

Evaluating Factors Associated with Abandoned and Disabled Vehicle Incidents in Tennessee

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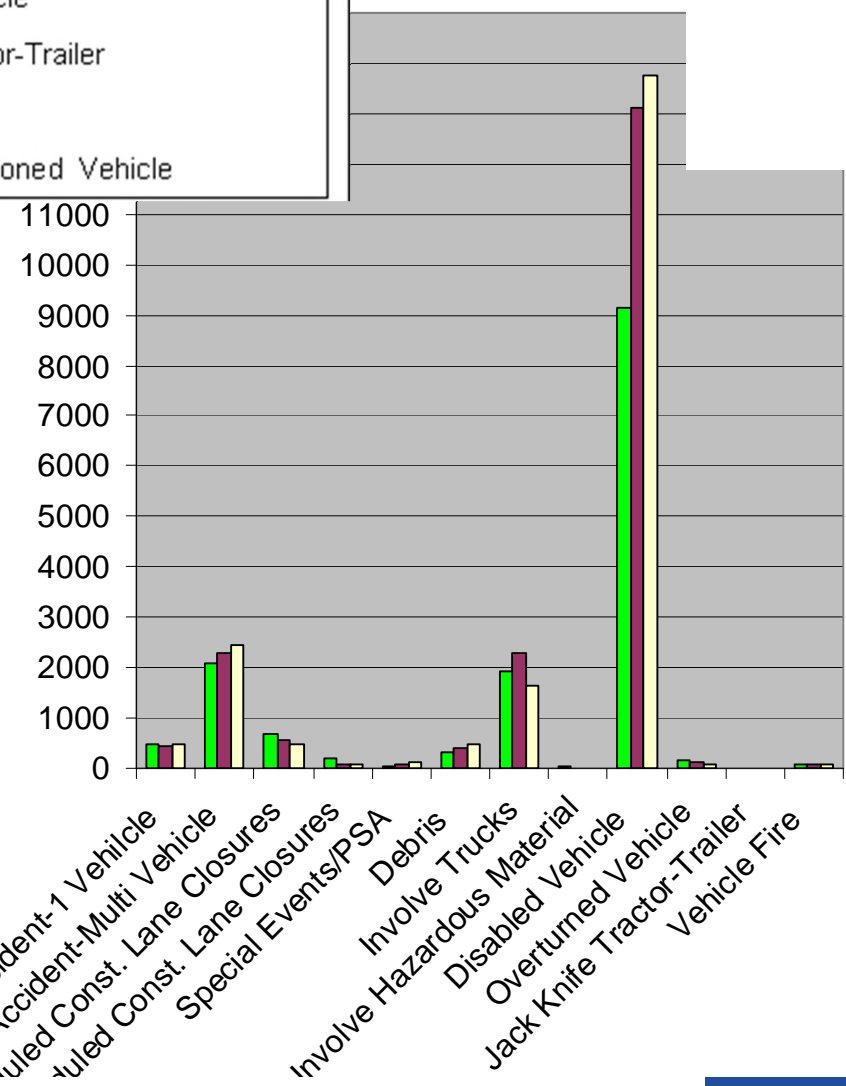
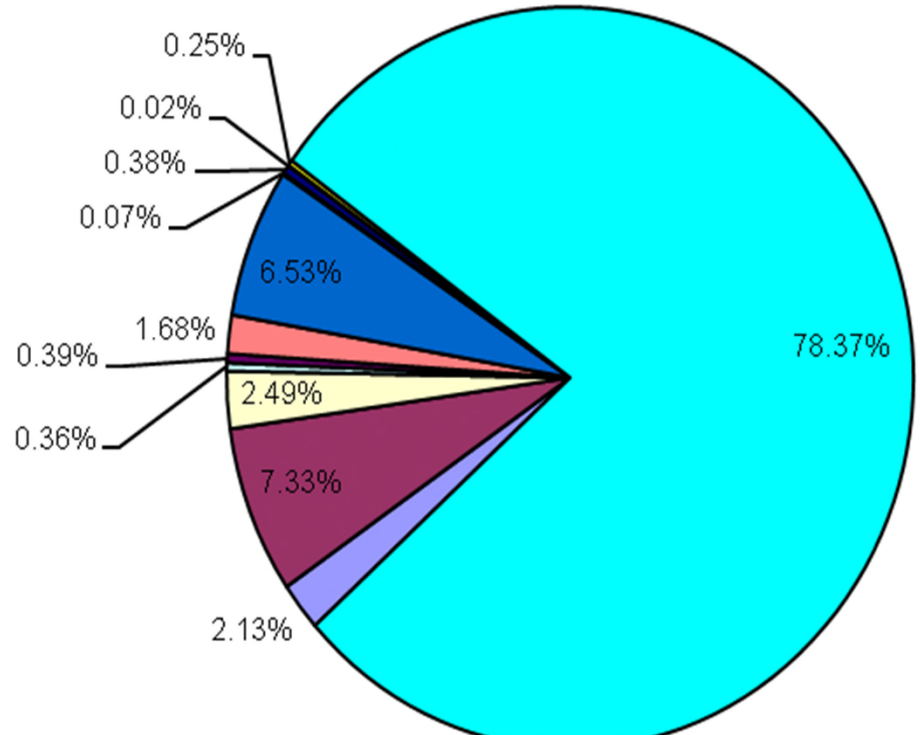
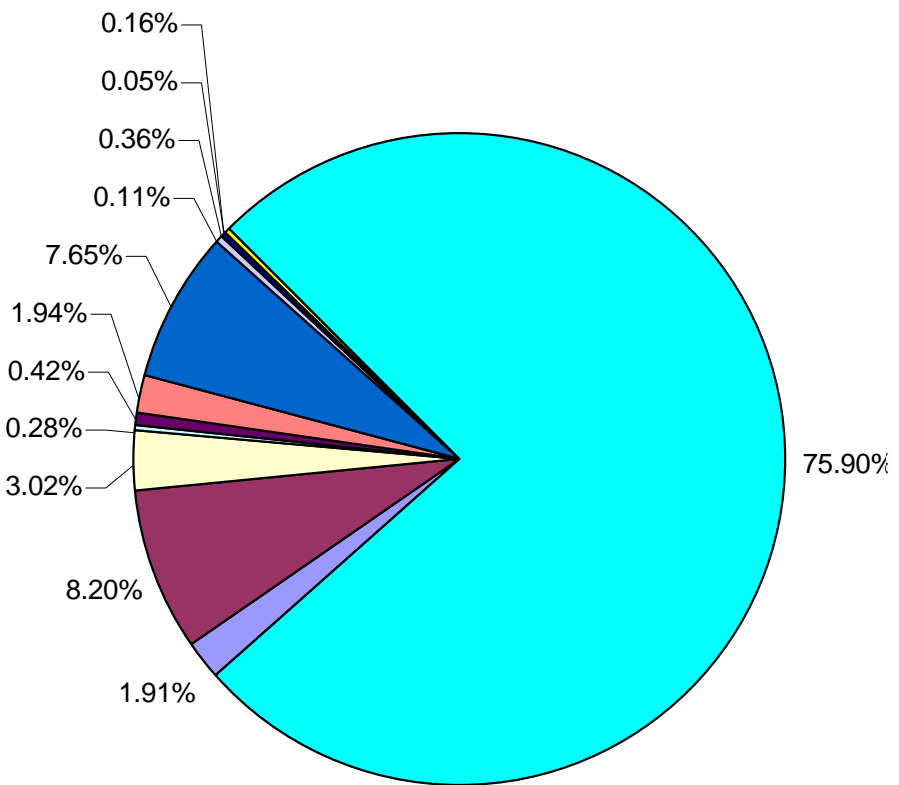
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BACKGROUND

- From previous incidents reported in TDOT Region 3 Traffic Management Center, **72%** were due to disabled or abandoned vehicles.
- Additional analysis also showed that disabled and abandoned vehicle incidents increased substantially at an average of **7% per year**.

- Crash-1 Vehicle
- Crash-Multi Vehicle
- Scheduled Roadwork (Const. & Maint.)
- Unsched. Roadwork (Const. & Maint.)
- Special Events/PSA
- Debris
- Involve Trucks
- Involve Hazardous Material
- Overturned Vehicle
- Jack Knife Tractor-Trailer
- Vehicle Fire
- Disabled / Abandoned Vehicle



BACKGROUND

- TN Code section 55-16-103 defines abandoned vehicles as those remaining illegally on public property for a period of more than 48 hours, among other definitions.
- To remove disabled/abandoned vehicles on access controlled facilities, TN Code 54-16-113 requires the removal to make a reasonable effort to allow the owner of the vehicle to arrange for its removal
- It is hypothesized that because of long duration of the disabled and abandoned vehicle incidents on freeways, secondary crashes are generated.
- The longer the disabled/abandoned vehicle, the higher the likelihood of secondary collisions or other safety related incidents to be generated.
- The safety impact resulting from crashes and injury severities associated with these incidents have not been fully examined

STUDY OBJECTIVES:

1. Evaluate the factors influencing the primary incidents and secondary crashes as a result of disabled or abandoned vehicles in Tennessee.
2. Examine the impact of some sections of Tennessee Code chapter 54 and 55 regarding removal of abandoned or disabled vehicles.

Abandoned Vehicle Law in Tennessee

State	Time Allowed to Be Left Unattended		Code Number	Text from State Laws & Codes
	Hours	Days		
TENNESSEE	48	2	55-16-103	<p>(A) is over four (4) years old and is left unattended on public property for more than ten (10) days;</p> <p>(B) is in an obvious state of disrepair and is left unattended on public property for more than three (3) days;</p> <p><i>(C) has remained illegally on public property for a period of more than forty-eight (48) hours;</i></p> <p><i>(D) has remained on private property without the consent of the owner or person in control of the property for more than forty-eight (48) hours</i></p>

Major Tennessee Cities Laws for Abandoned Vehicles

County or City	Time Allowed to Be Left Unattended		Code Number	Text from State Laws & Codes
	Hours	Days		
Chattanooga	48	2	24-341	(d) Abandoned vehicle shall mean any vehicle or part thereof which is left unattended on public or private property for more than ten (10) days, or a vehicle that has remained illegally on public property for a period of more than forty-eight (48) hours, or a vehicle that has remained on private property without the consent of the owner or person in control of the property for more than forty-eight (48) hour
Knoxville	48	2	17-122	(2) Any motor vehicle that has remained illegally on public property for a period of more than forty-eight (48) hours
Metropolitan Nashville	72	3	12.08.210	(B) "Abandoned motor vehicle," for the purposes of this chapter, means a motor vehicle that is over four years old including any contents of that vehicle, that is left unattended on public property for more than ten days, or a motor vehicle that is in an obvious state of disrepair and is left unattended on public property for more than three days.
Memphis	240	10	14-4-2	"Abandoned vehicle" means any motor vehicle to which the last registered owner of record thereof has relinquished all further dominion and control and/or any vehicle which is wrecked or partially dismantled or inoperable for a period often (10) days. There shall be a presumption that the last registered owner thereof has abandoned such vehicle, regardless of whether the physical possession of such vehicle remains in the technical custody or control of such owner, if it has remained inoperable or partially dismantled or if the owner has relinquished dominion or control of such vehicle for ten (10) days.

States with Longest Time Permitted for Abandoned Vehicles

State	Time Allowed to Be Left Unattended		Code Number	Text from State Laws & Codes
	Hours	Days		
NEW MEXICO	720*	30*	66-1-4.1	"Abandoned Vehicle" means a vehicle or motor vehicle which has been determined by a New Mexico law enforcement agency:(1) to have been left unattended on either public or private property for at least thirty days;
ALABAMA	168	7	32-13-1	2. [...] left unattended on a public street, road, or highway or other public property for a period of at least seven days;"
MISSISSIPPI	120	5	63-23-3	Left unattended on a public street, road or highway or other public property for a period of at least five (5) days
GEORGIA	120	5*	40-11-1	B) Which is left unattended on a public street, road, or highway or other public property for a period of at least five days and when it reasonably appears to a law enforcement officer that the individual who left such motor vehicle unattended does not intend to return and remove such motor vehicle.

States with Least Time Permitted for Abandoned Vehicles

State	Time Allowed to Be Left Unattended		Code Number	Text from State Laws & Codes
	Hours	Days		
CALIFORNIA	4	0	22650-2271	(f) When a vehicle, except highway maintenance or construction equipment, is stopped, parked, or left standing for more than four hours upon the right-of-way of a freeway that has full control of access and no crossings at grade and the driver, if present, cannot move the vehicle under its own power.
ILLINOIS	10	0	10.10.040	A. When a motor vehicle or other vehicle is abandoned on a highway in this municipality ten hours or more, its removal by a towing service ...
DELAWARE	12	0	4402	"...shall post a notice at some conspicuous place on the vehicle, which shall direct that such vehicle be removed by a stated time and date (such time and date to be not less than 12 hours following the posting of such notice)."

QUESTIONNAIRE SURVEY

States which Responded

- Kansas
- Minnesota
- Nevada
- New Jersey
- North Dakota
- Oregon
- Arkansas
- Colorado
- North Carolina
- Alaska***
- Wyoming***
- Texas***

***They don't specify

abandoned/disabled category

1. What areas (e.g., state, cities, counties) comprise your jurisdiction? _____
2. Freeway incident types by year (please fill in the table below for any available data)

Incident Type	2004	2005	2006	2007	2008	2009	2010	2011
Abandoned Vehicles								
Disabled Vehicles								
All Other Types								
4. Does an incident management manual exist for your jurisdiction? Yes No NA
 If yes, does it include instructions for removing abandoned/disabled vehicles? Yes No NA
3. Has a study of incident related to safety or congestion been conducted for your jurisdiction or institute? Yes No NA
 If yes, is it possible to obtain a copy of the study report/paper/presentation? Yes No NA
4. Does your jurisdiction have a guidelines of how to identify secondary crashes? Yes No NA
 If yes, which element do you consider? the time frame between incidents the distance between two incidents
 queue lengths built from the primary incident, other pre-defined criteria other methodologies
5. Has a study on the safety impact of abandoned/disabled vehicles been conducted for your jurisdiction? Yes No NA
 If yes, is it possible to obtain a copy of the study report? Yes No NA
6. Where disabled vehicles are typically relocated to? (Check all that apply)
 Nearest shoulder Nearest ramp Accident investigation site Private towing company yard Vehicle repair facility Other
7. Does your jurisdiction have a law requiring the removal of motor vehicles from the right-of-way on freeways? Yes No NA
 A. If no, is this law currently under consideration in your jurisdiction? Yes No NA
 B. If yes, what is the limit (in hours or days) that vehicles can stay on the shoulder or median before considered abandoned? _____
8. Has your jurisdiction been sued in connection with a secondary crash for not clearing a traffic incident in a timely manner? Yes No
9. Is towing disabled and abandoned vehicles a problem in your jurisdiction? Yes No NA
10. Has the law changed recently to facilitate dealing with highway incidents? Yes No NA
 A. If yes, When did the current law take effect? _____
 B. If yes, why did the law change? To reduce Secondary Crashes To reduce congestion
 To keep shoulders clear for emergency response units Other reasons
11. If the abandoned/ disabled vehicles law exist, indicate the degree of your agency's satisfaction with the law.
 Very satisfied Satisfied Unsatisfied Very unsatisfied (would like some changes)
12. Based on the overall satisfaction of the law, Should the time period for abandoned vehicles be extended, shortened, or kept the same?
 reduced to _____ hours extended to _____ hours kept the same
13. What benefits (if any) of the law have been observed? _____
14. What problems (if any) have been experienced? _____
15. What is the average incident time in your jurisdiction? (elapsed incident duration from the start of incident to the complete clearance) _____
16. If known, what is the average clearance time (elapsed incident duration from the start of incident removal to response personnel departure) _____

States with law requiring the removal of motor vehicles from the right-of-way on freeways

State	Removal Law	The Hours vehicle can Stay on the Shoulder or Median	Current Time for Abandoned Vehicles
Kansas	Yes	48	Kept the Same
Minnesota	Yes	Rural (4), Urban (2)	Kept the Same
Nevada	Yes	Unknown	---
New Jersey	Yes	48	Kept the Same
North Dakota	Yes	---	Kept the Same
Oregon	Yes	---	Kept the Same
Arkansas	Yes	24	Kept the Same
Colorado	Yes	48	Kept the Same
North Carolina	Yes	24	---

1. States with Incident Management Manual

2. States with Instructions for removing Disabled Vehicles

State	Have Incident Management Manual	Instructions on Removing Disabled Vehicles
Kansas	NA	---
Minnesota	No	---
Nevada	No	---
New Jersey	Yes	No
North Dakota	No	---
Oregon	Yes	Yes
Arkansas	Yes	No
Colorado	Yes	Yes
North Carolina	Yes	Yes

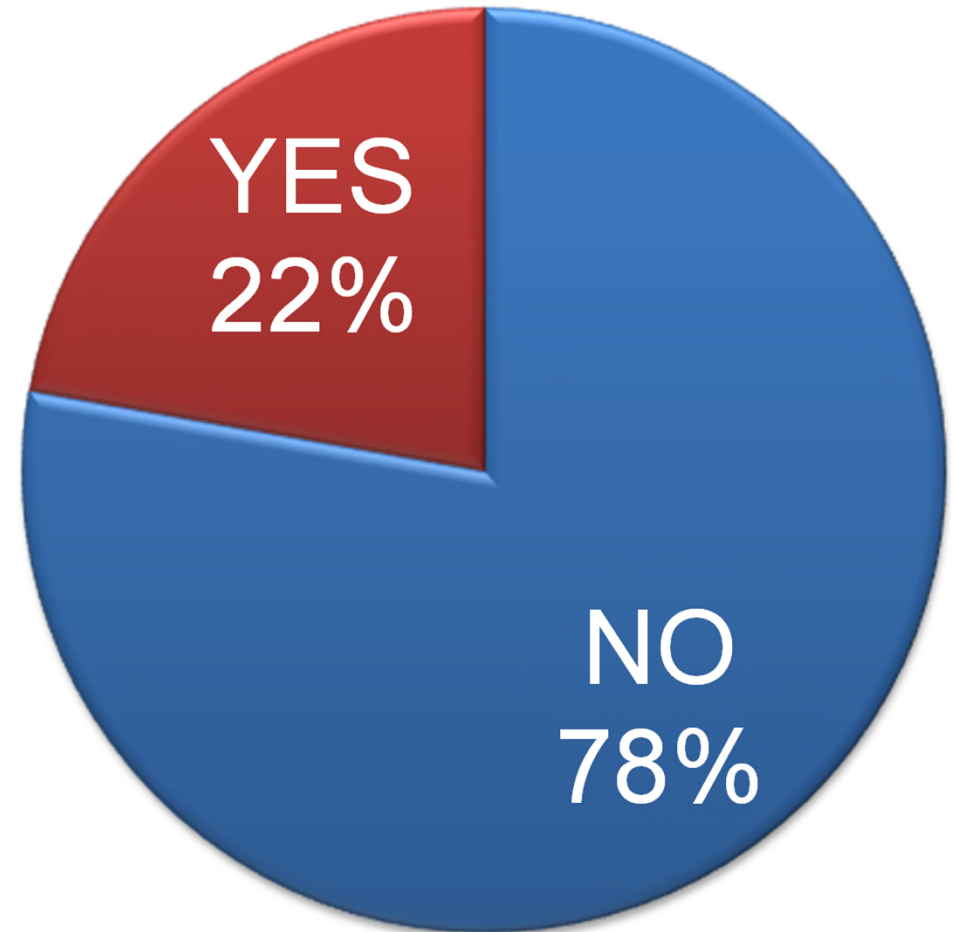


What is the average incident duration in your jurisdiction

State	Average Duration
Kansas	No data
Minnesota	31 min
Nevada	Unknown
New Jersey	45 min
North Dakota	---
Arkansas	---
Colorado	---
North Carolina	60 min

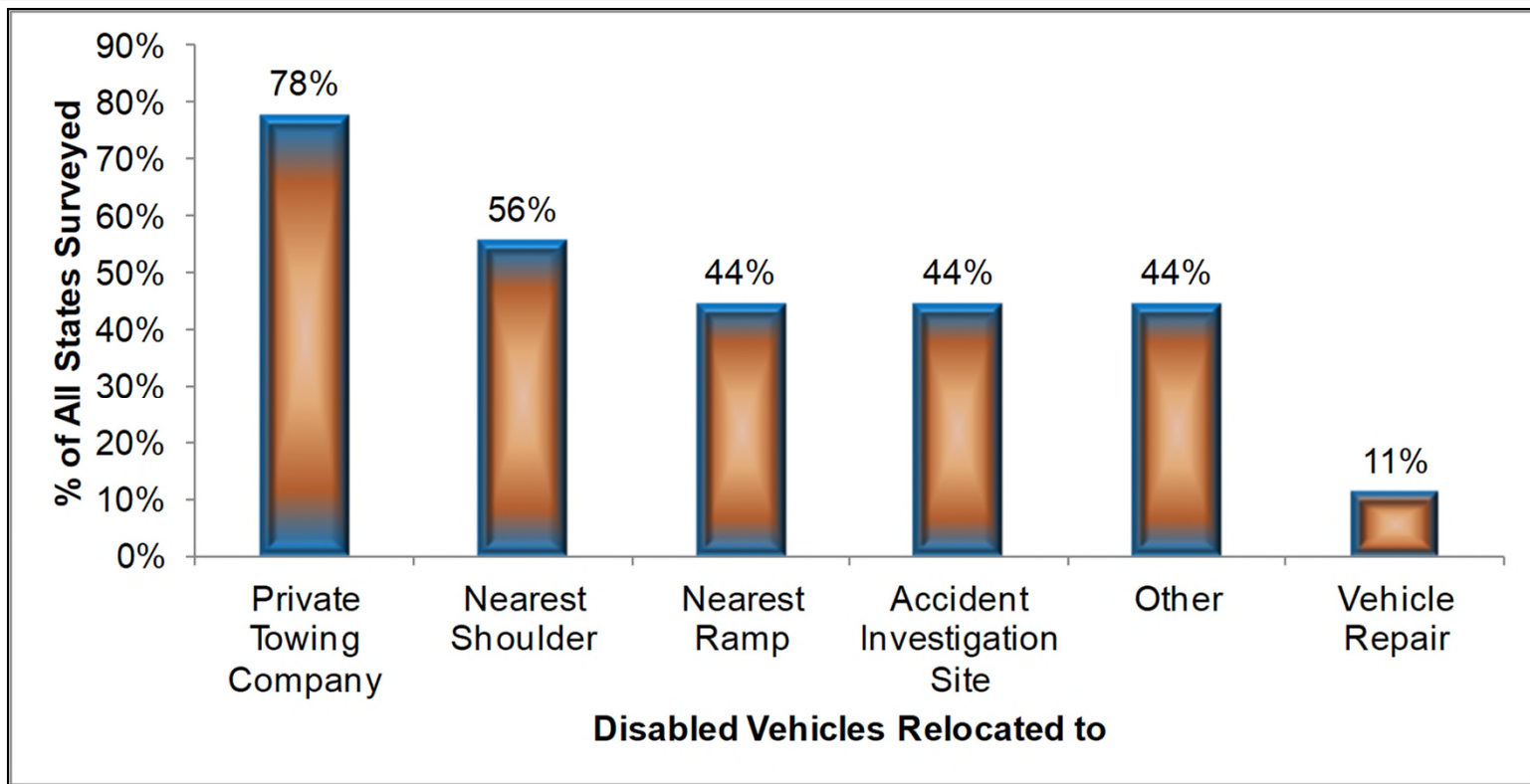
1. States which Conducted Study related on Incidents
2. States which can provide copy of their study to us

State	Study Conducted
Kansas	No
Minnesota*	Yes
Nevada	No
New Jersey	No
North Dakota	No
Oregon	No
Arkansas	No
Colorado	No
North Carolina	Yes



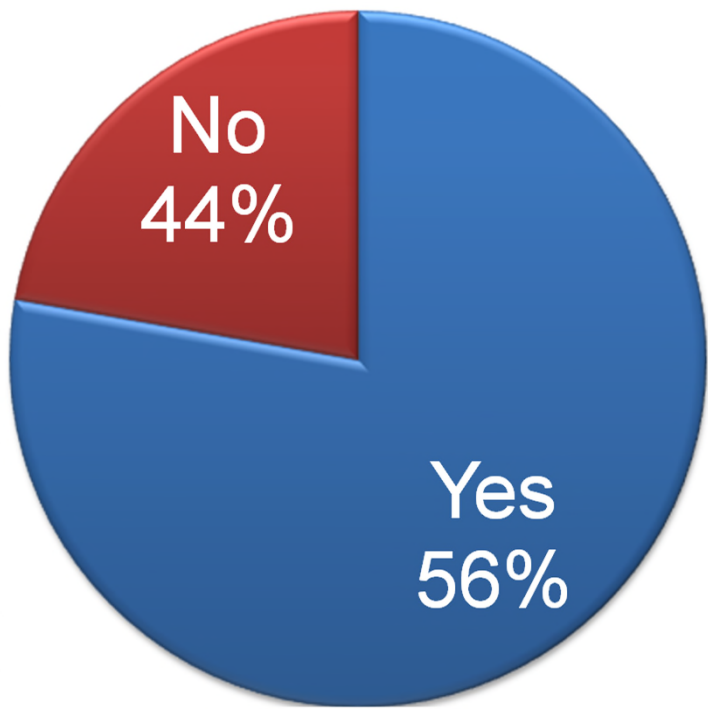
Where they Locate Disabled/Abandoned Vehicles

	Nearest Shoulder	Nearest Ramp	Accident Investigation Site	Private Towing Company	Vehicle Repair	Other
Kansas				✓		
Minnesota	✓	✓	✓	✓		
Nevada						✓
New Jersey	✓	✓	✓	✓	✓	
North Dakota	✓			✓		✓
Oregon	✓	✓	✓	✓		✓
Arkansas						
Colorado	✓	✓	✓	✓		✓
North Carolina				✓		



Has the law changed recently to facilitate dealing with highway incidents?

State	Law Changed	Year Changed	Why Law Changed
Kansas	Yes	2009	Reduce Secondary Crashes, Congestion clear shoulder and others
Minnesota	Yes	2009	Reduce Secondary Crashes & Congestion
Nevada	Yes	2011	Reduce Secondary Crashes & Keep Shoulder Clear
New Jersey	Yes	---	Move Over Law
North Dakota	No		
Oregon	No		
Arkansas	No		
Colorado	No	NA	
North Carolina	Yes	Last few years	Reduce Secondary Crashes, Congestion clear shoulder

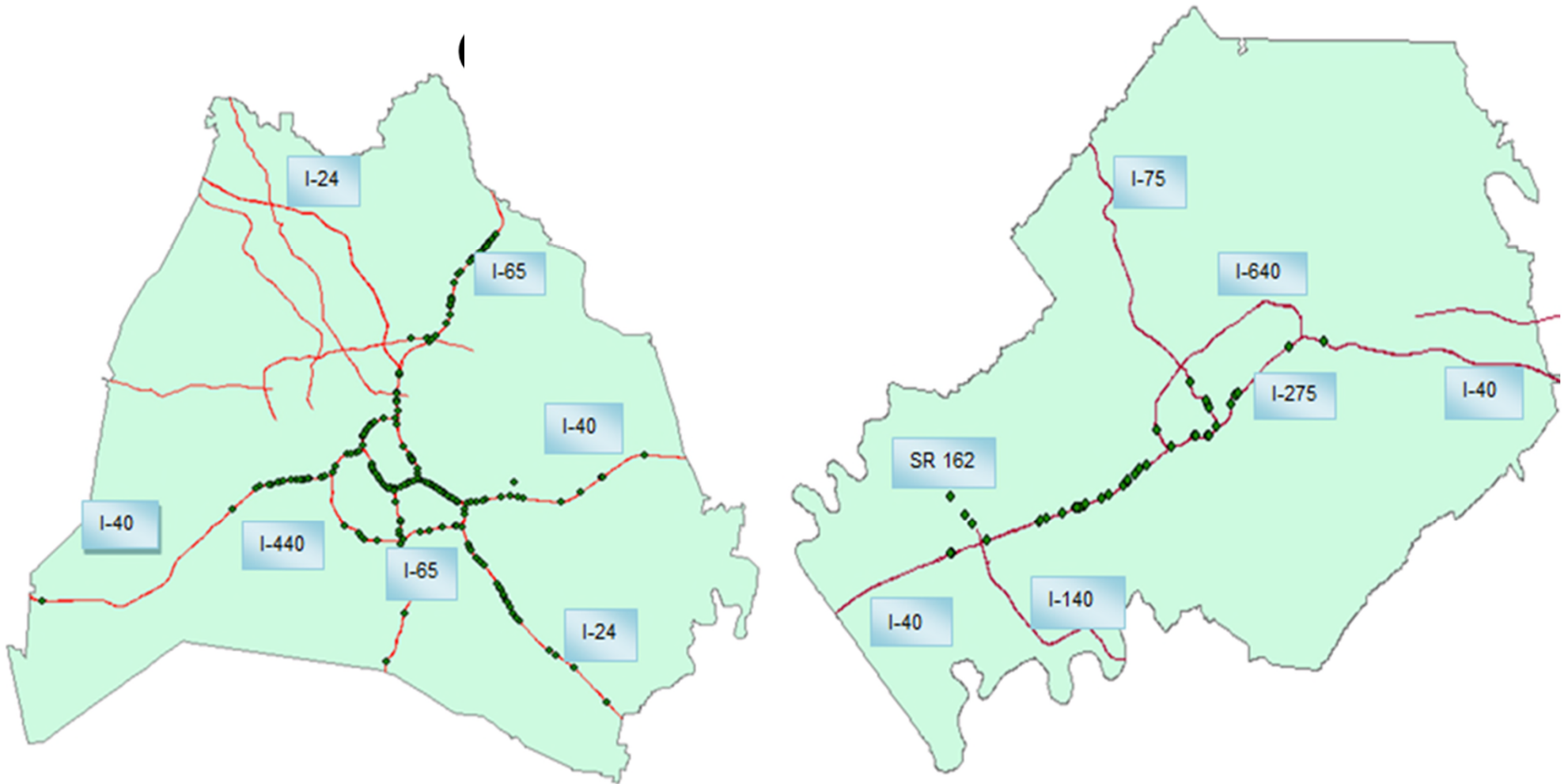


AGENCY SATISFACTION WITH THE LAW

State	Satisfactions
Kansas	Very Satisfied
Minnesota	Satisfied
Nevada	Satisfied
New Jersey	Satisfied
North Dakota	Satisfied
Oregon	Satisfied
Arkansas	Very Satisfied
Colorado	Satisfied
North Carolina	---

STUDY DATA

REGION 1 AND 3 DATA COMBINED



Two sources of data were utilized

1. Incident Data
2. Crash Data

CRASH DATA

Some of the Variables

Crash Time

Crash Date

Crash Log Miles

Direction

CrashType

InjuryClass

LightCondition

Location

RoadNbr

Removal

Construction Zone

Maneuver

MannerCollision

RelationToRoad

RoadAlignment

RoadSurface

Weather

TravelLanes

TrafficwayFlow

TrafficwayType

- Statewide Incident data was obtained from Tennessee Department of Safety (TDOS)
- Statewide Crash data downloaded from the **eTRIMS** database
- These crashes were screened and later correlated to incident data to determine secondary crashes and for developing safety performance function

TRAFFIC INCIDENT DATA FROM REGION 1 AND 3

- 172,645 screened Abandoned and Disabled Vehicle incidents data acquired from TDOT Region 1 and 3

The following criteria were used to retained incident for full analysis:

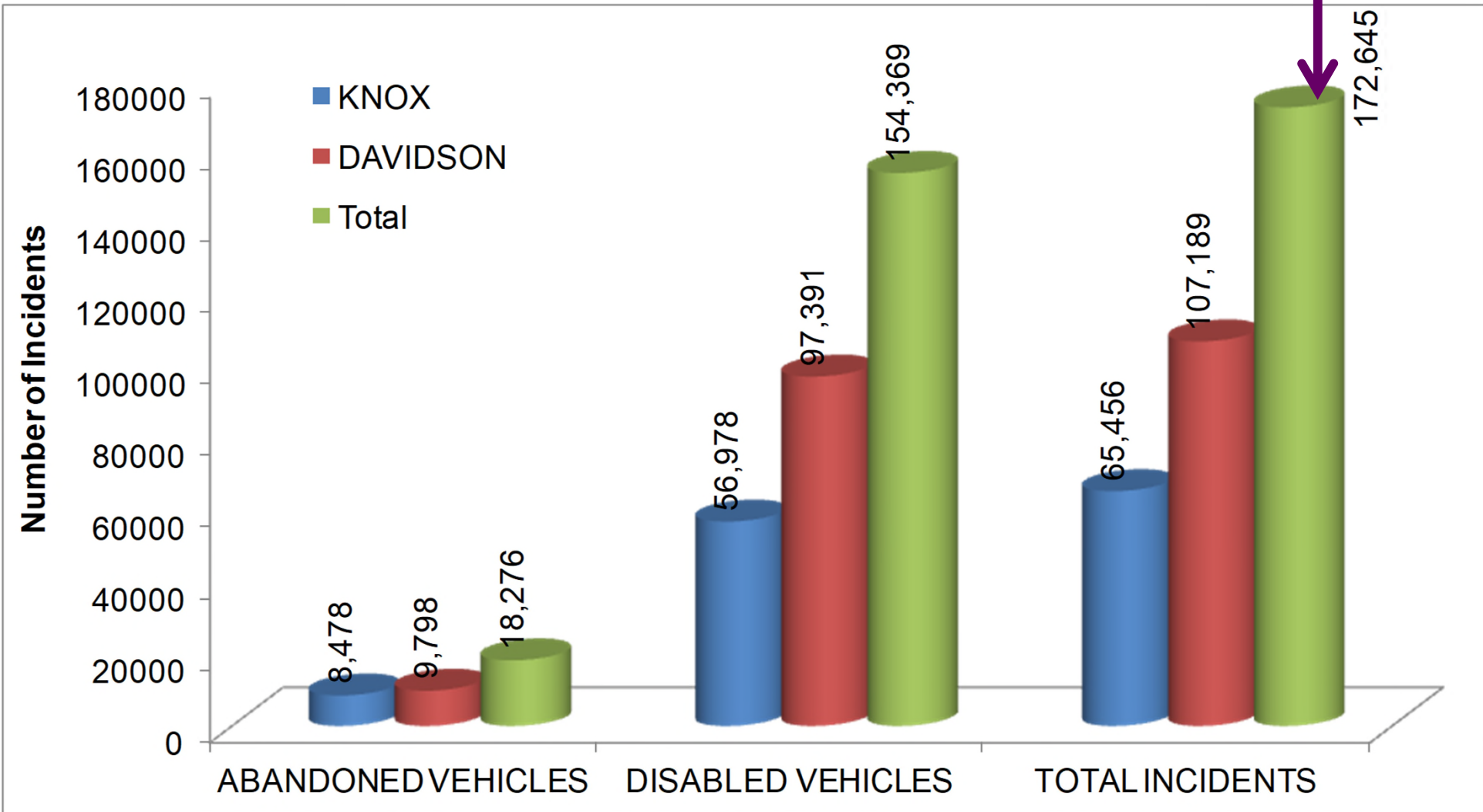
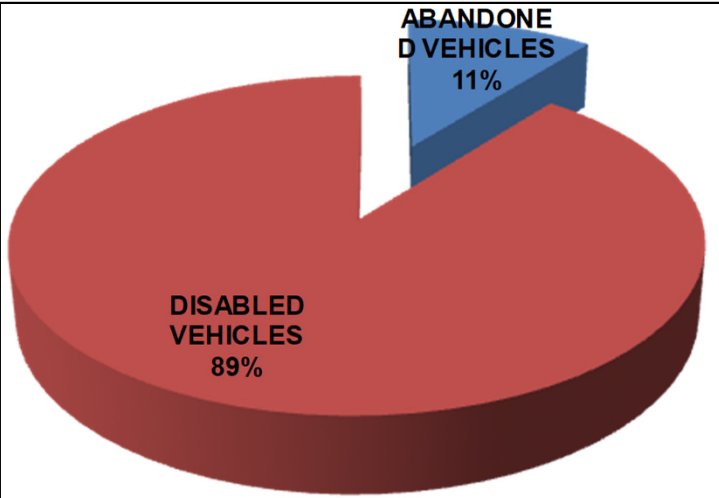
- Only disabled and abandoned vehicle incidents
- Only incidents with known route name by direction
- Incident that have the mile marker within study limits
- Only incidents on the Freeways
- The time of the incident shown to be before the clearance time
- The date of the incident shown to be before the clearance date

Based on screening, 172,645 incidents were retained for analysis

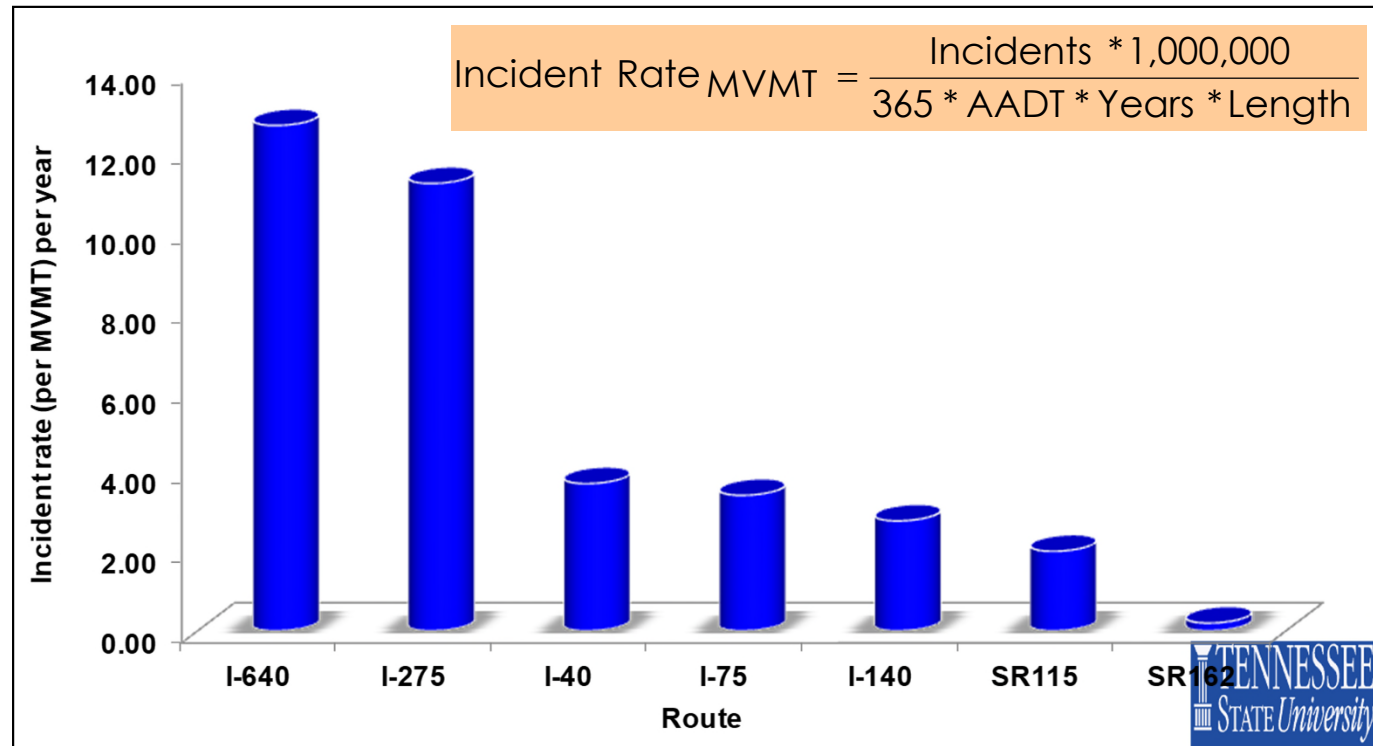
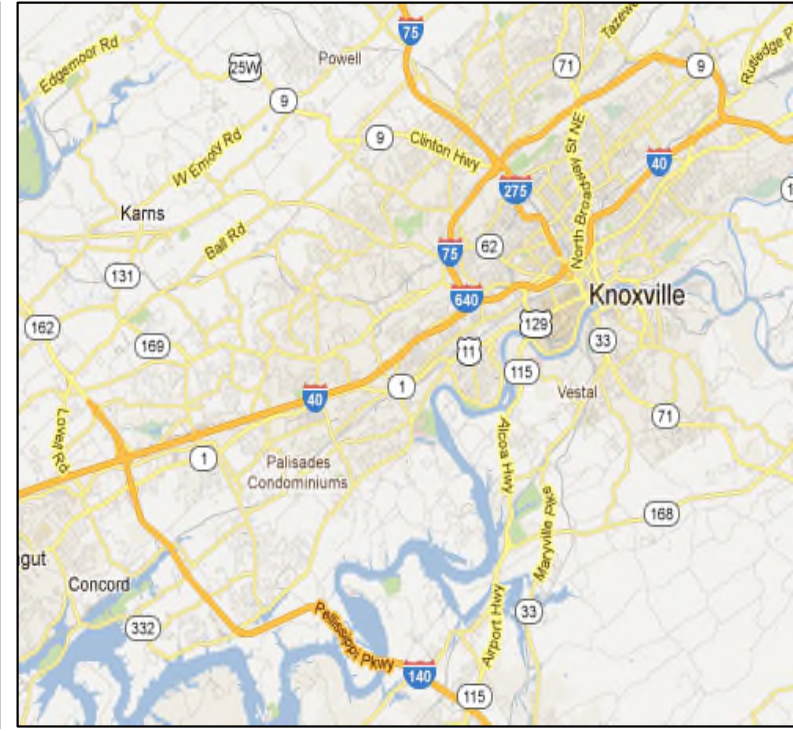
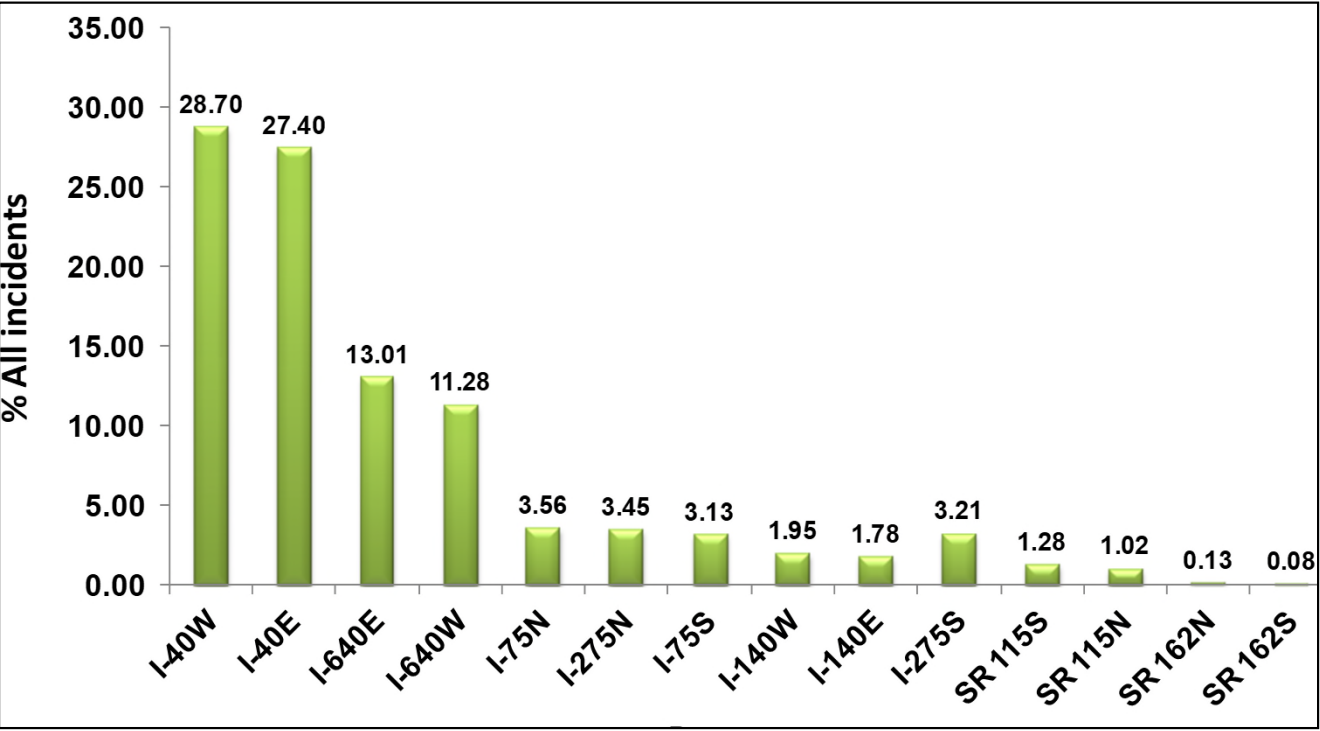
Cause of the Incidents	Frequency	Percent
Disabled Vehicle	154,369	89%
Abandoned Vehicle	18,276	11%
TOTAL	172,645	

DESCRIPTIVE STATISTICS OF PRIMARY INCIDENTS

Disabled and Abandoned Vehicle (Screened) Incidents Data received (Region 1 and 3)

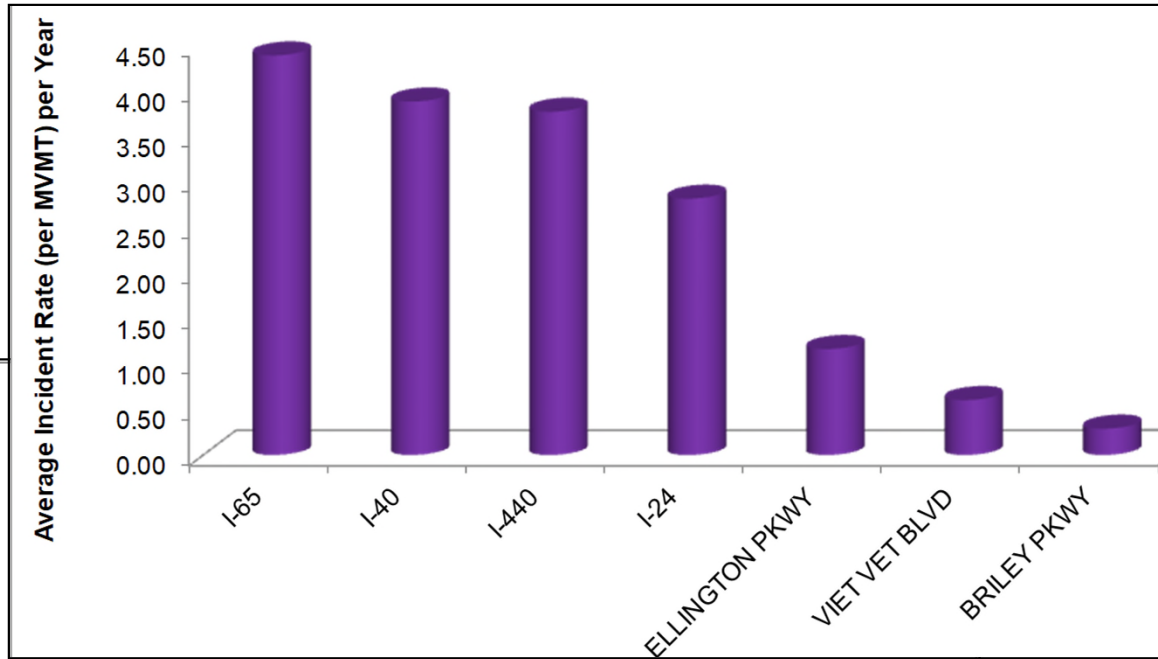
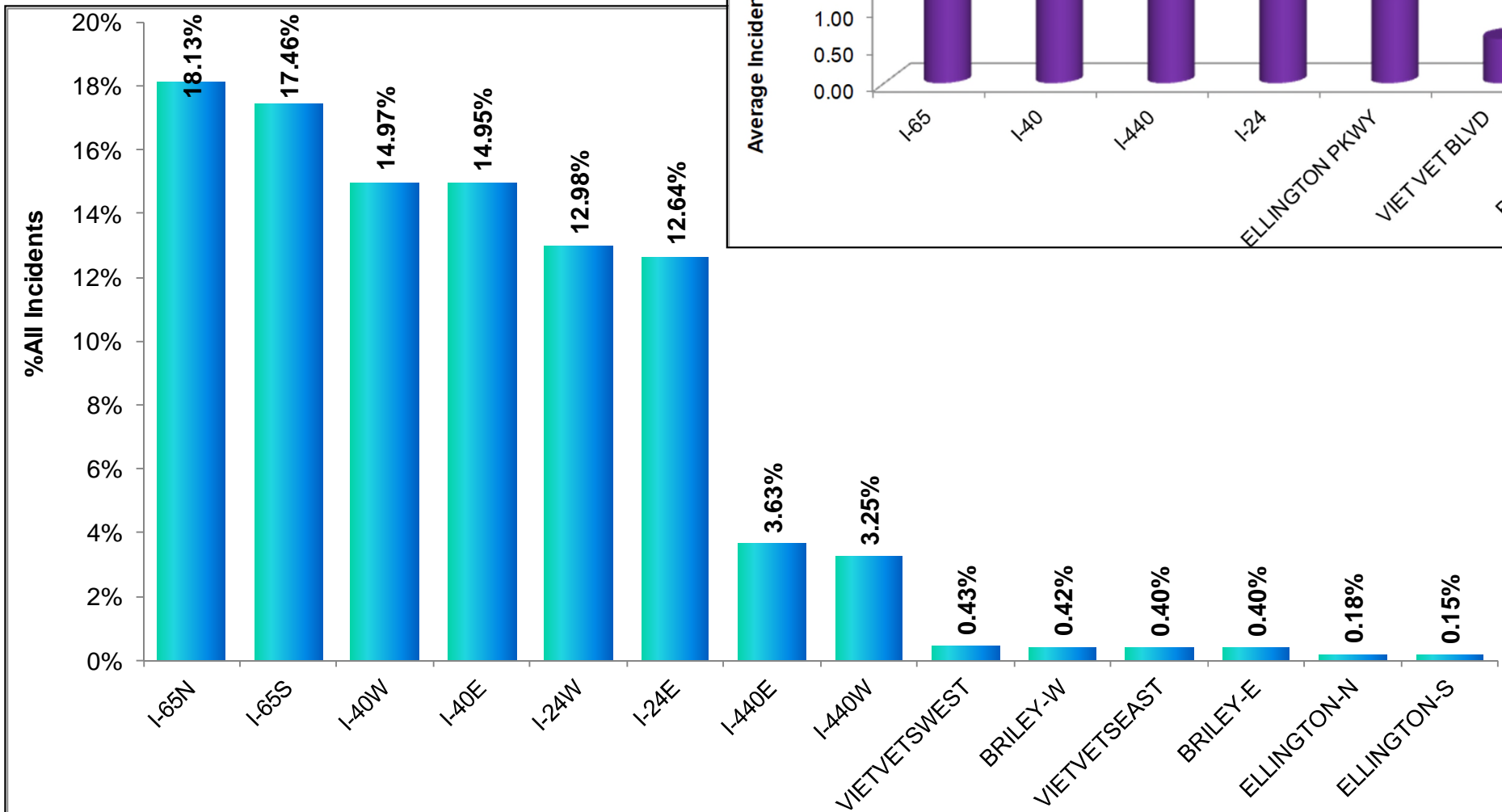


REGION 1 INCIDENTS DISTRIBUTION BY ROUTES



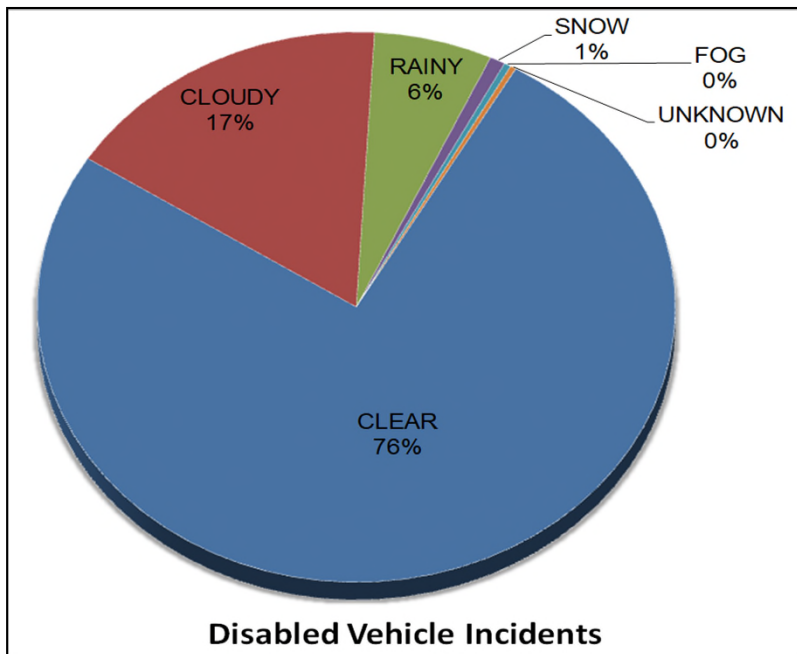
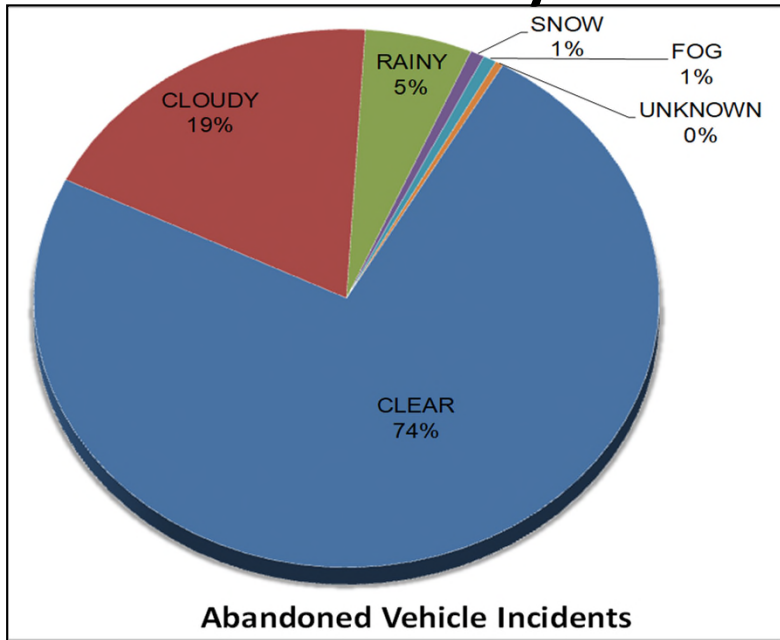
Percentage Incident and Rate for Region 3 TMC Data

$$\text{Incident Rate}_{\text{MVMT}} = \frac{\text{Incidents} * 1,000,000}{365 * \text{AADT} * \text{Years} * \text{Length}}$$

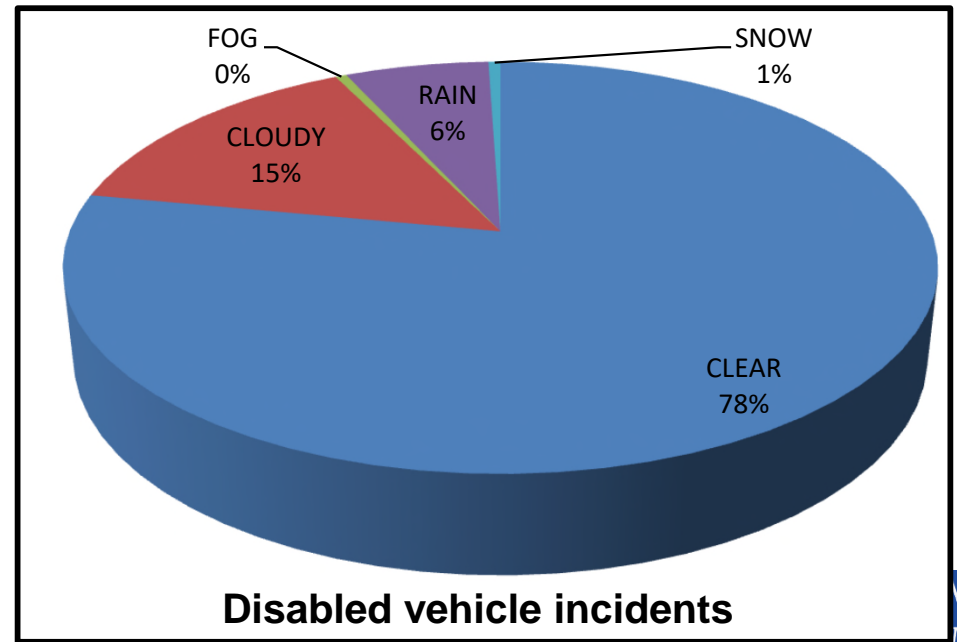
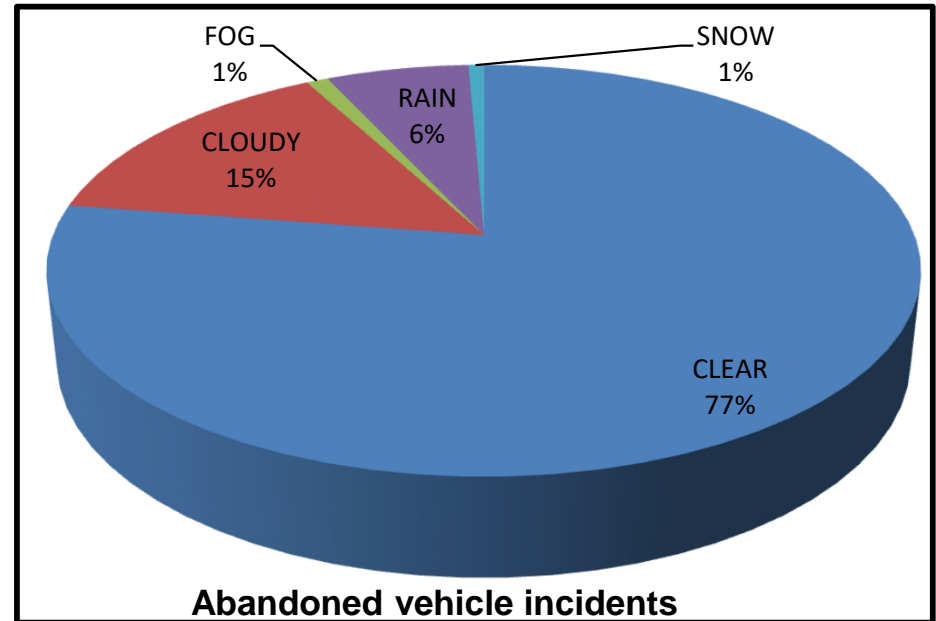


Incidents by Weather Condition

Davidson County

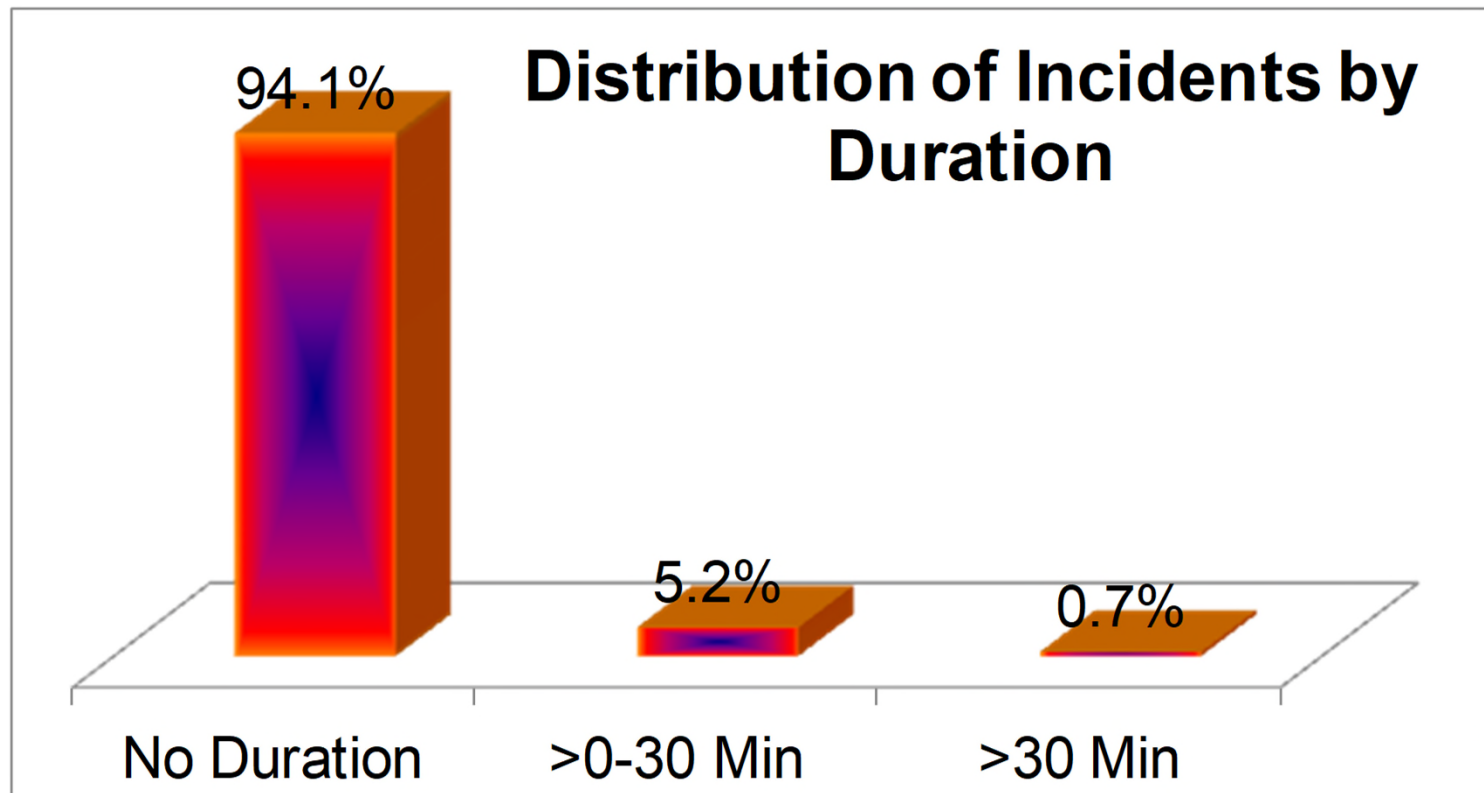


Knox County

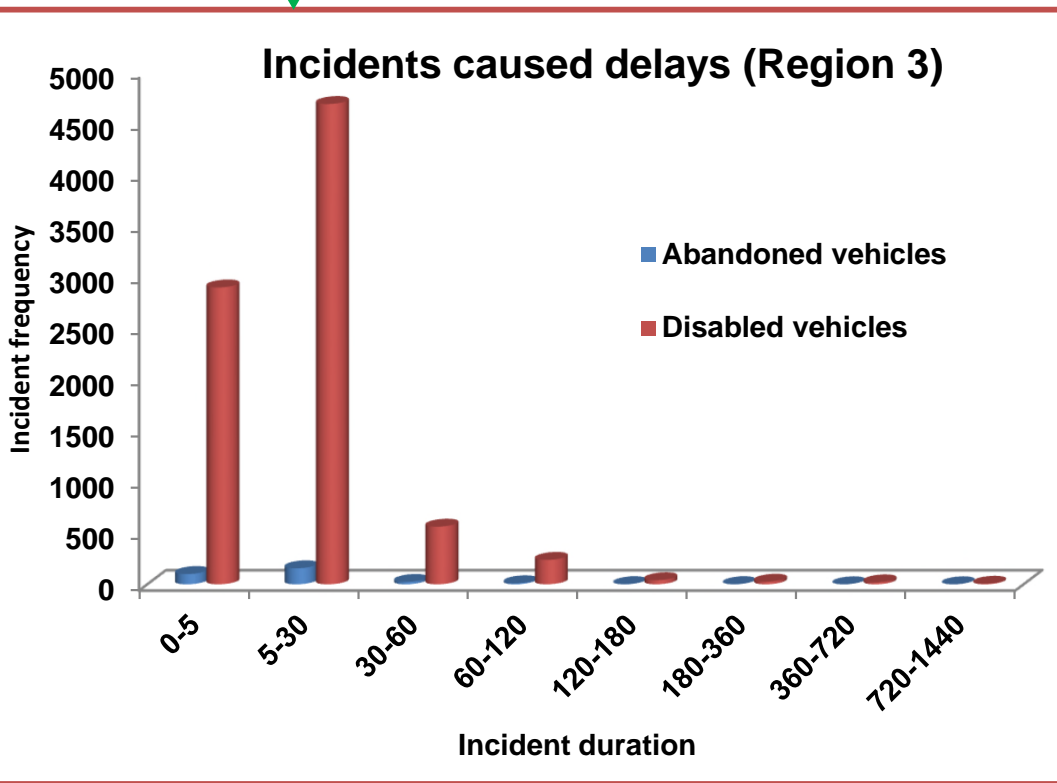
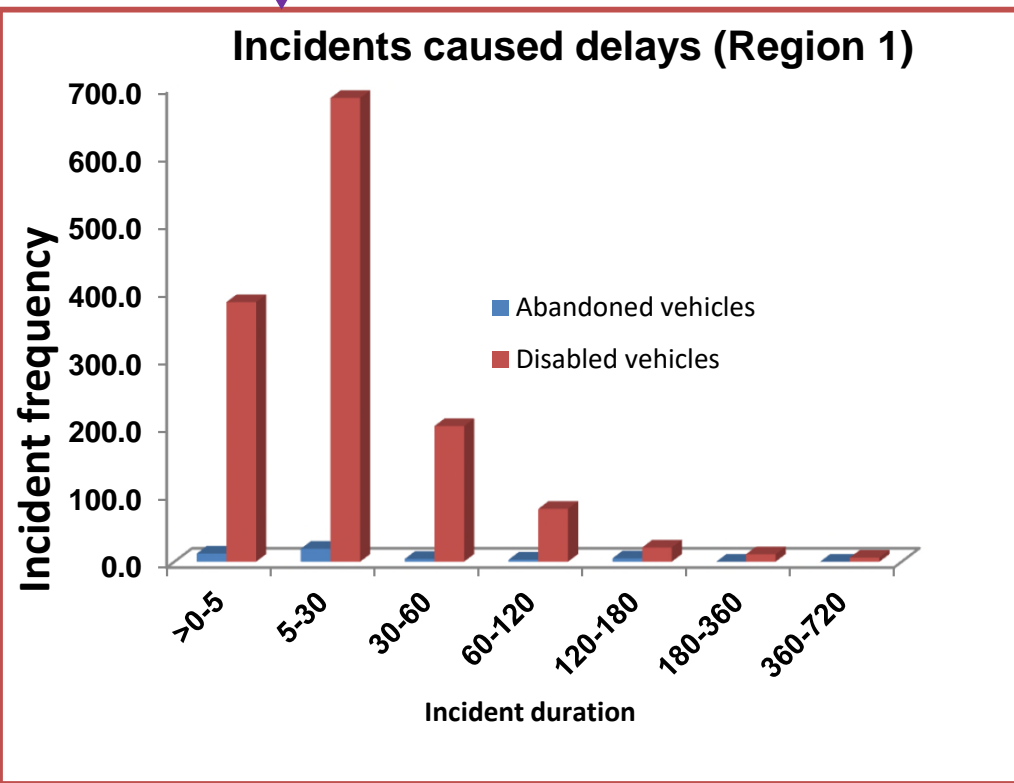
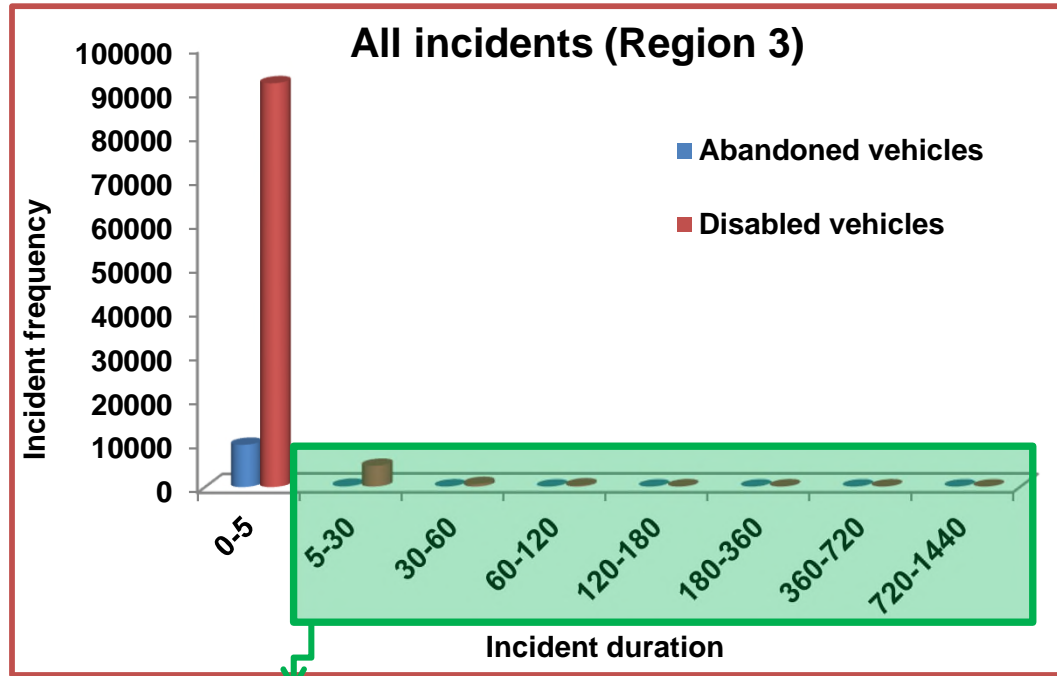
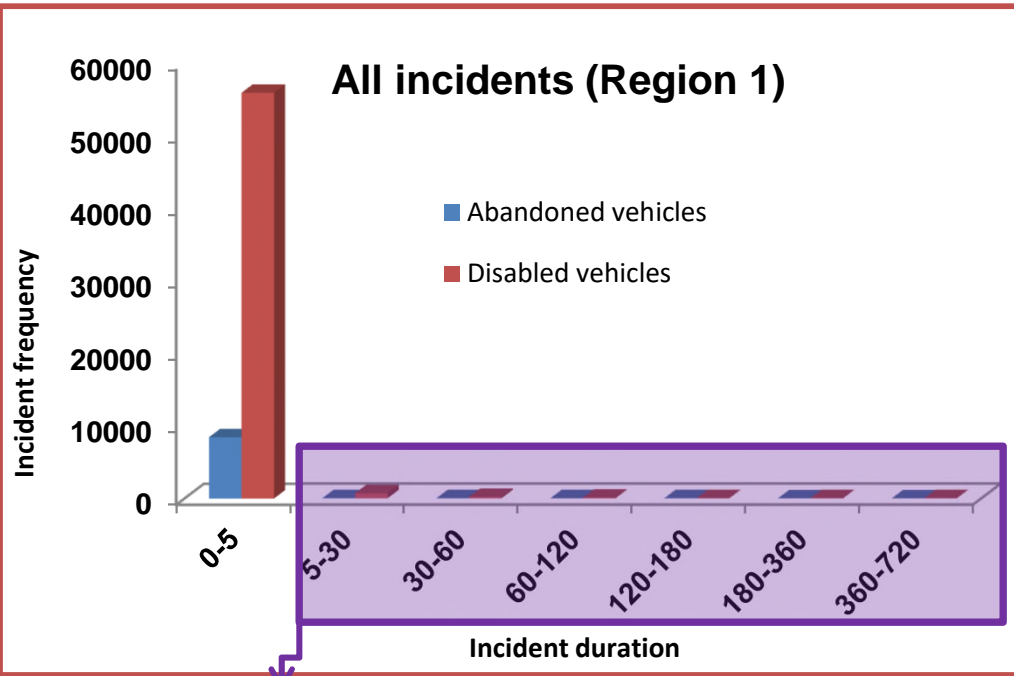


Abandoned/Disabled Vehicles Incident Duration

- Analysis was done to correlate incident duration with various operational, geometric and other related factors
- Almost 99% of incidents were cleared within 30 minutes
- Only 0.7% of all incidents lasted for more than 30 minutes

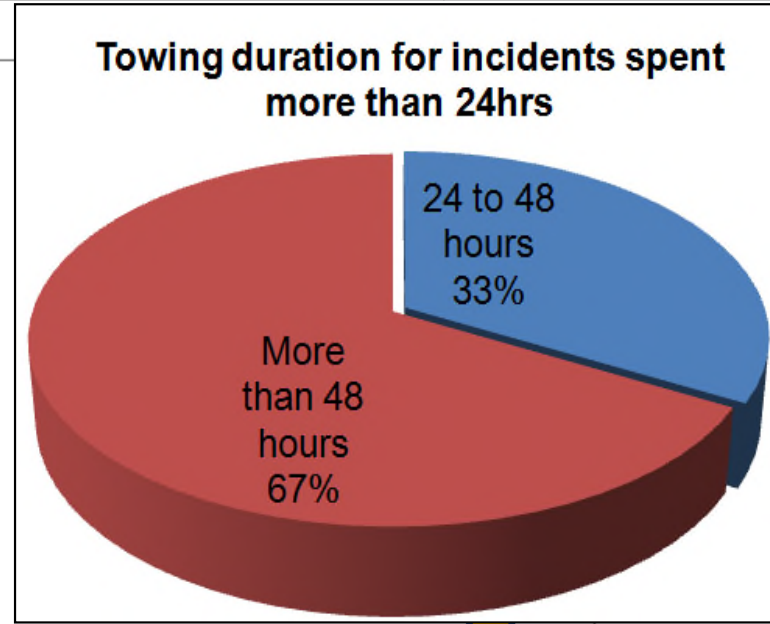
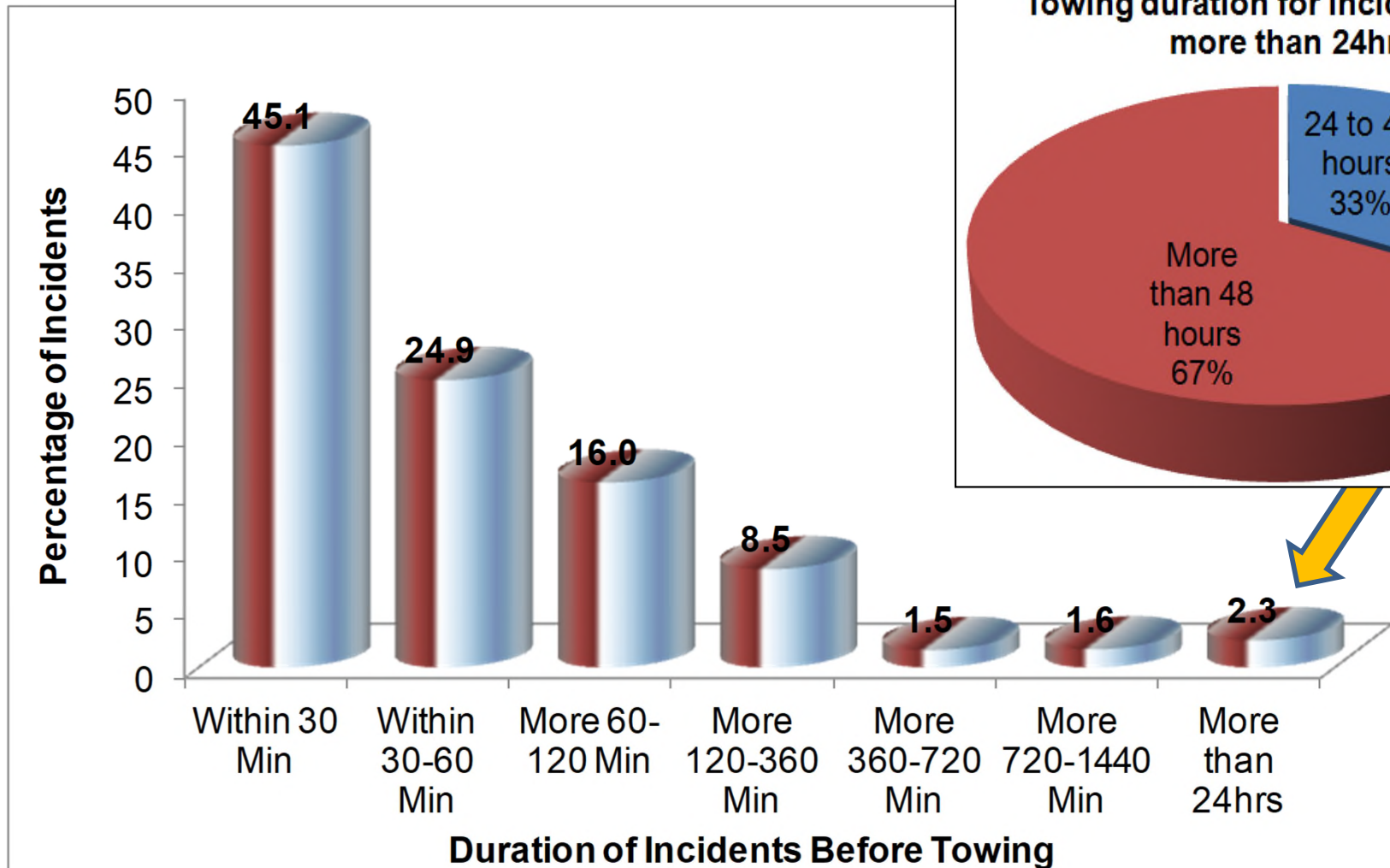
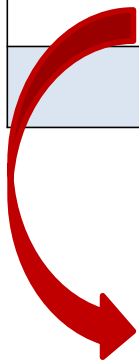


DISTRIBUTION OF INCIDENT DURATIONS



DISTRIBUTION OF INCIDENT DURATIONS BEFORE **TOWING**

VEHICLE TOWED	ABANDONED VEHICLE	DISABLED VEHICLE	TOTAL
NO (91%)	16,865	140,902	157,767
YES (9%)	1,411	13,467	14,878
Total	18,276	154,369	172,645



IDENTIFICATION OF SECONDARY CRASHES

Identifying Secondary Crashes

- The secondary crashes were identified based on the temporal and spatial relationship between Crashes and Incidents
- With the help of written computer program using C++ and visual studio.

Conditions to classify a crash as secondary crash

1. The crash should occur in the same route with the primary incident.
2. It should have occurred in the same day as the primary incident.
3. The crash time should fall within the start time and clear time of the incident.
4. The spatial limit between the location of the incident and the location of the crash should be within 2 miles.

IDENTIFYING SECONDARY CRASHES - CONDITIONS

172,645 PRIMARY INCIDENTS
114670
CRASH DATA

The crash occurred in the same route with the primary incident

YES

NO

The crash occurred in the same day as the primary incident.

YES

NO

The crash time was between the start time and clear time of the incident.

YES

NO

The spatial limit between the location of the incident and the location of the crash was within two miles.

YES

NO

The temporal limit between time of the incident and the time of the crash was within two hours.

YES

NO

317
Secondary crashes

114353
Non-secondary crashes

Identify Secondary Crashes—Script Program in Microsoft Visual Studio

Incident

ID	ROUTE_NAME	IncidentMileMarker	IncidentStartDateAndT	IncidentEndDateAr	IncidentDate	ClearDate	ROUTE_DIRECTIC	IncidentIDNumber
1	BRILEY	3	6/16/2009 12:38...	6/16/2009 12:38...	6/16/2009	6/16/2009	BRILEY E	NASH20090616...
2	BRILEY	3	8/17/2009 8:52 ...	8/17/2009 8:52 ...	8/17/2009	8/17/2009	BRILEY E	NASH20090817...
3	BRILEY	3	12/4/2009 9:42 ...	12/4/2009 9:42 ...	12/4/2009	12/4/2009	BRILEY E	NASH20091204...
4	BRILEY	3	12/31/2009 11:5...	12/31/2009 11:5...	12/31/2009	12/31/2009	BRILEY E	NASH20091231...
5	BRILEY	3	2/19/2010 7:37 ...	2/19/2010 7:37 ...	2/19/2010	2/19/2010	BRILEY E	NASH20100219...

Accident

ID	ROUTE_NAME	AccidentMileMarke	AccidentDateAndT	caseno	AccidentDate	Field6
1	BRILEY	0	9/5/2009 3:35 AM	9989930	9/5/2009	
2	BRILEY	0	12/24/2007 3:50...	9992739	12/24/2007	
3	BRILEY	0.001	12/12/2010 2:03...	10572141	12/12/2010	
4	BRILEY	0.02	11/22/2005 4:16...	9072064	11/22/2005	
5	BRILEY	0.057	9/16/2010 11:18...	10431528	9/16/2010	

Extracted

caseno	A.ROUTE_NAME	I.ROUTE_NAME	AccidentDateAndT	IncidentStartDateA	IncidentEndDateAr	IncidentMileMarker	AccidentMileMarke	Distance
7701631	BRILEY	BRILEY	1/10/2008 2:50 ...	1/10/2008 2:46 ...	1/10/2008 3:25 ...	7	7.12	0.120000000000...
7986023	I-65	I-65	5/4/2004 9:00 AM	5/4/2004 8:45 AM	5/4/2004 9:45 AM	96	95.72999999999...	0.270000000000...
7986223	I-65	I-65	7/15/2004 6:55 ...	7/15/2004 6:41 ...	7/15/2004 6:56 ...	94.2	94.63	0.429999999999...
7992428	I-65	I-65	4/27/2004 3:50 ...	4/27/2004 3:47 ...	4/27/2004 3:52 ...	94.6	95.02	0.420000000000...
8020643	I-40	I-40	11/11/2004 2:39...	11/11/2004 2:35...	11/11/2004 2:46...	211.6	212.08	0.480000000000...
8021401	I-40	I-40	1/7/2005 2:30 PM	1/7/2005 2:27 PM	1/7/2005 2:34 PM	211.6	211.6	0

A.AccidentDate = I.IncidentDate AND A.ROUTE_NAME = I.ROUTE_NAME And (A.AccidentDateAndTime > I.IncidentStartDateAndTime AND A.AccidentDateAndTime < I.IncidentEndDateAndTime) AND ABS(A.AccidentMileMarker - I.IncidentMileMarker) < 2 ";

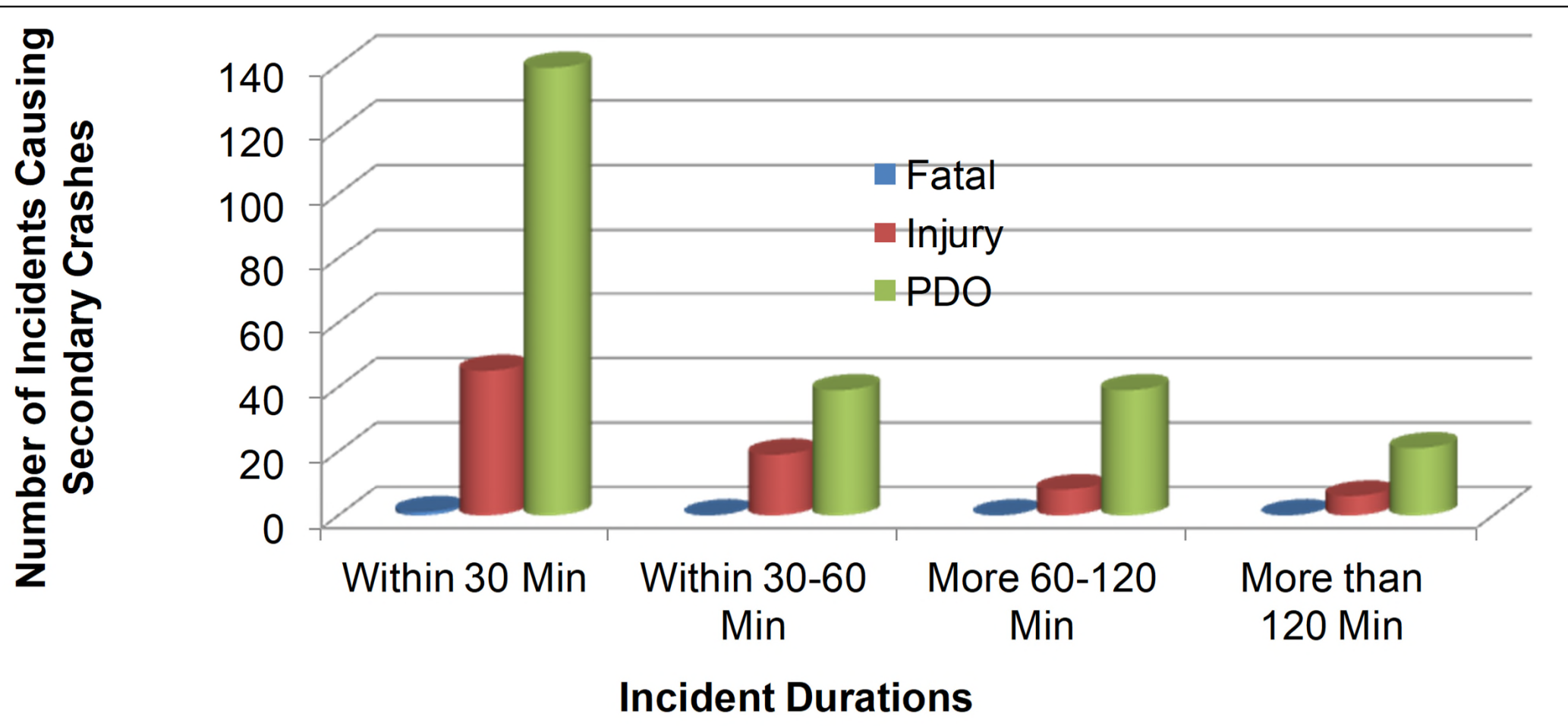
Incidents Which Caused **Secondary** Crashes

- Based on the stated conditions, 317 total incidents were identified to have caused secondary crashes within the same direction of travel
- Of all of these incidents only **14.5%** occurred in Knoxville (Knox County) and **85.5%** occurred in Nashville (Davidson County)
- Of all these incidents, **3%** were related to **Abandoned vehicles** and **97%** were related to **Disabled Vehicle** incidents

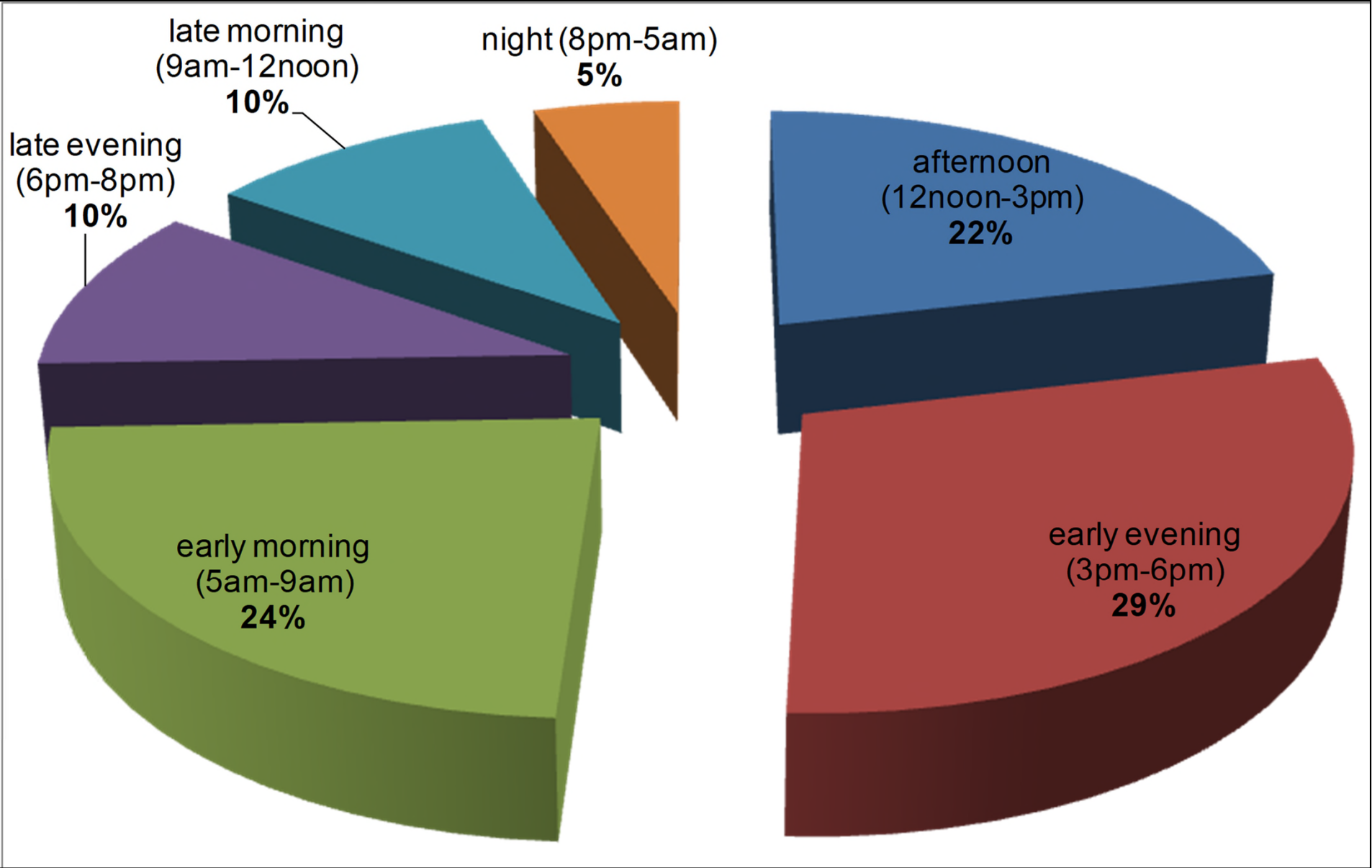
Incidents Which Caused Secondary Crashes

	Freq.	Percent
Abandoned Vehicles	9	3%
Disabled Vehicles	308	97%
Total Incidents\Crashes	317	

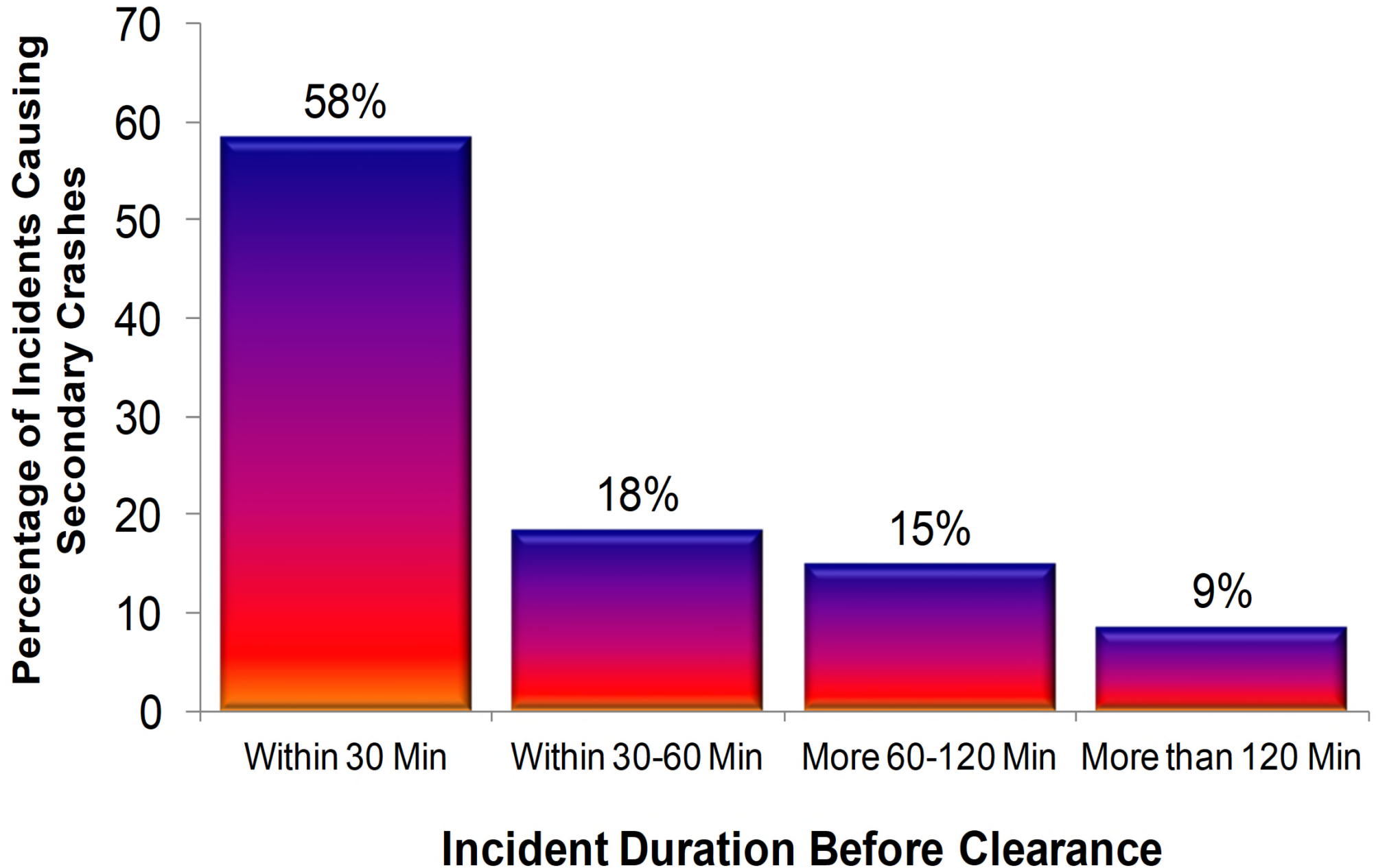
Duration of Incidents which Caused Secondary Crashes by Injury Severities



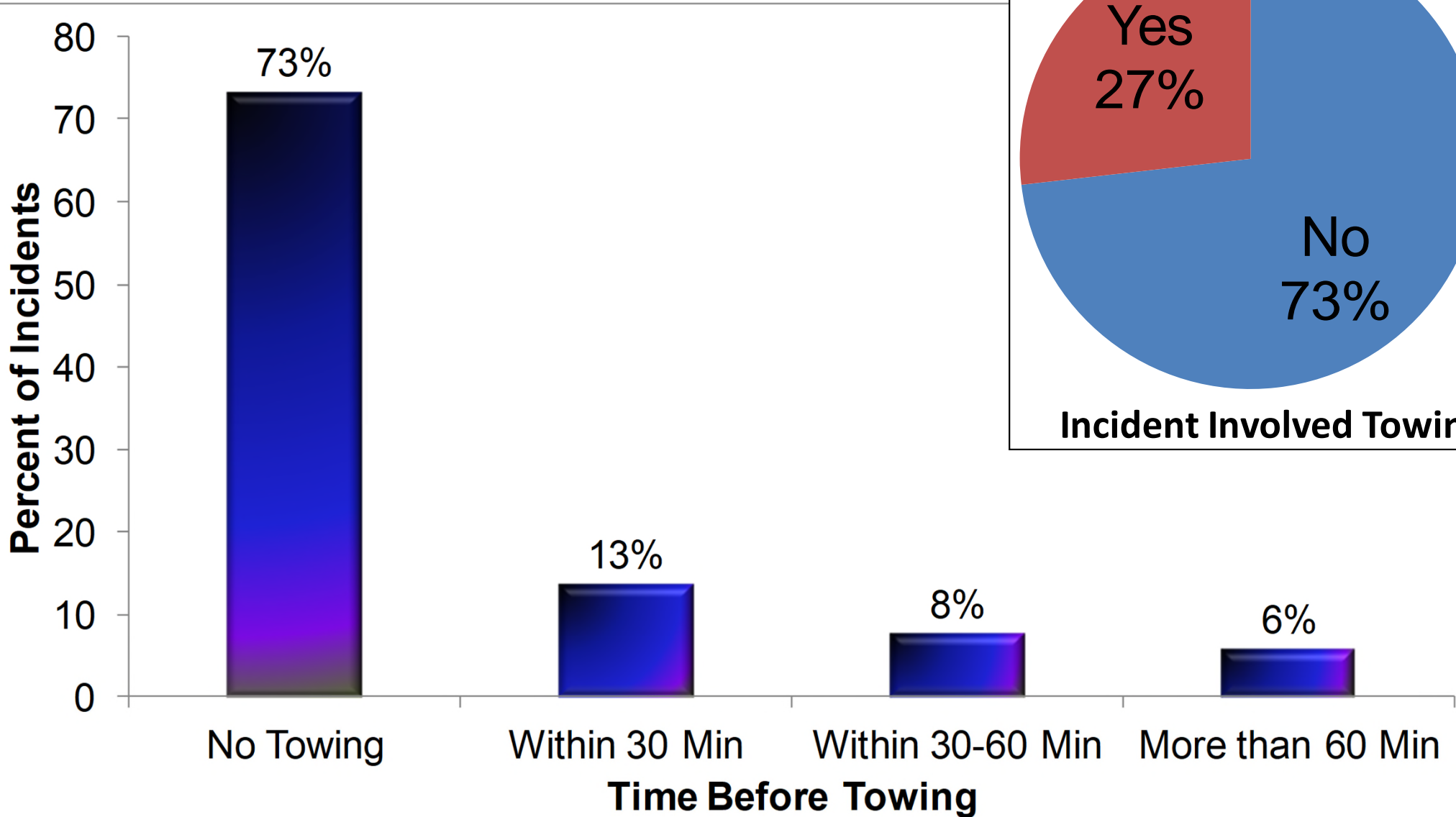
Distribution of Incidents which Caused Secondary Crashes by Time of the day



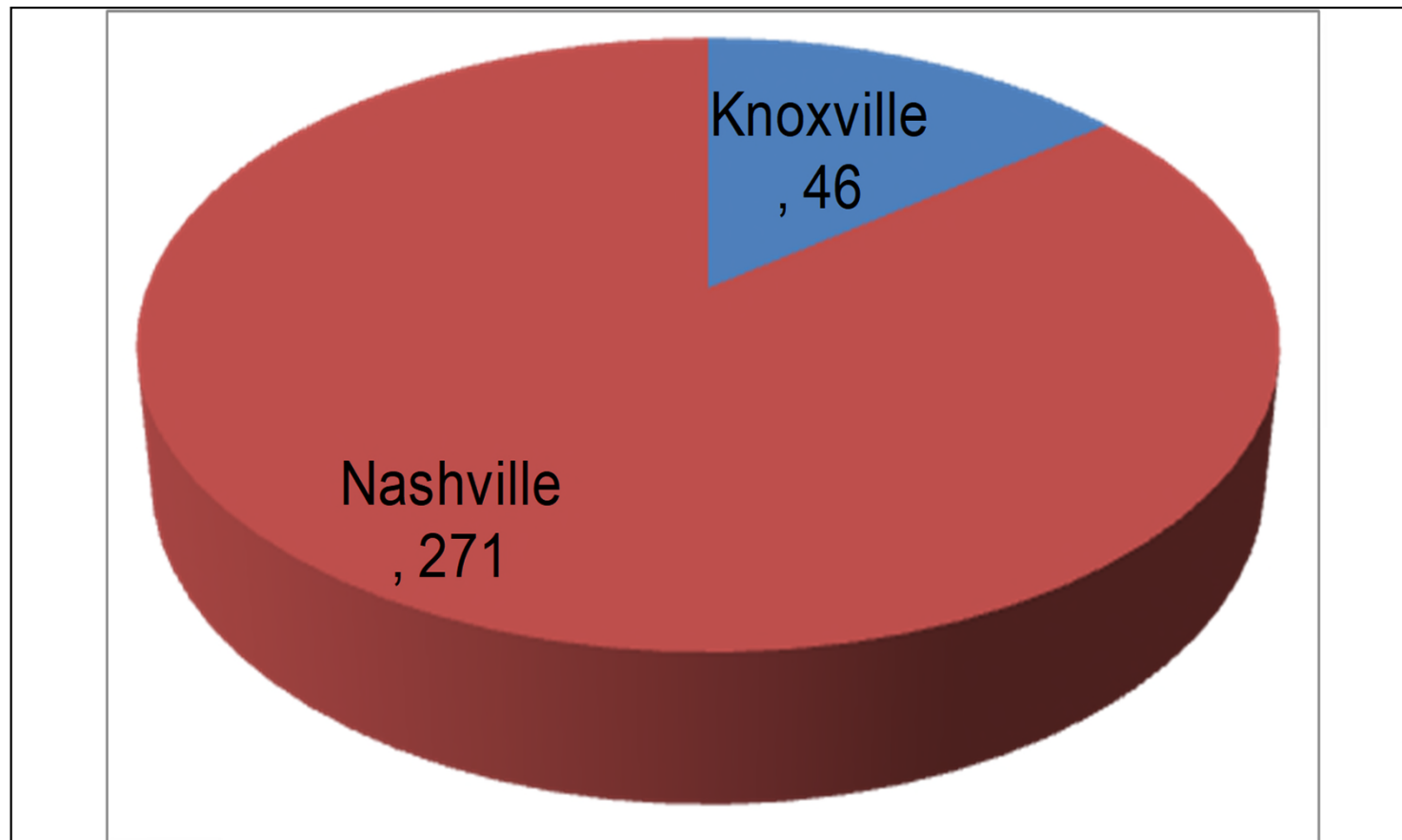
Distribution of Incidents which Caused Secondary Crashes Before Clearance



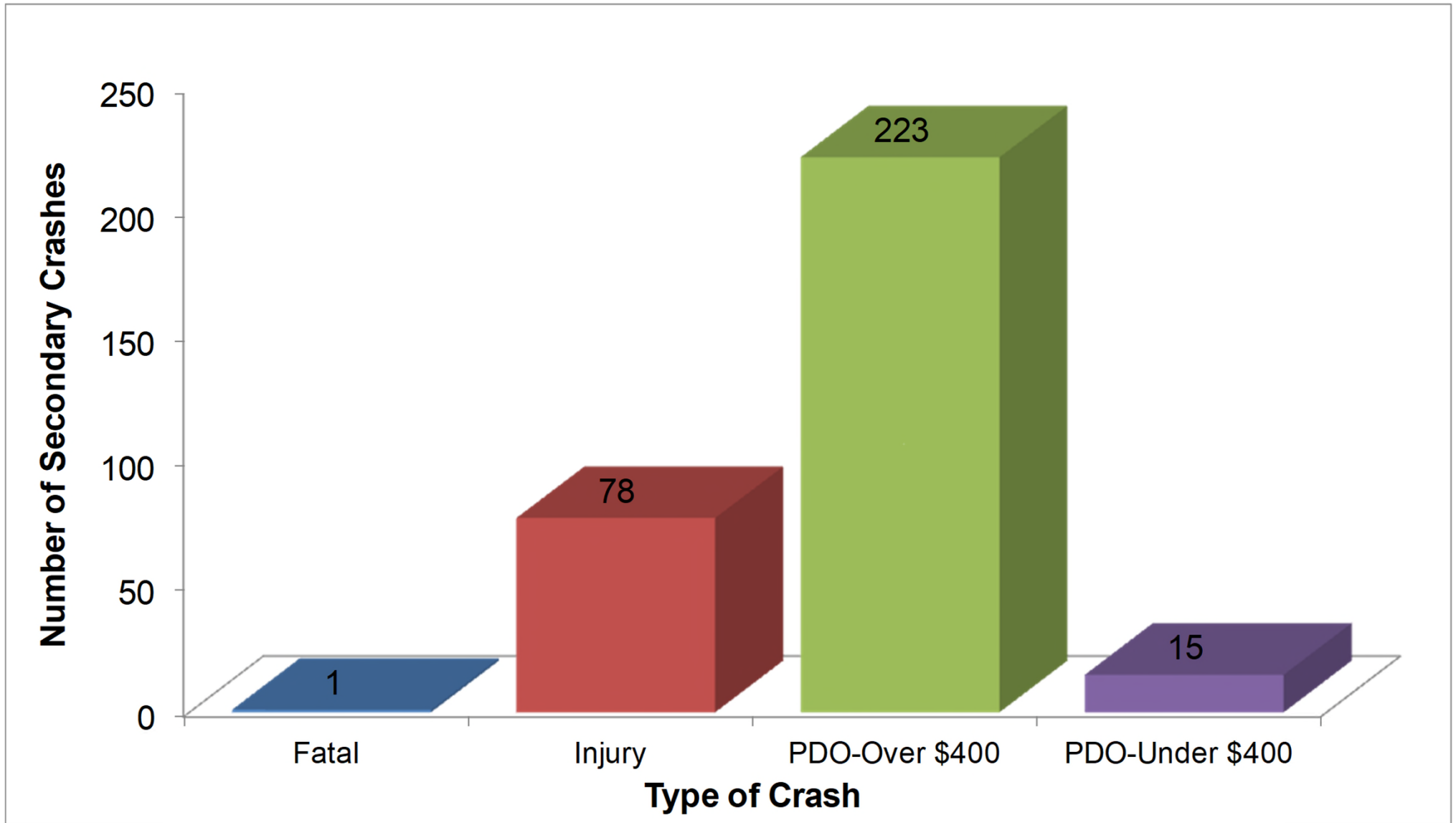
Distribution of Time before **Towing** with Respect to Incidents which Caused Secondary Crashes



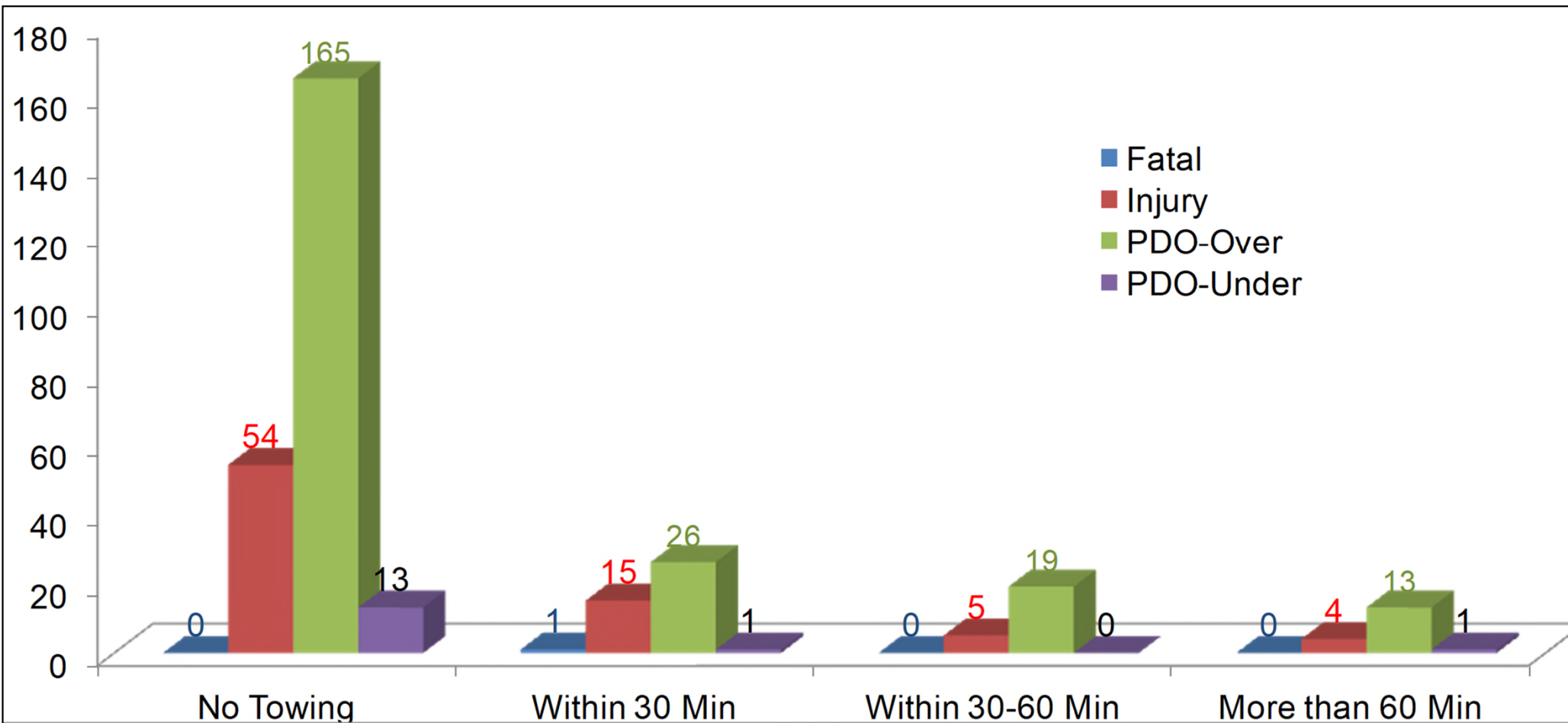
ANALYSIS OF INCIDENT CAUSED SECONDARY CRASHES



Number Incident Caused Secondary Crashes by Injury Severities



Distribution of Secondary Crashes with respect to time before Towing Disabled/Abandoned vehicles

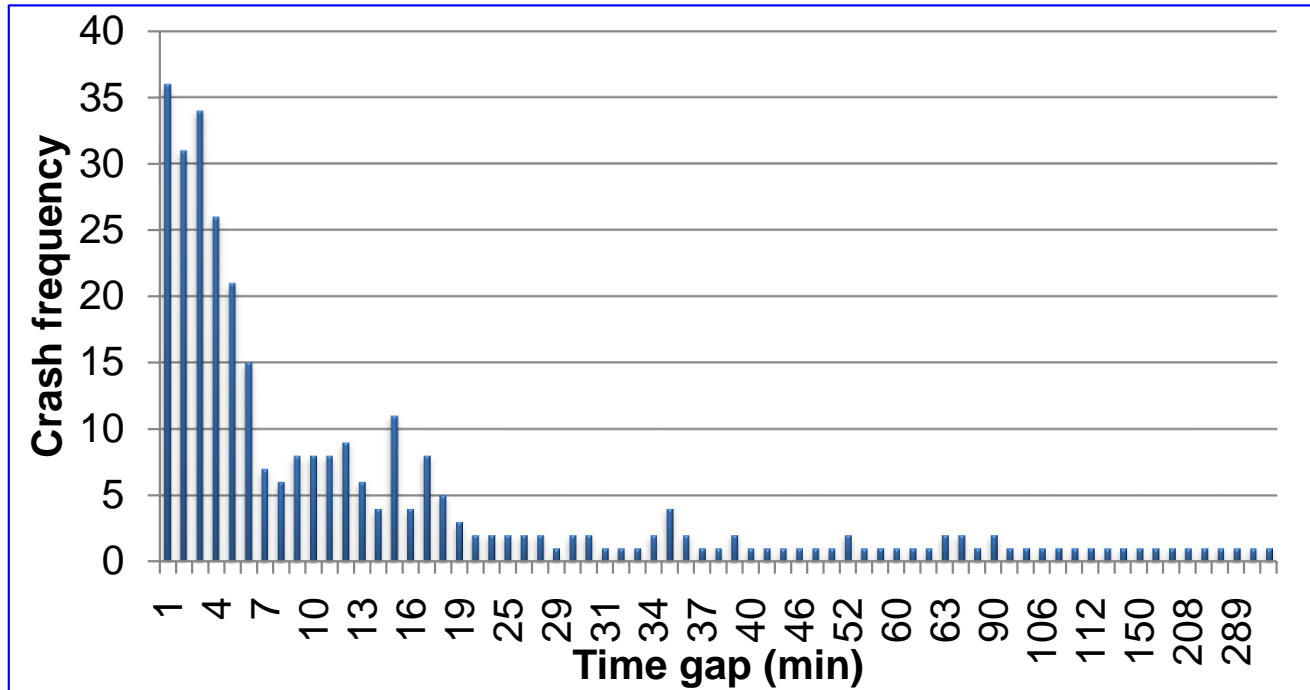


TIME GAP AND DISTANCE GAP

TIME GAP AND DISTANCE GAP

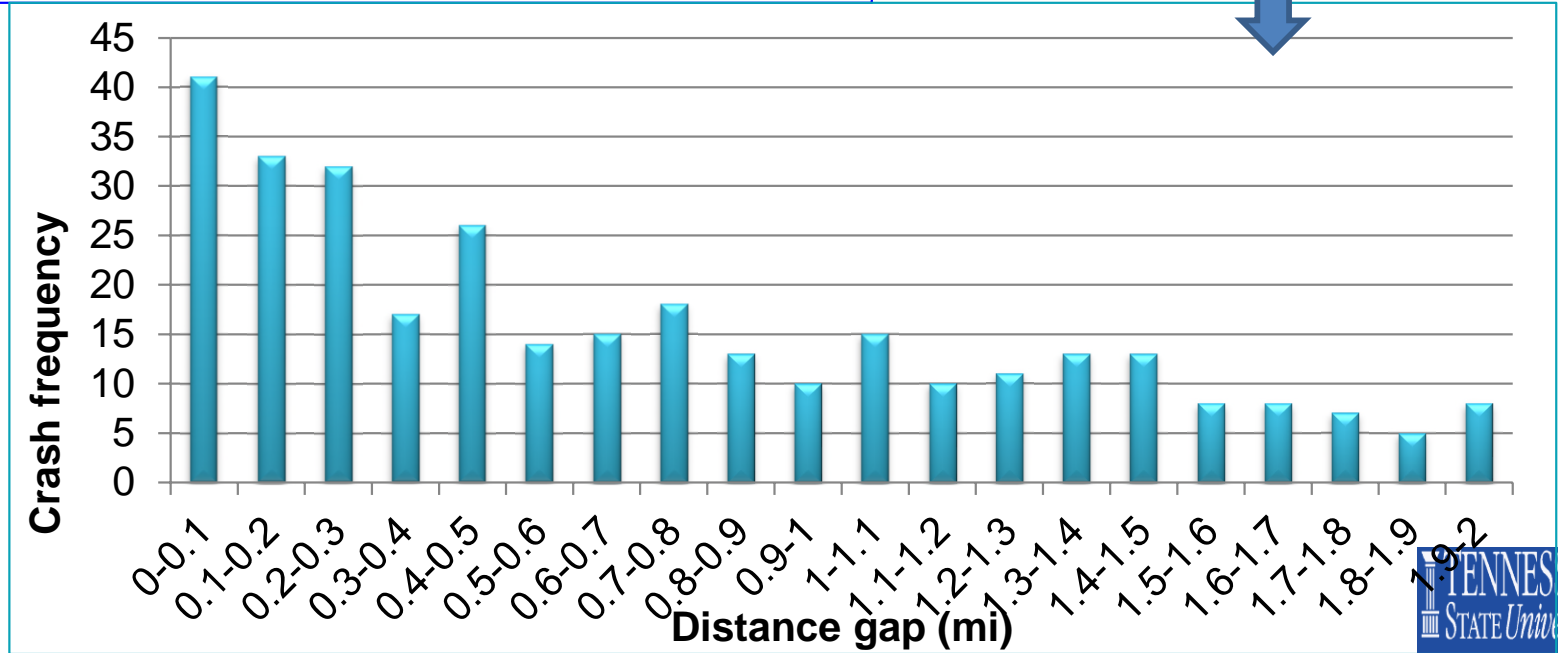
- The relationship between primary incident and secondary crashes can be characterized by time gap and distance gap.
- **Time Gap** is the difference between the time the primary incidence started to the time the secondary crash occurred
- **Distance Gap** is the difference between the location the primary incident occurred to the location the secondary crash occurred
- **The Gap** analysis therefore evaluates the variation of the incidence time location to those of the secondary crash and factors influencing those variations

Time and Distance Gaps to Secondary Crash



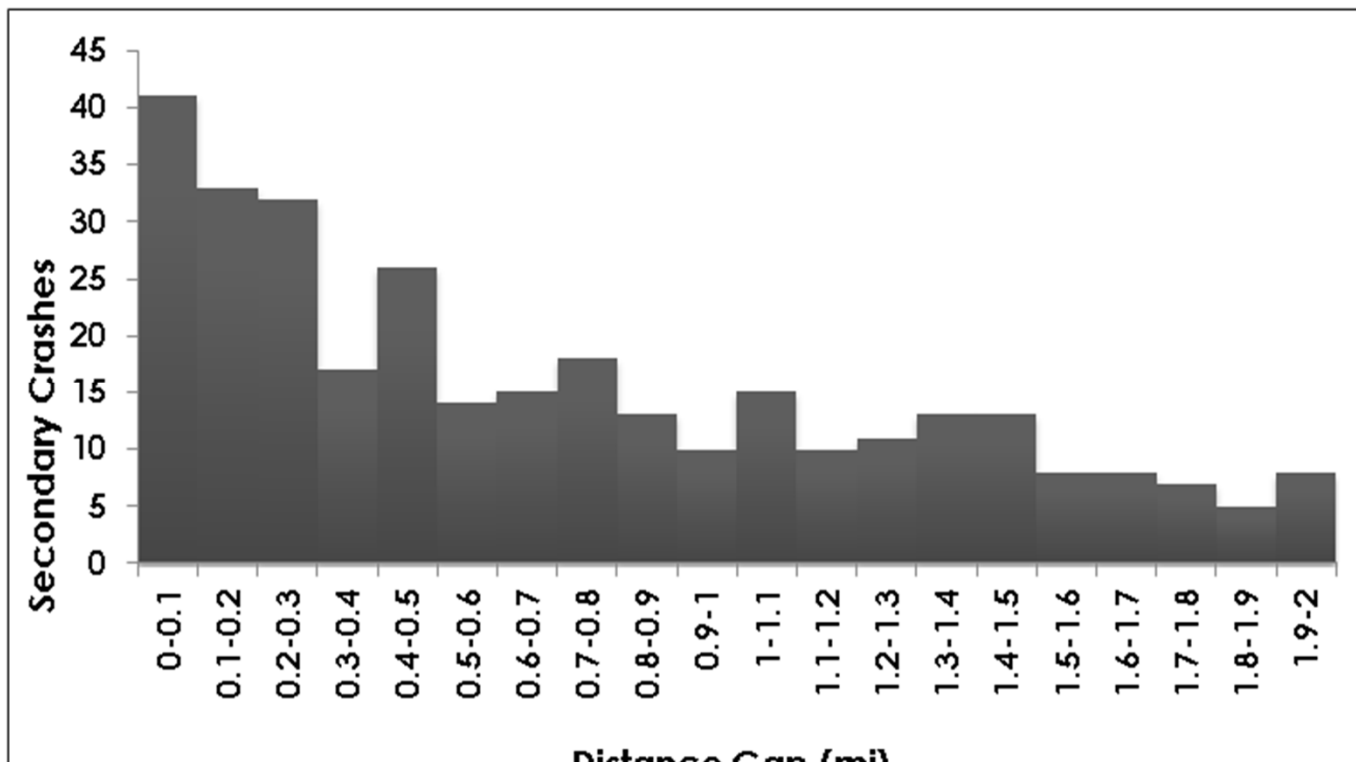
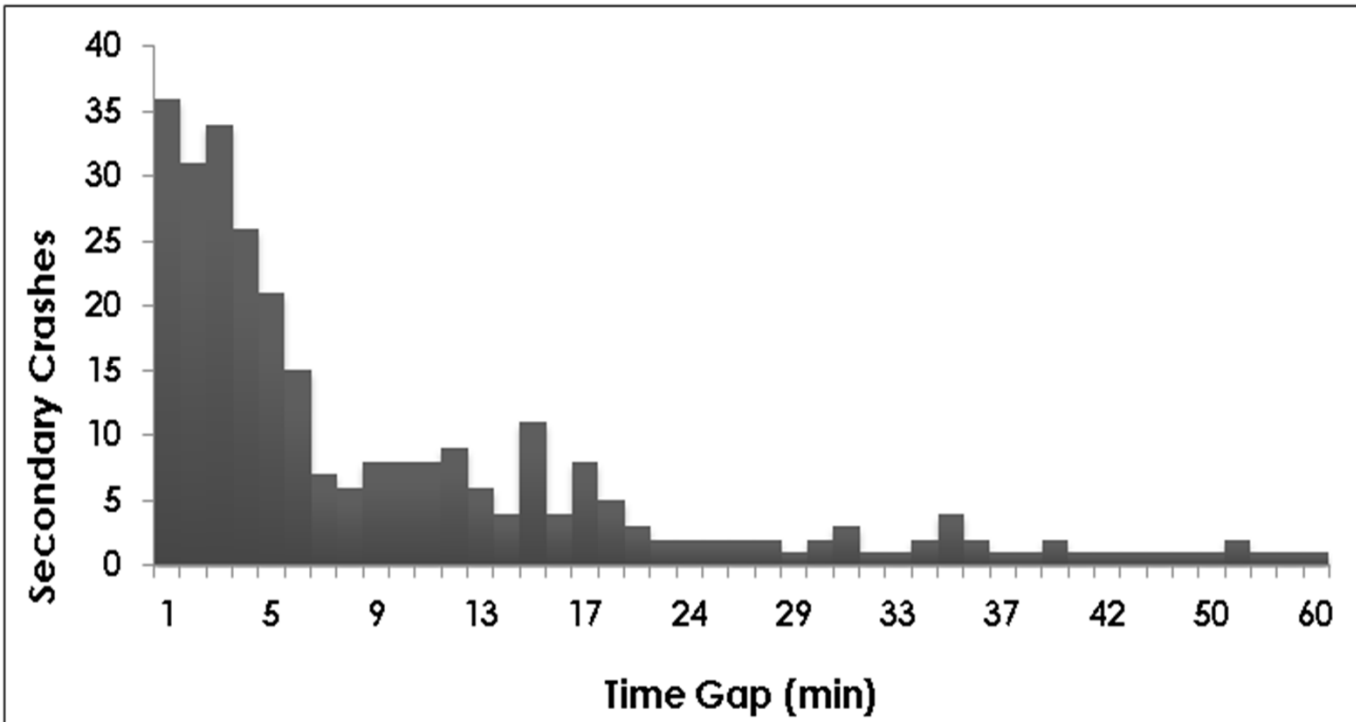
More than 75% of crashes occurred within 20 minutes

more than half of the crashes occurred within 1 mile from the primary incident.



Time Gap and Distance Gap

- Most of Secondary Crashes occurred within FIVE minutes after the occurrence of the primary incident and within a distance of 0.5 MILES upstream



FINDINGS FROM QUESTIONNAIRE SURVEY

- The abandoned/disabled vehicles incidents is problematic in other states just as in Tennessee.
- Most states seem to be satisfied with their current laws regarding abandoned/disabled vehicles.
- There have been law changes in some states to facilitate incident management.
- The time before towing of abandoned / disabled vehicles in many states ranges from 24-48 hours after the incident
- Very few states have conducted research studies specifically directed to disabled/abandoned vehicle incidents
- The average incident duration in many states ranges from 30-60 minutes
- Most states uses private towing companies to remove abandoned/disabled vehicles

Abandoned/Disabled Vehicles

Incident Duration

- ❑ Analysis was done to correlate incident duration with various operational, geometric and other related factors
- ❑ Almost 99% of incidents were cleared within 30 minutes
- ❑ Only 0.7% of all incidents lasted for more than 30 minutes

INCIDENTS DESCRIPTIVE STATISTICS SUMMARY OF FINDINGS

- I-65 for Region 3 and I-40 for Region 1 have the highest number of incidents (frequency)
- I-65 and I-640 have the highest incident rates for Region 3 and Region 1, respectively.
- Approximately 8.6% of all incidents involved towing. The towed included 9.5% abandoned vehicles and 90.5% disabled vehicles.
- The duration before towing varied from few minutes after the incident, to hours and days in few cases.
- About 208 incidents spent more than 48 hours on the highway Right of Way before being towed
- Almost 70% of the secondary crashes were PDO under \$400.

SECONDARY CRASHES DESCRIPTIVE STATISTICS SUMMARY OF FINDINGS

- ❑ 95% of the secondary crashes were PDO's
- ❑ 69% of the incidents caused secondary crashes involved two vehicles
- ❑ More than 75% of the secondary crashes occurred within 20 minutes of the primary incidents
- ❑ More than 50% of crashes occurred within 1 mile from the primary incidents
- ❑ 49% of secondary crashes were rear-end crashes
- ❑ 77% of the crashes occurred in the daylight
- ❑ For primary incidents which caused secondary crashes; the mean incident duration was 57 minutes, average queue length was 0.71 mile and mean duration before towing was 61 minutes