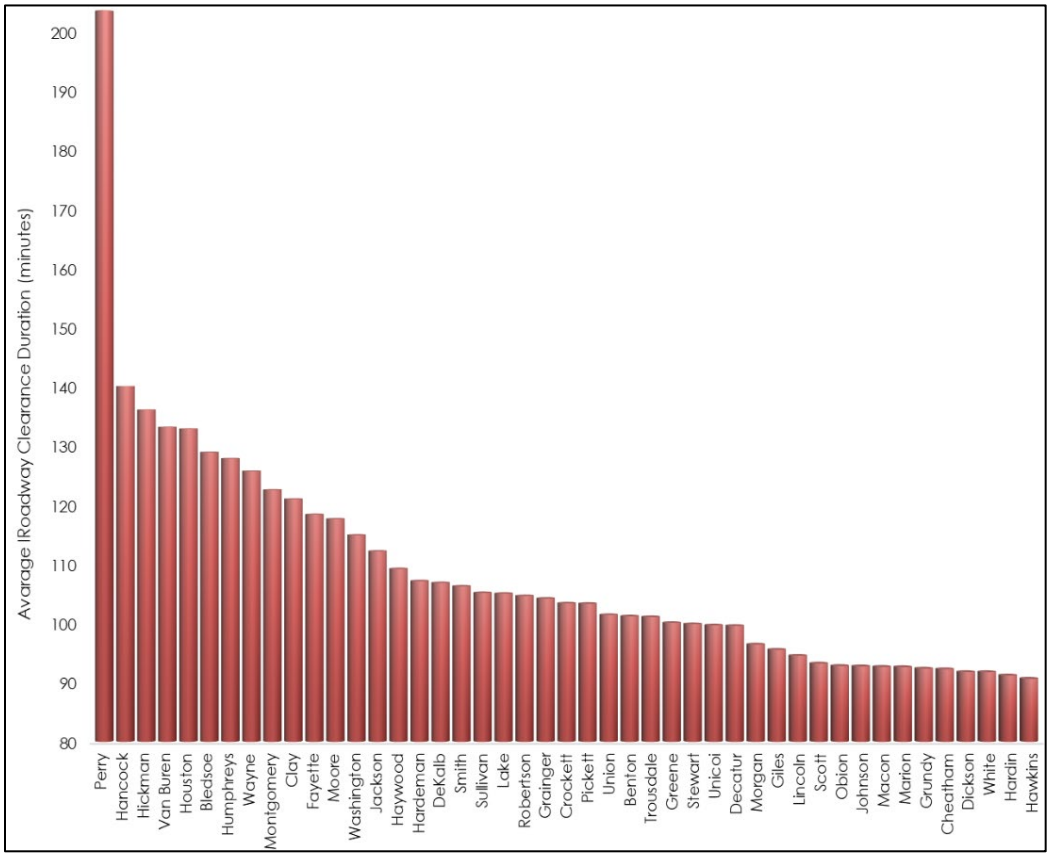

Figure 5.6. Top Counties with more than 90 Minutes Roadway Clearance Time

Overall, for all counties in Tennessee, out of 113,899 recorded lane blockage incidents with known start and end times, 11,872 involved trucks. Among these, Nashville and its surrounding areas (Davidson, Rutherford, Williamson, Wilson, and Sumner counties) accounted for nearly one-third of incidents involving large trucks. The average RCT in these five counties is only 68 minutes, despite handling many truck-related incidents. This suggests that both rural and urban areas are impacted by the challenges of clearing large truck incidents, but the impact may be more pronounced in rural areas. For example, in Perry County, 89% of the nineteen recorded incidents with durations that took over 80 minutes to be cleared and four truck-related incidents took more than 160 minutes to clear.

### 5.3.2. *Variation of Roadway Clearance Times by TDOT Regions*

The duration of incidents was also analyzed across TDOT regions to determine whether topographical variations between regions affected the time taken to clear incidents, as shown in Figure 5.7. Region 4, encompassing Shelby County and the Memphis area, recorded the highest average Roadway Clearance Time of 147 minutes, followed by Region 2 which includes Hamilton County, followed by Region 1, which includes Knoxville and northeastern counties. Region 3, covering the larger Nashville metro areas and middle Tennessee counties, had the shortest average Roadway Clearance Times. Also shown in Figure 5.7 are the variation of clearance time breakdown by truck involvement in the crash. The incidents in which the truck was involved in the crash had significantly higher Roadway Clearance Time compared to those where truck was not involved in all regions. In Region 1, the difference is 61 minutes, Region 2 is 69 minutes, Region 3 is 59 minutes and in Region 4 the difference is 74 minutes. Figure 5.8 shows the variation of RCT by interstate highways whereby I-55, I-240 and I-269 all in Memphis have the top three clearance times within this functional class. Figure 5.9 shows variation by cities in which Memphis has the highest duration.

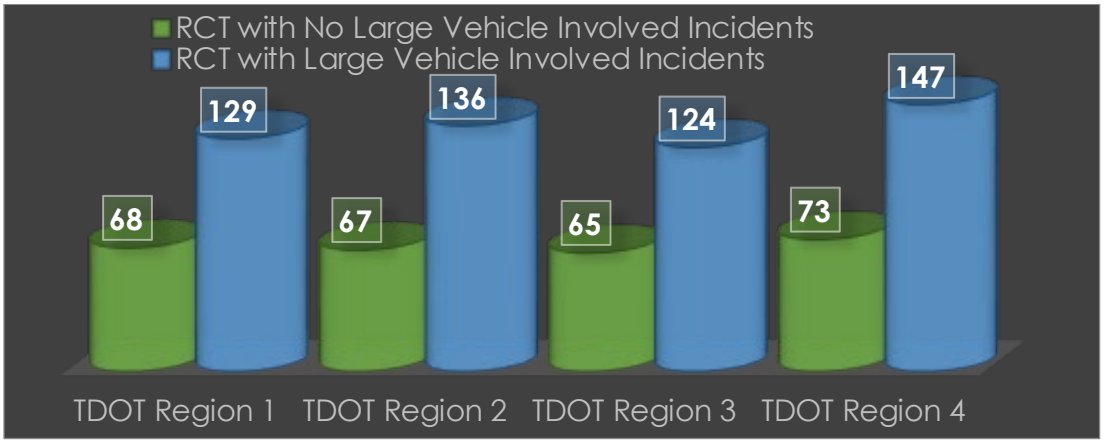


Figure 5.7: Variation of Roadway Clearance Times by TDOT Regions

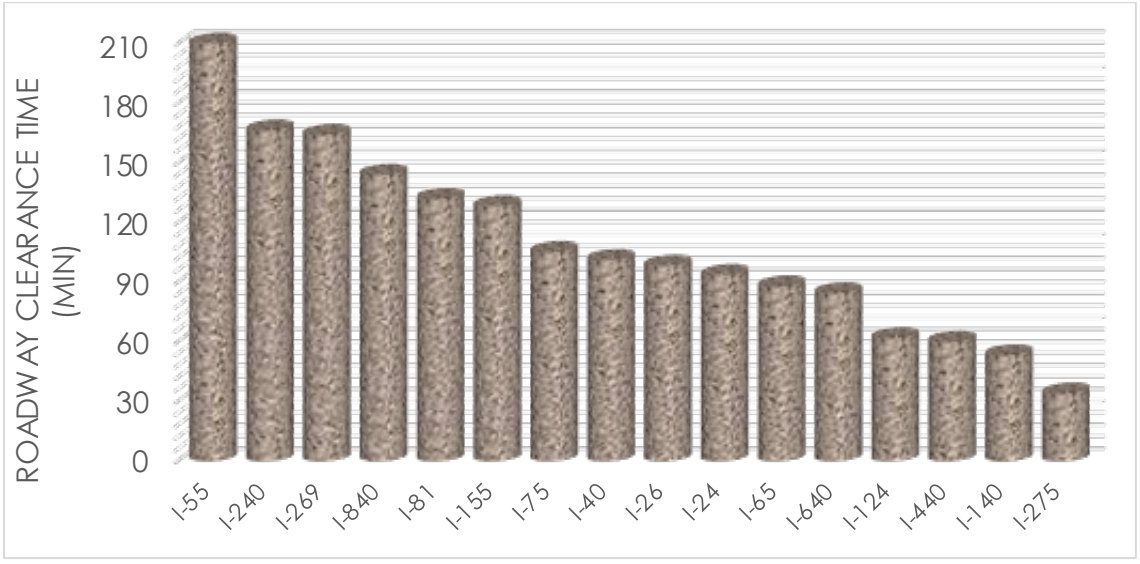


Figure 5.8: Variation of Roadway Clearance Times by Interstate Highways

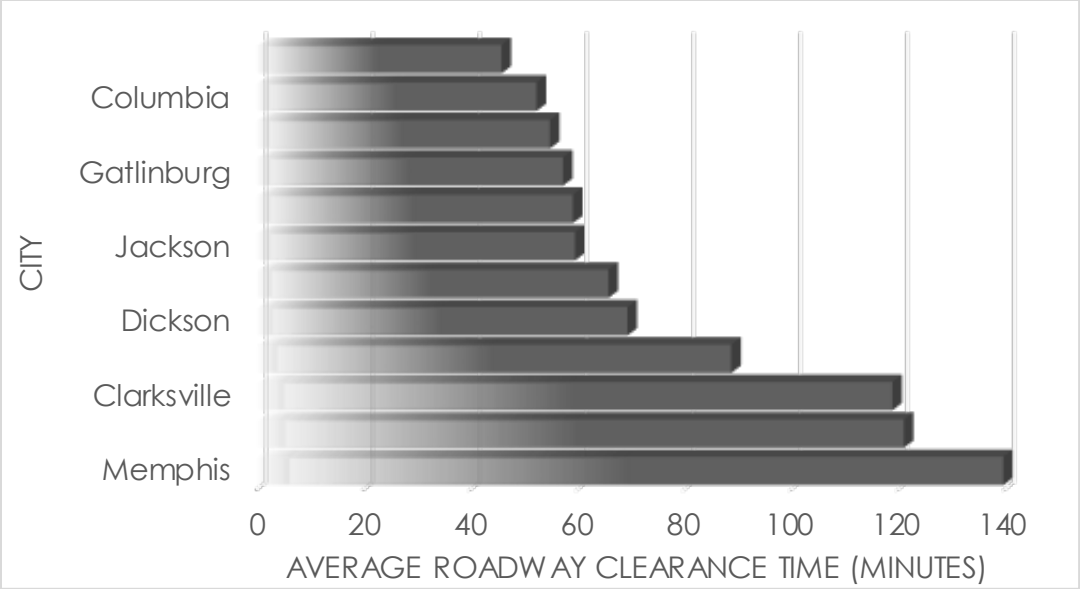


Figure 5.9: Variation of Roadway Clearance Times by Cities

### 5.3.3. Percentage Distribution of Roadway Clearance Times

Analysis shows that 59% of lane-blocking incidents were cleared within 30 to 60 minutes, while 22% were resolved between 61 and 90 minutes, Figure 5.10. Incidents cleared within 0 to 30 minutes accounted for 16% of cases, while those taking 91 to 360 minutes represented 18%. Only 1% of incidents lasted more than 6 hours. Approximately 18% of incidents took over 90 minutes to clear, most of these incidents that took such long to be cleared are believed to be associated with large vehicles.

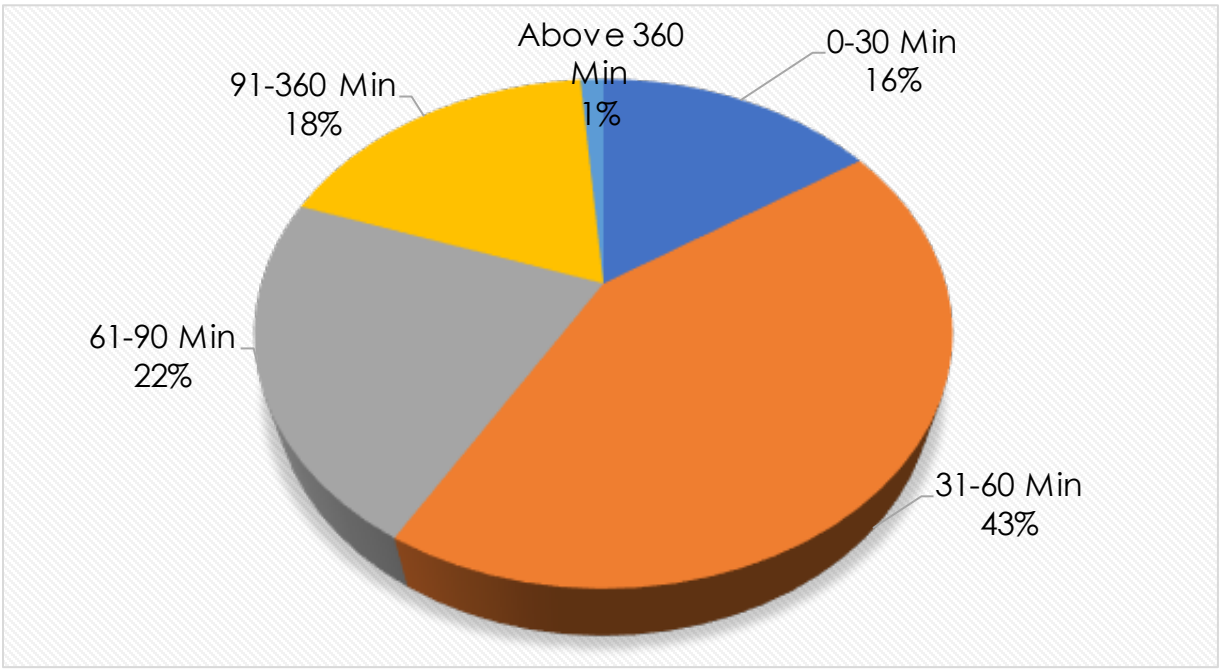


Figure 5.10: Percentage distribution of Roadway Clearance Times

### 5.3.4. *Impact of Roadway Clearance Time to Injury Severities*

Figure 5.11 illustrates the relationship between Roadway Clearance Times and injury severities. The majority of fatal and suspected serious injuries took place in incidents lasting over 60 minutes. It is worth noting that crashes involving fatal and serious injuries constituted 12% of total incidents (based on the FHP data provided with recorded durations). Approximately 17% of fatal crashes involved a truck, representing the highest proportion of crash outcomes related to truck involvement, as shown in Figure 5.11. Trucks also contributed to 12% of serious injury crashes while 88% of these types of crashes did not involve trucks. Figure 5.12 shows percentage distribution of the severities by roadway clearance times (RCT).

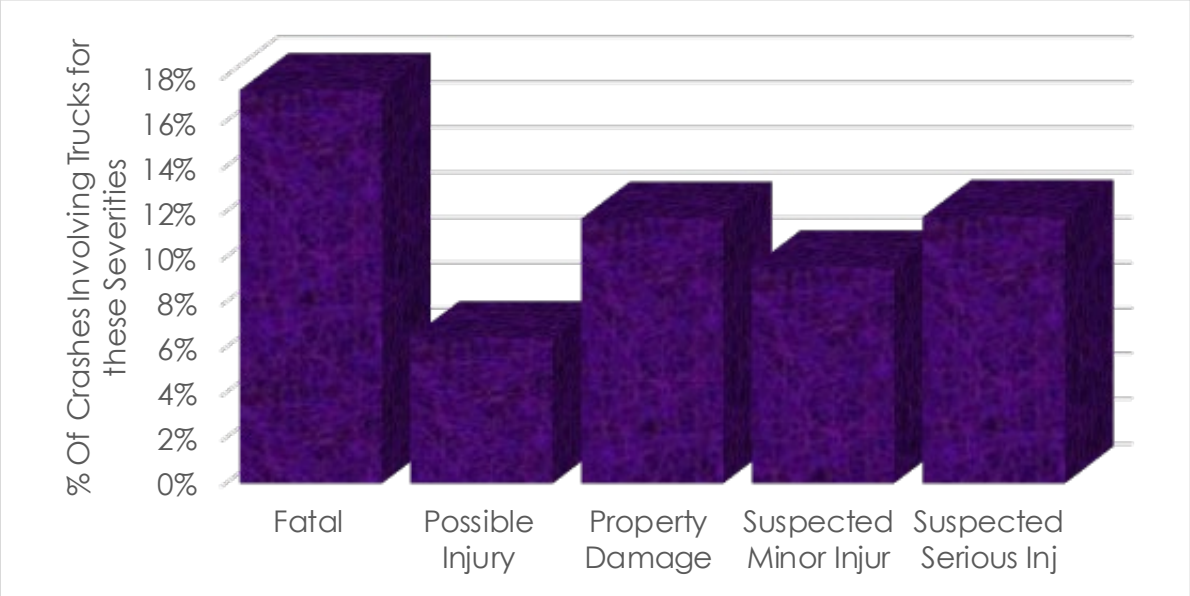


Figure 5.10: Percentage of Crashes Involving Trucks for each Injury Severity

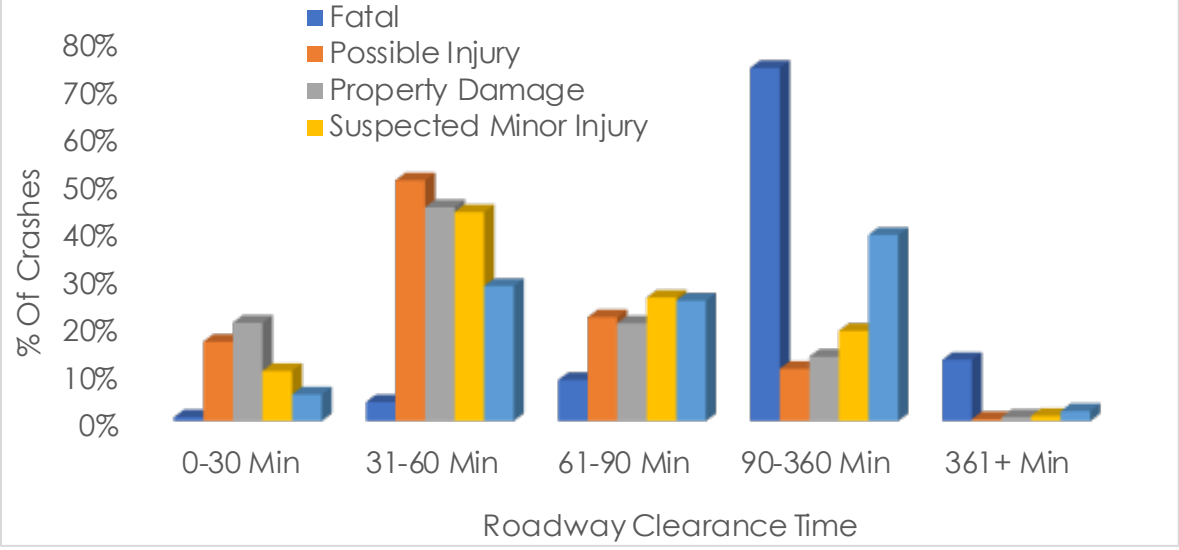


Figure 5.11: Crashes by Injury Severities per RCT Categories

## 5.4. Durations of Incidents Involving Large Trucks (THP Data)

The analysis specifically examined 11,872 crashes with recorded Roadway Clearance Times involving large trucks**.** The number of crashes involving non-large trucks was found to be inversely proportional to Roadway Clearance Time, whereas for large trucks, the number of crashes was directly proportional to Roadway Clearance Time. This indicates that incidents involving non-large vehicles generally took less time to clear, while large truck incidents required more time to resolve. The analysis revealed that 47% of incidents involving large trucks were cleared after more than 91 minutes. Additionally, around 6% of crashes involving large trucks were cleared after 360 minutes (6 hours), Figure 5.13.

*It is important to note that while there were more incidents involving trucks, the THP Data Analysis concentrated on those with documented start and end times (Roadway Clearance Times) only.*

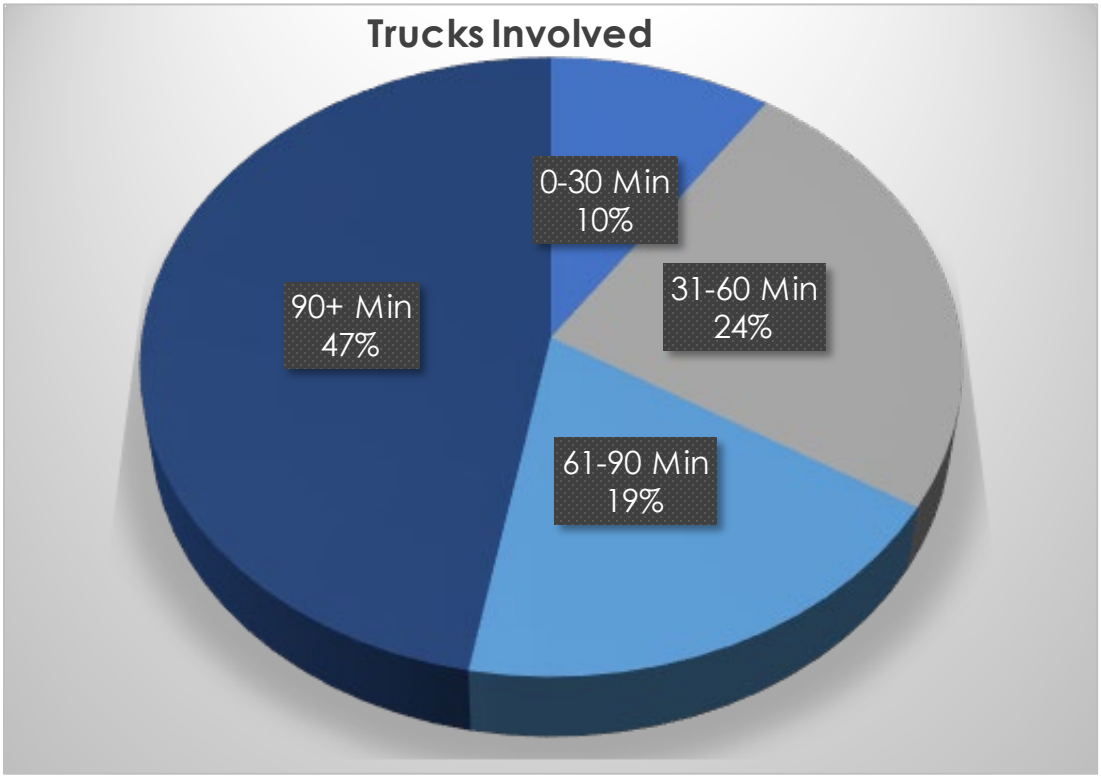


Figure 5.12: Incident Clearance Durations for Crashes that involved Trucks.

## 5.5. Incidents Involving Large Trucks by County (THP Data)

Table 5.3 presents the average duration of incidents involving large trucks by county. Nearly forty-five of the top counties with the longest truck crash clearance times are rural-based counties. More than 20 of these rural counties have clearance times exceeding three hours for crashes involving large trucks. Data analysis also showed that the average Roadway Clearance Time for truck crashes that required towing was about 153 minutes, while truck incidents that did not involve towing took roughly 94 minutes to clear.

Table 5.3: Average Roadway Clearance Times for Trucks by Counties

| County | # of Truck Crashes | Average Roadway Clearance Time | County | # of Truck Crashes | Average Roadway Clearance Time | County | # of Truck Crashes | Average Roadway Clearance Time |
|---|---|---|---|---|---|---|---|---|
| Polk | 25 | 247 | Haywood | 165 | 172 | Putnam | 184 | 129 |
| Hickman | 59 | 238 | Robertson | 301 | 171 | Overton | 33 | 128 |
| Lake | 6 | 231 | Obion | 68 | 166 | Warren | 68 | 127 |
| Perry | 4 | 230 | Bradley | 128 | 164 | Jefferson | 166 | 126 |
| Wayne | 26 | 229 | Monroe | 71 | 164 | Loudon | 195 | 126 |
| Pickett | 2 | 228 | Sullivan | 86 | 164 | Carroll | 57 | 126 |
| Houston | 12 | 221 | Lincoln | 64 | 163 | Carter | 88 | 126 |
| Moore | 16 | 220 | Jackson | 23 | 162 | Coffee | 189 | 124 |
| Sequatchie | 46 | 211 | Hancock | 7 | 162 | Wilson | 433 | 124 |
| Dickson | 175 | 208 | Montgomery | 152 | 162 | Maury | 205 | 124 |
| Crockett | 32 | 207 | Benton | 47 | 161 | Madison | 265 | 121 |
| Lewis | 10 | 201 | Grainger | 36 | 160 | Henry | 38 | 118 |
| Giles | 68 | 199 | Scott | 20 | 158 | Chester | 30 | 117 |
| Bledsoe | 29 | 197 | Greene | 193 | 158 | Stewart | 14 | 117 |
| Humphreys | 91 | 191 | Decatur | 26 | 156 | Weakley | 50 | 115 |
| Unicoi | 29 | 189 | Cumberland | 183 | 151 | Bedford | 126 | 115 |
| Cheatham | 118 | 188 | Shelby | 255 | 151 | Lawrence | 56 | 115 |
| Marshall | 79 | 186 | Campbell | 144 | 151 | McMinn | 173 | 114 |
| Morgan | 23 | 185 | Dyer | 96 | 149 | Cocke | 163 | 114 |
| Clay | 20 | 185 | Williamson | 372 | 146 | Hamblen | 111 | 110 |
| Macon | 33 | 185 | Union | 22 | 145 | Hamilton | 381 | 108 |
| Hardin | 54 | 183 | Fentress | 14 | 142 | McNairy | 73 | 106 |
| Fayette | 161 | 181 | Grundy | 77 | 141 | Anderson | 164 | 101 |
| DeKalb | 47 | 179 | Marion | 188 | 141 | Knox | 281 | 100 |
| Hardeman | 50 | 178 | Rhea | 54 | 138 | Blount | 118 | 99 |
| Trousdale | 28 | 178 | Roane | 275 | 138 | Gibson | 61 | 97 |
| Smith | 136 | 177 | Lauderdale | 51 | 138 | Franklin | 51 | 97 |
| Meigs | 18 | 177 | White | 44 | 137 | Sevier | 178 | 95 |
| Washington | 47 | 175 | Claiborne | 41 | 137 | Rutherford | 657 | 93 |
| Johnson | 39 | 174 | Henderson | 117 | 136 | Cannon | 16 | 90 |
| Van Buren | 18 | 173 | Hawkins | 62 | 134 | Davidson | 1984 | 86 |
| Tipton | 57 | 172 | Sumner | 324 | 130 | | | |

## 5.6. Police Response time by counties - Large Trucks (THP Data)

Table 5.4 shows the number of truck crashes and average police response times across various counties in Tennessee considering 60 minutes as the threshold which is twice the required response time considering free flow traffic as per towing regulation. The data provides valuable insights into the dynamics of emergency services in different counties. Analyzing the data, it becomes evident that there is considerable variation in police response times among the

counties. One noticeable trend is the inverse relationship between the number of truck crashes and average police response time in many instances. Urban areas, exemplified by Davidson County, tend to handle a significantly higher number of incidents with relatively low response times, possibly due to the presence of well-established emergency response systems and better infrastructure. Conversely, some rural counties, such as Hancock and Perry, maintain average police response times of more than 25 minutes despite fewer incidents. In comparison to all crashes police response time were relatively close to each other. The dataset underscores the importance of considering various factors, including population density, geographical challenges, and local emergency capabilities, to gain a comprehensive understanding of the observed patterns in police response times across different counties.

### 5.6.1. Police Response time by Metro areas - Large Trucks (THP Data)

Examining police response times in the Chattanooga, Knoxville, Memphis, and Nashville areas reveals noteworthy disparities between incidents occurring "Within the City" and those transpiring "Outside the City." Considering findings in Figure 5.14, in Chattanooga, the data indicates a relatively swift response time of 8 minutes within the city limits, suggesting a prompt and efficient deployment of police resources. However, this efficiency diminishes significantly to a 36-minute response time when incidents happen outside the city, pointing to potential challenges in responding to more remote locations. Contrasting this with other areas, Knoxville maintains an 8-minute response time within the city and a 16-minute response time outside, showcasing a less pronounced gap. Memphis displays a longer response time within the city of 14 minutes but a comparable 20-minute response time outside. Meanwhile, Nashville exhibits an impressive 7-minute response time within the city and a relatively short 13-minute response time outside. These variations highlight the diverse policing dynamics across these metropolitan areas, influenced by factors such as population density, geographical layout, and resource allocation strategies. Efficient resource distribution becomes crucial in optimizing response times and ensuring public safety in both urban and suburban contexts.

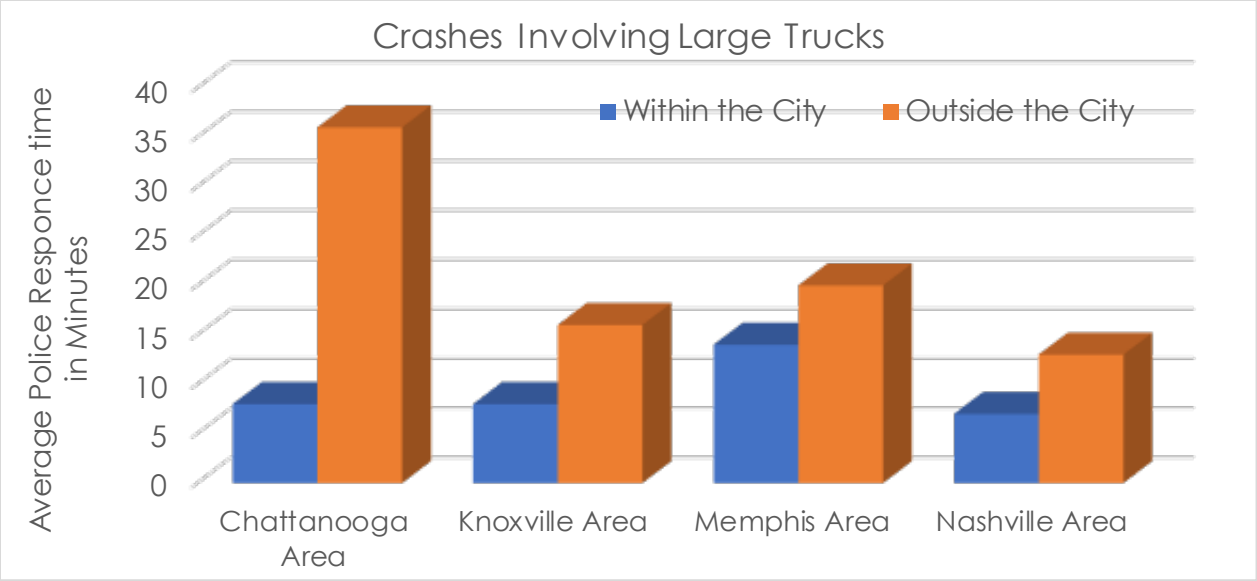


Figure 5.13: Large Vehicle Crashes Police Response Time: City vs. Outskirts

Table 5.4: Average Police Response Time for Trucks by Counties

| County | Number of Truck Crashes | Police Response Time (Trucks) | Police Response time (all Crashes) | County | Number of Truck Crashes | Police Response Time (Trucks) | Police Response time (all Crashes) |
|---|---|---|---|---|---|---|---|
| Hancock | 6 | 30 | 33 | DeKalb | 47 | 10 | 17 |
| Perry | 4 | 29 | 25 | Roane | 270 | 10 | 12 |
| Bledsoe | 24 | 25 | 27 | Cannon | 16 | 10 | 8 |
| Houston | 12 | 21 | 14 | Lawrence | 56 | 10 | 10 |
| Clay | 20 | 20 | 24 | McNairy | 73 | 9 | 10 |
| Morgan | 22 | 20 | 23 | Lauderdale | 50 | 9 | 13 |
| Grainger | 36 | 18 | 19 | Haywood | 162 | 9 | 10 |
| Humphreys | 86 | 17 | 20 | Cocke | 162 | 9 | 12 |
| Scott | 19 | 17 | 24 | Marshall | 78 | 9 | 9 |
| Union | 21 | 17 | 29 | Obion | 68 | 9 | 11 |
| Stewart | 12 | 17 | 16 | Macon | 32 | 9 | 13 |
| Jackson | 23 | 16 | 18 | Dickson | 172 | 9 | 10 |
| Washington | 43 | 16 | 15 | Sequatchie | 43 | 9 | 19 |
| Benton | 46 | 16 | 19 | Lincoln | 64 | 9 | 11 |
| Meigs | 17 | 16 | 15 | Fentress | 14 | 9 | 13 |
| Sullivan | 85 | 15 | 16 | Bradley | 126 | 8 | 10 |
| Hickman | 57 | 15 | 14 | Jefferson | 165 | 8 | 9 |
| Moore | 16 | 15 | 15 | Franklin | 50 | 8 | 12 |
| Greene | 191 | 15 | 15 | Weakley | 50 | 8 | 10 |
| Montgomery | 148 | 14 | 13 | Cumberland | 179 | 8 | 12 |
| Unicoi | 29 | 14 | 11 | Overton | 33 | 8 | 13 |
| Decatur | 26 | 14 | 10 | Dyer | 93 | 8 | 10 |
| Hawkins | 61 | 14 | 20 | Carter | 87 | 7 | 10 |
| Polk | 25 | 14 | 21 | Carroll | 57 | 7 | 10 |
| Chester | 30 | 13 | 14 | McMinn | 172 | 7 | 8 |
| Smith | 134 | 13 | 12 | Coffee | 186 | 7 | 8 |
| Van Buren | 17 | 13 | 16 | Gibson | 60 | 7 | 9 |
| Grundy | 73 | 13 | 16 | Davidson | 1972 | 7 | 7 |
| Fayette | 154 | 13 | 13 | Blount | 116 | 7 | 6 |
| Hardeman | 48 | 13 | 18 | Putnam | 180 | 7 | 9 |
| Wayne | 24 | 13 | 16 | Henry | 38 | 7 | 11 |
| Johnson | 33 | 12 | 19 | Wilson | 425 | 6 | 8 |
| Pickett | 2 | 12 | 7 | Williamson | 369 | 6 | 8 |
| Monroe | 63 | 12 | 14 | Sevier | 173 | 6 | 6 |
| Crockett | 31 | 12 | 17 | Maury | 201 | 6 | 6 |
| White | 42 | 12 | 18 | Rhea | 51 | 6 | 13 |
| Robertson | 296 | 11 | 13 | Anderson | 163 | 6 | 6 |
| Tipton | 56 | 11 | 13 | Sumner | 321 | 6 | 9 |
| Lake | 5 | 11 | 15 | Henderson | 113 | 6 | 8 |
| Cheatham | 115 | 11 | 14 | Warren | 67 | 6 | 9 |
| Campbell | 136 | 11 | 15 | Madison | 262 | 6 | 7 |
| Hardin | 53 | 11 | 13 | Hamilton | 369 | 6 | 6 |
| Knox | 279 | 11 | 9 | Hamblen | 111 | 6 | 8 |
| Giles | 67 | 10 | 13 | Shelby | 251 | 6 | 10 |
| Loudon | 192 | 10 | 14 | Bedford | 124 | 5 | 7 |
| Claiborne | 39 | 10 | 12 | Lewis | 9 | 5 | 6 |
| Trousdale | 26 | 10 | 13 | Rutherford | 654 | 5 | 5 |
| Marion | 183 | 10 | 10 | | | | |

## 5.7. Statistical Testing Comparing Roadway Clearance Times

Statistical tests were utilized to draw conclusions on the impact of different factors related to Roadway Clearance Times (RCT). These statistical tests provide a quantitative decision about how RCT varied across different observations. The statistical tests were applied and performed in STATA statistical software. Two sample t-tests which is used to compare RCT means from two groups. These two groups come from the observed data. In this THP data, groups included 1) whether a truck was involved or not, 2) whether towing was involved or not, 3) comparison of TDOT Regions etc. The two-sample t-test is applied to compare whether the average difference between two groups is significant or a result of random chance. The test helps to answer questions regarding whether the average Roadway Clearance Time was the same if the incident involved truck or not, towing or not, between TDOT regions, by injury severity etc. Two-sample t-test is based on the following formulation:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{{s_1}^2/n_1 - {s_2}^2/n_2}}$$

Where $\bar{x}_1$ and $\bar{x}_2$ are the means of the two samples, $s_1$ and $s_2$ are the standard deviations of the two samples, and $n_1$ and $n_2$ are the sizes of the two samples.

A common format for a hypothesis test is:

$H_0$: A statement of the null hypothesis, e.g., two population means are equal.

$H_a$: A statement of the alternative hypothesis, e.g., two population means are not equal.

### *5.7.1. Two Sample Test of Roadway Clearance Time Scenarios*

Table 5.5 presents a summary of the mean comparison tests for Roadway Clearance Time (RCT). This analysis compares the average RCT for incidents involving large trucks to those without, to assess the statistical significance of any difference observed. Incidents with large trucks reported an average clearance time of 130 minutes, in contrast to 67 minutes for those not involving trucks. The evaluation relies on the t-statistic and p-value to interpret the findings. A p-value of 0.05 or lower signifies a statistically significant difference between the two groups' Roadway Clearance Times at a 95% confidence level. Given a p-value of 0.0000 for the mean difference, the results indicate a significantly longer clearance time for crashes involving large trucks compared to those that do not. Further analysis explored differences in clearance times on interstate versus non-interstate highways. The outcomes, detailed in Table 5.5, show a mean clearance time of 149 minutes for interstates and 121 minutes for state routes, indicating a statistically significant longer duration for large truck crashes on interstate highways in Tennessee. Table 5.5 also documents significant statistical variations in Roadway Clearance Time concerning towing requirement, secondary collision occurrence, and HAZMAT (Hazardous Materials) involvement. Incidents requiring no towing were cleared 67 minutes faster than those necessitating towing. Moreover, secondary collisions resulted in longer clearance times, with a

significant increase compared to primary incidents—non-secondary crashes were cleared 73 minutes faster than secondary ones. Lastly, HAZMAT-involved crashes required substantially longer clearance times, averaging 200 minutes, compared to incidents without HAZMAT involvement.

Table 5.5: Summary of Two-Sample t-Tests on Roadway Clearance Tims

| **Response to be compared** | Comparable data | Mean Clearance duration | $H_o$ | $H_a$ (Alternative hypothesis) | Significant level | Difference is Statically significant |
|---|---|---|---|---|---|---|
| **Truck Involvement** | No | 67 | diff=0 | diff < 0 | Pr(T<t)=0.00 | YES |
| | Yes | 130 | | diff > 0 | Pr(T>t)=1.00 | |
| | Combined | 74 | | | | |
| | | | | | | |
| **Towing Involvement (Large Trucks Related)** | No | 88 | diff=0 | diff < 0 | Pr(T<t)=0.00 | YES |
| | Yes | 149 | | diff > 0 | Pr(T>t)=1.00 | |
| | Combined | 146 | | | | |
| | | | | | | |
| **Secondary Collion Incident** | No | 73 | diff=0 | diff < 0 | Pr(T<t)=0.00 | YES |
| | Yes | 98 | | diff > 0 | Pr(T>t)=1.00 | |
| | Combined | 74 | | | | |
| | | | | | | |
| **HAZMAT Involvement (Large Trucks Related)** | No | 127 | diff=0 | diff < 0 | Pr(T<t)=0.00 | YES |
| | Yes | 200 | | diff > 0 | Pr(T>t)=1.00 | |
| | Combined | 129 | | | | |
| | | | | | | |
| **Interstate Vs. Non Interstates** | Interstate Route | 149 | diff=0 | diff < 0 | Pr(T<t)=1.00 | YES |
| | State Route | 121 | | diff > 0 | Pr(T>t)=0.00 | |
| | Combined | 129 | | | | |

## 5.8. Chapter Summary on Roadway Clearance Times (THP Data)

This chapter offered a comprehensive analysis of crash data from the Tennessee Highway Patrol (THP) TITAN Business Unit, emphasizing the impact of large truck involvement on Roadway Clearance Time (RCT) and other factors. The dataset, encompassing 1,579,465 crashes between 2015 and 2022, reveals the Nashville metropolitan area, along with Shelby, Knox, and Hamilton counties, as the primary locales for incidents. A noteworthy finding is that only 7% of these crashes involved large trucks, a focal point of this study due to their significant impact on towing requirements and lane blockages. The analysis further digs into the distribution of RCT across different road functional classes, highlighting a pronounced increase in clearance times for incidents involving large trucks—particularly on Interstate routes, where such incidents took up to 149 minutes to clear, as opposed to 67 minutes for non-large truck incidents. This pattern extends to State Routes and local roads, underscoring the substantial delays large trucks contribute to overall traffic incident management. Moreover, the analysis established a correlation between RCT and the severity of injuries sustained in accidents. It was found that fatal

and serious injuries predominantly occurred in incidents that lasted over 60 minutes, underscoring the critical impact of timely incident clearance on reducing the severity of crash outcomes. Large trucks were notably involved in 17% of fatal crashes, marking the highest proportion of truck-related crash outcomes. Police response times, calculated from the notification to arrival at the crash site, also vary by crash scenario, with larger trucks and incidents involving towing or lane blockages generally requiring longer response times. The data indicates an average police response time of 9 minutes across all incidents, with specific scenarios such as fatal crashes or those involving large trucks showing slightly higher averages. An in-depth examination of RCT by county reveals that rural counties experience longer clearance times compared to urban areas, suggesting geographical and logistical challenges in managing roadway incidents involving large vehicles. The chapter highlights the disparities in RCT and police response times across Tennessee, pointing to the need for strategic resource allocation and response planning, especially in rural areas. Overall, the analysis emphasizes the geographical disparities in Roadway Clearance Times (RCT), particularly highlighting that rural counties face longer clearance times. This observation underscores the necessity for specific interventions in these areas to enhance incident management efficiency. The potential adoption of incentive-based towing programs, akin to those in Virginia, Georgia, and Florida, is suggested as a viable strategy to mitigate the challenges associated with clearing incidents involving large trucks, especially in less urbanized region, A significant portion of the analysis focuses on incidents involving large trucks, revealing that these incidents not only take longer to clear but also have a higher incidence of requiring towing services and resulting in lane blockages. The study suggests that large truck crashes, especially those necessitating towing or involving HAZMAT materials, disproportionately extend clearance times, thereby impacting traffic flow and safety. Non-parametric statistical tests were utilized to validate the significance of the differences in RCT, considering factors such as truck involvement, towing requirements, occurrence of secondary crashes, and HAZMAT involvement. The findings underscore a statistically significant longer clearance time for large truck incidents, particularly on interstate highways. This analysis is crucial for understanding the specific impacts of large truck crashes on roadway clearance efficiency and informs recommendations for improving traffic incident management practices, particularly in the context of large vehicle involvement. These findings provide valuable insights for TDOT and stakeholders in the development of targeted interventions and programs to improve incident response and management, with an emphasis on reducing clearance times.

# Chapter 6 Towing Regulations Impact on Incident Durations (THP Data)

## 6.1. Overview

To better understand the dynamics of incident clearances on Tennessee's roadways, this analysis embarks on a deep dive into the Tennessee Highway Patrol (THP) incident data, juxtaposing it with the towing regulations of the state's major cities. At the heart of this examination is an attempt to discern how current towing practices and associated regulations might be influencing the duration and efficiency of incident resolutions. By delving into the nuances of these regulations, and comparing them with real-world incident data, we aim to identify patterns and correlations that can offer a more holistic view of the on-ground situation. This preliminary overview sets the stage for a comprehensive exploration of potential impacts and areas of refinement within the towing regulatory framework of Tennessee.

## 6.2. Towing in Major Tennessee Metropolitan Areas

The study explored the influence of towing regulations on incident durations in Tennessee's major counties and cities. Data has been categorized based on major cities or metro areas, using major cities as reference points. This categorization aids in comparing roadway clearance times in relation to the number of observed crashes and understanding how towing regulations might impact incident durations using the provided accident data. Table 6.1 shows major cities and counties covered in this analysis with a total of 4,431 towing - related crash instances. Figure 6.1 shows distribution of crashes that involved towing large vehicles in Tennessee major metro areas. As shown in Figure 6.1, in the Memphis Metropolitan Area, 325 crash incidents that involve towing large vehicles were recorded with an average incident duration of 190 minutes. This duration seems to be very high, which validates the exploration of potential avenues for refining towing procedures and improving emergency response alignment with existing regulations. Conversely, the Chattanooga Metropolitan Area reported 608 events averaging a duration of 156 minutes. The clearance time in Chattanooga seems to be less by 34 minutes to that of Memphis despite of Memphis having a smaller number of sample size but scored more time (190 minutes) for clearance, it's vital to consider that factors other than towing regulations could contribute to some variance as two cities are geographically and terrain wise different. Also, Memphis is bordered by some major urban areas in Mississippi whose incidents are not included in this analysis. In Knoxville, where 927 incidents were documented, the average incident duration time is approximately 137 minutes. Knoxville data also suggests that towing rules might also be instrumental in bolstering response efficiency and overall incident resolution, irrespective of the incident count. This notion is further underscored when considering that Memphis, with three hundred and twenty-five recorded events, averaged an incident duration of 190 minutes. Figure 6.2 shows the distribution of RCT for Crashes not Involving Towing in Metro areas.

Table 6.1: Major Cities in Tennessee and Counties Covered in this Analysis.

| Major City in Consideration | Counties Covered in this Analysis | Number of Crash Incidents |
|---|---|---|
| Nashville Metro (2,571 Crashes) | Davidson | 1,085 |
| | Rutherford | 382 |
| | Williamson | 263 |
| | Wilson | 301 |
| | Sumner | 213 |
| | Cheatham | 93 |
| | Robertson | 234 |
| Memphis Metro (325 Incidents) | Fayette | 116 |
| | Shelby | 171 |
| | Tipton | 38 |
| Chattanooga Area (608 Incidents) | Bledsoe | 24 |
| | Bradley | 101 |
| | Meigs | 15 |
| | Rhea | 42 |
| | Hamilton | 234 |
| | Marion | 156 |
| | Sequatchie | 36 |
| Knoxville Area (927 Incidents) | Anderson | 80 |
| | Blount | 73 |
| | Jefferson | 123 |
| | Grainger | 27 |
| | Knox | 174 |
| | Loudon | 146 |
| | Roane | 213 |
| | Sevier | 76 |
| | Union | 15 |

In the Nashville Metropolitan Area, a staggering 2,571 incidents were recorded, averaging a duration of 132 minutes each. This interplay between regulatory standards, response efficiency, and the volume of incidents underscores the intricate challenges of incident management. These observations from these major metropolitan areas in Tennessee spotlight the vast array of challenges influenced by towing regulations, encompassing response times, resource deployment, and collaborative coordination efforts. Together, these elements shape the efficacy of crash-towing endeavors in Tennessee's major cities. Towing regulations represent just one aspect of a multifaceted incident management process. The findings accentuate the ongoing relevance of towing regulations, especially in areas with a higher frequency of crashes. The data underscores the pivotal role of towing regulations in navigating the complexities of incident management. These rules significantly influence the effectiveness of crash-towing procedures in the state's principal urban centers by shaping response durations, optimizing resource deployment, and guiding overarching coordination efforts.

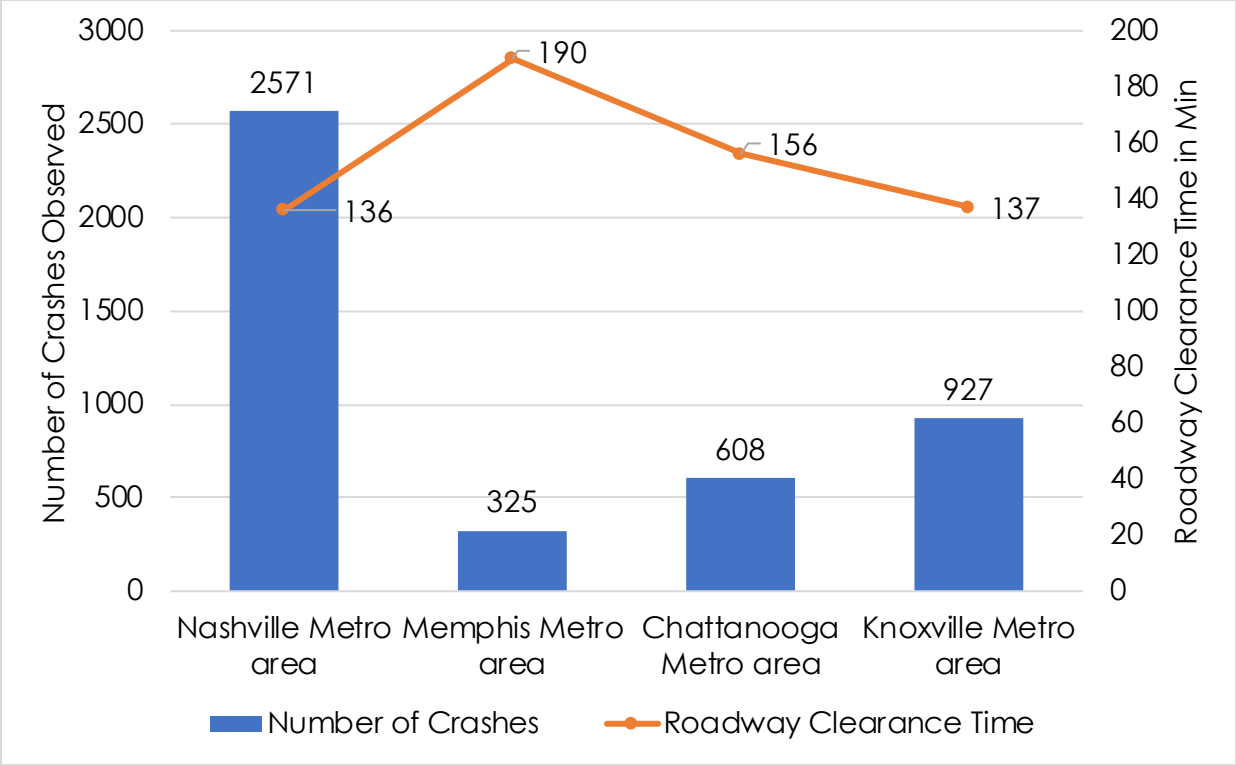


Figure 6.1: Distribution of RCT for Crashes Involving Towing in Metro areas

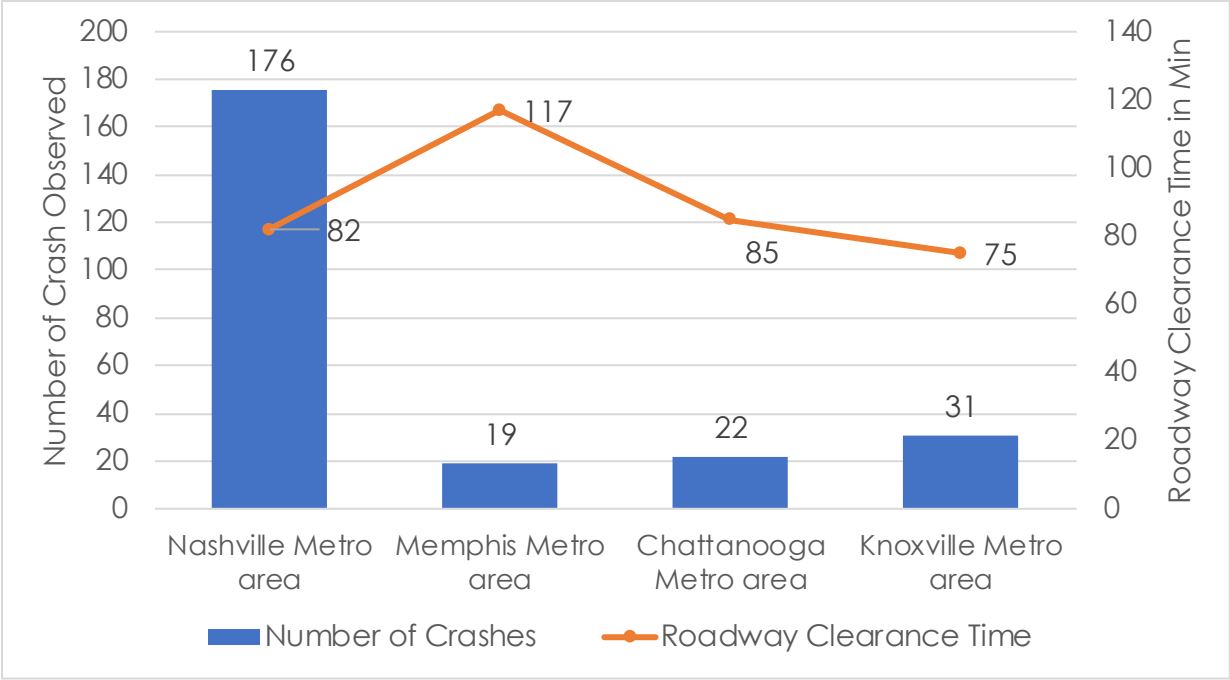


Figure 6.2: Distribution of RCT for Crashes not Involving Towing in Metro areas

Figure 6.3 presents a heat map depicting the distribution of large truck crash incidents in Tennessee. Clearly, Nashville stands out with a pronounced heat signature, signaling a considerably higher number of incidents compared to other significant cities in the state. This visualization strongly corroborates the data from Figure 6.1, which similarly indicated that the Nashville metropolitan area witnesses a disproportionately larger number of vehicle incidents, especially when juxtaposed with cities like Memphis. A crucial point to emphasize is the unique infrastructure of the Nashville metropolitan area. It's a network of transportation, with multiple freeways and interstate highways crossing the region. This includes major roadways such as I-40, I-24, I-65, Briley Parkways, I-440, and SR 840. Each of these highways bears a substantial volume of traffic daily, and a significant fraction of this traffic comprises large commercial vehicles. The confluence of these highways in one metropolitan area, combined with the sheer volume of large vehicles they facilitate, potentially contributes to the elevated number of incidents observed in Nashville.

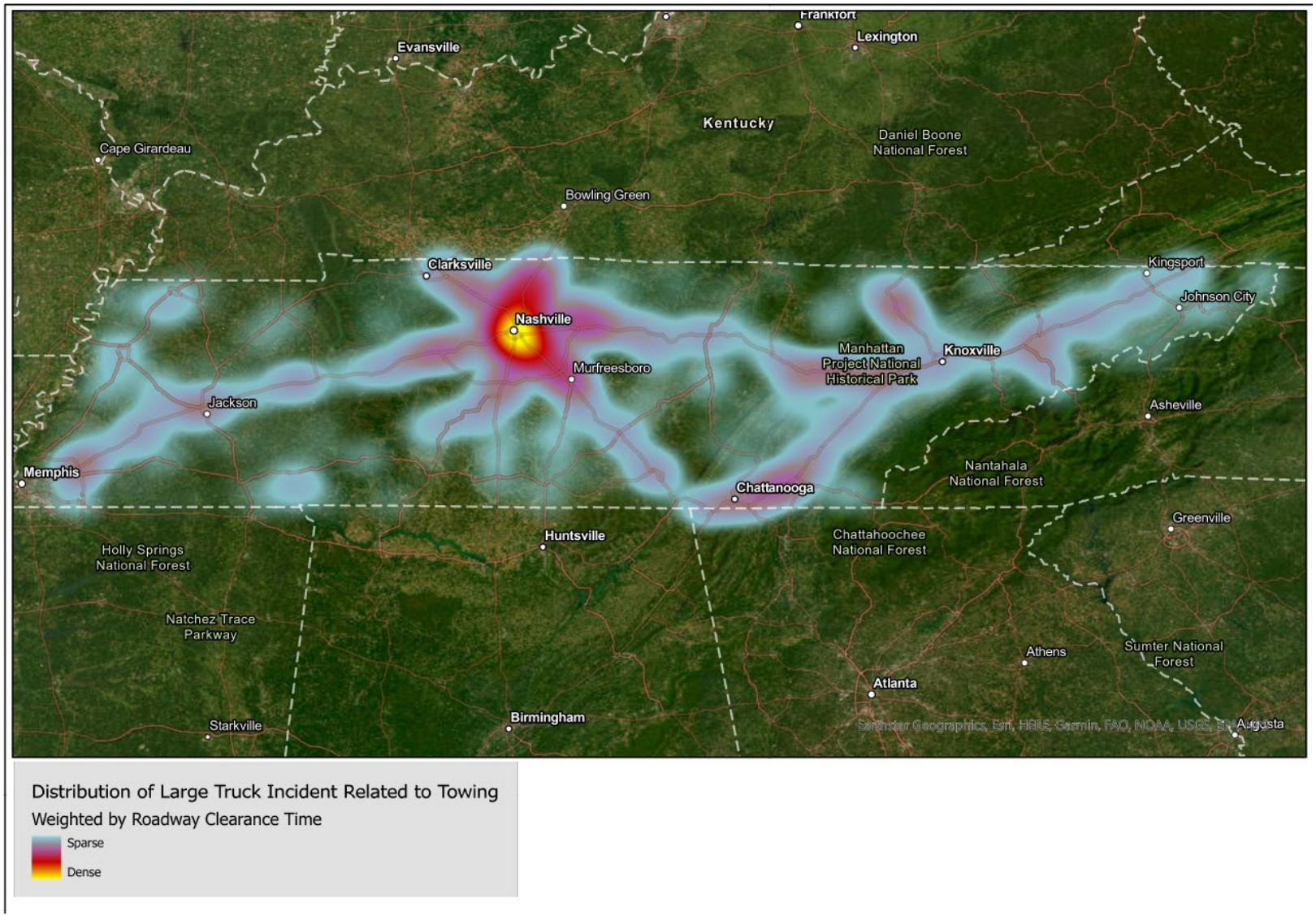


Figure 6.3: Heat Map for the Distribution of Large Truck Incident Related to Towing

## 6.3. Roadway Clearance time by counties – Towing involved

In the analysis, it was observed that certain counties, such as Lake, Lewis, Moore, Houston, Polk, Hickman, Macon, and Perry, experienced a relatively low number of crashes related to towing, typically less than 20 incidents per county. However, despite the low number of incidents, these counties exhibited extended clearance times, often exceeding three hours. This finding suggests that rural counties are grappling with incident clearance challenges compared to their urban counterparts. This contrast is evident when comparing these rural counties with Davidson County. Despite Davidson County having a higher frequency of crashes related to towing, they managed to clear incidents in less than two hours.

## 6.4. Implications to Local Jurisdictions Towing Regulation

While some of Tennessee's major cities towing regulations lack explicit language pertaining to large commercial vehicles, the general towing regulations still positively impact incident durations in some counties. It is evident that shorter incident durations can be linked to the effectiveness of the existing towing regulations in these areas, fostering efficient incident management. These regulations probably address factors like towing response times, tow truck availability, and coordination with emergency services.

### *6.4.1. Response time impact to total roadway clearance time*

Table 6.2 offers a comparative analysis of major metropolitan area jurisdictions in Tennessee, detailing their respective general towing regulations, stipulations specific to large vehicle towing, and the average incident durations (measured in minutes) that necessitate towing. As illustrated in the table, local regulations actively guide towing service providers. The towing regulations in these cities can be linked to the duration it takes to clear incidents, especially those for large vehicles. For instance, Metro Nashville's stipulations for Davidson County require service providers to arrive at crash scenes within a stringent 30-minute timeframe following the initial dispatch call, granted the weather conditions are permissible. Such mandates significantly drive the impetus for swifter response times, which invariably affects the total duration it takes to clear a roadway post-incident. From the observation in literature review and interview with officials from states where towing incentives are in place, emphasizing rapid responses serves multiple purposes: it not only streamlines the process of incident management but also considerably minimizes the extent of traffic disturbances. The direct implication of such a strategy is a marked reduction in incident durations. When towing service providers act swiftly following crashes, ensuring the efficient removal of the affected vehicles, the likelihood of subsequent accidents and extended road blockages diminish. Such proactive measures consequently stave off severe traffic congestion and potential logjams, especially crucial in high-density areas.

A closer examination, particularly of bustling metropolitan hubs like Nashville, illuminates the effectiveness of these regulatory frameworks. Literature shows that despite the inherent challenges posed by densely populated urban areas, notorious for frequent vehicular incidents, rigorous standards for response times manifest in commendable roadway clearance durations can be achieved in part through improved towing regulations.

Table 6.2: Correlation of Towing Regulations and Incident Durations

| Jurisdiction | General Towing regulation | Large vehicle Towing regulation | Average incident duration with Large Vehicles towing (min) |
|---|---|---|---|
| **Chattanooga Metro Area** | Licensing and Certification<br>Consensual and nonconsensual towing<br>Towing authorization (12hrs)<br>Recovery and Incident management<br>Trained personnel<br>Response time - 30min on clear weather after Dispatch<br>Towing equipment and capacity<br>Insurance coverage<br>Towing rate and storage fee | • Towing fee<br>• Pay by Pound for salvage, debris recovery<br>• Charges for exposure to hazardous and flammable materials<br>Sec.35-160 | 156 Minutes<br># of Incidents 608 |
| **Knoxville Metro Area** | Licensing and Certification<br>Maintaining towing list<br>Consensual and nonconsensual towing<br>Towing Equipment's<br>Trained personnel<br>Liability insurance for nonconsensual tows<br>Consensual and nonconsensual towing<br>Towing authorization (12hrs)<br>Cleaning when removing vehicles<br>Maintaining rotation list for wrecker services<br>Insurance coverage<br>Towing rate and storage fee | • Towing fee<br>• Hourly rate (Only if required)<br>• Winching Charge, per hour<br>• Storage Charge (For open or covered storage)<br>• Extra man power (Only if required)<br>• Spills requiring chemical agents for clean-up, only by the request of a police officer<br>• Mileage charge<br>Sec.26-302 | 137 Minutes<br># of Incidents 927 |
| **Memphis Metro Area** | Licensing and Certification<br>Towing rate and storage fee<br>Removal of accident debris<br>Towing authorization<br>Reporting accidents and scene calls<br>Insurance coverage<br>Cleaning when removing vehicles | • Towing fee<br>• Cleanup of hazardous materials not excess of 300 gallons<br>Sec.6-88-12 | 190 Minutes<br># of Incidents 325 |
| **Nashville Metro Area** | Licensing and Certification<br>Towing rate and storage fee<br>Liability Insurance<br>Towing authorization<br>Towing rate and storage fee<br>Signage<br>Towing equipment and capacity<br>Inspection and maintenance of vehicles<br>Emergence wrecker service<br>Cleaning when removing vehicles | • Towing fees<br>• Mileage charge<br>• Hourly rate for necessary preparation or removal of bumpers, drive shafts before towing is possible, and recommendation after towing<br>• Labor rates after first hour<br>• Storage fee<br>Sec. 6.80.550 | 132 Minutes<br># of Incidents 2571 |

## 6.5. Comparing Roadway Clearance Times Among Major Cities in Tennessee

A two-sample mean test was employed to compare the mean incident durations involving large vehicles across major cities in Tennessee. The two-sample t-test is a statistical technique used to determine if there is a significant difference between the means of two independent groups. To assess the variations in mean incident durations among major cities and their surrounding areas in Tennessee, a comprehensive analysis was undertaken. Results from this comparison are presented in Table 6.3. The data indicates significant differences in incident durations involving large vehicles, especially those requiring towing, between the Chattanooga and Nashville areas, the Memphis and Nashville Metro, the Memphis and Knoxville areas, and the Chattanooga and Knoxville areas. Factors such as towing and enforcement policies might account for some of these observed differences. However, no significant disparities in incident durations were identified between the Knoxville and Nashville areas or between the Memphis and Chattanooga areas, as their durations were nearly identical. Analysis also compared the duration of incidents within the city and outside the city. The average large vehicle related incident duration within the city is 118 minutes and outside the city is 156 minutes, which is significantly statistically different.

Table 6.3: Statistical Comparison of Mean Incident Durations Among Major Cities

| Response | Comparable data | Mean Clearance duration | $H_o$ | $H_a$ (Alternative hypothesis) | Significant level | Statistically significant |
|---|---|---|---|---|---|---|
| Roadway Clearance Time | Knoxville Area | 137 | diff= 0 | diff < 0 | Pr(T<t)= 0.8282 | No |
| | Nashville Metro | 132 | | diff > 0 | Pr(T>t)= 0.1718 | No |
| | Chattanooga | 156 | diff= 0 | diff < 0 | Pr(T<t)= 0.9999 | No |
| | Nashville Metro | 132 | | diff > 0 | Pr(T>t)= 0.0001 | Yes |
| | Memphis Metro | 190 | diff= 0 | diff < 0 | Pr(T<t)= 1.0000 | No |
| | Nashville Metro | 132 | | diff > 0 | Pr(T>t)= 0.0000 | Yes |
| | Memphis Metro | 190 | diff= 0 | diff < 0 | Pr(T<t)=1.0000 | No |
| | Knoxville Area | 137 | | diff > 0 | Pr(T>t)= 0.0000 | Yes |
| | Chattanooga | 156 | diff= 0 | diff < 0 | Pr(T<t)= 0.9973 | No |
| | Memphis Metro | 190 | | diff > 0 | Pr(T>t)= 0.0027 | Yes |
| | Chattanooga | 156 | diff= 0 | diff < 0 | Pr(T<t)= 0.0096 | Yes |
| | Knoxville Area | 137 | | diff > 0 | Pr(T>t)= 0.9904 | No |
| | Inside the City Center | 126 | diff= 0 | diff < 0 | Pr(T<t)= 1.000 | No |
| | Outside the City | 182 | | diff > 0 | Pr(T>t)= 0.000 | Yes |

Figure 6.4 presents a comparative analysis of large vehicle incident durations within and outside major city areas in Tennessee. A close examination of the data reveals insightful patterns and potential reasons for variations in incident durations. In the Chattanooga Area, incidents within the city are resolved on average, 48 minutes faster than those outside the city. Knoxville displays a different pattern to Chattanooga; it clears the incident with a 36-minute longer duration for incidents outside the city. Memphis Area recorded the clearance in city in 38 minutes less to outside the city. Nashville Area incidents clear approximately 44 minutes faster within the city than outside. Digging deeper into these variations in Figure 6.4 indicates the variations in large

vehicle incident clearance durations, both within city limits and on the outskirts, can be directly linked to towing practices, regulations, and policies. Inside these cities, stringent regulations often mandate prompt response times from towing service providers, and the dense network of service providers can often reach incident sites quickly. This efficiency is bolstered by city policies aiming to reduce traffic disruptions and enhance urban mobility even though the towing regulations are not clearly laid in the city codes. In contrast, the outskirts or less urbanized areas might lack such rigorous enforcement or might be serviced by fewer towing companies. As a result, the response and clearance times can be longer. Furthermore, the infrastructure and equipment necessary for large vehicle towing might be more readily available in urban centers of these major cities in Tennessee due to the higher frequency of such incidents. The observed extended clearance times outside cities could also be a consequence of longer travel distances for towing services, potential difficulties in accessing remote locations, and the lack of stringent regulatory oversight. This comparative data underscores the importance of adapting towing practices and policies to specific geographical and infrastructural contexts.

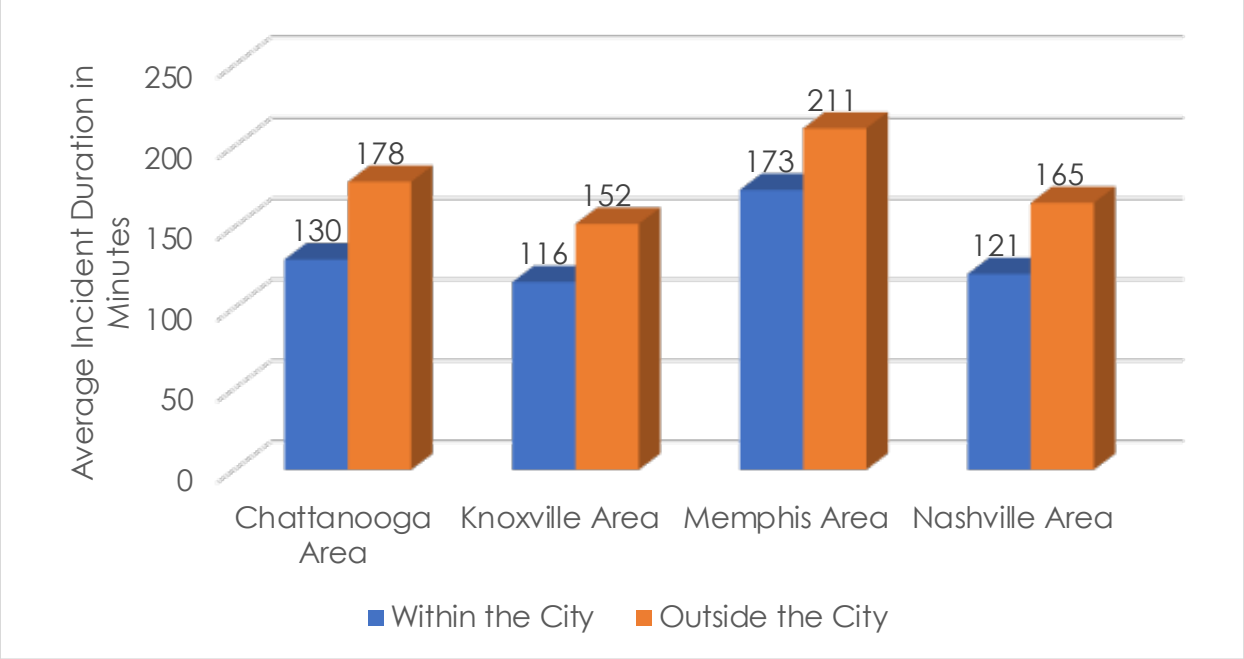


Figure 6.4: Large Vehicle Incident Clearance Durations: City vs. Outskirts

When examining towing practices across various states, it's evident that the large vehicle crashes clearance times for roadways in Tennessee's major cities (Nashville, Knoxville, Chattanooga) are significantly longer than the average times documented in Virginia and Georgia for 2021 and 2022. This difference is particularly striking given that states like Virginia and Georgia benefit from specific initiatives, such as the Towing and Recovery Incentive Program, designed to expedite the clearance of major commercial vehicle incidents. The extended clearance durations in Tennessee might stem from unique traffic patterns, emergency response strategies, or other state-specific factors. The average roadway clearance time for incidents involving large vehicles in Virginia and Georgia under TRIP program are 79 minutes and 87 minutes respectively [2,3], Figure 6.5. On the

other hand, the Florida Turnpike, which operates under the Rapid Incident Scene Clearing (RISC) program, reported prolonged road clearance times in the fiscal year 2016/2017 compared to other states and urban areas in Tennessee. This observation underscores the notion that the efficacy of towing strategies can greatly differ, even when bolstered by specialized programs.

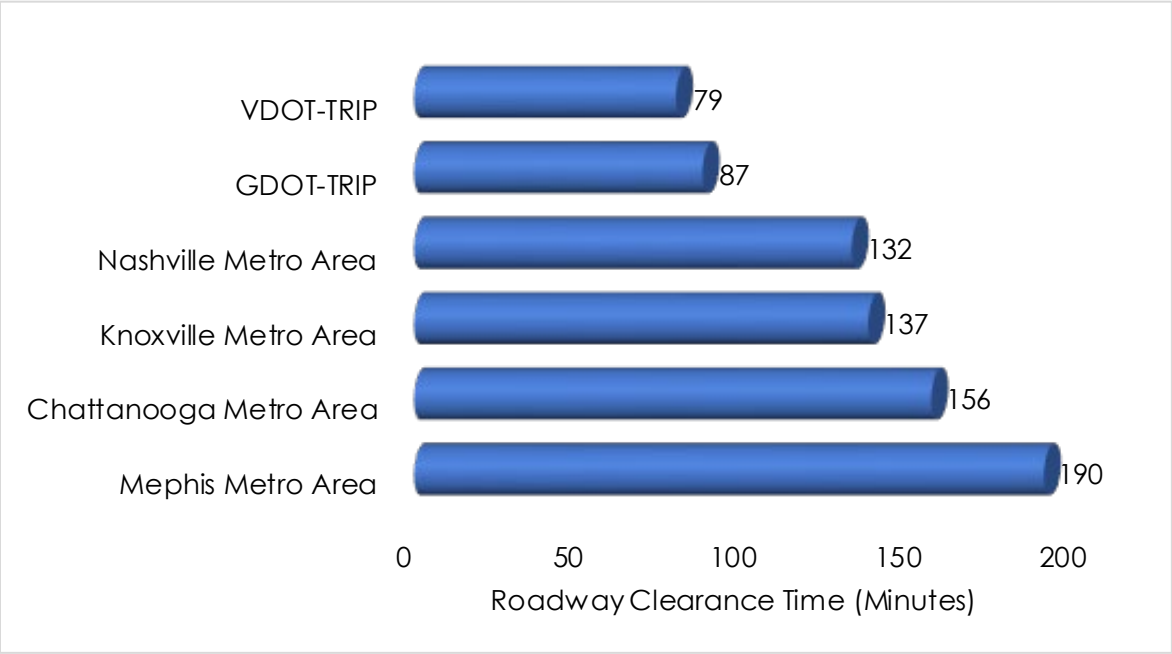


Figure 6.5: Comparative Average Roadway Clearance Time with TRIP Programs

## 6.6. Chapter Summary

This chapter analyzed the impact of towing regulations on incident durations within the context of Tennessee's major metropolitan areas, comparing these findings with the Towing and Recovery Incentive Program (TRIP) initiatives in Virginia and Georgia. The analysis utilizes Tennessee Highway Patrol (THP) data to explore how towing practices and regulations influence the resolution efficiency of roadway incidents, particularly those involving large vehicles. In Tennessee's major cities—Nashville, Knoxville, Chattanooga, and Memphis—the study finds considerable variation in the average duration of incidents requiring towing. Memphis reported the longest average incident duration at 190 minutes, followed by Chattanooga, Knoxville, and Nashville, with the latter averaging 132 minutes per incident. These durations underscore the challenges and complexities of managing large vehicle crashes, especially in urban settings with dense traffic and varied infrastructure.

The analysis also highlights the extended clearance times in rural counties compared to urban ones like Davidson County, suggesting a disparity in towing response efficiency across different regions. This disparity points to the potential benefits of targeted interventions and improved towing regulations to enhance clearance times in less urbanized areas. The implications of local towing regulations on incident management efficiency are significant.

In areas with stringent towing regulations, such as Nashville, where service providers are required to arrive within 30 minutes under clear weather conditions, shorter incident durations are observed. This suggests that well-defined towing regulations, coupled with effective enforcement, can lead to more efficient incident clearance. A statistical comparison of mean incident durations among major cities reveals significant differences, indicating that local policies, towing practices, and geographical factors may contribute to these variations. The comparison further suggests that incidents within city limits are resolved more quickly than those outside, likely due to better towing infrastructure and stricter regulatory enforcement in urban areas.

The comparison with TRIP programs in Virginia and Georgia reveals a stark contrast, with Tennessee's major cities experiencing longer roadway clearance times for large vehicle incidents. Virginia and Georgia, with average clearance times of 79 and 87 minutes respectively under the TRIP program, demonstrate the efficacy of incentive-based towing initiatives in reducing incident durations. This suggests that adopting similar incentive-based programs in Tennessee could potentially improve clearance times and overall traffic management efficiency.

Overall, the examination of the Tennessee Highway Patrol (THP) incident data in tandem with state towing regulations reveals a pronounced relationship between these regulations and incident durations on Tennessee's roads. When observed across major metropolitan areas, there exists a broad variance in towing-related crash instances and corresponding clearance times. While the Nashville Metropolitan Area exhibits a high number of incidents, its average clearance duration is notably less than that of Memphis. The data makes evident the correlation between regulatory norms, response efficiency, and incident volume, emphasizing the pivotal role of towing regulations in the efficient handling of crash incidents. Key findings highlight that Nashville has the most significant number of incidents, especially involving large commercial vehicles, largely due to its intricate transportation infrastructure. This intricacy underscores the challenges posed to incident management. Notably, incidents within city confines tend to resolve faster than those outside, potentially due to stringent city regulations, dense networks of service providers, and availability of towing infrastructure. Yet, areas outside cities might face extended durations due to factors like limited towing services, infrastructural challenges, and less regulatory oversight. Moreover, when Tennessee's major city clearance durations are contrasted with those in Virginia and Georgia, Tennessee's times are notably prolonged. States such as Virginia and Georgia, which have adopted programs to expedite clearance, report significantly shorter durations, underscoring the potential benefits of such initiatives. The data emphasizes the urgent need for TDOT to carefully evaluate and refine the towing regulations, harnessing insights from other states and considering local specificities, to significantly reduce roadway incident durations.

# Chapter 7 Analysis of Primary CMV Crashes Impact on Secondary Crashes

## 7.1. Introduction

Secondary crashes occurring as a result of primary incidents were also evaluated. A detailed analysis of crashes derived from these incidents (which are termed as secondary crashes) was undertaken. Building on the foundational analyses of incidents involving large vehicles, towing operations, and their intricate implications on road safety within Tennessee, this chapter further connects the complex relationship between primary incidents and the emergence of secondary incidents and crashes. The focus is on the dynamics introduced by large vehicle incidents and the critical role of towing in incident management as well as the effects these primary incidents have on subsequent roadway safety challenges. In the context of large vehicles playing a significant role in both the frequency and severity of roadway incidents, this analysis aims to address how these primary incidents act as catalysts for secondary crashes. Recognizing the significant impact of large vehicle breakdowns, collisions, and the subsequent towing operations on traffic flow and safety, analysis investigate into the mechanisms through which these events precipitate further incidents down the road—both literally and figuratively. The analysis examines the Time Gap and Distance Gap between primary and secondary incidents, aiming to quantify the direct and indirect influences exerted by the initial event on the roadway environment. This quantitative approach is pivotal in identifying patterns and risk factors associated with the transition from primary to secondary incidents, thereby offering a more granular understanding of the challenges at play. Analysis also includes towing impact on secondary collision bringing a critical aspect of incident management into focus. Given the prominence of towing operations in the aftermath of incidents involving large vehicles in Tennessee, understanding its role provides a comprehensive view of the incident lifecycle. These secondary crashes analysis connects with previous discussions into a coherent narrative that not only highlights the complexities inherent in managing traffic incidents involving large vehicles but also sheds light on the pivotal moments and decisions that can influence the trajectory towards safer roadways in Tennessee.

## 7.2. Identifying Secondary Crashes

A computer script was developed in Python to identify secondary crashes resulting from primary incidents. Four predetermined conditions were established to classify a crash as "secondary," as shown in Figure 7.1:

i. The crash must have occurred on the same route and in the same direction as the primary crash.
ii. The crash must have occurred on the same day as the primary incident.
iii. The crash time must be after the start and before the clearance time of the primary incident.

iv. The spatial distance between the incident location and the crash location must be within two miles.

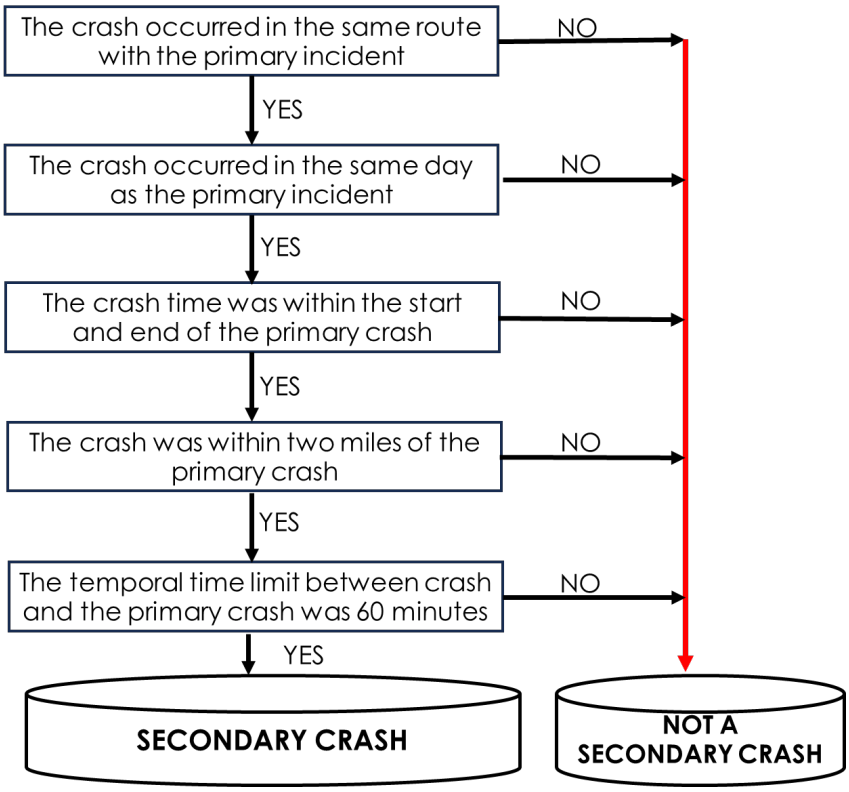


Figure 7.1: Flow Chart for Secondary Crashes Identification

The initial step involved categorizing collisions as either "Primary" or "Secondary" using the THP data. This categorization is based on specific conditions related to the route, collision date, time, and log mile, aiming to enhance the understanding of collision patterns and identify secondary incidents influenced by proximity in time and location. The dataset contained diverse information about traffic collisions, including details such as route name, collision date, collision time, log mile, latitude, longitude, and other relevant attributes. The data was imported into a Pandas DataFrame, and the 'Collision Time' was converted to datetime format to facilitate temporal analysis. To streamline the analysis, the DataFrame was sorted based on 'TDOT_Route', 'Collision Date', and 'Collision_DateTime'. A new column, 'Primary/Secondary Collision', was added to the DataFrame and initialized with the value "Primary." To identify secondary collisions, an iterative process was employed to consecutively evaluate collisions along the same route. The developed algorithm iterated through each collision record, considering route continuity, date and time proximity, and log mile proximity. The 'Primary/Secondary Collision' column is dynamically updated based on the outcomes of these evaluations. The results of the categorization process, providing an enriched dataset with the classification of each collision as either "Primary" or "Secondary," were obtained. To validate the temporal and spatial patterns of the traffic crashes, analyses were conducted using ArcGIS, and manual checks were performed by examining the relationship between primary and secondary crashes in terms of date, time, and location, Figure 7.2.

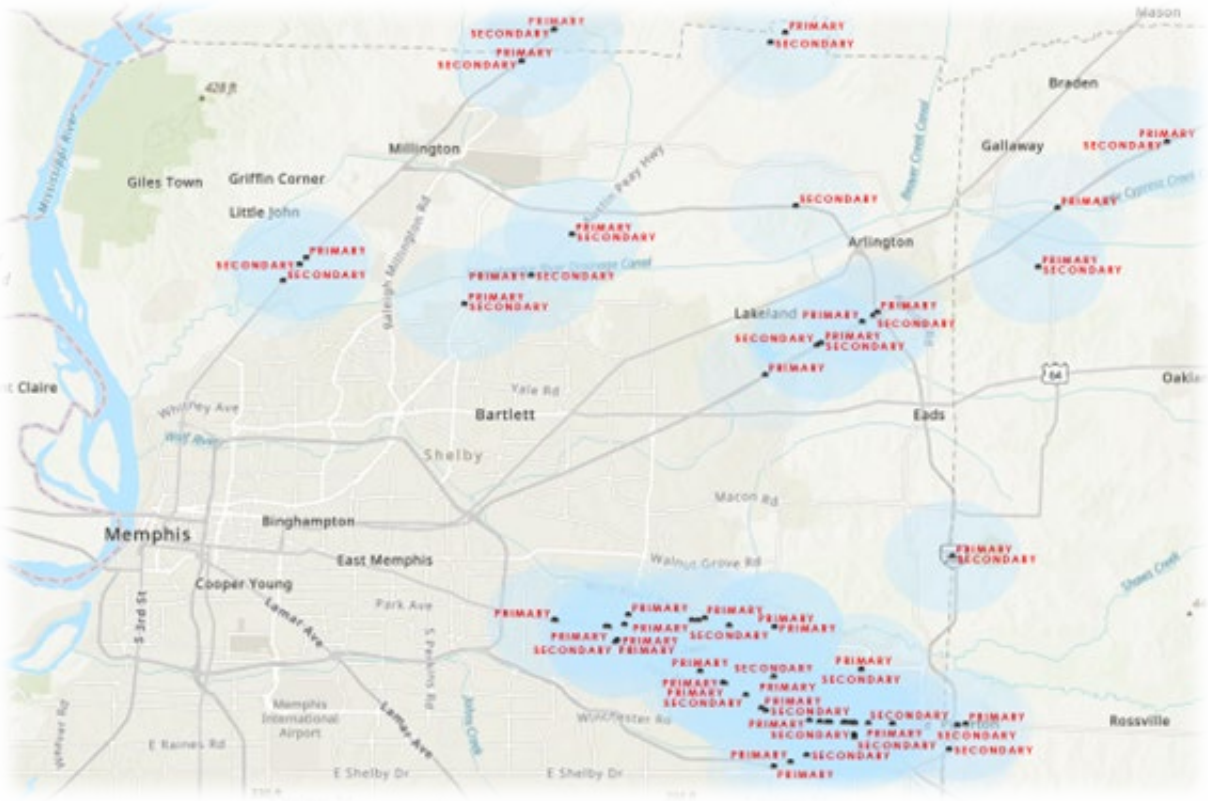


Figure 7.2: ArcGIS Output Validation - Crashes within 2 miles buffer zone

## 7.3. Descriptive Statistics of Identified Secondary Crashes

In a dataset encompassing a total of 113,969 incidents with recorded incident durations, the methodology employed successfully identified 1,017 secondary crashes. Upon detailed analysis, it was noted that the distribution of these secondary crashes exhibited distinct patterns across different times of the day, Figure 7.3. Specifically, 35% of the secondary crashes occurred during evening peak hours, morning peak hours accounted for 27% of the secondary crashes, nighttime incidents 23% and noon time about 15%. The analysis of secondary crash data highlights key insights into crash severities, weather conditions, and police response times. A significant portion of these crashes, 54%, resulted in property damage only, while suspected minor injuries and possible injuries were noted in 20% and 16% of the cases, respectively. Suspected serious injuries and fatalities were less common, reported in 8% and 2% of the incidents, respectively. Most of these incidents, 61%, occurred in clear weather, suggesting that adverse weather conditions were less influential, contributing to 39% of the crashes. Regarding response times, law enforcement demonstrated commendable efficiency, arriving within 30 minutes in 94% of the cases. Only a small fraction, 5%, saw police response times between 31 to 60 minutes, and a mere 1% experienced delays beyond 60 minutes.

About 71% of the identified secondary crashes occurred within the city boundaries while 29% took place outside the city limits, Figure 7.4. Most of primary crashes which resulted with induced

secondary crashes didn't have specification about the towing situation. Only 101 crashes out of 1,017 identified secondary crashes were marked with information about towing involvement. Within this small sample, it was observed that 94% of secondary crashes involved towing services, while the remaining 6% did not require towing assistance.

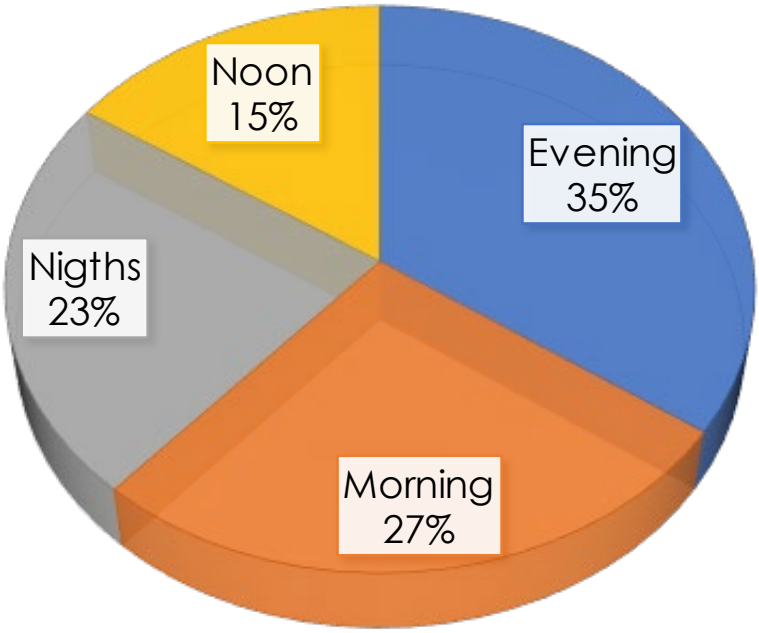


Figure 7.3: Distribution of Crashed by the Time of the Day


Figure 7.4: Secondary Crashes Distribution by City Limits

## 7.4. Factors Affecting Secondary Collision

To identify the factors influencing the occurrence of secondary collisions, an analysis of the time gap and distance gap was conducted. The aim was to understand the temporal and spatial aspects that contribute to the occurrence of secondary collisions. This comprehensive analysis involves assessing the time intervals between incidents as well as the distances separating them. By examining these factors, valuable insights can be gained into the patterns and potential correlations that may exist, providing a foundation for further understanding the dynamics of secondary collisions and informing strategies for improved traffic safety and incident response.

### *7.4.1. Distance and Time Gap Analysis*

The relationship between primary and secondary incidents can be characterized by time and distance gaps. In associating primary incidents and secondary crashes, the direction of travel is an important aspect which highlights two relationships into consideration.

- The time elapses between the occurrence of primary incident and secondary crash in the same direction known as “time gap”.
- The distance between primary and secondary incident location in the same direction known as “distance gap”.

Calculation of the time gap between primary incident and secondary crash involved differentiating the start times of the identified primary-secondary pairs. The distance between primary incident and secondary crash was determined through computing the differences between their mile mark locations. Figure 7.5 shows distribution of secondary crashes with time gap. Figure 7.6 shows distribution of secondary crashes with distance gaps. The time-gap distribution indicates that a large portion of secondary crashes occurred within 20 minutes after their primary incidents. The finding concurs with that by Zhang and Khattak [21] which found that secondary incidents typically occur within 20 minutes after primary incident. Figure 7.6 shows that most secondary crashes occurred within 1.5 miles. In general, the average distance and time gap from primary to secondary crash was about 0.4 miles and 18 minutes respectively.

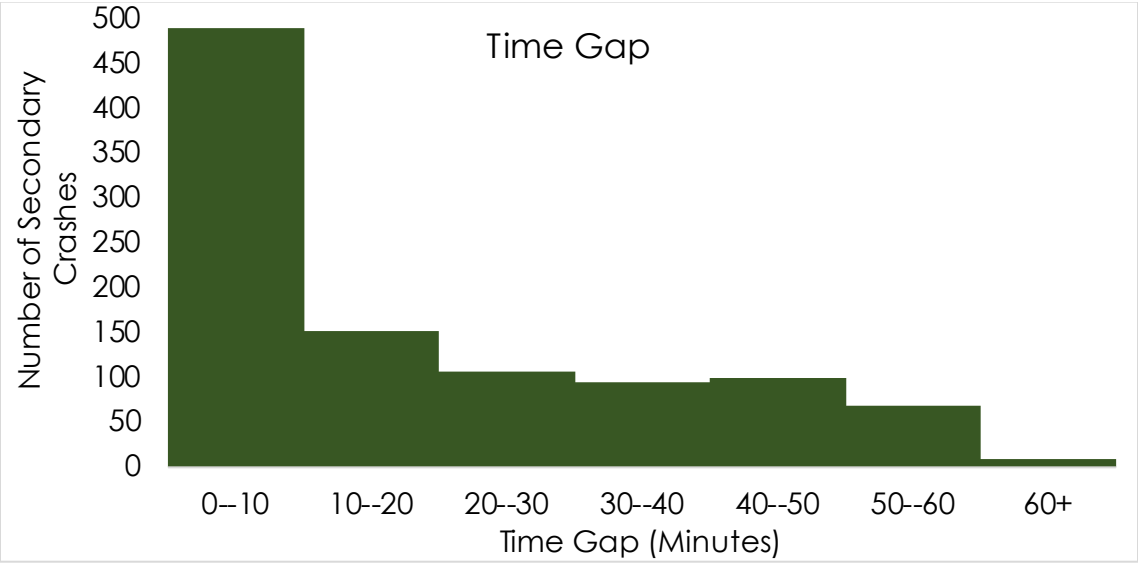


Figure 7.5: Time Gap Distribution to Secondary Crashes

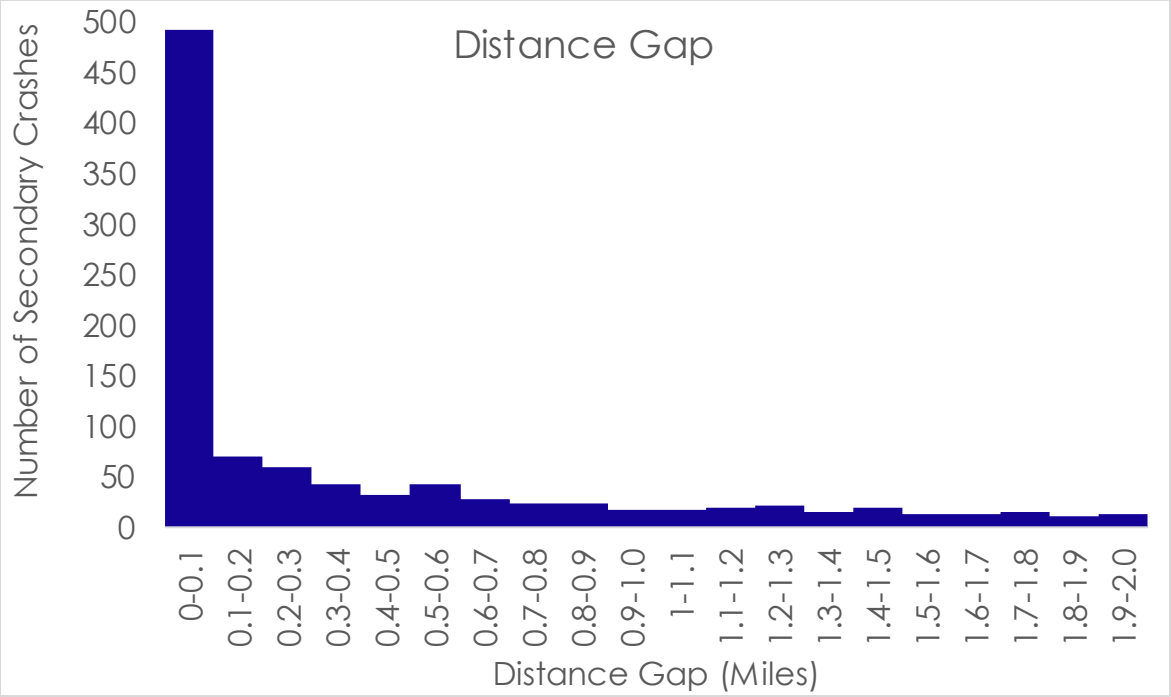


Figure 7.6: Distance Gap Distribution to Secondary Crashes

### *7.4.2. Factors Affecting Time Gaps*

Factors affecting time gap were analyzed through statistical modeling utilizing hazard-based survival models. Generally, the literature indicates that the hazard-based approach is a convenient way to interpret duration associated with a dynamic sequence of conditional probabilities of incidents. As this study focused on the incident duration with the aim of evaluating the role of large vehicles and towing impacts, Log-logistic Hazard-Based duration model was utilized. Using Log-logistic hazard-based model, the incident durations were modeled as a continuous variable. The aim of the modeling was to evaluate the impact of different roadway and traffic variables to the incident duration. Parametric formulation of the baseline hazard function requires a distribution assumption. The hazard function, which is the conditional probability of an end-of-incident (e.g. the incident being cleared), given that the incident has lasted for some specific time is given as [22]: A log-logistic regression model was employed to investigate the factors influencing the time gap between primary and secondary collisions. The analysis utilized a 95% confidence level to assess the statistical significance of predictor variables, judging their impact based on a p-value threshold of less than 0.05, Table 7.1. Interpreting weather conditions outcome, adverse weather conditions are associated with a shorter time gap between the primary and secondary collisions. The time so secondary crash showed a reduction in the time gap between primary and secondary collisions, particularly during peak hours. This phenomenon may be attributed to rush hours, creating traffic queues that increase the likelihood of closely spaced collisions. The congestion and increased volume of vehicles during peak hours can contribute to a more immediate succession of crashes, highlighting the impact of traffic patterns on the temporal dynamics of road incidents. Collisions at intersections and incidents

involving large trucks are associated with an increase in the time gap. Longer incident durations may involve prolonged clearance and cleanup efforts, requiring more time for emergency response teams to address the aftermath of the primary collision. This extended duration can result in a decreased time gap between primary and secondary crashes, as subsequent incidents may occur before the full resolution of the initial collision.

Table 7.1: Factors affecting the time gap between primary and secondary crashes

| Time Gap | Coefficient | Z-Statistic | P-Value |
|---|---|---|---|
| Bad Weather Conditions | -0.2232 | -2.710 | 0.007 |
| Evening Time | -0.1477 | -1.290 | 0.198 |
| Morning Time | -0.2862 | -2.350 | 0.019 |
| Nighttime | -0.3262 | -2.390 | 0.017 |
| Collision at Intersection | 0.3334 | 3.760 | 0.000 |
| Large Truck Involved | 0.2691 | 2.200 | 0.027 |
| Incident Duration | -0.0008 | -3.990 | 0.000 |
| Cons | 3.0452 | 28.110 | 0.000 |

### *7.4.3. Factors Affecting Distance Gaps*

Factors affecting distance gap were analyzed through linear regression. Linear regression, which is also known as Ordinary Least Squares (OLS) is a modeling technique that is used to model a single response variable. At a very basic level, the relationship between a continuous response variable Y, in this case distance gap and an explanatory variable X may be represented using a line of best-fit. If this relationship is linear, it may be appropriately represented mathematically using the straight-line equation 7.1 which can be graphed [23].

$$Y=\alpha+\beta x \quad (7.1)$$

The OLS regression model can be extended to include multiple explanatory variables by simply adding additional variables to the equation. The form of the model is the same as of equation 7.1, but this time Y is predicted by multiple explanatory variables X.

$$Y = \alpha + \sum_{k=1}^{n} \beta_i X_i \quad (7.2)$$

Where α is the model constant and β is the variable coefficient.

As some of the distance gaps were very small number, the dependent (response) variable was modeled as the natural logarithm of the distance gap, i.e. Ln(Y) instead of Y. Each ß parameter indicates the average change in Y that is associated with a unit change in X, whilst controlling for the other explanatory variables in the model.

Table 7.2 summarizes distance gap model results. As shown in the table, the severity associated with fatal and severe injury outcomes often necessitates extensive emergency response

operations, involving clearance for vehicles and thorough investigations. These processes can increase distance gaps, causing traffic flow disruptions in the aftermath of severe crashes. Additionally, suspected serious injury, suspected minor injury, and possible injury are identified contributors to the widening of distance gaps between primary and secondary crash occurrences. When considering the time of the crash occurrence, distance gaps were found to increase during evening and morning peak hours, possibly due to the formation of queues, although these effects were not statistically significant. Conversely, nighttime was associated with a reduction in the distance gap between primary and secondary crashes, likely attributed to lower traffic volumes during nighttime hours. Both collisions at intersections and the involvement of large trucks are associated with a significant increase in the distance gap. This could be attributed to the specific challenges posed by these scenarios, such as increased complexity in managing traffic flow and ensuring safety during emergency responses.

Table 7.2: Factors affecting Distance Gaps

| Distance Gap Log | Coef. | t-statistic | P-Value |
|---|---|---|---|
| Crash Severity - Fatal | 0.374 | 2.73 | 0.007 |
| Suspected Serious Injury | | | |
| Suspected Minor Injury | | | |
| Possible Injury | | | |
| Evening Time | 0.04 | 0.2 | 0.839 |
| Morning Time | 0.039 | 0.18 | 0.855 |
| Nighttime | -0.554 | -2.36 | 0.019 |
| Collision at Intersections | 0.536 | 3.33 | 0.001 |
| Large Truck Involved | 0.704 | 3.28 | 0.001 |
| Incident Duration | -0.001 | -2.78 | 0.006 |
| Cons | -1.797 | -9.55 | 0.000 |

## 7.5. Towing Impact to Secondary Collision

In assessing the impact of towing on secondary collisions, a correlation analysis was conducted to examine the observed trends. Out of a sample size of 101 cases with available information about towing involvement, a significant correlation emerged, indicating that towing services were highly likely to be required in the aftermath of secondary collisions. Specifically, 94% of the secondary collisions within this sample necessitated towing services. This finding underscores the crucial role of towing in addressing the aftermath of secondary collisions, with a substantial majority of incidents requiring professional towing assistance. Upon comparing the type of vehicles that necessitated towing services, the analysis revealed distinct patterns for large trucks and non-large trucks. For large trucks, a substantial 95% of the incidents required towing services,

underscoring the significant role of towing in addressing issues related to these vehicles. In contrast, a smaller but still noteworthy 5% of large truck-related collisions did not necessitate towing services. On the other hand, for non-large trucks, most crashes did not require towing services, indicating that these incidents were often managed without the need for professional towing assistance.

The analysis of cases requiring towing assistance revealed a distinct pattern in clearance times compared to incidents where towing services were not needed. A significant majority, comprising 43% of the crashes necessitating towing services, were cleared within the time range of 91 to 360 minutes. Following this, 24% of incidents were resolved between 31 to 60 minutes, indicating a moderate but noteworthy proportion. For a smaller percentage of cases, 12%, the clearance time exceeded 361 minutes, suggesting a prolonged resolution process. Conversely, a relatively minor 4% of incidents requiring towing services were cleared swiftly within the first 31minutes. For incidents that did not require towing services, the overall number was relatively low, although it is noteworthy that some of these cases took an extended time to clear, as indicated in the graph below illustrating the proportion. Despite the reduced frequency of incidents not needing towing, the graphical representation suggests variability in clearance times. In terms of city boundaries, a discernible pattern was observed, revealing a relatively balanced distribution in towing requirements. Specifically, 49% of the secondary crashes that necessitated towing services occurred within city boundaries, while a slightly higher proportion, 51%, was observed outside the city boundaries.

# Chapter 8 Conclusions and Recommendations

The efficient clearance of traffic incidents, especially those involving commercial motor vehicles (CMVs), is essential for maintaining roadway safety and minimizing congestion on Tennessee's highways. This study, sponsored by the Tennessee Department of Transportation (TDOT), focused on evaluating the effectiveness of current towing regulations and their impact on roadway clearance times (RCT), secondary crashes, and overall traffic incident management (TIM) outcomes. Prolonged incident durations worsen traffic delays, increase secondary crash risks, and impose economic costs. The problem is further compounded in rural areas, where towing capabilities and enforcement are often limited. The study's objectives included assessing Tennessee's existing towing practices, comparing them with innovative strategies from other states, and providing evidence-based recommendations to enhance TIM efficiency. To achieve these goals, the research analyzed a comprehensive dataset from the Tennessee Highway Patrol (THP), supported by Smart Way Central Software (SWCS) data for comparative purposes. Insights were further enriched through literature reviews, stakeholder surveys, and interviews with towing managers in states like Virginia, Washington, Georgia, Florida, and Virginia, where incentive-based programs have demonstrated significant success. The study revealed critical insights, including disparities in incident clearance times between urban and rural areas, the impact of secondary crashes, and the benefits of adopting innovative towing strategies. The analysis highlighted how data-driven interventions and stakeholder collaboration could enhance Tennessee's TIM outcomes. These findings formed the basis for the conclusions and recommendations presented below.

## 8.1. Conclusions

### *8.1.1. Towing Regulation at Tennessee Largest Cities*

- No direct language for treating large commercial vehicle were observed. But there is a pronounced emphasis guidelines that ensure both vehicle, owner protection and standardized towing practice.
- Cities codes include charge rate that varies depending on time (hours) and distance.
- City of Chattanooga has a language to charge depending on weight and size. ( Charge by pound)
- There is absence of stipulations for large commercial vehicles in the codes of most cities in Tennessee

### *8.1.2. Towing Incentive Experience from Other States*

- The programs have been implemented successfully in several states, including Georgia, Washington, Virginia, and Florida, with positive feedback from all involved agencies.
- Overall, towing incentive programs have proven to be a valuable tool for enhancing roadway safety and efficiency, and continued efforts to improve and expand these programs benefit both the public and emergency responders.
- With TRIP (in Virginia and Georgian) and RISC (In Florida) incentive towing programs, there have been reduction in incident clearance times and secondary crashes that have

potentially brought significant positive impact on traffic incident management in those states.

- The Virginia VDOT-TRIP program has resulted in 79 minutes average CMV crashes clearance time
- The Georgia GDOT-TRIP program has resulted in 87 minutes average CMV crashes clearance time
- In Virginia, TRIP programs have an average response time of 37 minutes statewide.
- In Virginia, the program clears the live lanes within 90 minutes, about 91% of the time.
- The TRIP program has also helped to virtually eliminate the worst incidents, such as 10–18-hour events, which used to occur more frequently.
- The incentive program managers showed that the towing incentive white paper policy was drafted by different entities for each state to address the specific needs and goals of each region.
- The review from these four programs also shows that establishing such an incentive program can be a lengthy process, with a nine-to-12-month outreach phase serving as just the beginning.

### *8.1.3. Some Key Finding Observations from Incident DATA Analysis*

- When observed across major metropolitan areas, there exists a broad variance in towing-related crash instances and corresponding clearance times.
- The data makes evident the correlation between regulatory norms, response efficiency, and incident volume, emphasizing the pivotal role of towing regulations in the efficient handling of crash incidents.
- Comparisons among major Tennessee cities indicate statistically significant differences in incident durations, highlighting the potential influence of varying towing and enforcement policies.
- Notably, incidents within city confines tend to resolve faster than those outside, potentially due to stringent city regulations, dense networks of service providers, and availability of towing infrastructure. Yet, areas outside cities might face extended durations due to factors like limited towing services, infrastructural challenges, and less regulatory oversight.
- Study found that there is a variation on clearance time between major cities in Tennessee
    - Memphis – 190 Minutes
    - Chattanooga – 156 Minutes
    - Knoxville – 137 Minutes
    - Nashville – 132 Minutes
- Urban areas are clearing the crashes in less time compared to rural areas as data analysis showed 182 minutes of average roadway clearance time outside the cities and 126 minutes within city boundaries.
- When Tennessee's major city clearance durations are contrasted with those in Virginia and Georgia, Tennessee's times are notably prolonged. States such as Virginia and Georgia, which have adopted programs to expedite clearance, report significantly shorter durations, underscoring the potential benefits of such initiatives.

- The data justifies the need for carefully evaluating and refining the towing regulations, harnessing insights from other states and considering local specificities, to significantly reduce roadway incident durations.
- Most of the secondary collisions were observed to occur at an average distance gap of 0.4 miles (and 1.5 miles at most) at an average of 18 minutes (45 minutes at most).
- Several Variable were observed to have an effect to time and distance gap between primary and secondary collision. Those variables includes: Large truck involvement, Bad weather conditions, Time of day, Incident duration, Crash severity including fatal and suspected serious injury and collisions happening at intersections.
- 43% of the crashes necessitating towing services were cleared within time range of 91-360 while 24% were cleared in time range 31-60 minutes, 17% between 61-90 minutes, 12% above 361 minutes and 4% cleared within first 30 minutes.

### *8.1.4. Conclusions Summary*

**Significance of Towing Regulations in Incident Management:** Analysis of THP and SWCS data confirmed that towing regulations play a critical role in determining RCTs. CMV crashes in Tennessee took an average of over 130 minutes for clearance, compared to 67 minutes for non-CMV incidents. Towing-involved incidents required over 149 minutes on average, underscoring the need for improved towing policies to expedite clearance.

**Urban and Rural Disparities:** Urban areas exhibited shorter RCTs due to well-defined towing regulations and better access to resources. Nashville's average clearance time was 68 minutes, whereas rural counties like Perry experienced durations exceeding 200 minutes. Limited towing infrastructure and enforcement gaps in rural regions were identified as key challenges.

**Secondary Crashes and Their Implications:** Secondary crashes, linked to primary CMV incidents, were found to occur within 1.5 miles and within 45 minutes of the initial incident. These crashes, accounting for 17% of secondary incidents, highlighted the cascading risks posed by prolonged primary crash durations. Statistical analysis confirmed a direct correlation between extended RCTs and higher risks of severe secondary crashes.

**Effectiveness of Incentive-Based Programs:** Literature and interviews demonstrated the success of programs like Virginia's and Georgia's TRIP and Florida's RISC in reducing RCTs. For instance, Virginian and Georgia achieved average clearance times of 83 minutes under TRIP, compared to Tennessee's over 130 minutes. Financial incentives, strict response standards, and collaborative frameworks were pivotal to these programs' success.

**Inconsistent Towing Regulations:** Analysis of Tennessee's towing policies revealed inconsistencies across jurisdictions. Urban centers enforced stringent response times, whereas rural areas lacked uniform regulations. Moreover, existing policies did not adequately address the unique challenges posed by CMVs, creating gaps in effective incident management.

## 8.2. Recommendations

**Adopt Incentive-Based Programs**: Based on findings from Virginia, Georgia and Florida, TDOT should implement a statewide incentive program similar to TRIP or RISC. These programs demonstrated measurable reductions in RCTs by aligning towing company incentives with rapid clearance goals. TDOT can offer performance-based bonuses for meeting clearance targets, using data from this study's analysis to establish benchmarks for Tennessee.

**Standardize Towing Regulations Across Tennessee**: TDOT should develop a comprehensive towing policy manual that harmonizes regulations across urban and rural areas, ensuring consistency in response times and operational standards. This should be tailored to address the specific requirements of CMV incidents, including guidelines for handling hazardous materials and large vehicle recovery.

**Enhance Rural Towing Capabilities**: TDOT should allocate resources to establish regional towing hubs equipped with advanced recovery tools and trained personnel, as identified through the rural vs. urban disparity analysis. TDOT should use survey and interview insights gathered through this study to design targeted training programs for towing operators and first responders in rural areas.

**Leverage Data-Driven Interventions**: TDOT can utilize THP and SWCS data as analyzed in this study and other relevant data to identify high-risk areas and allocate resources accordingly, as supported by the heat maps and spatial analysis conducted in the study.

**Prioritize Secondary Crash Prevention**: Based on findings linking longer RCTs to secondary crashes, TDOT can consider establishing rapid clearance protocols to minimize cascading effects.

**Foster Stakeholder Collaboration**: TDOT should build on insights from surveys and interviews to enhance collaboration between TDOT, towing companies, and law enforcement. Regular workshops and training sessions can facilitate knowledge sharing and alignment. TDOT can consider developing public-private partnerships to ensure sustainable implementation of incentive programs, as recommended by stakeholders.

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# Appendices

# Appendix A: Smart Way Central Software (SWCS) Incident Data Analysis

## Overview of SWCS Data

In the earlier sections detailing incident data analysis, it was highlighted that this study relied on four primary sources for incident and crash data. Notably, the SWCS (Smart Way Central Software) custom report was one of these pivotal datasets. This comprehensive data was obtained from Gannett Fleming Inc., the TDOT consultant, spearheading the integration of SWCS into the Traffic Management Center. Spanning a period from 2017 to 2022, the SWCS report offered a detailed chronicle of incidents, providing a foundation for the analyses in this study parallel to THP data. The depth and breadth of information available in this dataset underlines its significance, making it an invaluable resource for understanding patterns and trends related to traffic incidents over a substantial time frame and comparing the findings with those from THP Data analysis.

## SWCS Data Description

Over the span of five years, an extensive dataset comprising 774,346 incident records was provided for the analysis in this study. These records encompassed a diverse range of variables, including:

- Incident Cause Type
- Crash Involvement
- County
- TDOT Region
- Latitude & Longitude
- Incident Start Date and Time
- Incident End Date and Time
- Duration
- Blockage Description
- Tow Involvement
- Hazmat Involvement
- Weather Conditions
- Large Vehicle Involvement

To refine the scope and enhance the precision of the study, the dataset was meticulously shifted. The primary focus in sorting the data was denoting entries as 'Yes' or 'No' based on their crash involvement, Figure A.1. This step enabled the exclusion of incidents attributed to non-crash causes, such as abandoned vehicles—which constituted 11.32% of the data—and disabled vehicles, which accounted for a notable 54.62%. An additional 20.56% was comprised of other varied incident causes. Given the hypothesis of the study, these variables were considered less pertinent since such incidents—like abandoned vehicles—are typically found on shoulder lanes. Though they might occasionally contribute to secondary collisions, their direct relevance to the primary research was limited. Of the entire dataset, only 104,529 records, or 13.5% of the 774,346

total entries, were strictly related to crashes. Delving further into this refined data subset, the research aimed to spotlight crashes involving large vehicles. Filtering using the 'Large Vehicle Involved' variable, 91% of these crash incidents were identified as not involving large vehicles. About 9% of incidents involved the key subject of the investigation: large trucks.

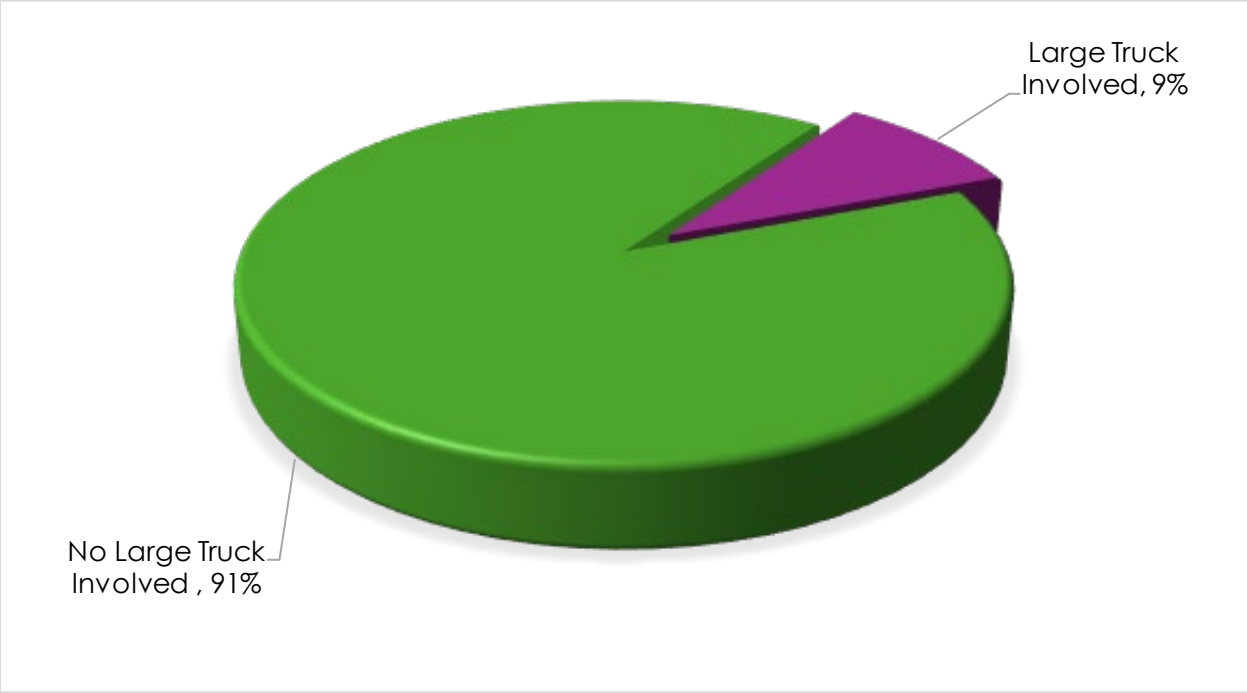


Figure A. 1: Percentage distribution of vehicles involved in Crashes (SWCS Data)

## Durations of incidents Involving Large Trucks

The analysis examined the 41,414 crashes identified as relevant. Of these crashes, 9% of the crashes involved large trucks, totaling 3,091 crashes. The number of crashes involving large trucks were found to be inversely proportional to the road clearance time. Crash scenarios with large truck involvement and longer clearance times of more than 91 minutes accounted for 43%. Additionally, approximately 5% of incidents required more than 6 hours for clearance, Figure A.2. This reveals that when crashes involve large trucks, they tend to have significantly longer clearance time.

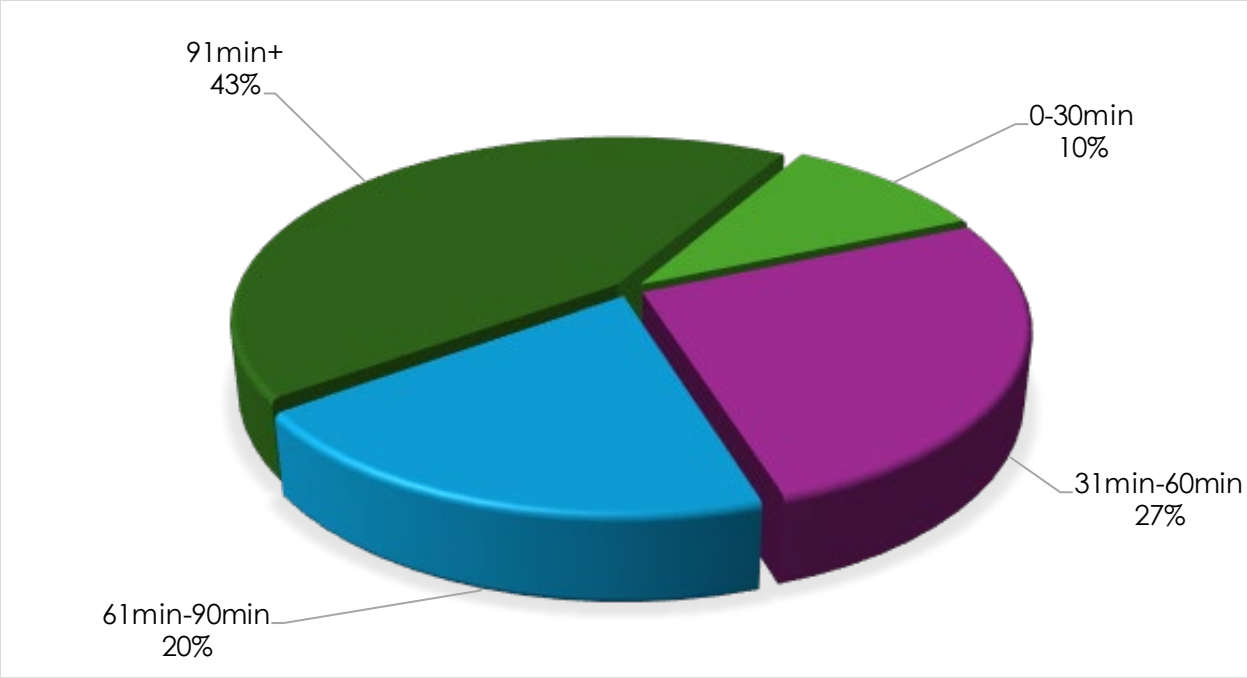


Figure A. 2 Incident Clearance Durations for Crashes that Involved Large Trucks

## Incidents involving large trucks by county

Table A.1 presents the average duration of incidents that involved large trucks by county. The data showed that rural counties experienced the longest truck crash clearance times of an average of 162 minutes while urban counties averaged 132 minutes. The crashes with clearance times exceeding three hours (180 minutes) made up 22% of rural crashes and 2% of urban crashes. The data also reveals a notable difference in roadway clearance times for truck crashes involving towing versus those not requiring towing. Truck crashes that involved towing had an average clearance time of 147 minutes, while those without towing were cleared in an average of 85 minutes.

Table A. 3: Number of incidents by county with clearance time

| County | Number of Truck Crashes | Average Roadway Clearance Time | County | Number of Truck Crashes | Average Roadway Clearance Time | County | Number of Truck Crashes | Average Roadway Clearance Time |
|---|---|---|---|---|---|---|---|---|
| Lake | 1 | 660 | Perry | 1 | 160 | Weakley | 10 | 120 |
| Lewis | 3 | 366 | Cumberland | 54 | 160 | Henry | 15 | 120 |
| Hancock | 1 | 340 | Smith | 37 | 156 | Meigs | 9 | 120 |
| Polk | 6 | 324 | Marion | 42 | 155 | McMinn | 55 | 119 |
| Hickman | 12 | 289 | Dyer | 25 | 154 | **Wilson** | **143** | **118** |
| Obion | 18 | 262 | Campbell | 64 | 153 | Stewart | 4 | 115 |
| DeKalb | 17 | 257 | Jackson | 8 | 153 | Cocke | 51 | 115 |
| Crockett | 10 | 255 | Overton | 7 | 152 | Coffee | 52 | 115 |
| Morgan | 7 | 254 | Lauderdale | 20 | 151 | Union | 8 | 114 |
| Wayne | 9 | 245 | Rhea | 21 | 147 | Haywood | 52 | 114 |
| Houston | 4 | 243 | **Montgomery** | **50** | **147** | Roane | 78 | 113 |
| Robertson | 92 | 235 | Greene | 62 | 144 | Loudon | 54 | 111 |
| **Washington** | **13** | **235** | Fayette | 32 | 141 | Anderson | 50 | 108 |
| Dickson | 53 | 219 | Macon | 7 | 140 | Benton | 10 | 107 |
| Cheatham | 41 | 210 | Lawrence | 17 | 139 | Grainger | 6 | 107 |
| **Sullivan** | **30** | **199** | Bledsoe | 13 | 139 | Tipton | 15 | 105 |
| Trousdale | 8 | 199 | Marshall | 21 | 139 | Warren | 24 | 105 |
| Fentress | 6 | 196 | Maury | 68 | 139 | **Hamilton** | **161** | **99** |
| Decatur | 7 | 190 | **Shelby** | **66** | **138** | Chester | 11 | 98 |
| Hardin | 26 | 187 | Hawkins | 20 | 138 | McNairy | 18 | 98 |
| Hardeman | 14 | 186 | Johnson | 14 | 138 | **Rutherford** | **252** | **96** |
| Moore | 6 | 186 | Humphreys | 29 | 134 | Blount | 38 | 96 |
| Clay | 6 | 182 | Jefferson | 48 | 133 | Sequatchie | 13 | 95 |
| Monroe | 21 | 176 | Lincoln | 24 | 133 | Hamblen | 40 | 93 |
| Bradley | 64 | 171 | **Sumner** | **101** | **130** | Franklin | 16 | 93 |
| VanBuren | 4 | 169 | Grundy | 19 | 130 | Cannon | 6 | 89 |
| White | 20 | 166 | Putnam | 74 | 130 | **Knox** | **115** | **86** |
| Giles | 12 | 165 | Scott | 13 | 129 | **Davidson** | **718** | **83** |
| Unicoi | 13 | 164 | Bedford | 31 | 128 | Carroll | 19 | 78 |
| Henderson | 45 | 163 | **Williamson** | **121** | **126** | Gibson | 16 | 73 |
| Perry | 1 | 160 | Carter | 24 | 126 | Sevier | 46 | 60 |
| Cumberland | 54 | 160 | Claiborne | 10 | 126 | | | |
| Smith | 37 | 156 | **Madison** | **84** | **122** | | | |

The analysis indicated that incidents in rural counties took longer to clear compared to urban counties where there is quick and efficient access to towing and emergency services, Figure A.3. Most of the incidents in rural counties took 19% longer to clear than urban incidents which indicates a delay in service provision. This data underlines the critical need to implement standardized response protocols and improve the towing infrastructure, particularly in rural areas, to reduce the countable delays in clearing truck crash incidents and enhance roadway safety and efficiency.

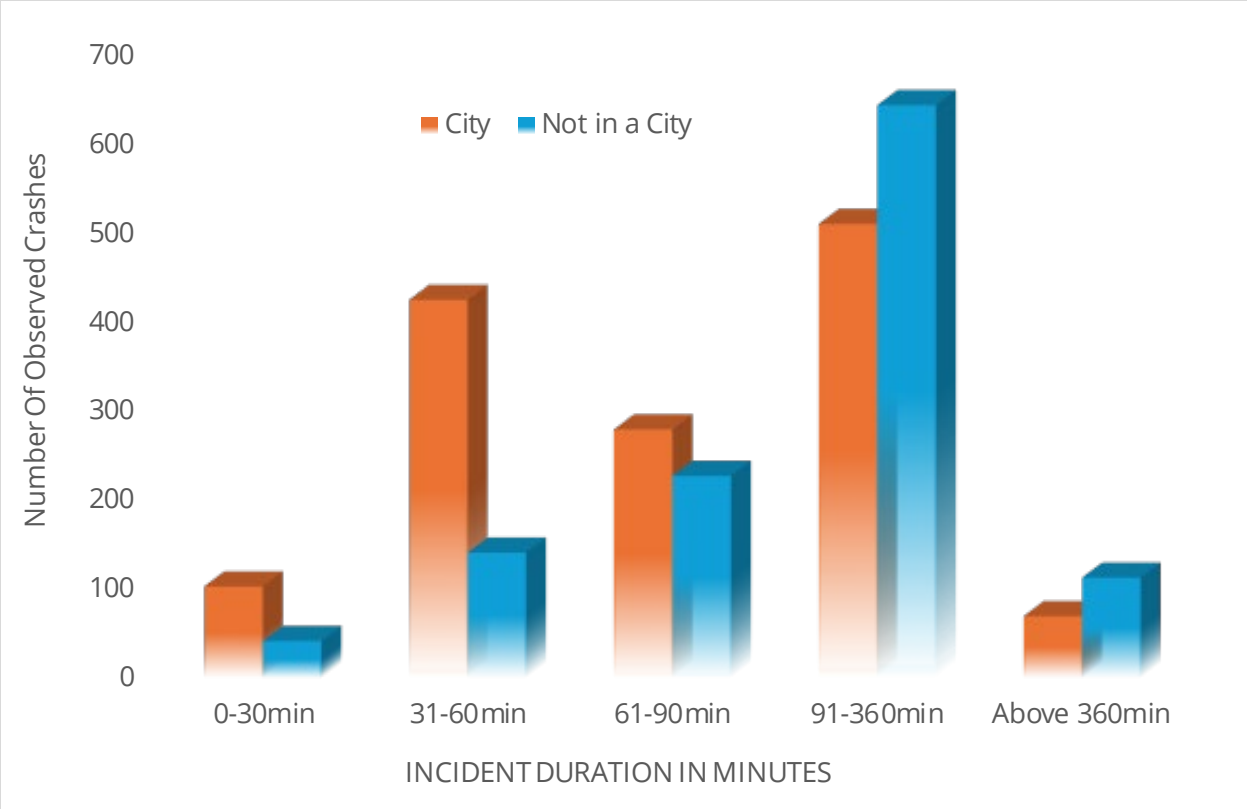


Figure A. 3: Incident duration in City vs Not in a city

## Police Response Time

Police response times generally have an impact on the overall roadway clearance time. Faster police response time ensures quicker engagement of on-scene assessment, coordination of towing services, and removal of vehicles, leading to reduced incident durations and the restoration of normal traffic flow. Crashes involving lane blockages and large trucks had a relatively fast police response time of 8 minutes, indicating a priority of clearing the roadway to prevent further delays. Conversely, crashes with increased severity, such as fatal crashes, received a longer average response time of 18 minutes, likely due to the situation's complexity. The overall response time for all incidents was 11 minutes. While response efforts are generally prompt, there is room for improvement in the Police Response Time (PRT), especially in critical situations. Additionally, the data shows that incidents involving large trucks had a faster police response time (8 minutes) compared to crashes without large trucks (9 minutes). The faster response for large trucks may be attributed to the perceived urgency due to the higher risks large trucks pose for safety and traffic flow. Large truck incidents tend to involve more significant disruptions, making them a higher priority for first responders, such as the police. This faster response time, while beneficial, highlights the need to further enhance response mechanisms across all incident types, particularly focusing on how efficient coordination can reduce roadway clearance time and mitigate overall traffic delays.

Table A. 4: Average Police Response Time by Crash Scenario

| | Crash Scenario | Police Response Time (Minutes) |
|---|---|---|
| **Towing Involvement Crash** | Towing involved | 15 |
| | No towing involved | 13 |
| | Trucks involved | 8 |
| | No trucks involved | 9 |
| **Lane Blockage** | Lane Blockage | 8 |
| | No lane Blockage | 9 |
| **Crash Severity** | Fatal | 18 |
| | Possible Injury | 9 |
| | Property Damage Only (PDO) | 7 |
| | Suspected minor injury | 11 |
| | Suspected major injury | 13 |
| **All incident** | Average response time for all accidents | 11 |

## Large truck crash severity and incident duration

The analysis of large truck crashes through injury severity reveals a relationship between the incident's duration and severity, Figure A.4. Most of the large truck incidents were cleared within 91 and 360 minutes. In this clearance time range, a notable increase in crash severity is observed, particularly in fatal crashes and suspected serious injuries. This indicates that extending incident durations may contribute to more severe outcomes. Delaying emergency responses cause prolonged exposure to the crash site which may increase the risk of secondary collisions or further harm to involved parties. In contrast, shorter incident durations, especially those cleared within 30 to 60 minutes, appear to be associated with fewer fatalities and serious injuries. This suggests that rapid incident clearance plays a vital role in mitigating the overall severity of crashes. By reordering the injury severities from most severe to least severe—fatal, suspected serious injury, suspected minor injury, possible injury, and property damage only (PDO)—it is evident that crashes with shorter durations tend to experience lower levels of severity. For example, fatal crashes are more frequent in incidents lasting 91 minutes or longer, while the shorter incidents are predominantly characterized by property damage and minor injuries. This pattern reinforces the importance of reducing incident durations and improving response times as critical factors in minimizing crash severity. This further supports the case for enhanced roadway clearance protocols and faster emergency response efforts to prevent serious injuries and fatalities.

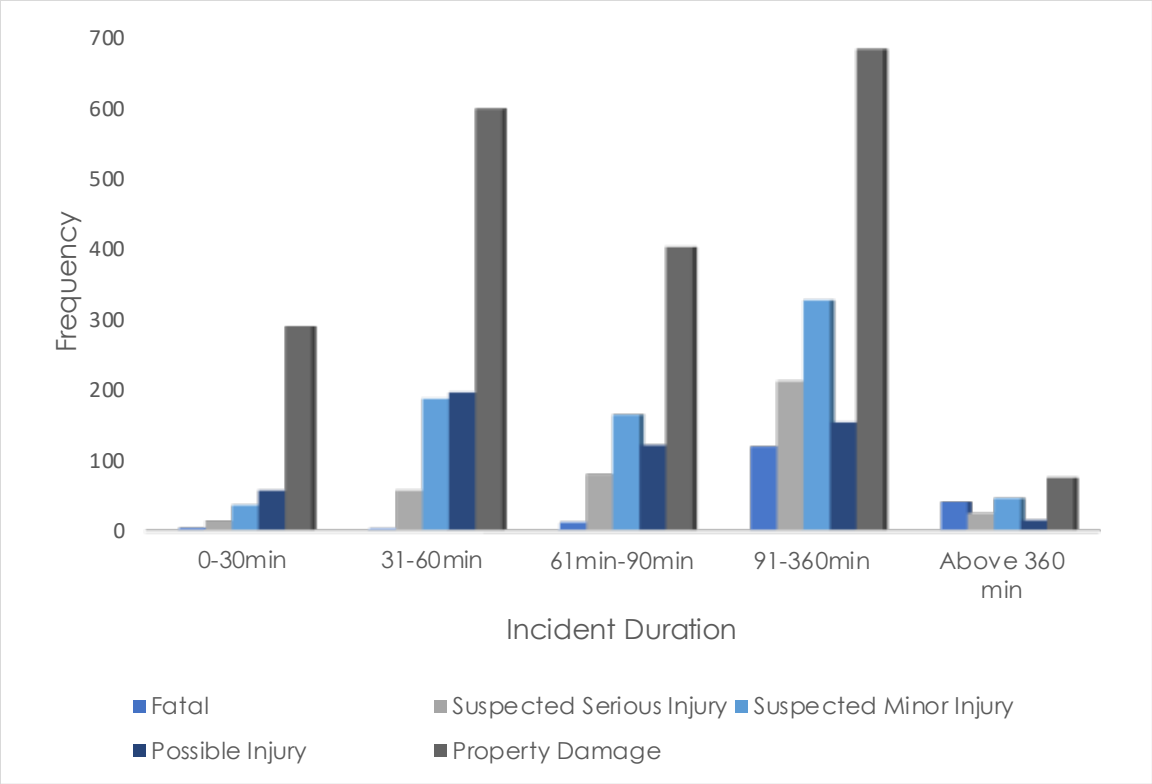


Figure A. 4: Large Truck Crashes by Injury Severities

## Towing Involved in Truck Crashes

The data, shown in Figure A.5, reveals that 97% of large truck crashes require towing, underlining the significant role that towing plays in resolving such incidents. It can be observed that the complexity and size of large trucks often necessitates specialized towing services, which in turn leads to longer incident durations. In rural counties, towing services may be less readily available, thus the reliance on towing can further extend roadway clearance times and delay the use of closed traffic lanes. This increases the chances of secondary crashes because of the prolonged exposure to hazardous conditions and roadway congestion. Towing involvement directly impacts how long the scene remains active when correlated with the range of the incident duration. Crashes that required towing had an average clearance time of 147 minutes and crashes that did not require towing had an average clearance time of 85 minutes. The significant difference reinforces the need for faster access to towing services. Additionally, the data showed that most large truck incidents, particularly those requiring towing, were within the range of 91–360 minutes and coincided with the highest injury severities (including fatalities). This emphasizes the importance of shortening incident durations to reduce crash severity through the enhancement of towing infrastructure, notably for rural areas, which improves the response time.

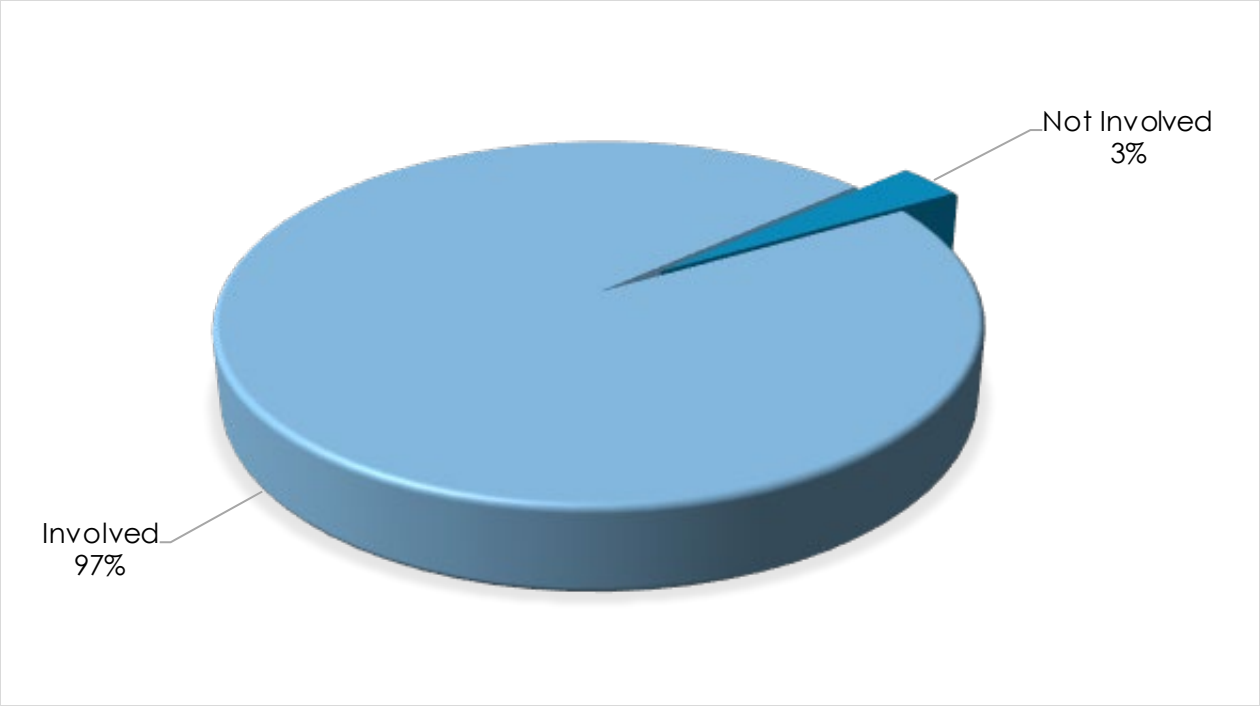


Figure A. 7: Percentage distribution of Towing Involved in Large Trucks

## Secondary Collisions

A crucial influence for the occurrence of secondary collisions is the duration of the initial incident, Figure A.6, A.7 and A.8. Although only 1% of crash data that involved large trucks were classified as secondary collisions, their potential impact on roadway safety should not be underestimated. Due to the extended presence of vehicles on the road during crashes, there is an increased likelihood of secondary collisions. This is exacerbated in incidents involving trucks which are characterized by longer clearance times. In fact, from the analysis of the secondary crashes involving large trucks, 92% required towing, indicating that delays in removing these large vehicles from the scene significantly contribute to the occurrence of secondary collisions. The relationship between longer incident clearance times and secondary collisions becomes particularly important when considering large trucks. This is due to their size as they present greater obstruction on the roadway, posing delays in clearance and increasing the risk of subsequent accidents. This can create hazardous conditions for other road users, particularly in high-traffic areas where vehicles are forced to navigate around the initial crash. Shorter clearance times, on the other hand, would help to minimize the chances of secondary collisions by removing the obstacle and therefore removing the hazard from the roadway. This insight shows the importance of quick responses of towing and emergency services, especially for large trucks, to prevent additional crashes from occurring and reduce the duration of the initial incident. By ensuring faster clearance of large truck incidents, the risk of secondary collisions can be significantly reduced. The reduced risk minimizes the cascading effects of a single incident and generally improves safety. There is a critical need for improved towing and fast response to address the vulnerabilities posed by large truck crashes and prevent their evolution into secondary collisions.

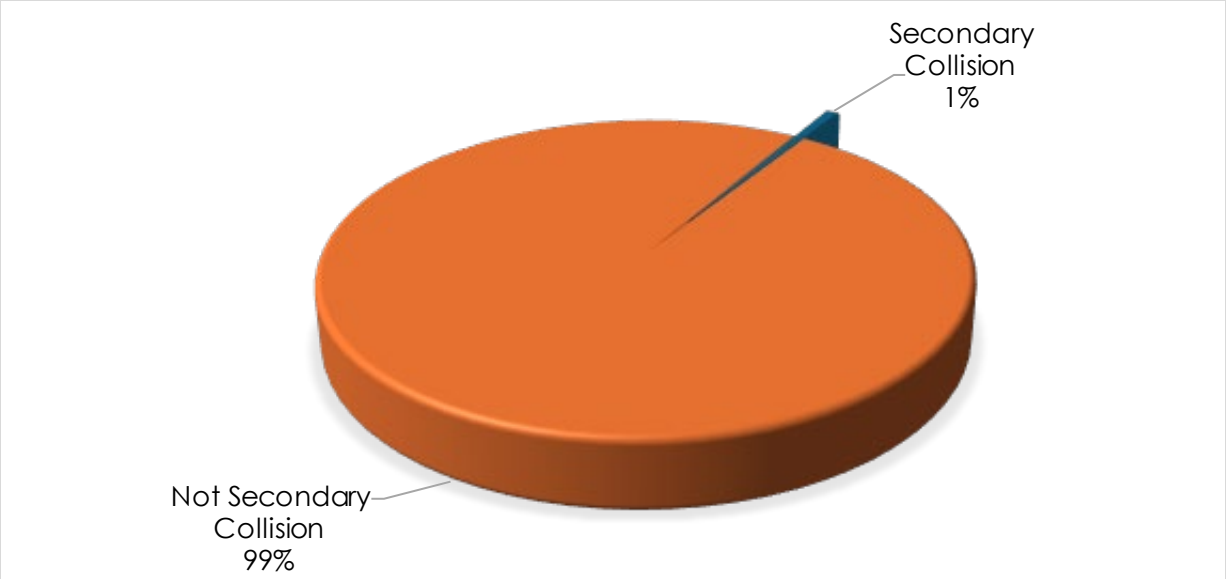


Figure A. 8: Percentage distribution of Secondary Collision involved in all crashes

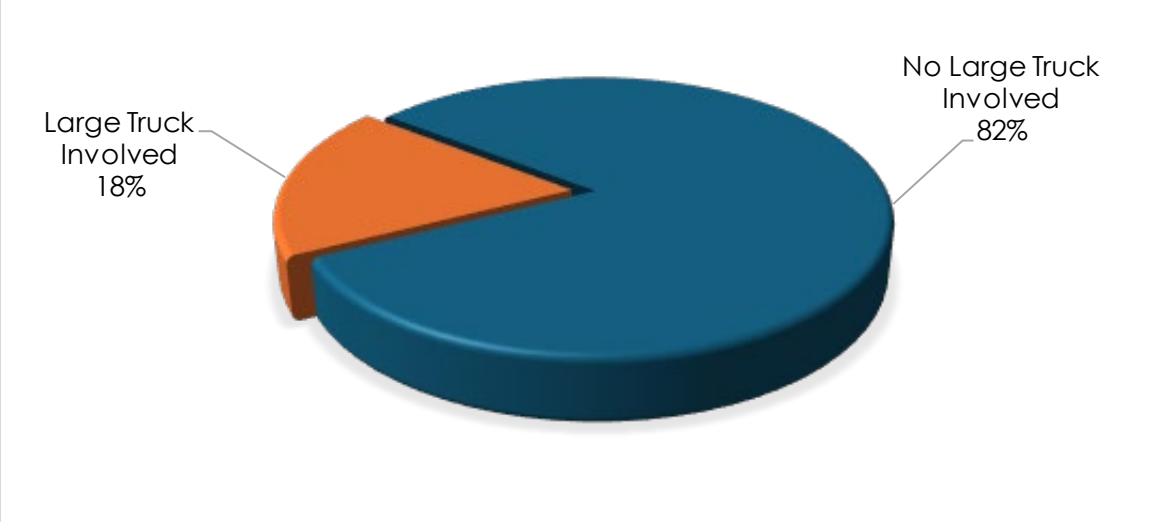


Figure A. 9: Percentage distribution of Large Trucks involved in Secondary Collision

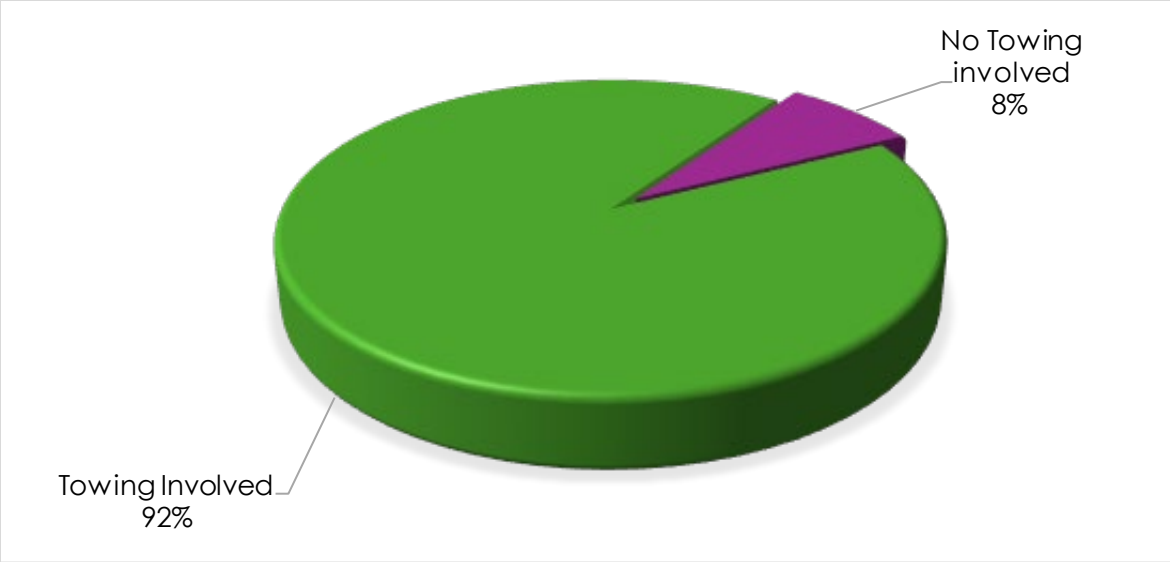

Figure A.8: Percentage distribution of Towing involved Large Trucks – Secondary Collision

## Roadway Clearance Time in Cities

Figure A.9 highlights the roadway clearance times in the metro area. From this analysis, the roadway clearance times in the major Tennessee metropolitan areas show a significant variation that appears to be influenced by the towing regulations and policies in place. Knoxville was observed to have the shortest average clearance time of 119 minutes. This stands out due to its streamlined approach, though it lacks large vehicle-specific towing regulations. In contrast, Memphis has an added complexity that contributes to its longest clearance time of 150 minutes, whereby it implements towing regulations that include specific requirements for the cleanup of hazardous materials [25]. Chattanooga, with an average of 149 minutes for clearance, utilizes a "pay by pound" system, which encourages efficient removal. This could also introduce delays due to logistical factors related to vehicle size and weight [27]. Nashville has an average clearance time of 127 minutes and operates without specific large-vehicle regulations. Nashville's time is longer than the clearance time in Knoxville, however, it still outperforms Memphis and Chattanooga, potentially reflecting a less complicated towing and clearance protocol.

Table A.4 shows the correlation of policy to clearance time. It compares the general towing regulations, large vehicle towing regulations, and incident durations. Based on the results, more complex towing regulations such as those observed in Memphis' metro area may contribute to extended clearance time, though they reflect necessary safety measures for more complex incidents. On the other hand, Knoxville's shorter times suggest that a simpler approach to towing regulation may help reduce clearance times. The differences between the metro areas provide valuable insights into Tennessee's policy making. While robust regulations are essential for safety, a balance is needed to improve both efficiency and effectiveness in incident management.

Table A. 5: Major Cities in Tennessee and Countries Covered in this Analysis

| Major City in Consideration | Counties covered in this Analysis | Number of crash incidents |
|---|---|---|
| **Nashville Metro (884 Incidents)** | Davidson | 381 |
| | Rutherford | 153 |
| | Williamson | 83 |
| | Wilson | 102 |
| | Sumner | 63 |
| | Robertson | 70 |
| | Cheatham | 32 |
| **Memphis Metro (80 Incidents)** | Fayette | 25 |
| | Shelby | 47 |
| | Tipton | 8 |
| **Chattanooga Area (230 Incidents)** | Bledsoe | 13 |
| | Bradley | 49 |
| | Meigs | 9 |
| | Rhea | 18 |
| | Hamilton | 93 |
| | Marion | 37 |
| | Sequatchie | 11 |
| **Knoxville Area (267 Incidents)** | Anderson | 22 |
| | Blount | 18 |
| | Jefferson | 28 |
| | Grainger | 4 |
| | Knox | 68 |
| | Loudon | 45 |
| | Roane | 57 |
| | Sevier | 19 |
| | Union | 6 |

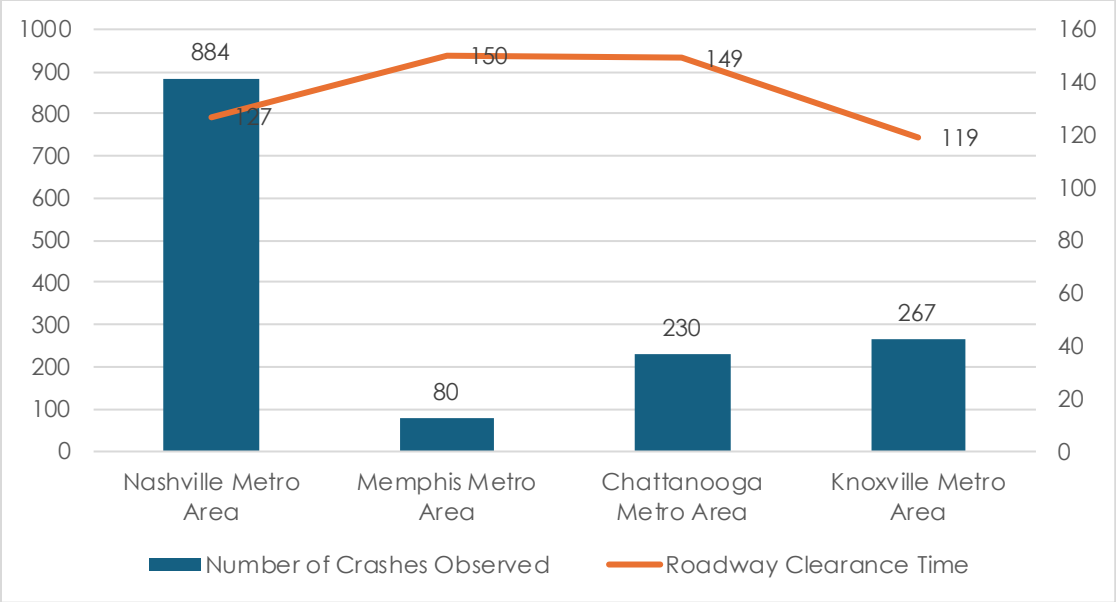


Figure A.9: Distribution of RCT for crashes involving Towing in Metro Areas

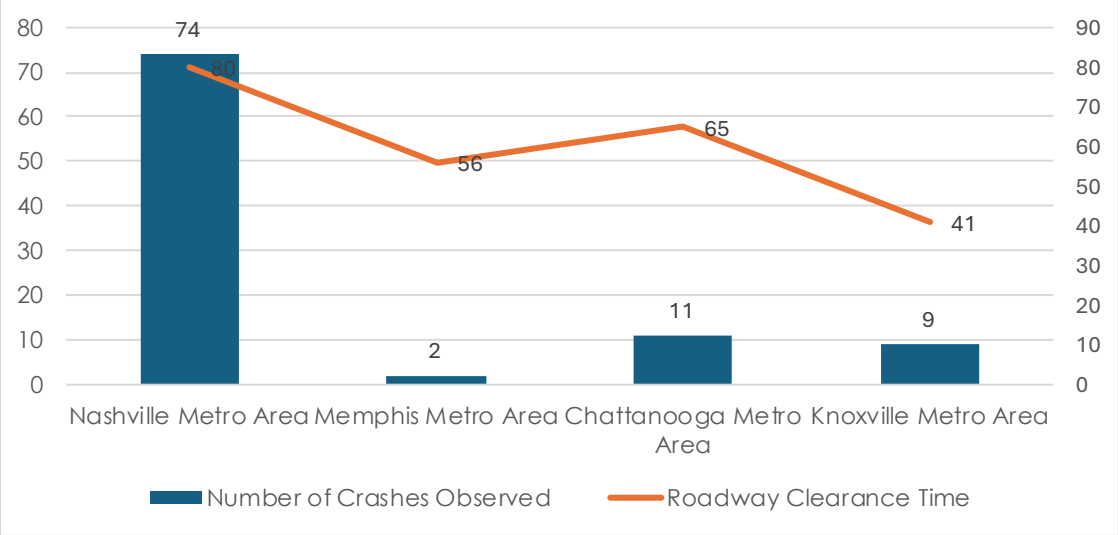


Figure A. 100: Distribution of RCT for crashes not involving Towing in Metro Areas

## Roadway Clearance Times and Crash Frequency across the Metro Areas

The analysis of Figures A.9 and A.10 shows significant variations in clearance times between the metro areas. This appears to be caused by factors beyond the frequency of crash occurrences and the factor of whether towing is involved or not. In Figure A.10, the Memphis metro area had the longest average roadway clearance time of 150 minutes despite recording the lowest crash count of 80 incidents. This trend in Memphis contrasts with the Nashville metro area, which has the highest crash count of 884 and was able to maintain the shortest average clearance time of 127 minutes. The shortest clearance time in Nashville indicates a potentially more effective incident management system and better practices. For crashes that did not involve towing as in

Figure A.10, the trend mirrors the trend that involves towing on the frequency of counts, though with generally shorter clearance times. In this analysis, Nashville again had the highest number of incidents at 74 and the longest clearance time of 80 minutes. Memphis on the other hand, though it had only 2 crashes observed, had an average clearance time of 56 minutes, indicating delays. Chattanooga and Knoxville, with moderate crash counts of 11 and 9, respectively, exhibited clearance times of 65 and 41 minutes. This reflects reasonably efficient responses in those areas. The difference in clearance times between incidents that involved towing and those that did not underscores the complexity of traffic incident management. Crashes that required towing in the Tennessee Metro areas have longer clearance times due to the added complexity of vehicle recovery. However, the efficiency of incident clearance in high-crash areas, like Nashville, highlights the influence of streamlined operations and infrastructure that support rapid response and road clearance. This analysis emphasizes fostering improvements in areas with fewer crashes and longer clearance durations to standardize response times and reduce traffic disruption across all metro areas.

## Roadway Clearance Times and Crash Frequency across the Metro Areas

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Table A. 6: Correlation of Towing Regulations and Incident Duration

| Jurisdiction | General towing regulation | Large vehicle towing regulation | Average incident duration with large trucks towing (min) |
|---|---|---|---|
| **Chattanooga Metro Area** | Licensing and Certification<br>Consensual and nonconsensual towing<br>Towing authorization (12hrs)<br>Recovery and Incident Management<br>Trained personnel<br>Response time - 30 min on clear weather after dispatch<br>Towing equipment and capacity<br>Insurance coverage<br>Towing rate and storage fee | • Towing fee<br>• Pay by Pound for salvage, debris recovery<br>• Charges for exposure to hazardous and flammable materials<br>Sec.35-160 | 149 |
| **Knoxville Metro Area** | Licensing and Certification<br>Maintaining towing List<br>Consensual and nonconsensual towing<br>Towing Equipment's<br>Trained personnel<br>Liability insurance for nonconsensual tows<br>Towing authorization (12 hrs.)<br>Cleaning when removing vehicles<br>Maintaining rotation list for wrecker services<br>Insurance coverage<br>Towing rate and storage fee | • Towing fee<br>• Hourly rate (Only if required)<br>• Winching Charge, per hour<br>• Storage Charge (For open or covered storage)<br>• Extra manpower (Only if required)<br>• Spills requiring chemical agents for clean-up, only by the request of a police officer<br>• Mileage charge<br>Sec.26-302 | 119 |
| **Memphis Metro Area** | Licensing and certification<br>Towing rate and storage fees<br>Removal of accident debris<br>Towing authorization<br>Reporting accidents and scene calls<br>Insurance coverage<br>Cleaning and when removing vehicles | • Towing fee<br>• Cleanup of hazardous materials does not excess of 300 gallons<br>Sec.6-88-12 | 150 |
| **Nashville Metro Area** | Licensing and certification<br>Towing rate and storage fees<br>Liability insurance<br>Towing authorization<br>Signage<br>Towing equipment and capacity<br>Inspection and maintenance of vehicles<br>Emergency wrecker service<br>Cleaning when removing vehicles | • Towing fees<br>• Mileage charge<br>• Hourly rate for necessary preparation or removal of bumpers, drive shafts before towing is possible, and recommendation after towing<br>• Labor rates after first hour<br>• Storage fee<br>Sec. 6.80.550 | 127 |

## Correlation of Towing Regulations and Incident Duration

Table A.4 offers a comprehensive comparison of towing regulations across major metropolitan areas in Tennessee, focusing on policies for large vehicle towing and the average duration of incidents requiring towing. The findings indicate that variations in towing regulations among these jurisdictions may significantly affect the time it takes to clear roadways after accidents. For instance, in Chattanooga, towing regulations feature specific authorization periods, thorough training for personnel, and capacity requirements for towing equipment. The city mandates a response time of 30 minutes under clear weather conditions, reflecting its emphasis on prompt intervention. However, despite implementing a pay-by-pound system for large vehicle towing, the Chattanooga metro area still experiences a high average clearance time of 149 minutes. This suggests that while there is a focus on training and equipment readiness, the towing fee structure may adversely affect the overall efficiency of clearance operations, potentially extending response times during severe incidents.

Knoxville has a lower average clearance time of 119 minutes and employs a slightly different regulatory approach. It uses a rotation system for service providers, requiring insurance coverage and regulated storage fees, but does not have specific provisions for large vehicle towing. The absence of extensive regulations for large vehicle towing may correlate with quicker clearance times as fewer regulatory hurdles could expedite the process. Knoxville's streamlined requirements may support faster response times by reducing procedural complexities, although this could also pose challenges during significant incidents involving larger vehicles.
Memphis has the longest average clearance time among the metropolitan areas at 150 minutes, likely due to additional regulatory measures for cleaning up hazardous materials. While these requirements are essential for safety and environmental protection, they may extend the duration of roadway clearance following major incidents. The Memphis metro area mandates protocols and accident scene inspections which enhance post-incident safety. This could also contribute to delays in incident resolution.

Nashville demonstrates the shortest average clearance time at 127 minutes despite having the most comprehensive towing regulations. Its policies include strict response timeframes, requirements for emergency wrecker services, and extensive certifications for equipment and personnel. As an example, it requires service providers to reach crash scenes within a 30-minute window. These regulations likely enable Nashville to maintain both high safety standards and efficient incident clearance. The structured approach in Davidson County suggests that rigorous standards combined with strict timelines can improve response efficiency, even in densely populated areas with heavy traffic.

In summary, the differences in towing regulations—particularly those concerning large vehicle towing and hazardous materials—appear to influence the duration of roadway clearance times. While regulatory measures in each metro area aim to ensure safety and preparedness, they introduce varying levels of procedural requirements that can impact the speed of incident resolution. Nashville's approach, which balances stringent requirements with enforced response timelines, demonstrates an effective model for minimizing clearance times without compromising safety standards.

Table A.5: Statistical Comparison of Mean Incident Durations Among Major Cities

| Response | Comparable data | Mean Clearance duration | Ho | Ha (Alternative hypothesis) | Significant level | Statistically Significant |
|---|---|---|---|---|---|---|
| Roadway Clearance Time | Knoxville Area | 119 | diff = 0 | diff < 0 | Pr(T < t) = 0.1784 | No |
| | Nashville Metro | 127 | | diff > 0 | Pr(T > t) = 0.8216 | No |
| | Chattanooga | 149 | diff = 0 | diff < 0 | Pr(T < t) = 0.9789 | No |
| | Nashville Metro | 127 | | diff > 0 | Pr(T > t) = 0.0211 | Yes |
| | Memphis Metro | 150 | diff = 0 | diff < 0 | Pr(T < t) = 0.9322 | No |
| | Nashville Metro | 127 | | diff > 0 | Pr(T > t) = 0.0678 | No |
| | Memphis Metro | 150 | diff = 0 | diff < 0 | Pr(T < t) = 0.9735 | No |
| | Knoxville Area | 119 | | diff > 0 | Pr(T > t) = 0.0265 | Yes |
| | Chattanooga | 149 | diff = 0 | diff < 0 | Pr(T < t) = 0.4855 | No |
| | Memphis Metro | 150 | | diff > 0 | Pr(T > t) = 0.5145 | No |
| | Chattanooga | 149 | diff = 0 | diff < 0 | Pr(T < t) = 0.9821 | No |
| | Knoxville Area | 119 | | diff > 0 | Pr(T > t) = 0.0179 | Yes |
| | Inside the City | 122 | diff = 0 | diff < 0 | Pr(T < t) = 1.0000 | No |
| | Outside the City | 171 | diff = 0 | diff > 0 | Pr(T > t) = 0.0000 | Yes |

## Comparing Roadway Clearance Time among Major Cities

Two sample mean tests comparing the roadway clearance times in Tennessee metropolitan areas were done using STATA. This analysis was used for checking whether there is significant difference between the mean clearance times of the selected metro areas and for the incidents occurring in and outside the cities. The statistical results resulted in both significant and insignificant results which show the potential insights of towing regulations, responses and protocols, and geographical factors. The metro cities that indicated insignificant results were between Knoxville and Nashville areas, Chattanooga and Memphis areas, and the Memphis and Nashville area. The similarities of these metro areas can be explained, such as between Knoxville and Nashville, reflects close operational efficiencies despite the slight variations. Chattanooga and Memphis as well as Memphis and Nashville are in close alignment perhaps because they share some regulatory elements, such as comprehensive certification requirements and towing protocols. On the other hand, the remaining relationships were significant, including the following: Chattanooga and the Nashville area, Knoxville and Memphis, Chattanooga and Knoxville, and inside and outside the city. For Chattanooga and Nashville, Chattanooga had a longer clearance time, possibly due to the differences in regulations such as payment structures (e.g. pay-by-pound) and specific towing authorization protocols. In contrast, Nashville's stringent 30-minute response time on their regulation might be a contributing factor to shorter clearance times. For Memphis and Knoxville, Memphis' long durations may be because of the additional requirements, such as hazardous materials protocols, which increase the clearance process unlike for Knoxville. Chattanooga vs Knoxville also exhibits significant differences, the procedural difference including towing authorization periods and equipment requirements in Chattanooga, may be the cause of the complexity while Knoxville on the other hand has similar and fewer restrictions and regulations that enable it to have a faster response than Chattanooga. The

analysis also dived into comparing the incident's durations inside and outside the cities. Incidents inside the city took shorter times than outside the city. This is likely due to differences in accessibility and response logistics. It is well agreed that urban populations generally have better service availability compared to rural or less accessible areas outside the city. The areas outside the city may experience delays due to limited resources and longer travel times. This explains the need to highlight regulations that would favor rural areas as well so that they may be prioritized for reducing the clearance time through towing ease of access.

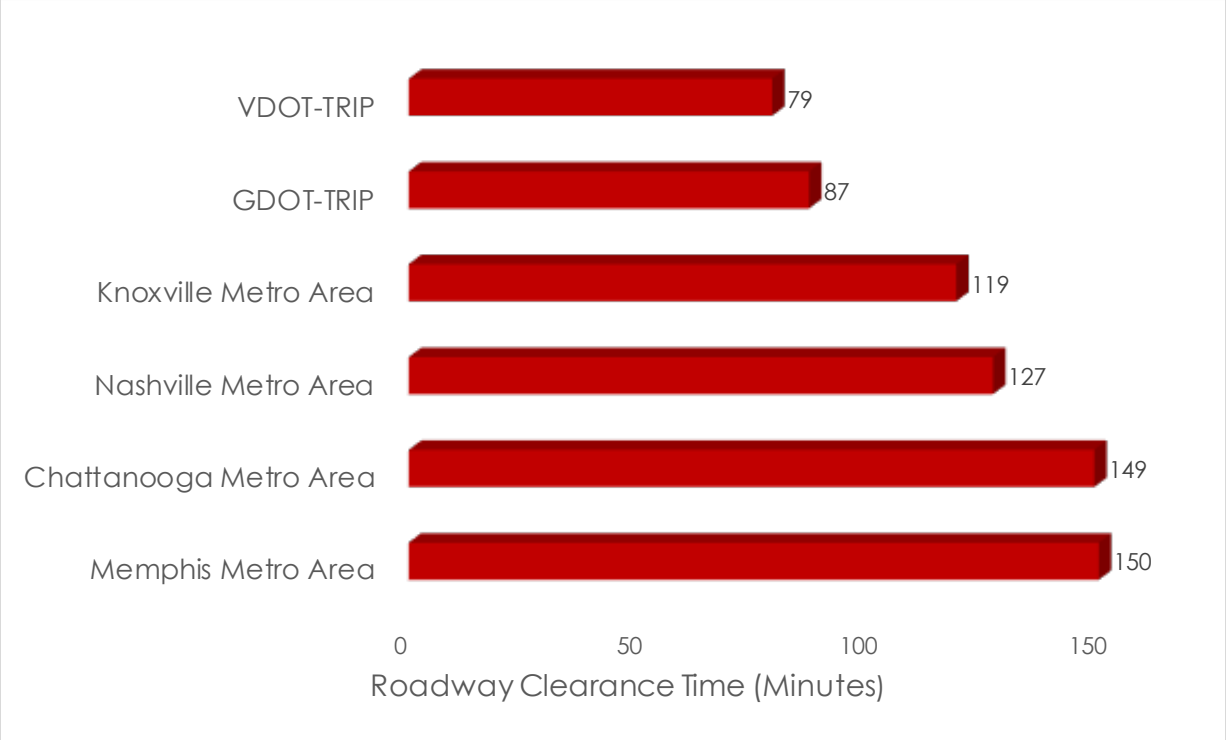


Figure A. 11: Comparative Average Roadway Clearance Time with TRIP Programs

Figure A.11 shows the comparison of roadway clearance times for large vehicle crashes across the metropolitan areas in Tennessee, Georgia, and Virginia, utilizing the towing and recovering incentives programs (TRIP) for the data documented in 2021 and 2022. The results showed that Knoxville, Nashville, Chattanooga and Memphis metro areas have generally longer roadway clearance times compared to Georgia and Virginia. The TRIP program in Georgia and Virginia reports an average clearance time of 79 minutes for Virginia and 87 minutes for Georgia. These programs have a great influence in reducing the clearance times through the incentives they give to the towing providers, which is why there is a swift clearance time compared to Tennessee metro areas where such incentives are absent. This absence of standardized towing incentives programs, like TRIP, in these metro areas contributes to extended clearance durations, as Tennessee's towing protocols vary by jurisdiction and lack uniform incentive-driven practices. The longer clearance times in Tennessee underscore the influence of incentive-based strategies, indicating a need for policymaking to consider similar programs to streamline roadway clearance times and enhance incident management efficiency.

## Chapter Summary

This Chapter looks at the influence of towing regulation on the roadway clearance time (RCT) across the Tennessee metropolitan areas. It points out the relationships between the metro areas' frequency of incidents and their respective clearance times, highlighting Nashville's high incident frequency and a relatively short time clearance of 127 minutes. This performance brings us to the management practices and the regulations of towing set by Nashville for the effective handling of incidents. Knoxville has a recorded shortest time of 119 minutes, though the statistical mean test conducted showed no significant difference when compared to Nashville. Absence of statistical significance between these metro areas indicates that Nashville's approach is likely competitive and may be adopted statewide due to its ability to handle higher incident loads. Its balanced regulatory framework can serve as a model for other metro areas. The complexity of regulation does not necessarily correlate with its efficiency. In contrast, Memphis and Chattanooga demonstrate the impact of complex towing regulations on clearance times. Memphis had the longest average clearance time, attributed to its stringent requirement for hazardous material cleanup and additional reporting protocols. These measures may improve safety, but they contribute to long delays in roadway clearance times. Chattanooga, which implements a pay-by-pound towing fee structure, also reported an average clearance of 149 minutes. These observations show that complex regulations lead to slowing down the incidence clearance time of large vehicles.

The analysis also strengthens the argument for incentive-base towing programs, such as the towing and recovery incentive program (TRIP) which have proven successful in Georgia and Virginia. The comparative advantages of these programs in offering financial incentive to towing providers for their rapid response and efficient clearing highlights the benefits of implementing a similar incentive–based approach for Tennessee. Tennessee may implement a similar program to reduce the incident durations without compromising safety. This emphasizes adopting a balanced approach, such as the TRIP program. Tennessee can optimize the roadway clearance times and ultimately reduce the roadway clearance like those observed in Virginia and Georgia.

# Appendix B: Washington State DOT Major Incident Tow (MIT) Program

Washington State DOT Major Incident Tow (MIT) Program

Joint Operations Policy Agreement (JOPS) - A WSDOT/WSP Partnership

Traffic Incident Management is a key component in the Joint Operations Policy Statement (JOPS) agreement between WSDOT and the Washington State Patrol (WSP). WSDOT and WSP established a mutual goal of safely clearing highway traffic incidents within 90 minutes. Achieving this goal requires additional partnerships with local fire and EMS services, the tow industry, the media, the insurance industry, and drivers. The purpose of establishing quick-clearance goals is to enhance motorist and responder safety and minimize congestion.

Washington State Patrol (WSP) and Washington State DOT (WSDOT) formally established the 90-minute clearance goal in 2002. In spite of the efforts of both agencies, the average clearance time for a heavy truck involved in a fatality collision in FY 06 was 349 minutes, or 5.8 hours. In order to expedite clearance of major incidents involving heavy trucks, WSDOT requested and received legislative funding to implement the "Blok-Buster Major Incident Tow" program to expedite the removal of heavy truck collisions on July 1, 2007. Based upon a similar program in Florida, the Blok-Buster program raises minimum training and equipment requirements and provides a $2,500 incentive payment when quick-clearance goals are met.

The initial pilot program was funded in the amount of $300,000 for the 2007-09 biennium in King, Pierce, and Snohomish Counties. The program name was modified to the Major Incident Tow (MIT) program and legislative funding was renewed in both the 2009-11 and 2011-13 biennium. Coverage was extended to include all of Interstate 5 and all major state highways in the Puget Sound area.

Tow companies that meet stipulated requirements in equipment and personnel training such as Class "C" and Class "S" tow companies are eligible to apply for a letter of appointment (LOA) and when approved receive a designation as MIT Program authorized Registered Tow Truck Operator (MIT-RTTO) and are placed in a special call list.

The MIT-RTTO Contractor agrees to seek compensation for actual vehicle recovery and towing services performed pursuant to the LOA solely from the owner of the vehicle or their insurance provider.

Recovery Wrecker Requirements (company owned or leased)

Upon signing the LOA, the Contractor shall submit to the Washington State Patrol proof of the equipment with the minimum capacity, size and number, listed below:

• General truck requirements must meet the current criteria outlined in WAC 204-91A-170 for Class C, and Class S1 Rotators. Tow trucks must have a current inspection on file with the WSP. The contractor must respond to a MIT activation with (2) Class C or (1) Class C and (1) Class S1 Rotator. Trucks may be contracted with other tow companies, provided they meet all the above criteria.

• Drivers of required equipment shall be qualified, competent, and trained in accordance with the equipment they operate. Lead drivers must have at least two-year's experience in the recovery of commercial motor vehicles. Company Owners shall provide documentation indicating company drivers have received formal training on use of large recovery vehicles from a recognized source such as a Tow Association (TRAW, ITOW, etc.) or equivalent. Operator negligence as a result of inexperience or lack of training will result in the immediate voiding of the LOA pending investigation.

## Appendix C: Survey and Interview Questions

1. What was the towing policy/program you were using before considering Incentive Towing?
2. Apart from towing incentives, how does the towing companies charge vehicle owners?
3. What were the initial steps which led you to come up with the Idea of Towing Incentives
4. Is the policy part of State passed legislation or it is a DOT/Turnpike only managed program
5. Who wrote you the Towing Incentive White Paper (Policy)—Did you draft it yourself or you used law firm to draft it
6. Did you have any hearings from the towing companies or the public about introducing the program
7. How much did the Towing Incentive program cost when it started (initial cost to launch the program)
8. What was the starting towing incentives you offered when the program started (do you have any criteria which led you to that initial incentive number).
9. What are the current towing incentives you are offering (any justification or supporting reason which made you reach that incentive number)
10. What is(are) the source of funds for supporting the Towing Incentives Program
11. Does the Towing Incentive program receive any financial support from agencies such as EPA?
12. How does the program select the Towing companies for the Incentive Program
13. How many Towing companies you have for the program
14. What is the coverage per towing company (number of highways covered or miles or counties)-Any reasoning behind which led to select those coverage limits?
15. What are the towing vehicle capacities you consider as a threshold for any towing company to qualify for the Incentive Program
16. Do you offer training to Towing Companies entering the Incentive Program
17. What has been the benefit of this program so far in terms of reducing incident durations and clearing the highways
18. Is it possible to quantify the success or benefit of this Incentive program in terms of dollar amount? How much the program has saved compared to before situations
19. Are there any towing regulation governing commercial vehicles which are not covered by insurance (Truck and Trailer)
20. Is there any pushback or dissatisfaction with some section of state agencies with the Towing Incentive program? What has been your response to them to make the program keep on running