Technical Memorandum

I-290

Preliminary Engineering

and Environmental (Phase I) Study

West of Mannheim Road to East of Cicero Avenue

Crash Analysis

July 2010

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1.0 Executive Summary

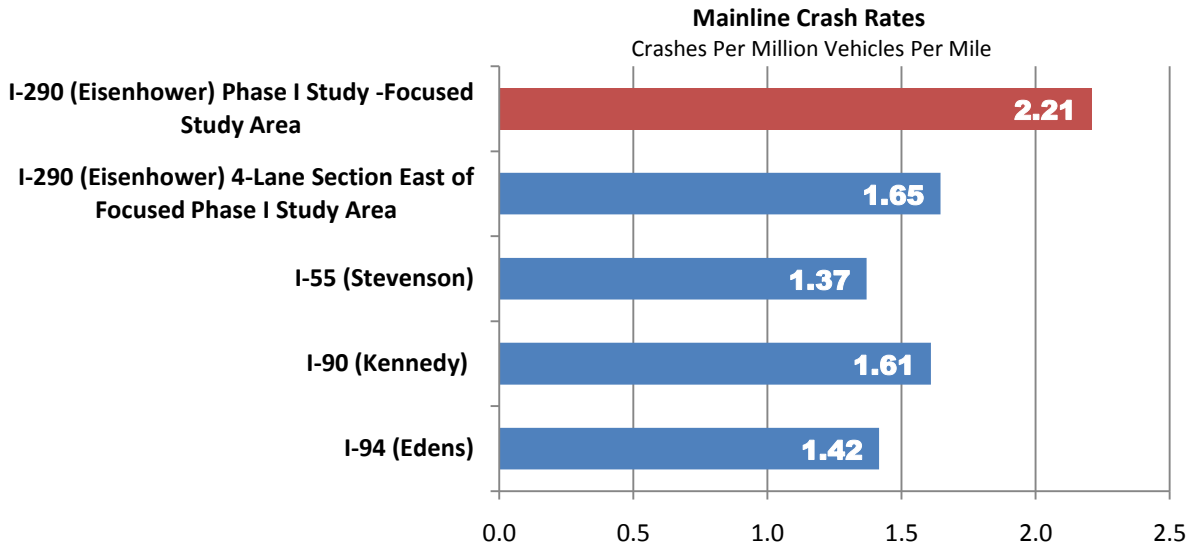
This report summarizes the results of a crash analysis performed along a 9.65 mile section of I-290 from I-294 to Kostner Avenue, including cross streets and adjacent frontage roads within a focused study area. The latest available three year crash data and police reports from 2006, 2007 and 2008 for I-290 and similar facilities were used for this analysis. Summaries of the crash data used can be found in the appendices.

Overall, the I-290 mainline and its associated ramps, frontage roads and crossroads in the study area experienced over six thousand crashes within the three year study period. Approximately 75% of the crashes in this analysis occurred on I-290, 15% on the crossroads, and the remaining 10% occurred on the ramps and frontage roads.

Study Area Facility	Total Crashes	Injuries	
		Total	Fatal
Mainline	4,559	410	9
Ramps	310	82	0
I-290 Crossroads	913	187	0
Frontage Roads	284	46	0
Total	**6,066**	**725**	**9**

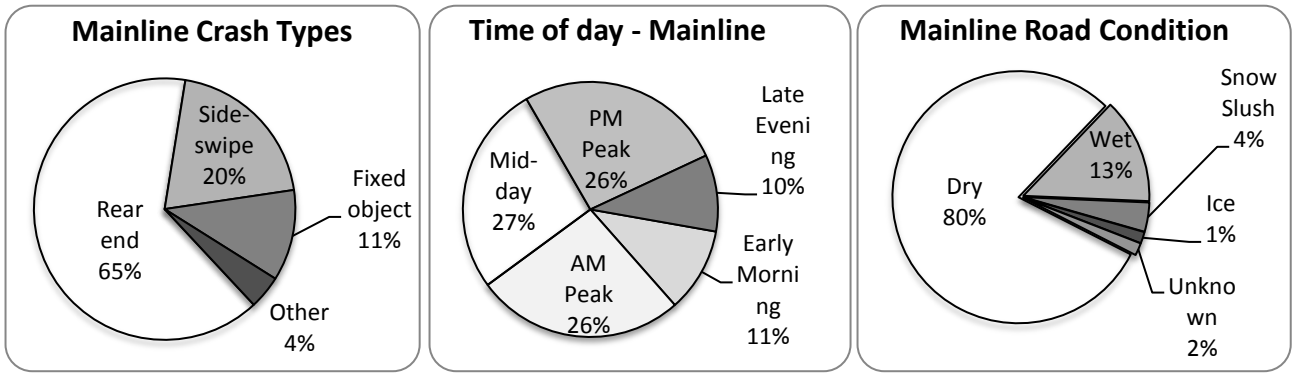
Approximately 12% of the crashes resulted in an injury with less than 2/10ths of one percent being fatal. 55% of the severe crashes occurred during the uncongested period between 11PM and 6AM.

Compared to similar expressways in the Chicago area, the section of I-290 between I-294 and Kostner Avenue experienced the highest crash rates in the region by a wide margin.



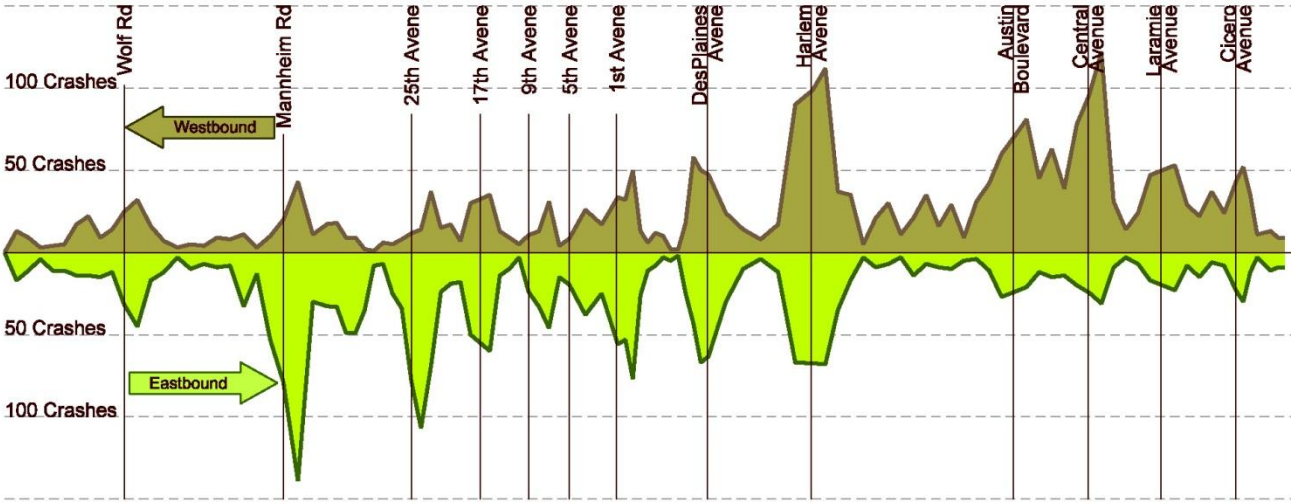
Along the mainline, the predominant crash type was rear-end. The majority of crashes occurred between 6 AM and 9 PM on dry pavement. These predominant crash characteristics occurred

under congested conditions for most crashes. Analysis of the crash records, along with review of national studies correlating crash types and traffic volumes, indicate that congestion along the mainline is a principal contributing factor to crashes in the corridor.



The number of crashes varied widely by location along I-290. Locations with the highest "spikes" in crash frequency are associated with extended periods of heavy congestion at the mainline lane drops/capacity reductions west of Mannheim Road in the eastbound direction, east of Austin Boulevard in the westbound direction, and the left hand exit and entrance ramps at Harlem and Austin Boulevard.

Mainline Three Year Crash Totals at Every 1/10 Mile (Eastbound and Westbound)



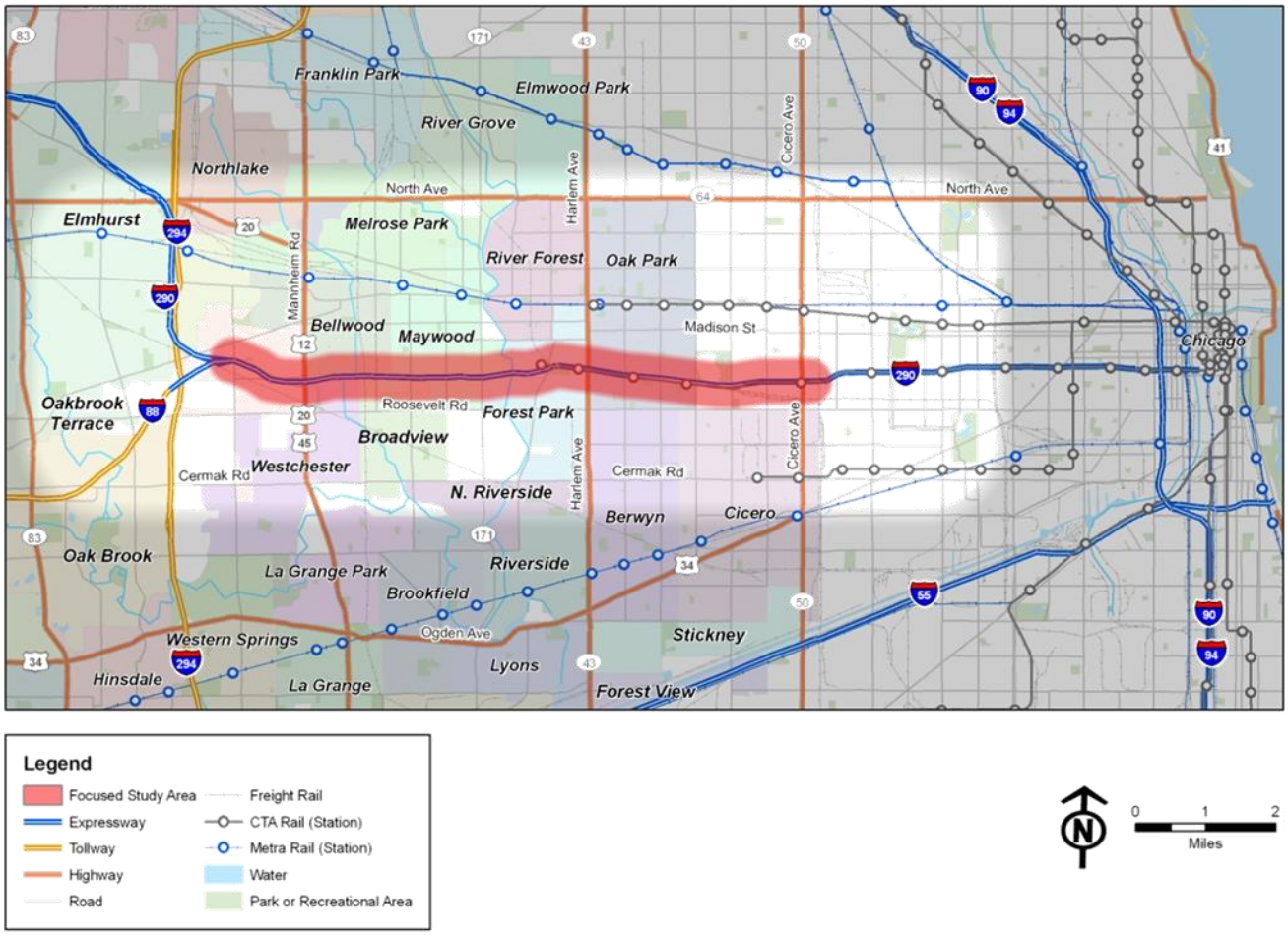
Identified existing roadway geometric factors that contributed to crashes are:

- Narrow shoulders (Less than 10' wide)
- Inconsistent exit and entrance ramp patterns between successive ramps
- Short weaving distances between successive ramps
- Short ramp entrance and exit gore tapers
- Substandard curve geometry & sight distance
- Inadequate turn lane storage capacity at cross road intersections
- Lack of channelization at cross road intersections

2.0 Introduction

The Illinois Department of Transportation is conducting a Phase I Study to evaluate improvements to the Eisenhower Expressway, Interstate 290 (I-290), from west of Mannheim Road to east of Cicero Avenue. See Figure 2-1for the identified limits of the Study Area.

Figure 2-1 - Study Area Map



As part of this Phase I Study, IDOT performed a crash analysis of I-290 and the associated facilities within the focused study area. The focused study area extends along I-290 from west of Mannheim Road to east of Cicero Avenue, and includes the cross roads and frontage roads immediately adjacent to I-290. The purpose of the analysis was to utilize reported crash data to identify predominant safety problems and causes early in the planning process so corrective measures can be incorporated into any improvement.

Methodology

IDOT maintains records of all crashes reported to police that have occurred on marked state routes or on routes under state jurisdiction. The most recent three year crash data available from IDOT (2006, 2007, and 2008) was used for this analysis. The crash records for the I-290 mainline, ramps,

cross roads and frontage roads within the study area for those three years were extracted from IDOT database and analyzed.

Special emphasis was placed on severe injuries (fatal and incapacitating injury - "K & A" types); these types are included in the overall analysis, and also examined separately. A "5% Crash Report" is also prepared annually by IDOT which determines segments of roadways with higher incidences of fatal and incapacitating injuries and was referenced in the analysis (See Appendix J).

The crash data was analyzed to determine characteristics and trends of crashes, and causative factors. For instance, it was determined that the majority of crashes occurred in daylight hours, under clear and dry roadway conditions. Also, most of the crashes occurred during peak or "peak shoulder" times, just before and after the morning and afternoon peak travel times, and the most severe crashes tended to happen at off-peak travel times and between dusk and dawn.

Causative crash factors can be numerous, and generally involve: human factors (including driver error, reaction time, impairment, or other factors); vehicle factors (including its mechanical condition and crash-worthiness); road environment factors (including roadway geometric design, roadside objects, lighting conditions and other factors); natural environmental conditions such as weather or presence/absence of daylight; or a combination of these. The focus of this crash study is on the physical roadway facility for the purpose of setting up corrective measures for potential alternative roadway improvements; studies indicate that road environment factors contribute in part or in whole to approximately 28% of all highway crashes[1]. Illinois has undertaken efforts such as the Illinois Strategic Highway Safety Plan[2] to improve safety, which includes driver training, law enforcement, improving medical response, and other areas in addition to safety-related improvement of road environment factors.

National experience (including research by FHWA and others) and studies of crash reports can be used to determine general causative factors of types of crashes, and additional studies of the crash types can be used to corroborate the national studies and determine if there are patterns of crash types happening in a particular location. For example, the most common type of crash along I-290 in the study area is rear end collision. National studies[3] indicate congested, stop and go traffic is a contributing factor to this type of crash on limited access facilities. I-290 crash records indicate several locations where these types of crashes are concentrated or appear to "spike" at a relatively high rate, and confirm a higher incidence of rear end crashes during heavy traffic congestion during morning and evening commuting periods.

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[1] Road Safety Assessment Technical Training manual, IDOT; K. Rumar (1985). "The Role of Perceptual and Cognitive Filters in Observed Behavior," *Human Behavior in Traffic Safety*

[2] Illinois Strategic Highway Safety Plan, http://www.dot.state.il.us/illinoisSHSP/default.html

[3] Zhou, M. and V.P. Sisiopiku (1997). Relationship between volume-to-capacity ratios and accident rates. *Transportation Research Record,* No. 1581: 47-52.; Thomas F. Golob and Wilfred W. Recker (2001). Relationships Among Urban Freeway Accidents, Traffic Flow, Weather and Lighting Conditions. *Institute for Transportation Studies, UC-Berkeley*

Potential countermeasures are briefly discussed here for general information; specific crash reduction strategies will be explored during future portions of the Phase I Study.

3.0 Crash Analysis

The crash analysis is the first activity in determining existing roadway safety problems and providing a framework for determining contributing causes and developing effective countermeasures for build alternatives in later parts of the study. This crash analysis examines all crashes, regardless of potential cause, and examines the details of when, where, what happened, and under what conditions the crashes occurred.

3.1 Corridor Crashes Overview

Table 3-1 summarizes the three year crash totals within the study area for the mainline, ramps and cross-streets. An Existing Lane Diagram, representing these facilities and their relationship to one another, can be found in Appendix A.

Table 3-1 - Corridor Crash and Injury Totals

Facility	Quantity Reviewed	Total Crashes	Injuries	
			Total	Fatal
Mainline Eastbound	9.66 miles	2,220	185	2
Mainline Westbound	9.66 miles	2,339	225	7
Ramps	48 ramps	310	82	0
I-290 Crossroads	16 x-roads	913	187	0
Frontage Roads	11.28 miles	284	46	0
Total		**6,066**	**725**	**9**

Over the three year study period, the number of annual crashes have increased by 18% overall within the focused study area, with the highest increase having occurred in the eastbound direction of I-290. Crossroad crash rates have remained relatively stable during this same time period.

Table 3-2 - Corridor Crashes by Year

Facility	2006	2007	2008	Total	% Change '06 to '08
Mainline Eastbound	648	757	815	2,220	26%
Mainline Westbound	718	798	823	2,339	15%
Ramps	82	124	104	310	26%
Crossroads	294	315	304	913	3%
Frontage Roads	86	92	106	284	23%
Total	**1,828**	**2,086**	**2,152**	**6,066**	**18%**

3.2 Comparative Crash Analysis

To determine how crash rates in the I-290 focused study area compare against other facilities in the Chicago area, the crash rates of several similar freeways in the region were calculated for the same three-year period from 2006 through 2008. Table 3-3 presents the crash rates for these similar sections of I-94, I-90 and I-55, as well as the four lane section of I-290 east of the focused study area.

Table 3-3 - Chicago Area Comparable Freeway Crash Rates

Facility	Comparable Section		Length (miles)	3 yr Total Traffic (millions)	3 yr Crash Total	Crashes/ Million/ Mile	Crashes Per Mile
	From	To					
I-94 (Edens)	Rt. 14 - Peterson	Lake Ave	6.79	176.3	1,696	**1.42**	250
I-90 (Kennedy)	DesPlaines River Rd	Central Ave.	5.1	248.7	2,042	**1.61**	400
I-55 (Stevenson)	La Grange Rd.	Western Ave.	11.29	175.6	2,716	**1.37**	241
I-290 (Eisenhower) 4-Lane Section East of Focused Phase I Study Area	Kostner Ave.	Racine Ave.	4.03	235.0	1,558	**1.65**	387
I-290 (Eisenhower) Phase I Study - Focused Study Area	I-294	Kostner Ave.	9.65	213.7	4,559	**2.21**	472

By comparing the crash rates in 'crashes per million vehicles per mile', this analysis indicates that I-290 between I-294 and Kostner Avenue experiences a crash rate between 34% and 61% higher than similar facilities in the Chicago region.

Crash rates vary between the subsections within each freeway (see the more detailed breakdown of the Comparative Crash Analysis provided in Appendix B). For instance, the sub-section of I-290 between Central Avenue and Austin Boulevard had a crash rate of 800 crashes per mile and 3.5 crashes per million vehicles per mile, which was the highest of any sub-section of the four highway sections studied. In addition, out of the 34 separate sub-sections analyzed within these four facilities, I-290 had the eight highest crash rates per million vehicles per mile and the five highest crash rates per mile. This analysis indicates that I-290 within the study area is problematic in both overall crash experience as well as in several crash "hot spots" within its study area length in comparison to its peer group.

3.3 Mainline Crash Analysis

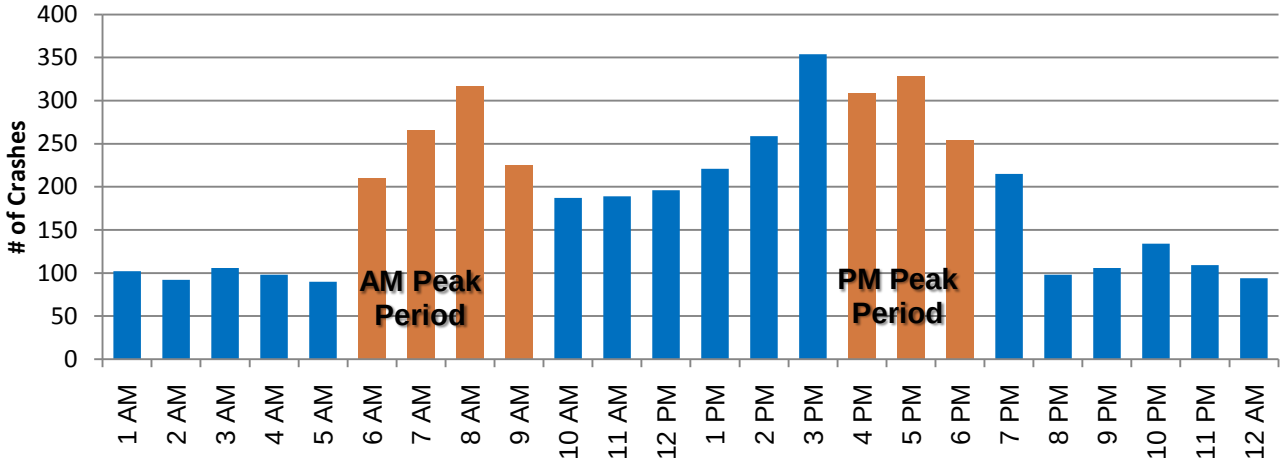
Mainline crashes were analyzed in three different ways to ascertain where crashes had occurred and what may have contributed to them:

- **Time of day** - Charted when crashes occurred on average over a 24 hour period to identify any crash trends by time of day.
- **1/10th mile analysis** - Summarized crashes every 1/10th of a mile along the mainline for eastbound and westbound travel, independently, with the purpose of pinpointing concentrated crash locations.
- **Mainline Segment Analysis** - Eastbound and westbound mainline were divided into contiguous segments with similar cross-sections; i.e. # of lanes and shoulder widths. This was to look for any relationship between crash rate, severity, type, time of day and the characteristics of the roadway.

3.3.1 Time of Day

For the mainline, the three year crashes were totaled by time of day and charted in one-hour time increments to identify any trends in crashes by time of day. Figure 3-1 presents this chart and superimposes the peak AM and PM travel periods for reference. The hours in which the highest number of crashes occurred, correlate very closely to the peak congestion periods, indicating that there higher crash rate is related to an increase in traffic volumes and resulting congestion.

Figure 3-1 - Mainline Crashes by Time of Day (2006 -2008)



To further draw out any relationship between crash rate and congestion levels, crash totals were broken out by the AM & PM peak periods, as well as the mid-day range. Additionally, the existing traffic operations analysis has shown that I-290 experiences congested conditions from between 6 AM and 11 PM. This time period is also represented in Table 3-4.

Table 3-4 - Crash Rates by Periods of Congestion

Time Period		# of Crashes	% of All Crashes	Predominant Crash Type			Dry	Wet	Ice Snow Slush
				Rear end	Sideswipe same direction	Fixed object			
I-290 Eastbound Total									
AM Peak	6a to 10a	531	24%	73%	19%	6%	80%	14%	5%
Midday	10a to 4p	683	31%	70%	20%	6%	82%	13%	3%
PM Peak	4p to 7p	423	19%	72%	21%	4%	80%	16%	2%
Congested Period	6a to 11p	1929	87%	70%	20%	7%	81%	14%	4%
I-290 Westbound Total									
AM Peak	6a to 10a	487	21%	77%	13%	7%	79%	12%	6%
Midday	10a to 4p	723	31%	73%	19%	5%	87%	10%	2%
PM Peak	4p to 7p	468	20%	80%	16%	1%	86%	9%	2%
Congested Period	6a to 11p	1939	83%	73%	18%	6%	84%	10%	4%
I-290 Mainline Total (EB & WB)									
AM Peak	6a to 10a	1018	22%	75%	16%	6%	79%	13%	5%
Midday	10a to 4p	1406	31%	72%	19%	6%	85%	12%	3%
PM Peak	4p to 7p	891	20%	76%	19%	3%	83%	13%	2%
Congested Period	6a to 11p	3868	85%	71%	19%	7%	82%	12%	4%

Overall 85% of all the recorded crashes for the three year reporting period occurred during congested conditions. Rear end crashes account for over 70% of the recorded crash types with a very high majority occurred on dry pavement. Rear end crashes on urban freeways are typically associated with congested, stop and go traffic[4].

[4] Zhou and Sisiopiku (1997); Golob and Recker (2001).

3.3.2 Mainline 1/10th mile Analysis

Mainline crashes for the east and westbound travel were totaled in 1/10th mile increments and plotted by milepost. The following two figures show the number of crashes every 1/10th mile:

Figure 3-2 - Mainline Crashes per 1/10th Mile - Eastbound

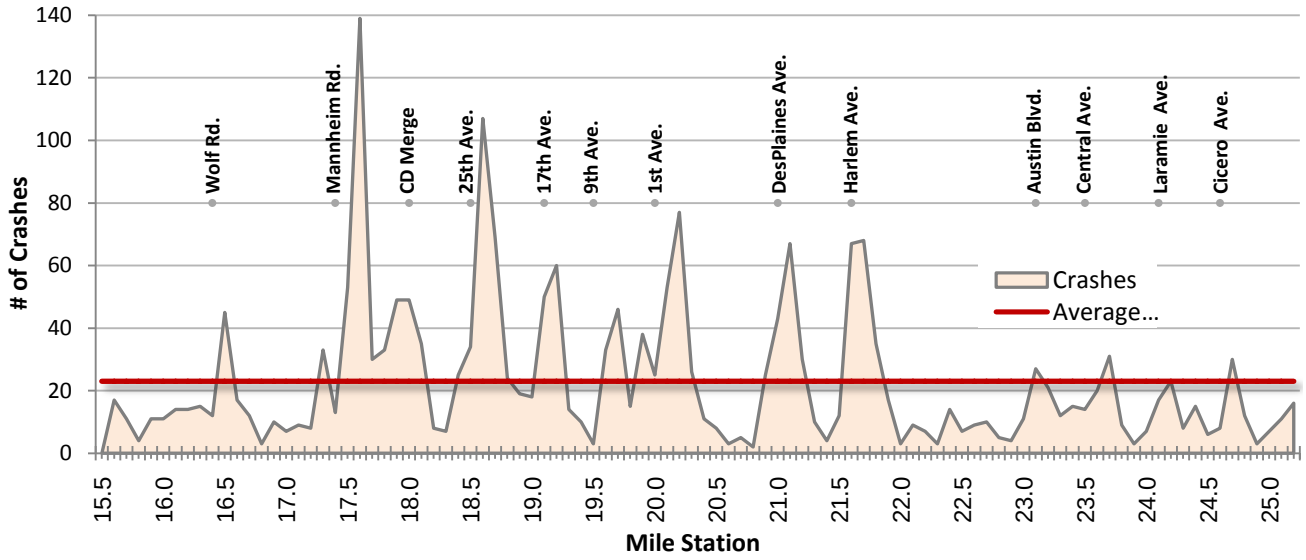
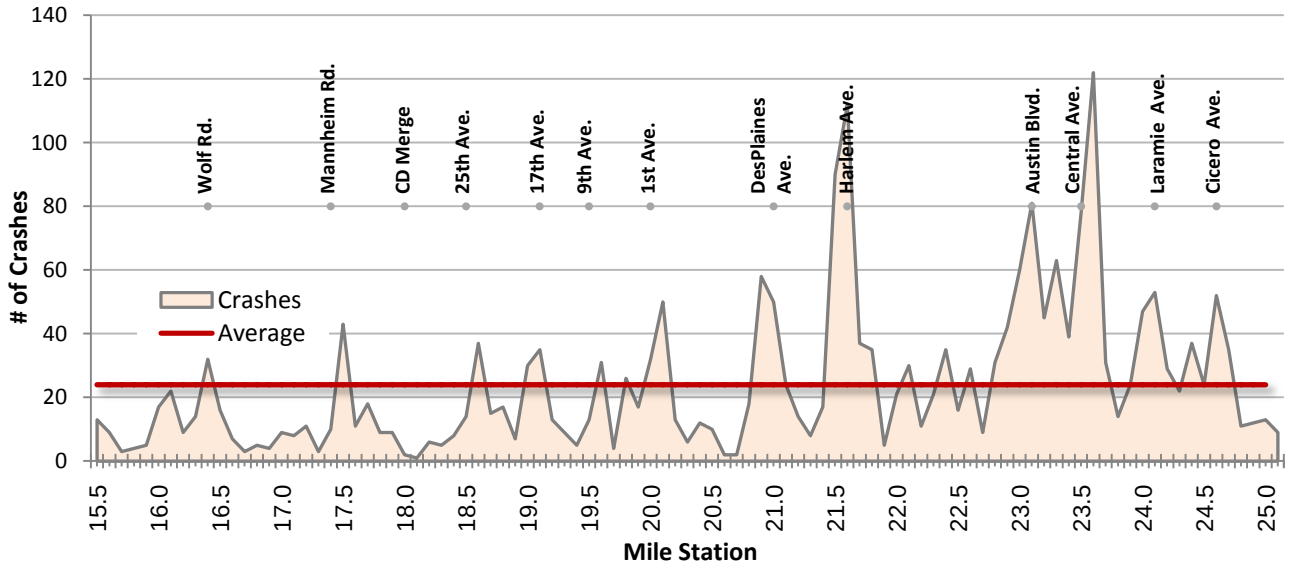


Figure 3-3 - Mainline Crashes per 1/10th Mile - Westbound



The average crash rates calculated for eastbound and westbound are 23 and 24 crashes per 1/10th mile for eastbound and westbound, respectively.

In the eastbound direction, the highest spike in crashes occurs in the vicinity of Mannheim Road. Because there are no mainline connections to or from Mannheim Road in the eastbound direction, these crashes are attributed to congestion related traffic backups due to the CD road merge east of Mannheim and the auxiliary lane drop prior to 25th Avenue (this is further explained in Section

3.3.3). A second high crash spike occurs in relationship to 25th Avenue. Here, a short auxiliary lane connection to two closely spaced loop ramps introduces a complicated traffic weaving condition that increases the likelihood of an incident. Extended periods of congestion in this area (up to 14 hours a day) also contribute to an increased chance of a crash. The remaining crash spikes correlate to interchange ramp exit and entrance locations.

In the westbound direction, the highest crash spike occurs over Central Avenue, just east of the Austin Boulevard left hand exit and mainline lane drop. Here, traffic experiences severe congestion for extended periods of time each day due to four lanes of heavy traffic merging into three, as well as weaving traffic to exit at Harlem Avenue. Two prominent crash spikes also occur just west of the first, related to the locations of the Austin Boulevard and Harlem Avenue left hand entrance ramps. The remainder of the crash spikes in the westbound direction generally correlate with the locations of interchange ramp exit and entrance locations and are further discussed in section 3.3.4.

The Mainline Crash and Operations Exhibit in Appendix C presents the 1/10th mile crash graph with respect to the AM and PM peak period mainline operations. This exhibit helps to indicate where crash clusters occurred and their relationship to physical roadway features, operations and provides additional reference for the mainline segment analysis below.

3.3.3 Mainline Segment Analysis

For more detailed analysis, the mainline was divided into 9 segments for both the eastbound and westbound. The segments were determined by direction of travel, consistent number of lanes, similar shoulder widths and by locations between major crossroads. Segment diagrams that identify the location and primary characteristics of each segment can be found in Appendix D. Detailed segment crash summary reports for each mainline segment can be found in Appendix E. The following two tables summarize the crash data by segment and list the predominant crash factors for each:

Table 3-5 - Mainline Segment Analysis Summary - Eastbound

Location (listed in direction of travel)	Mile post	Segment	Length	Crashes			Injuries		Predominant Crash Factors				
				Total	Rate (per mile)	RANK	Total	Rate (per mile)	Crash Type	Weather	Road Condition	Time Period	Vehicle Type
West of Wolf Road	15.49		(Mile)										
Wolf Road	16.46	EB1	0.97	122	126	8	14	14.4	Rear end 46%	Clear 71%	Dry 62%	PM Peak 31%	Passenger 70%
Westchester Blvd	17.79	EB2	1.33	393	295	3	26	19.5	Rear end 62%	Clear 79%	Dry 73%	AM Peak 31%	Passenger 69%
25th Avenue	18.56	EB3	0.77	288	374	1	18	23.4	Rear end 56%	Clear 82%	Dry 82%	PM Peak 34%	Passenger 60%
1st Avenue	20.11	EB4	1.55	510	329	2	41	26.5	Rear end 78%	Clear 87%	Dry 82%	PM Peak 31%	Passenger 66%
CSX RR Overpass	21.29	EB5	1.18	305	258	4	28	23.7	Rear end 73%	Clear 88%	Dry 85%	AM Peak 29%	Passenger 72%
East Ave	22.39	EB6	1.10	240	218	5	24	21.8	Rear end 70%	Clear 84%	Dry 81%	AM Peak 31%	Passenger 72%
Austin Avenue	23.15	EB7	0.76	78	103	9	9	11.8	Rear end 46%	Clear 83%	Dry 79%	AM Peak 33%	Passenger 69%
Laramie Avenue	24.15	EB8	1.00	152	152	6	12	12.0	Sideswipe same 38%	Clear 76%	Dry 72%	AM Peak 26%	Passenger 65%
Kostner Avenue	25.15	EB9	1.00	132	132	7	13	13.0	Rear end 52%	Clear 77%	Dry 73%	AM Peak 31%	Passenger 66%
West of Wolf Road to	**9.66 Miles**			**2220**	**230**		**185**	**19.2**	**Rear end 63%**	**Clear 82%**	**Dry 78%**	**AM Peak 29%**	**Passenger 67%**

Table 3-6 - Mainline Segment Analysis Summary - Westbound

Location (listed in direction of travel)	Mile post	Segment	Length	Crashes			Injuries		Predominant Crash Factors				
				Total	Rate (per mile)	RANK	Total	Rate (per mile)	Crash Type	Weather	Road Condition	Time Period	Vehicle Type
Kostner Avenue	25.15		(Mile)										
Laramie Avenue	24.15	WB1	1.00	298	298	4	20	20.0	Rear end 72%	Clear 86%	Dry 84%	Midday 37%	Passenger 67%
Austin Avenue	23.15	WB2	1.00	537	537	1	38	38.0	Rear end 77%	Clear 87%	Dry 84%	PM Peak 32%	Passenger 70%
East Ave	22.39	WB3	0.76	238	313	3	30	39.5	Rear end 80%	Clear 91%	Dry 88%	Midday 37%	Passenger 72%
CSX RR Overpass	21.29	WB4	1.10	387	352	2	39	35.5	Rear end 70%	Clear 86%	Dry 82%	PM Peak 31%	Passenger 68%
1st Avenue	20.11	WB5	1.18	258	219	5	19	16.1	Rear end 60%	Clear 78%	Dry 75%	AM Peak 28%	Passenger 66%
25th Avenue	18.56	WB6	1.55	294	190	6	36	23.2	Rear end 63%	Clear 87%	Dry 84%	AM Peak 32%	Passenger 69%
Mannheim Road	17.53	WB7	1.03	98	95	9	10	9.7	Rear end 36%	Clear 79%	Dry 74%	AM Peak 23%	Passenger 69%
Wolf Road	16.46	WB8	1.07	121	113	7	10	9.3	Sideswipe same 41%	Clear 77%	Dry 69%	AM Peak 28%	Passenger 67%
West of Wolf Road	15.5	WB9	0.96	108	113	8	23	24.0	Fixed object 34%	Clear 71%	Dry 66%	Early Morning 29%	Passenger 65%
Kostner Avenue to	**9.65 Miles**			**2339**	**242**		**225**	**23.3**	**Rear end 66%**	**Clear 84%**	**Dry 81%**	**Midday 28%**	**Passenger 68%**

These tables summarize the number of crashes, injuries and the predominant crash types within each segment to draw out any unique crash condition that may be occurring. The segments were also ranked by their crash rate, with a rank of 1 representing the highest rate of crashes per mile.

The average mainline crash rate for I-290 is 236 crashes per mile for the 19.3 total miles, east and westbound combined. The overall average crash rate for the mainline, as a whole, is 472 crashes per mile, combining both east and westbound crash totals and dividing by the 9.66 mile length of the focused study area.

In the east and westbound directions, the segments with the highest crash rates were those that included a lane/capacity reduction, EB3 and WB2. The predominant crash factors in each of those segments support the finding that theses crashes are primarily related to heavy and extended periods of congestion.

3.3.4 Segment Analysis Findings

A detailed review of the crash types, pavement conditions, and time period was performed for each segment to determine what roadway design elements or operational issues contributed to the crashes.

For comparison to the segments, Table 3-7 presents an overall summary of east and westbound mainline crashes by predominant type and conditions.

Table 3-7 - Predominant Mainline Crash Types

Predominant Crash Type	# of Crashes	% of All Crashes	AM Peak 6a to 11a	Midday 11a to 4p	PM Peak 4p to 7p	Congested Period 6a to 11p	Dry	Wet	Ice Snow Slush
Eastbound									
Rear end	1407	63%	34%	28%	22%	95%	82%	13%	3%
Sideswipe same direction	463	21%	26%	25%	19%	83%	79%	15%	6%
Fixed object	264	12%	13%	14%	7%	52%	59%	22%	18%
Westbound									
Rear end	1533	66%	27%	32%	24%	93%	85%	10%	3%
Sideswipe same direction	454	19%	19%	26%	17%	76%	79%	14%	5%
Fixed object	250	11%	16%	12%	3%	46%	62%	23%	15%
Mainline Total									
Rear end	2940	64%	30%	30%	23%	94%	84%	12%	3%
Sideswipe same direction	917	20%	22%	25%	18%	80%	79%	15%	5%
Fixed object	514	11%	15%	13%	5%	49%	60%	22%	16%

The following conclusions regarding the mainline as a whole can be drawn from this table:

- The predominant crash types (rear end & sideswipe) occurred during periods of highest traffic volume and congestion
- Road surface condition is not a primary crash factor
- 51% of the Fixed object crashes occurred during the 7 hours of off-peak, uncongested conditions

Each segment was analyzed to draw out correlations between crash type and roadway design and operational issues the following summarizes those findings. Please refer to the Mainline Segment Diagrams in Appendix D and the Mainline Segment Crash Summary Reports in Appendix E when

reviewing this section. Note that crashes related to mainline ramp entrances and exits are treated as mainline crashes. Crashes that occurred entirely on a ramp, beyond the gore area, are summarized in section 3.3.5.

EB1 – West of Wolf Road (MP 15.49) to Wolf Road (MP 16.46) – EB Rank 8

This segment encompasses just under 1 mainline mile and begins in the west where the ramp from I-294 southbound enters I-290 Eastbound. The majority of the segment consists of two mainline lanes and an auxiliary lane connecting the ramp from I-294 to the CD road exit ramp which diverges from the mainline west of Wolf Road. This segment lies beyond the western limit of the focused study area. Detailed existing roadway analysis was not conducted in this segment and the crash statistics are provided here for additional reference. Crash rates in the section were among the lowest in the study area, with the majority consisting of rear-end crashes. A somewhat higher relative percentage of fixed object crashes (26%) in this section were due to the CD Road exit ramp diverge where a majority of these vehicles ran off the roadway and collided with the concrete barrier. According to Table 2-6 the average fixed object crash rate for the entire expressway was 11%. The 26 sideswipe crashes occurred where entering traffic from I-294 merges to the left with I-290 through traffic that merges to the right to exit at the CD road. These crashes represent 20% of the crashes that occurred in this segment consistent with the mainline average for this crash type.

The time period that the majority of the accidents occurred was the PM Peak Period. This could be attributed in part to the strong reverse commute pattern in this corridor where evening eastbound (inbound) traffic volumes are similar to the evening westbound (outbound) volumes of the traditional commute direction.

EB2 – Wolf Road (MP 16.46) to Westchester Boulevard (MP 17.79) – EB Rank 3

This segment encompasses about 1.33 mainline miles with a consistent 3 lane cross-section with a 12′ shoulder and guardrail to the right and 6′ shoulders with a concrete median barrier to the left. There are no ramps entering or exiting the mainline in this segment. The east end of this segment experiences extended peak periods of heavy, stop and go level of service F congestion related to the downstream three lane cross-section in segment EB3. The west end of this segment is typically less congested during peak periods, operating between a level of service of C and D.

A comparison of the percentages of crash types that occurred in Segment EB2 revealed that rear end crash percentages were comparable to mainline averages while sideswipes were 3% below average and fixed object 6% above overall mainline crash averages. The lower rates of sideswipe crashes are consistent with a roadway section that maintains the basic number of lanes and does not contain entrance and exit ramps.

Over 75% of the rear end crashes occurred between ½ mile west of Mannheim Road and Westchester Boulevard, which is consistent with the areas of heavy congestion as shown on the Mainline Crashes and Operations Exhibit in Appendix C. Eighty five percent of the fixed object crashes in this segment were with either a concrete median barrier or guardrail, the majority of which occurred during congested periods. Since there are no ramps entering or exiting, the fixed object crashes were possibly due to motorists who have not slowed down adequately when approaching the back end of the traffic queue, and taking an evasive maneuver to avoid a rear-end collision. Roadway curvature may also be a factor in the fixed object accidents as this segment

contains both right and left hand curves with substandard rates of superelevation. The majority of these crashes occurred on dry pavement which indicates that condition of the roadway surface in this segment was not a major crash factor.

EB3 –Westchester Boulevard (MP 17.79) to 25th Avenue (MP 18.56) – EB Rank 1

This segment encompasses approximately 0.77 miles of mainline and consists of three through mainline lanes, an auxiliary lane connecting the CD road entrance ramp to the 25th Avenue exit ramp and the 25th Avenue loop entrance ramp. To the left is a concrete median barrier separated from traffic by a 6' wide shoulder. To the right are narrow, variable width shoulders (6' to 8'), varied sections of guard rail, grass side-slopes and concrete barrier. This segment experiences extended peak periods of heavy stop-and-go level of service F congestion related to the very high volume CD road traffic merging onto an over-capacity mainline section.

This ¾ mile long segment experienced 288 crashes over three years, making it the highest EB crash rate segment, and second highest mainline segment overall. The two predominant crash types were rear-end (56%) and sideswipe (33%) which reflect congested conditions and complex weaving maneuvers, respectively.

A comparison of the percentages of crash types that occurred in Segment EB3 revealed that rear end crash percentages were 8% below, sideswipes were 13% above, and fixed object 4% below overall mainline averages. The higher rates of sideswipe crashes are consistent with a roadway section that contains numerous ramp movements.

Half of the recorded crashes in this segment were concentrated in an eastern ¼ mile section associated with the 25th Avenue loop entrance ramp. This loop ramp connects to the 25th Avenue loop exit ramp (in Segment EB4) by a 450' long auxiliary lane. The weaving section, combined with heavy stop-and-go congestion, are the primary crash factors related to the 65% rear-end crashes and 22% sideswipes that occurred here.

Fixed object crashes represent only 7% of the overall crashes in this segment, indicating that road-side safety issues are not a major crash factor, however substandard shoulder widths may be a contributing factor. The majority of these crashes occurred on dry pavement, indicating that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the PM Peak Period. This could be attributed in part to the strong reverse commute pattern in this corridor where evening eastbound (inbound) traffic volumes are similar to the evening westbound (outbound) volumes of the traditional commute direction.

EB4 – 25th Avenue (MP 18.56) to 1st Avenue (MP 20.11) – EB Rank 2

This segment encompasses over 1.5 miles of mainline, consisting of three though lanes and six exit and entrance ramps. These ramps provide interchange access to four cross streets, 25th Avenue, 17th Avenue, 9th Avenue, and 1st Avenue. The spacing of these interchanges equates to approximately 1 interchange every 4/10 mile on average. This segment of I-290 is over capacity and experiences heavy, extended periods of congestion at level of service F (see Appendix C), due in part to the residual turbulence caused by the high volume upstream CD merge and number of closely spaced

entrance and exit ramps. Along the left is a concrete median barrier separated from traffic by a 6.5′ wide shoulder. To the right are grass side slopes separated from a 9′ shoulder with curb and gutter.

This segment experienced 510 crashes over the three year reporting period, making it the segment with the second highest crash rate in the eastbound direction. Rear-end crashes were the predominant crash type at 78% of all crashes in this segment for a total of 397 rear end crashes. These rear-end crashes can be attributed to severe congestion and stop-and-go conditions. Side swipe crashes were the second highest crash type at 15% and can be attributed to the multiple weaves associated with the exit and entrance ramp maneuvers.

A comparison of the percentages of crash types that occurred in Segment EB4 revealed that rear end crash percentages were 14% above, sideswipes were 5% below, and fixed object 6% below overall mainline crash averages.

Over 25% of all crashed in this segment were concentrated at the 25th Avenue loop exit ramp at the west end of this segment. This loop ramp connects to the 25th Avenue loop entrance ramp (in Segment EB3) by a very short 440′ auxiliary lane. The very short weaving section, combined with heavy stop-and-go congestion are the primary crash factors related to the 75% rear-end crashes and 15% sideswipes that occurred here.

East of 25th Avenue, crashes clustered around each of the five subsequent exit and entrance ramps. Most of these ramps are very short in length with substandard geometrics that force drivers to make abrupt maneuvers when exiting and entering the freeway. In particular, the 9th Avenue entrance ramp taper of 35:1 is less than the standard 50:1 that should be provided, pressing motorists to react and merge into lanes at an undesirable rate.

Less than 200′ downstream of the 9th Avenue entrance ramp taper is the beginning of the 1st Avenue exit ramp taper. This very short distance between ramps with entering and exiting traffic presents an undesirable weaving situation with 9th Avenue entrance ramp traffic accelerating in the same 200′ space that the 1st Avenue exit ramp traffic is decelerating.

Fixed object crashes represent only 5% of the crashes in this segment indicating that roadside safety issues are not a major crash factor; however, substandard left hand shoulder widths may be a contributing factor. The majority of these crashes occurred on dry pavement (82%) indicating that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the PM Peak Period. This could be attributed in part to the strong reverse commute pattern in this corridor where evening eastbound (inbound) traffic volumes are similar to the evening westbound (outbound) volumes of the traditional commute direction.

EB5 – 1st Avenue (MP 20.11) to CSX RR Overpass (MP 21.29) – EB Rank 4

This segment encompasses nearly 1.2 miles of mainline consisting of three through lanes, the 1st Avenue entrance ramp and the Des Plaines Avenue exit ramp. Narrow, 2′ wide left shoulders also exist through much of this section. Although EB5 experiences level of service F during peak

periods, traffic tends to move with shorter periods of stop-and-go traffic than its neighboring segments.

305 crashes occurred in this segment, with 73% consisting of the rear-end type and 15% sideswipes. Stop-and-go congestion is likely the primary factor contributing to crashes in this segment; however there are some roadway geometric deficiencies that may also have been contributing factors.

The First Avenue entrance ramp taper of 25:1 is less than half the current policy taper rate, creating a very short merge condition that may have contributed to rear-end and sideswipe crashes. Along the mainline, two back-to-back horizontal curves do not comply with cross-slope criteria and may not drain adequately. This may be a contributing factor to the 11% wet condition related crashes.

A comparison of the percentages of crash types that occurred in Segment EB5 revealed that rear end crash percentages were 9% above, sideswipes were 5% below, and fixed object 1% below overall mainline crash averages.

The radius of the left hand mainline curve that begins near the Des Plaines Avenue exit ramp, combined with the narrow 2' wide left shoulder, results in inadequate horizontal sight distance. Inadequate sight distance may contribute to the high rate of rear end (73%) crashes that occurred in this ¼ mile stretch of freeway.

Fixed object crashes represent 10% of the crashes in this segment, overall, with 65% involving impacts with the concrete median barrier. These are possibly related to the rear-end crash avoidance maneuvers combined with the substandard 2' wide inside shoulder. The high percentage of these crashes occurred on dry pavement (85%) indicating that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the AM Peak Period. This is consistent with the Traditional Commute Travel Pattern where the majority of the vehicles are eastbound (inbound) in the morning and westbound (outbound) in the evening.

EB6 – CSX RR Overpass (MP 21.29) to East Avenue (MP 22.39) – EB Rank 5

This segment encompasses 1.1 miles of mainline consisting of three through lanes and the left hand exit and entrance ramps of the Harlem Avenue Interchange. Left and right shoulder widths are typically 6' to 10' wide, with concrete median barriers. Near-breakdown level of service E conditions are also prevalent during peak periods in EB6, with travel speeds being more uniform than a LOS F resulting in less stop-and-go activity.

Inconsistent ramp patterns between successive interchanges (left to right hand ramps) may cause driver confusion that result in drivers slowing down in higher speed lanes and making unexpected maneuvers. Drivers entering the freeway via a left hand ramp must look over their right shoulder into their vehicles blind spot to identify the appropriate time and speed to merge into traffic. The crash data in the 0.55 mile section of this segment that contains the Harlem Avenue left hand entrance and exit ramps (MP 21.40 to MP 21.95) seem to indicate this situation. Two hundred crashes occurred in this section resulting in a very high crash rate of 363 crashes per mile. The

predominant crash types were rear-end crashes (70%) and sideswipe crashes (20%), consistent with the predominant type of maneuvers associated with these ramps.

A comparison of the percentages of crash types that occurred in Segment EB6 revealed that rear end crash percentages were 6% above, sideswipes were approximately equal to, and fixed object 2% below overall mainline averages.

The narrow, 6' wide inside shoulder between the Harlem Avenue exit and entrance ramps may also be a crash factor. Disabled or emergency vehicles using the shoulder do not have adequate space to clear the through traffic lane, interfering with traffic flow and contributing to crashes.

Fixed object crashes represent 9% of the crashes in this segment, overall, and this indicates roadside conditions are not a major safety factor. The high percentage of these crashes occurred on dry pavement (81%) indicates that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the AM Peak Period. This is consistent with the Traditional Commute Travel Pattern where the majority of the vehicles are eastbound (inbound) in the morning and westbound (outbound) in the evening.

EB7 –East Avenue (MP 22.39) to Austin Blvd (MP 23.15) – EB Rank 9

This segment encompasses ¾ mile of mainline consisting of three through lanes and the left hand exit ramp to Austin Boulevard. Left and right shoulder widths are typically 6' to 10' wide, with concrete median barriers. Congested, level of service E conditions are also prevalent in EB7 during peak periods, with travel speeds being more uniform than a LOS F, resulting in less stop-and-go activity. Smoother flowing traffic is attributed to the mainline lane addition/capacity increase in the immediate downstream segment, E8.

At a crash rate of 103 crashes per mile, this segment has the lowest crash rate in the eastbound direction. The predominant crash types were rear-end (46%), side swipe (23%) and fixed object (18%). The rear end and side swipe crashes could be attributed to a combination of congested conditions, traffic merging left to exit at Austin Boulevard, and traffic slowing down in a higher speed lane to exit at Austin Boulevard.

A comparison of the percentages of crash types that occurred in Segment EB7 revealed that rear end crash percentages were 18% below, sideswipes were 3% above, and fixed object 7% above overall mainline averages.

All 14 fixed object crashes involved impacts with the concrete barrier which does not indicate any roadside safety issues. Only two fixed object crashes occurred during peak hours, and half occurred during the late evening, which implies that the fixed object crashes were related to higher speed, uncongested conditions.

The narrow, 6' wide inside shoulder between the Austin Boulevard exit and entrance ramps may also be a crash factor. Disabled or emergency vehicles using the shoulder do not have adequate space to clear the through traffic lane, interfering with traffic flow and contributing to crashes.

The high percentage of these crashes occurred on dry pavement (79%) indicates that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the AM Peak Period. This is consistent with the Traditional Commute Travel Pattern where the majority of the vehicles are eastbound (inbound) in the morning and westbound (outbound) in the evening.

EB8 –Austin Blvd (MP 23.15) to Laramie Avenue (MP 24.15) – EB Rank 6

This segment encompasses 1 mile of mainline, including the addition of a fourth through lane with the Austin Boulevard left hand entrance ramp, and the exit and entrance ramps to and from Central Avenue. Left shoulder widths vary from 6′ to 9′ wide and right shoulders from 9.5′ to 12′ wide, both with both concrete barriers and guardrail. EB8 experiences peak levels of service ranging from D to E, and although average travel speeds may approach the speed limit, maneuverability is still restricted.

Rear-end and fixed object crash type proportions in EB8 were similar at 36% for rear-end and 38% for sideswipe. The relatively low percentage of rear-end crashes can be attributed to lower congestion levels, and smoother flowing traffic at higher operating speeds. Sideswipe incidents may be increased by drivers abruptly merging left into the less congested, newly formed lane from Austin Boulevard. This creates conflicts with accelerating traffic entering the expressway from Austin Boulevard.

A comparison of the percentages of crash types that occurred in Segment EB8 revealed that rear end crash percentages were 28% below, sideswipes were 18% above, and fixed object 8% greater than overall mainline averages.

There are mainline geometric deficiencies related to the pavement superelevation rate (cross-slope) through the left and right curves straddling Central Avenue. The superelevation rates at both these curves do not meet current design policy, with the left curve super elevation rate substantially less than required. Only the left-hand curve appears to have a cluster of crashes associated with it, most of which occurred in the early morning hours when operating speeds are not restricted by congestion.

Fixed object crashes represent 19% of the crashes in this segment overall, with only 17% that occurred during peak periods. The majority of the fixed object crashes occurred when congestion did not restrict the travel speed of the vehicle, and involved guardrail or a concrete barrier. Inadequate superelevation rates at the right and left curves may contribute to a loss of control at higher speeds and result in the vehicle running off the roadway.

The high percentage of these crashes occurred on dry pavement (72%) indicates that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the AM Peak Period. This is consistent with the Traditional Commute Travel Pattern where the majority of the vehicles are eastbound (inbound) in the morning and westbound (outbound) in the evening.

EB9 – Laramie Avenue (MP 24.15) to Kostner Avenue (MP 25.15) – EB Rank 7

This segment encompasses 1 mile of mainline consisting four through lanes and a 700′ auxiliary lane connecting the Laramie Avenue entrance ramp to the Cicero Avenue exit ramp. Left and right shoulder widths are 10′ wide, except near the Belt RR bridge both with both shoulders narrow to 5′ in some locations. Concrete barriers exist along the left with and grass-slopes behind curb and gutter sections to the right. EB9 experiences peak levels of service ranging from D to F, with average travel speeds reduced and maneuverability restricted.

Segment EB9 experienced a below-average crash rate per mile compared to the other segments, with predominant crash types of rear end (52%), sideswipe (23%), and fixed object (18%). Crashes were fairly evenly distributed with a slightly higher number of crashes having occurred east of Cicero Avenue. A fairly sharp left hand curve exists in this section, with a superelevation rate less than half of that required for this curve. This coincides with an increase in reported fixed object crashes that resulted from skidding or loss of control; however, most of these crashes occurred at off-peak hours where operating speeds were not restricted by congestion.

A comparison of the percentages of crash types that occurred in Segment EB9 revealed that rear end crash percentages were 12% below, sideswipes were 3% above, and fixed object 7% above overall mainline crash averages.

Rear-end and sideswipe crashes were equal to the average rate in the area between the Laramie Avenue entrance ramp and the Cicero Avenue exit ramp.

The high percentage of these crashes occurred on dry pavement (73%) indicate that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the AM Peak Period. This is consistent with the Traditional Commute Travel Pattern where the majority of the vehicles are eastbound (inbound) in the morning and westbound (outbound) in the evening.

WB1 – Kostner Avenue (MP 25.15) to Laramie Avenue (MP 24.15) – WB Rank 4

This segment encompasses 1 mile of mainline consisting of four through lanes and a 550′ auxiliary lane connecting the Cicero Avenue entrance ramp to the Laramie Avenue exit ramp. Left and right shoulder widths are typically 10′ wide, except just east of the Belt RR bridge where the left shoulder narrows to 5 feet. Concrete barriers exist along the left with grass-slopes behind curb and gutter sections to the right. WB1 experiences peak levels of service of D and E, with average travel speeds reduced and maneuverability restricted.

Overall, Segment WB1 experienced a crash rate slightly higher than the average crash mainline crash rate, with the predominant crash types being rear end (72%) and side swipe (18%). Fixed object crashes represented only 9% of the overall total.

A comparison of the percentages of crash types that occurred in Segment WB1 revealed that rear end crash percentages were 8% above, sideswipes were 2% below, and fixed object crashes 2% below overall mainline averages.

This segment has two distinct ½ mile sections. East of Cicero Avenue is a ramp-free section of mainline that contains two reverse curves with substandard rates of superelevation. West of Cicero Avenue, the mainline is straight, but contains the short auxiliary lane connecting the opposing entrance and exit ramps of Cicero and Laramie Avenues.

Focusing on the curved east section, the average crash rate drops slightly and the predominant crash type percentages show an increase in fixed object crashes (15%) and decrease in rear end crashes (65%). Most fixed object crashes occurred in the early morning period, when operating speeds are not restricted by congestion, and were run-off-roadway incidents that impacted a concrete median barrier. Rear ends still represent the highest crash type and occurred primarily during the congested, stop-and-go conditions that exist through this area in the AM and PM peak periods.

In the west section the crash rate rises to nearly 350 crashes per mile, with predominant crash types being rear end (78%) and sideswipe (17%). The rear end and sideswipe crashes occurred primarily during congested periods, and were grouped around the weaving section between the Cicero and Laramie Avenue ramps and auxiliary lane. Here, mainline traffic intending to exit at Laramie Avenue is weaving against traffic entering I-290 from Cicero Avenue within a very short distance. Weaving maneuvers in congested conditions increase the likelihood of both rear end and sideswipe type crashes. Due to low operating speeds and straight mainline alignment, fixed object crashes were low, representing only 4% of all crashes in this ½ mile section.

The high percentage of these crashes occurred on dry pavement (84%) indicates that condition of the roadway surface in this segment is not a major crash factor.

The majority of the crashes occurred midday but closer to the PM Peak period and were, therefore, most closely associated with the Traditional Commute Travel Pattern.

WB2 – Laramie Avenue (MP 24.15) to Austin Blvd (MP 23.15) – WB Rank 1

This segment encompasses 1 mile of mainline consisting of four through lanes with a lane drop where the left mainline lane terminates as a mandatory exit to Austin Boulevard, and two horizontal mainline curves. Left shoulder widths vary from 6’ to 10’ wide and right shoulders from 10’ to 12’ wide, with both concrete barriers and guardrail. WB2 experiences extended periods of highly congested, level of service F traffic conditions.

By a wide margin, Segment WB1 had the highest number of crashes and highest crash rate of any eastbound or westbound segment, with a total of 537 crashes over its 1 mile length. The predominant crash types were rear end (77%) and side swipe (16%). These can be attributed to the extended periods of congestion, and erratic driving due to the imposed traffic weave between through vehicles merging to the right out of the mandatory left lane exit and Austin Boulevard bound vehicles merging left to exit.

A comparison of the percentages of crash types that occurred in Segment WB2 revealed that rear end crash percentages were 13% above, sideswipes 4% below, and fixed object crashes 6% below overall mainline averages.

The right hand Central Avenue entrance ramp overlaps with the Austin Avenue exit ramp, resulting in no available weaving distance. Weaving is prohibited with lane striping, but is also very difficult due to high congestion and the lack of room available for the maneuver. The side swipe crashes that occurred were likely due to the merging of the entrance ramp traffic as well as the weave in and out of the left hand exit lane.

There are mainline geometric deficiencies related to the pavement superelevation rate (cross-slope) through the left- and right-hand curves straddling Central Avenue. Although the superelevation rates at both these curves do not meet current design policy, the crash types and frequency do not indicate that the curve geometry contributes to crashes.

Fixed object crashes represent only 5% of the crashes in this segment and indicate roadside safety issues are not a major crash factor. The majority of all crashes occurred on dry pavement (84%), indicating that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the PM Peak Period. This is consistent with the Traditional Commute Travel Pattern where the majority of the vehicles are eastbound (inbound) in the morning and westbound (outbound) in the evening..

WB3 – Austin Blvd (MP 23.15) to East Avenue (MP 22.39) – WB Rank 3

This straight mainline segment encompasses ¾ of a miles consisting of three through lanes and the left hand entrance ramp from Austin Boulevard. Left shoulder widths vary from 5' to 10' wide with concrete barrier wall, and right shoulders from 6' to 12' wide, with both concrete barriers and grass slopes behind curb and gutter. WB3 experiences extended periods of highly congested, breakdown level of service F.

Overall, Segment WB3 experienced a crash rate higher than the average mainline crash rate, with the predominant crash types being rear end (80%) and side swipe (11%). Fixed object crashes represented only 3% of the overall total.

A comparison of the percentages of crash types that occurred in Segment WB3 revealed that rear end crash percentages were 16% above, sideswipes 9% below, and fixed object crashes 6% below overall mainline crash averages.

To better understand how crashes were distributed in this segment, it was analyzed as two smaller sections; east end from Austin Boulevard to just west of the left hand ramp terminal (MP 23.15 to MP 22.80), and the west end from west of the ramp entrance to East Avenue (MP 22.80 to MP 22.39).

Predominant crash factors in both sections were rear end (83% and 77%) and side swipe (10% and 11%), however the east section that included the ramp experienced a crash rate of 434 crashes per mile, over double the 219 crashes per mile in the west section. The primary factor contributing to crashes in the east (and west) sections is congestion, with extended periods of breakdown stop and go traffic conditions. Contributing to the congestion are the merging maneuvers related to the Austin Boulevard left hand entrance ramp.

The narrow, 6′ wide inside shoulder between the Austin Boulevard exit and entrance ramps may also be a crash factor. Disabled or emergency vehicles using the shoulder do not have adequate space to clear the through traffic lane, interfering with traffic flow and contributing to crashes.

Fixed object crashes represent only 5% of the crashes in this segment overall, and indicate roadside safety issues are not a major crash factor. The high percentage of these crashes occurred on dry pavement (88%) indicates that condition of the roadway surface in this segment is not a major crash factor.

The majority of the crashes occurred midday but towards the PM Peak period and were, therefore, most closely associated with the Traditional Commute Travel Pattern.

WB4 – East Avenue (MP 22.39) to CSX RR Overpass (MP 21.29) – WB Rank 2

This mainline segment encompasses 1.10 miles consisting of three through lanes and the left hand exit and entrance ramps with Harlem Avenue, two reverse curves just west of East Avenue, and a left hand curve exiting the segment on the east. Left shoulder widths vary from 5′ to 10′ wide with concrete barrier wall, and right shoulders from 6′ to 12′ wide, both with both concrete barriers and grass slopes behind curb and gutter. WB4 experiences extended periods of congested, breakdown level of service F.

A comparison of the percentages of crash types that occurred in Segment WB4 revealed that rear end crash percentages were 6% above while sideswipes and fixed object crashes were 2% below overall mainline crash averages. To better understand how crashes were distributed in this segment, two smaller sub-sections were analyzed; reverse curve section from East Avenue to just east of the Harlem Avenue left hand exit ramp terminal (MP 22.39 to MP 21.94), and the Harlem Avenue interchange area from just east of the Harlem Avenue left hand exit ramp to just west of the Harlem Avenue entrance ramp terminal (MP 21.94 to MP 21.34). The latter 0.6 mile long segment encompasses the WB ramp exit to Harlem Avenue and the WB entrance from Harlem Avenue.

In this 0.45 mile reverse curve section, the overall crash rate of 184 crashes per mile was well below the study area average. Predominant crash types were rear end (69%) side swipe (16%) and fixed object (12%). The high number of rear end crashes that occurred in this segment during peak travel periods indicates that the primary factor contributing to crashes in this section is congestion. by The reverse horizontal curves in this section do not provide a tangent section between them to provide adequate space for superelevation transition, and the superelevation rates provided are below the standard. Due to their low occurrence, the three fixed object crashes that could be attributed to these geometric deficiencies (occurred during free flow conditions on dry pavement) indicate that the deficiencies are not a primary factor in crash rates.

The 0.60 mile Harlem Avenue interchange section experienced at very high crash rate of 498 crashes per mile, over double the average crash rate of the focused study area. The predominant crash types were rear end (70%), side swipe (19%), and fixed object (8%). The primary factor contributing to crashes in this section is congestion, due to the high percentage of rear end crashes. Contributing to the congestion are the merging maneuvers related to the Harlem Avenue left hand exit and entrance ramps, but primarily because of the left hand entrance ramp. Slower vehicles entering the

freeway via a left hand ramp must enter into the left lane which is typically reserved for higher speed traffic. This maneuver interferes with mainline flow, introducing lower speed merging traffic with higher speed mainline traffic traveling in the left lane. Adding to the complicated weaving maneuver is the deficient entrance ramp merge taper rate of 35:1 that does not meet the minimum 50:1 standard and does not provide desirable merging distance. Due to low operating speeds and primarily straight mainline alignment, fixed object crashes were low, representing only 8% of all crashes in this section.

The high percentage of these crashes that occurred on dry pavement (82%) indicates that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the PM Peak Period. This is consistent with the Traditional Commute Travel Pattern where the majority of the vehicles are eastbound (inbound) in the morning and westbound (outbound) in the evening.

WB5 – CSX RR Overpass (MP 21.29) to 1st Avenue (MP 20.11) – WB Rank 5

This mainline segment encompasses 1.18 miles consisting of three through lanes, the DesPlaines Avenue entrance ramp and an exit ramp to 1st Avenue. Four horizontal curves transition the mainline from its northwest-southeast direction to an east-west direction. Left shoulder widths vary from 2' to 8' wide with concrete barrier wall, and right shoulders from 10' to 12' wide, both with concrete barriers and grass slopes behind curb and gutter. Although WB5 experiences level of service F during peak periods, traffic tends to have relatively shorter periods of stop-and-go traffic than its neighboring segments.

Overall, Segment WB5 experienced a crash rate slightly below the average crash mainline crash rate, with the predominant crash types being rear end (60%), side swipe (19%), and fixed object (15%).

A comparison of the percentages of crash types that occurred in Segment WB5 revealed that rear end crash percentages were 4% below, sideswipes approximately equal to, and fixed object crashes approximately 4% above overall mainline crash averages.

The 1/10th mile crash analysis presented earlier, indicates two potential issue locations in this westbound segment; near the Des Plaines Avenue entrance ramp (MP 21.11 to MP 20.86) and the 1st Avenue exit ramp (MP 20.36 to MP 20.11). These two sections were analyzed independently to draw out any conclusions:

The ¼ mile Des Plaines Avenue ramp section experienced a very high crash rate of 456 crashes per mile, over double the average mainline crash rate. The predominant crash types were rear end (57%), fixed object (20%), and side swipe (17%). There appear to be multiple factors that contribute to the high crash rate in this section. The primary crash factor here can be related to congestion due to the majority of rear end and side swipe crashes that occurred during peak travel time; however, 74% of the fixed object crashes occurred at off peak travel times when operating speeds are not restricted by congestion. The Des Plaines Avenue entrance ramp enters the expressway in the middle of the mainline horizontal curve, which does not meet design standards for superelevation. Also, 54% of the fixed object crashes in this segment occurred on wet or slushy pavement. The

combination of inadequate superelevation and reduced friction factors of wet pavement may be factors that contribute to crashes in this section. The mainline resurfacing project that will be completed by the end of the 2010 construction season will improve the pavement surface and may reduce crashes due in part to wet pavement.

The 1st Avenue ramp section experienced a slightly higher crash rate (276 crashes per mile) than the mainline average crash rate. The predominant crash types were rear end (68%) and side swipe (20%). The primary crash factor here can also be related to congestion due to the majority of rear end and side swipe crashes that occurred during peak travel times. Additionally, less than half the required sight distance is provided through the curve approaching the 1st Avenue exit ramp due to the sharp radius of the curve and the very narrow, 2' wide inside shoulder. Congested conditions, coupled with reduction in sight distance, reduce a driver's ability to avoid a rear end collision. Also, the narrow inside shoulders do not provide a refuge area for breakdowns or for evasive maneuvers to avoid a collision. This may also have contributed to the high percentage of side swipe crashes as well.

Other than the conditions near the Des Plaines Avenue entrance ramp, the high percentage of these crashes that occurred on dry pavement (75%) indicates that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the AM Peak Period. This could be attributed in part to the strong reverse commute pattern in this corridor where morning westbound (outbound) traffic volumes are similar to the morning eastbound (inbound) volumes of the traditional commute direction.

WB6 – 1st Avenue (MP 20.11) to 25th Avenue (MP 18.56) – WB Rank 6

This segment encompasses over 1.5 miles of mainline, consisting of three though lanes and five exit and entrance ramps. These ramps provide interchange access to four cross streets (1st Avenue, 9th Avenue, 17th Avenue, and 25th Avenue), which equates to approximately 1 interchange within every 4/10 of a mile, on average. Although WB6 experiences levels of service between E and F during peak periods, traffic generally tends to move faster with shorter periods of stop-and-go traffic throughout the day.

Overall, Segment WB6 experienced a crash rate below the average mainline crash rate, with the predominant crash types being rear end (63%), side swipe (20%), and fixed object (12%). Crashes were generally clustered around the multiple, closely spaced exit and entrance ramp terminals.

A comparison of the percentages of crash types that occurred in Segment WB6 revealed that rear end, sideswipes, and fixed object crashes approximately equal to overall mainline crash averages. 80% of the side swipe and rear end crashes occurred during the periods of congestion, indicating that congestion is a primary crash factor in this segment.

Geometric deficiencies may also contribute to crashes, as most of these ramps are very short in length with substandard geometrics that force drivers to make abrupt maneuvers when exiting and entering the freeway. In particular, the 1st Avenue entrance ramp taper is less than half the

required 50:1 merge taper rate that should be provided, pressing motorists to react and merge into lanes at an undesirable rate.

Approximately 300' downstream of the 1st Avenue entrance ramp taper is the beginning of the 9th Avenue exit ramp taper. This very short distance between ramps with entering and exiting traffic presents an undesirable weaving situation with 1st Avenue entrance ramp traffic accelerating in the same 200' segment where the 9th Avenue exit ramp traffic is decelerating.

Narrow, 6.5' wide left hand shoulder widths do not provide an adequate refuge area for breakdowns or for evasive maneuvers to avoid a collision. This may also contribute to side swipe crashes.

Fixed object crashes represented 12% of the crashes in this segment, the majority of which involved the concrete median barrier. Also, 58% of the fixed object crashes occurred within periods of congestion. Fixed object crashes are typically higher speed crashes, which is consistent with the overall higher rates of speed that can be achieved in this section during an average day.

The high percentage of these crashes that occurred on dry pavement (84%) indicates that condition of the roadway surface in this segment is not a major crash factor.

The time period that the majority of the accidents occurred was the AM Peak Period. This could be attributed in part to the strong reverse commute pattern in this corridor where morning westbound (outbound) traffic volumes are similar to the morning eastbound (inbound) volumes of the traditional commute direction.

WB7 – 25th Avenue (MP 18.56) to Mannheim Road (MP 17.53) – WB Rank 9

This segment encompasses approximately 1 mainline mile with three through lanes and an auxiliary lane connecting the 25th Avenue entrance ramp to the Mannheim Road exit ramp. On the east end is also the loop exit ramp to south bound 25th Avenue and on the west end a fourth mainline through lane is added by the northbound Mannheim Road loop entrance ramp to I-290. Although WB7 experiences levels of service between E and F during peak periods, traffic generally tends to move faster with shorter periods of stop-and-go traffic throughout the day.

Overall, Segment WB7 had the lowest crash rate for eastbound and has the lowest crash rate of any mainline segment analyzed. The predominant crash types were rear end (35%), side swipe (33%), and fixed object (19%). The overall low rate of crashes can be attributed in part to the generally less congested operating conditions associated with the downstream lane/capacity addition.

A comparison of the percentages of crash types that occurred in Segment WB7 revealed that rear end crash percentages were 28% below, sideswipes 13% above and fixed object crashes approximately 8% above overall mainline crash averages. The relatively high percentage of side swipe crashes in this corridor can be attributed weaving associated with the auxiliary lane ramp connection; however, the relatively low overall number of side swipe crashes indicates no major safety factor with the standard weaving section.

As with most other low crash rate segments, the relative percent of fixed object crashes appear to increase. This is due to the overall number of crashes decreasing, relative to a fairly constant number of off-peak fixed object crashes between segments. In this segment, 84% of fixed object crashes occurred during the off peak period. 32% of the fixed object crashes occurred on wet, snow, slush or icy conditions that may indicate a worn pavement surface condition. The mainline resurfacing project that will be completed by the end of the 2010 construction season will improve the pavement surface and may reduce crashes due in part to wet pavement. There were no geometric issues found in this segment that would contribute to fixed object crashes.

The time period that the majority of the accidents occurred was the AM Peak Period. This could be attributed in part to the strong reverse commute pattern in this corridor where morning westbound (outbound) traffic volumes are similar to the morning eastbound (inbound) volumes of the traditional commute direction.

WB8 – Mannheim Road (MP 17.53) to Wolf Road (MP 16.46) – WB Rank 7

This segment encompasses approximately 1 mainline mile with four through lanes and an auxiliary lane connecting the Mannheim Road entrance ramp with the Wolf Road & Frontage Road exit ramp. At the west end of WB8, the left two lanes diverge to westbound I-88, and the right two lanes continue on as I-290. Operations within this segment are relatively better, experiencing shorter periods of peak congestion at level of service D and E and longer periods of free flow conditions.

Overall, Segment WB8 had a crash rate that was less than half of the average mainline crash rate. The predominant crash types were sideswipe (41%), rear end (34%), and fixed object (15%). The overall low number and rate of crashes can be attributed in part to the generally less congested operating conditions associated with the addition of lane capacity without a commensurate level of additional traffic.

A comparison of the percentages of crash types that occurred in Segment WB8 revealed that rear end crash percentages were 30% below, sideswipes 21% above, and fixed object crashes approximately 4% above overall mainline crash averages. The relatively high percentage of side swipe crashes in this corridor can be attributed to weaving associated with the auxiliary lane ramp connection; however, the low overall number of side swipe crashes indicates no major roadway-related safety problems associated with weaving.

The majority of the fixed object crashes (77%) occurred at off peak periods when operating speeds are not restricted by congestion. Almost all reported fixed object crashes involved a vehicle that ran off the roadway and impacted the concrete median barrier. There were no geometric issues found in this segment that appear to contribute to these types of crashes, so they were likely related to driver error or vehicle problems.

19% of the reported crashes occurred on wet pavement, which equates to about 23 incidents. The mainline resurfacing project that will be completed by the end of the 2010 construction season will improve the pavement surface and may reduce crashes due in part to wet pavement.

The time period that the majority of the accidents occurred was the AM Peak Period. This could be attributed in part to the strong reverse commute pattern in this corridor where morning westbound (outbound) traffic volumes are similar to the morning eastbound (inbound) volumes of the traditional commute direction.

WB9 – Wolf Road (MP 16.46) to West of Wolf Road (MP 15.49) – WB Rank 8

This segment encompasses approximately just under 1 mainline mile with an exit ramp to north I-294. Operations within this segment are relatively better with shorter periods of peak congestion at level of service E and longer periods of free flow conditions. This segment lies beyond the western limit of the focused study area. Detailed existing roadway analysis was not conducted in this segment and the crash statistics are provided here for additional reference.

Overall, Segment WB9 had a crash rate that was less than half of the average mainline crash rate. The predominant crash types were fixed object (34%), sideswipe (30%), and rear end (30%).

A comparison of the percentages of crash types that occurred in Segment WB9 revealed that rear end crash percentages were 34% below, sideswipes 10% above, and fixed object crashes approximately 23% above overall mainline crash averages.

Fixed object crashes appear to be associated with the right hand mainline curve to the north just past the I-88 diverge. The high number of wet pavement crashes indicates that the pavement surface may be a primary factor contributing to fixed object crashes, in combination with the mainline curve in this location. The mainline resurfacing project that will be completed by the end of the 2010 construction season will improve the pavement surface and may reduce crashes due in part to wet pavement.

3.3.5 Ramp Analysis

Ramp crash analysis relates to crashes that occurred entirely within the ramp itself. Crashes on the ramp at an intersection or within the ramp gore area are analyzed as part of the cross-road or mainline segment, respectively. There are 48 ramps in the focused study area, consisting of 24 exit and 24 entrances. Table 3-8 summarizes the crash statistics for these ramps.

Table 3-8 - Ramp Crash Statistic Summary

Statistic	Eastbound		Westbound		Total		
	Entrance	Exit	Entrance	Exit	Entrance	Exit	Total
# Ramps	14	13	10	11	24	24	48
# Crashes	104	87	56	63	160	150	310
Crashes/Ramp	7.4	6.7	5.6	5.7	6.7	6.3	6.5
Crash Type	Rear End 52%	Rear End 55%	Rear End 75%	Rear End 63%	Rear End 75%	Rear End 63%	Rear End 59%
Weather	Clear 83%	Clear 83%	Clear 95%	Clear 78%	Clear 95%	Clear 78%	Clear 84%
Road Condition	Dry 75%	Dry 71%	Dry 88%	Dry 76%	Dry 88%	Dry 76%	Dry 76%
Time Period	AM Peak 27%	Midday 27%	Midday 38%	Midday 29%	Midday 38%	Midday 29%	Midday 29%
Manuver	Straight Ahead 39%	Straight Ahead 46%	Straight Ahead 55%	Straight Ahead 60%	Straight Ahead 55%	Straight Ahead 60%	Straight Ahead 48%

Generally, ramp crash rates were low for both directions of travel and for both entrance and exit ramps, with less than three reported crashes per ramp per year, and approximately 1 injury per

year for every two ramps, on average. The prevalence of rear end crashes having occurred with good road conditions and during peak hours (67%) suggest that the vast majority of the crashes can be attributed to congested, stop-and-go traffic conditions on the mainline, causing traffic backups onto the ramp. Congested traffic conditions at the intersections result in vehicle backups along the short exit ramps, and mainline congestion will result in backups along the entrance ramps, both situations increase the likelihood of rear-end collisions. Also, almost all the ramps in the focused study area have narrow, substandard shoulders that limit room for avoidance maneuvers.

A ramp crash summary of all 48 ramps is provided in Appendix F, but Table 3-9 below presents the five ramps in each direction that had the most number of reported crashes from 2006 to 2008.

Table 3-9 - Top 5 Eastbound and Westbound Ramp Crash Locations

	Ramp		Rank	Crash #	Predominant Crash Factors							
					Type		Weather		Road Con.		Time Period	
Eastbound	I-88 to EB I-290	Entrance	1	49	Rear End	47%	Clear	84%	Dry	73%	AM Peak	29%
	EB I-290 C-D to SB Mannheim Road	Exit	2	21	Rear End	48%	Clear	57%	Dry	48%	Midday	29%
	1St Avenue to EB I-290	Entrance	3	12	Rear End	50%	Clear	83%	Dry	75%	Midday	42%
	EB I-290 to Harlem Avenue	Exit	4	9	Sideswip e-Same	56%	Clear	100%	Dry	100%	Midday	44%
	Harlem Avenue to EB I-290	Entrance	5	8	Rear End	50%	Clear	88%	Dry	88%	Midday	38%
Westbound	WB I-290 to Mannheim Road	Exit	1	16	Fixed Object	56%	Clear	69%	Dry	63%	Early Morning	44%
	WB I-290 to Harlem Avenue	Exit	2	14	Rear End	71%	Clear	86%	Dry	86%	Late Evening	50%
	Harlem Avenue to WB I-290	Entrance	3	13	Rear End	85%	Clear	92%	Dry	85%	Late Evening	38%
	WB I-290 to Austin Blvd	Exit	4	10	Rear End	80%	Clear	90%	Dry	90%	AM Peak	30%
	SB Mannheim Road to WB I-290	Entrance	5	10	Rear End	60%	Clear	90%	Dry	70%	Midday	40%

The high number of crashes along the I-88 to EB I-290 ramp is attributed to two EB lanes of EB I-88 reducing to one prior to connecting with I-290. Here, two lanes of traffic merge into one, resulting in a high number of conflicts and crashes.

The second highest location, EB I-290 CD Road to EB I-290, the high number of crashes was attributed to downstream congestion related conflicts caused by the two CD road lanes of traffic converging to one.

Westbound, the exit ramp to Mannheim Road experienced a high percentage of fixed object crashes; 6 of the 9 fixed object crashes reported, occurred during off-peak hours with dry pavement conditions and with no congestion. This suggests that these crashes were due to drivers exceeding safe operating speeds.

The remainder of the crashes can be attributed primarily to either mainline or intersection congestion causing backups onto the ramps. The presence of ramp control signals may also contribute to rear-end crashes. Again, narrow shoulders at these locations limit the space available for avoidance maneuvers.

3.4 Cross Road Analysis

There are 16 cross roads included in this analysis. Of these cross roads, 10 have full or partial access to I-290, and 6 cross I-290 without any direct access. Cross roads with or without access typically have intersections, either stop controlled or signalized, with frontage roads or dedicated freeway ramps parallel to I-290, and the majority of the crashes involve vehicle movements at these intersections.

Overall, the most common types of crashes were rear end and turning movements (32% each), followed by angle (14%) and same direction sideswipes (13%). These crash types accounted for 92% of all cross road crashes. Cross roads with interchanges had more crashes than cross roads without interchanges, due to the higher exposure to traffic volumes and turning movements at interchange locations. This is borne out by the non-interchange cross roads averaging 16 crashes per location and cross roads with interchanges averaging 82 crashes per location.

Table 3-10 provides a summary of the cross road crashes within the I-290 study area and individual cross road crash summary reports are available in Appendix G. Detailed cross road crash statistics related to crash factors and time of day can be found in Appendix H.

Table 3-10 - Cross Road Crash Summary

Cross Street	I-290 Access	Crashes		Injuries	Predominant Crash Factors			
		Total	RANK		Crash Type	Weather	Road Condition	Time Period
25TH Ave	Full - Direct/Slip Ramps	102	4	28	Rear end 48%	Clear 81%	Dry 75%	Midday 40%
17TH Ave	Full - Slip Ramp	39	9	10	Rear end 36%	Clear 79%	Dry 69%	Midday 27%
9TH Ave	Partial - Slip Ramp	40	8	6	Angle 40%	Clear 70%	Dry 73%	Midday 37%
5TH Ave	No Access	24	12	6	Angle 46%	Clear 71%	Dry 58%	Midday 36%
1ST Ave (IL 171)	Full - Slip Ramp	101	5	11	Rear end 40%	Clear 77%	Dry 73%	Midday 28%
Des Plaines Ave	Partial - Diamond	38	10	7	Rear end 45%	Clear 63%	Dry 55%	Midday 34%
Circle Ave	No Access	9	15	2	Angle 44%	Clear 78%	Wet 56%	PM Rush 56%
Harlem Ave	Full - Single Point	163	1	23	Rear end 37%	Clear 76%	Dry 74%	Midday 30%
Oak Park Ave	No Access	26	11	12	Rear end 35%	Clear 77%	Dry 65%	Midday 30%
East Ave	No Access	13	14	1	Angle 46%	Clear 77%	Dry 77%	PM Rush 62%
Ridgeland Ave	No Access	19	13	4	Rear end 37%	Clear 63%	Dry 63%	Midday 53%
Lombard Ave	No Access	2	16	0	Angle 100%	Clear 50%	Dry 50%	PM Rush 50%
Austin Blvd	Full - Single Point	114	3	26	Turning 38%	Clear 74%	Dry 70%	Midday 25%
Central Ave	Full - Diamond	57	6	20	Turning 28%	Clear 74%	Dry 68%	Midday 38%
Laramie Ave	Partial - Slip Ramp	51	7	12	Turning 49%	Clear 84%	Dry 75%	Midday 52%
Cicero Ave (IL 50)	Partial - Slip Ramp	115	2	19	Turning 52%	Clear 75%	Dry 70%	Midday 41%
Crossroad Total		**913**		**187**	**Rear end 32%**	**Clear 76%**	**Dry 70%**	**Midday 34%**

The top five crossroads with the highest crash rates are reviewed in further detail. Harlem Avenue, Cicero Avenue, Austin Boulevard, 25th Avenue, and 1st Avenue all have three year crash totals that exceed 100 crashes and were analyzed in greater detail to determine any noteworthy crash factors. More detailed information regarding the below referenced crossroad traffic operations can be found in the I-290 Phase I Study Existing Roadway Operations Technical Memorandum.

Harlem Avenue – Rank 1

The Harlem Avenue crossing of I-290 consists of two 11' wide through lanes in each direction that interchange with I-290 via a full access, single point intersection controlled by one signal. Of the 163 crashes on Harlem Avenue, the predominant crash types were rear-end (37%), turning (32%), and sideswipe (23%) with the majority of crashes (83%) having occurred during congested periods.

Harlem Avenue's Average Daily Traffic (ADT) is between 36,000 and 40,000 with peak hour operations functioning at an overall LOS of E. The left and right turn lane demand exceeds the available single turn lane storage capacities by over 200%. The excess demand causes turn queues to spill back into the through lane, resulting in a blockage to through traffic. This imposed blockage contributes to congestion and increases the probability of rear end crashes. Furthermore, vehicles attempting to maneuver around a stopped turning vehicle also increase exposure to sideswipe crashes.

I-290 on-ramp metering may also be contributing factor for rear-end and turning crashes. During peak hours, the stop requirement on the on-ramp may cause the ramp to back up into the intersection resulting in turning vehicles not being able to clear the intersection before a yellow or red signal.

The 11' through lane widths are narrower than the 12' lanes that are preferred where truck traffic exists. Narrower though lanes contribute to sideswipe crashes as there is less room between lanes for trucks to maneuver. Also, the sustained 4% grades of the approaches to the I-290 intersection are not desirable for operations. When releasing the clutch to accelerate, stopped trucks and vehicles on the grade may roll backward, increasing the chance of a collision, and steeper grades may also factor into the 7% of crashes having occurred in ice or snow conditions.

Cicero Avenue (IL 50) – Rank 2

The Cicero Avenue interchange provides partial I-290 access to and from the west via slip ramps to the one way frontage roads of Lexington Street and Flournoy Street that intersect Cicero Avenue just south and north of I-290, respectively. Each intersection is controlled by a separate, fixed timed signal, and dual left turns onto Cicero Avenue are provided on Lexington Street, as well as on Cicero Avenue at its intersection with Flournoy Street. Cicero Avenue's Average Daily Traffic (ADT) is between 29,000 and 33,000 with peak hour operations functioning at an overall intersection LOS of E at Lexington Street and F at Flournoy Street.

Of the 115 crashes on Cicero Avenue, the predominant crash types were turning (52%), rear-end (22%), and sideswipe (14%) with the majority of crashes (89%) having occurred during congested periods. The relatively high percentage of turning crashes is likely due to vehicles colliding during high volume dual left turning movements. Also, at four of the left and right turn lanes, demand

exceeds the available storage capacity by up to 400%. The excess demand causes turn queues to spill back into the through lanes, resulting in a blockage of though traffic. This imposed blockage contributes to congestion and increases the probability of rear end crashes. Furthermore, vehicles attempting to maneuver around a stopped turning vehicle also increase the exposure to sideswipe crashes.

Austin Boulevard – Rank 3

The Austin Boulevard crossing of I-290 consists of two through lanes in each direction that vary between 10 and 12 feet, just north and south of the I-290 ramps intersection. Full access to I-290 is provided via a single point intersection controlled by one signal. Austin Boulevard Daily Traffic (ADT) is between 20,000 and 22,000 with peak hour operations functioning at an overall LOS of F.

Of the 114 crashes on Austin Boulevard, the predominant crash types were turning (38%) and rear-end (28%), and angle (18%) with the majority of crashes (84%) having occurred during congested periods.

Demand that exceeds the available capacity at Austin Boulevard results in severe congestion that is a primary factor in rear end collisions.

I-290 westbound on-ramp metering may also be contributing factor for rear-end and turning crashes. During peak hours, the stop requirement on the on-ramp may cause the ramp to back up into the intersection resulting in turning vehicles not being able to clear the intersection before a yellow or red signal.

Varying lane widths to the north and south of the intersection produce poor traffic channelization, forcing vehicles to make course corrections as they proceed through the intersection and increasing the likelihood of angle crashes.

The left and right turn lane demand exceeds the available single turn lane storage capacities by a wide margin. The excess demand causes turn queues to spill back into the through lane, resulting in a blockage to through traffic. This imposed blockage contributes to congestion and increases the probability of rear end crashes. Furthermore, vehicles attempting to maneuver around a stopped turning vehicle also increase exposure to sideswipe crashes.

In the southbound direction, there is a dedicated and shared left turn & through lane. Through-trip vehicles in the shared lane that are caught behind stopped left turning vehicles are more likely to perform a lane change maneuver which increases the likelihood of both rear end and side-swipe crashes.

25th Avenue – Rank 4

The 25th Avenue crossing of I-290 consists of two 12’ through lanes in each direction, separated by a 4’ raised median. Full access to I-290 is provided via three directional loop ramps, two diagonal ramps, as well as two slip ramp connections connect indirectly to 25th Avenue via signalized intersections north and south of I-290 at Congress Street and Lexington Street, respectively. Average Daily Traffic is between 21,000 and 24,000 vehicles per day with peak hour operations functioning at an overall LOS of B.

Of the 102 crashes on 25th Avenue, the overall predominant crash types were rear-end (48%), turning (29%), and side swipe (9%) with the majority of crashes (89%) having occurred during congested periods.

56% of these crashes were related to the Congress Street intersection, which were predominantly rear end (57%) and turning (27%) crashes. Contributing to the relatively high percentage of rear end crashes is the I-290 westbound off ramp to northbound 25th Avenue. Although a stop condition, vehicles accelerating onto 25th Avenue from this ramp encounter though vehicles that are stopping for the traffic signal at Congress. Turning movement crashes at Congress occurred primarily in the PM rush period, likely as a result of increased left turn volumes to access I-290 westbound. The short left turn storage lane may also contribute to rear end crashes when traffic waiting for the left-turn signal overflows into the through lane.

Thirty seven (36%) of the 102 crashes along 25th Avenue in the focused study area are related to the Lexington Street intersection that conveys traffic exiting I-290 eastbound, to 25th Avenue. The predominant crash types at this intersection were turning (38%) and rear end (32%). The relatively low number of crashes and the predominant rear end and turning crash types that are typical at intersections do not indicate any specific crash factors.

1st Avenue (IL 171) – Rank 5

1st Avenue is a state route that provides full access to I-290 with a one way frontage road and slip ramp configuration. Westbound I-290 slip ramps connect to/from 1st Avenue via Harrison Street, (one-way westbound) and eastbound I-290 slip ramps connect via Bataan Drive (one-way eastbound). Harrison Street and Bataan Drive frontage roads intersect 1st Avenue just north and south of I-290, respectively, and are controlled by separate, interconnected signals. North and southbound turning movements on 1st Avenue are shared with the through lanes. 1st Avenue's Average daily traffic is between 27,000 and 30,000 vehicles per day with peak hour operations functioning at an overall intersection LOS of F and E at Harrison Street and Bataan Drive respectively.

Of the 101 crashes that occurred on 1st Avenue, the predominant crash types were rear-end (40%), turning (30%), and sideswipe (18%) with the majority of crashes (79%) having occurred during congested periods.

Forty three crashes (43%) along 1st Avenue are associated with the Harrison Street intersection and were predominately rear end (40%) and turning crash types (40%) that occurred primarily during congested periods. The lack of dedicated northbound left turn lanes to Harrison Street is a key crash factor at this location. The high demand for this left turn movement causes queues to form in the shared lane, choking off the north through movement contributing to congestion related rear-end crashes. Through-trip vehicles in the shared lane that are caught behind stopped left turning vehicles are more likely to perform a lane change maneuver, which increases the likelihood of both rear end and side-swipe crashes. Vehicles attempting to avoid waiting though another signal cycle will continue to turn though the yellow light, increasing the potential for turning type crashes with opposing traffic. Commercial property driveway access located within close proximity to this intersection may also contribute to rear end and turning crashes.

Forty crashes (40%) along 1st Avenue are associated with the Bataan Street intersection and were predominately rear end (38%), turning (28%), and side swipe (20%) crash types that occurred primarily during congested periods. Congestion is a key factor in rear end type crashes. Conflicts between southbound left turning traffic and northbound right turning traffic are eliminated by the advance ramp exit from northbound 1st Avenue to eastbound I-290, which may contribute to the slightly lower number of crashes at the Bataan Street location in comparison to Harrison Street.

Varying lane widths to the north, between, and south of the intersections produce poor traffic channelization, forcing vehicles to make course corrections as they proceed to through the intersection and increasing the potential for crashes.

Fourteen crashes (14%) are associated with the Lexington Street intersection and eastbound I-290 on ramp. The predominant crash type at this location was side swipe (57%) and is attributed to northbound vehicles driving the ramp gore (either to jump the queue or to abort an exit to I-290) and attempting to merge back into the northbound through lane. The relatively low number of crashes over the three year period does not indicate any exceptional crash factors.

3.5 Frontage Road Crash Analysis

There are twelve different named streets that generally parallel I-290 along the north and south of the expressway. Their locations are shown in the Existing Lanes Diagram in Appendix A. The frontage road crashes were summarized by each continuous section of the streets. Streets such as Harrison and Flournoy are discontinuous within the study area, so each section was evaluated individually. Harrison has four distinct sections and Flournoy has two, which raise the total number of segments analyzed to 15. Table 3-11 summarizes the three year frontage road crash data, and detailed crash summary reports for each frontage road can be found in Appendix I.

Generally, the frontage road crash rate is low for the three year period from 2006 to 2008. The average crash rate was less than four crashes per mile, per year for the 11.3 miles of frontage roads reviewed.

Indian Joe Drive and Beach Avenue exhibit a crash rate higher than all other frontage road segments within the focused study area. These two local streets provide the most direct access to 25th Avenue from the I-290 Eastbound exit ramp, which is stop-controlled at its intersection with Wedgewood Drive (just west of Indian Joe) exiting from eastbound I-290. There are numerous commercial entrances, sharp curve radii (including a 90° turn signed for 20 MPH where southbound Beach Avenue intersects with eastbound Lexington Street), and narrow pavement width (approx. 20 feet) along these two segments.

Table 3-11 - Frontage Road Crash Summary

Frontage Road	From Street To Street	One/Two Way	Length	Crashes			Injuries		Predominant Crash Factors									
				Total	Rate (per mile)	RANK	Total	Rate (per mile)	Crash Type		Weather		Road Condition		Time Period		Cause	
			(Mile)															
Harrison Street	Bellwood Ave 25th Ave	2 Way	0.78	11	14	11	6	7.7	Fixed object	50%	Clear	55%	Wet	55%	PM Peak	36%	Exceeding safe speed	18%
Harrison Street	24th Ave 1st Ave	1 Way, (WB)	1.46	15	10	12	8	5.5	Fixed object	42%	Clear	100%	Dry	80%	AM Peak	27%	Fail to reduce speed to avoid	7%
Wedgewood Dr.	Suffolk Drive I-290 ramp	2 Way	0.25	1	4	13	0	0.0	Rear end	100%	Clear	100%	Ice	100%	AM Peak	100%	Construction/maintenance	0%
Indian Joe Dr.	I-290 ramp N. of Beach Street	2 Way	0.13	13	102	1	4	31.3	Rear end	62%	Clear	85%	Dry	85%	PM Peak	38%	Fail to reduce speed to avoid	23%
Beach Street	Indian Joe Dr. Lexington	2 Way	0.10	4	40	2	0	0.0	Sideswipe same direction	100%	Snow	50%	Snow or Slush	50%	Midday	50%	Construction/maintenance	0%
Lexington St.	Beach Street 25th Ave	2 Way	0.12	4	32	6	0	0.0	Fixed object	50%	Clear	100%	Dry	75%	AM Peak	50%	Fail to yield right-of-way	25%
Bataan Drive	23rd Ave 1st Ave	1 Way, (EB)	1.39	26	19	10	2	1.4	Sideswipe same direction	32%	Clear	80%	Dry	72%	AM Peak	35%	Fail to reduce speed to avoid	12%
Lehmer St	Elgin Ave Lathrop	2 Way	0.50	1	2	14	0	0.0	Fixed object	100%	Clear	100%	Dry	100%	Early Morning	100%	DUI	100%
Harrison Street	Harlem Ave DesPlaines Ave.	2 Way	0.59	16	27	9	3	5.1	Rear end	44%	Clear	81%	Dry	63%	AM Peak	31%	Following too closely	25%
Harrison Street	Maple Ave Austin Blvd	2 Way	1.51	47	31	7	4	2.7	Parked motor vehicle	38%	Clear	75%	Dry	60%	PM Peak	36%	Fail to yield right-of-way	36%
Flournoy Street	Highland Ave Humphrey St.	2 Way	0.28	0	0	15	0	0.0	None	0%	None	0%	None	0%	None	0%	None	0%
Flournoy Street	Central Ave Kilpatrick Ave	1 Way, (WB)	1.13	42	37	3	6	5.3	Rear end	26%	Clear	95%	Dry	69%	PM Peak	36%	Following too closely	7%
Garfield Street	Harlem Ave Austin Blvd	2 Way	1.57	56	36	4	9	5.7	Parked motor vehicle	40%	Clear	72%	Dry	52%	Midday	38%	Fail to reduce speed to avoid	20%
Railroad St	Austin Blvd Menard Ave	2 Way	0.25	7	28	8	0	0.0	Fixed object	29%	Clear	57%	Dry	57%	AM Peak	57%	Exceeding safe speed	14%
Lexington St.	Long Ave Kostner	1 Way, (EB)	1.22	41	34	5	4	3.3	Parked motor vehicle	23%	Clear	69%	Dry	59%	AM Peak	34%	Fail to yield right-of-way	7%
Total		**11.28 Miles**		**284**	**25**		**46**	**4.1**	**Parked motor vehicle**	**24%**	**Clear**	**75%**	**Dry**	**62%**	**AM Peak**	**27%**	**Fail to yield right-of-way**	**12%**

4.0 Type K & A Crash Analysis

4.1 Background

In 2005, the federal Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) transportation bill was enacted. As part of that bill, the Federal Highway Administration (FHWA) was authorized to enact a Highway Safety Improvement Program (HSIP) that formulates safety policy and provides funding for safety improvements to the various states. Special emphasis was placed on targeting fatal and serious injury crashes as a part of HSIP. The administrative law following the SAFETEA-LU act states that "each State shall develop, implement, and evaluate on an annual basis a HSIP that has the overall objective of significantly reducing the occurrence of and the potential for fatalities and serious injuries resulting from crashes on all public roads."[5]

Identification and diagnosis of highway safety problems and inclusion of effective safety countermeasures in highway projects contribute to the larger societal goals of improving highway safety. Targeted HSIP funds can be used to defray some or all of a project's construction costs where crash reduction countermeasures meet the federal requirements for HSIP funding; however, an emphasis on safety is inherent on all federally funded highway construction projects and with interstate rehabilitation or reconstruction projects, regardless of project status within the HSIP program. Therefore, identifying these types of major crashes, examining the conditions under which they occurred, and recommending countermeasures proven effective in reducing the occurrence and severity of crashes are fundamental activities in the preliminary engineering process for highway projects. This analysis focuses on the location, conditions, and probable causes for fatal and serious injury crashes on I-290 and adjacent frontage roads, ramps and cross roads through the study area.

DUI-Related Crashes: Driving Under the Influence (DUI) of alcohol (blood alcohol content of 0.08% or greater in Illinois), is a contributing factor in many severe crashes. Nationwide, 31.4% of the 34,017 fatal crashes were identified as DUI-related in 2008. In Illinois, 362 of 1,043 highway fatalities (34.7%) were DUI-related. The trend nationwide and in Illinois is toward lower overall fatalities and lower percentages of DUI related fatalities over the last several years. For instance, in Illinois, overall highway fatalities declined 30% from 1,355 in 2004 to 1,043 in 2008, and DUI-related fatalities decreased 27% from 2004 to 2008 in actual numbers (458 to 362) but increased slightly as a percentage of all fatalities (33.8% to 34.7%). Fatal DUI crashes usually occur in nighttime or early dawn conditions; for the year 2008 in Illinois, 39% of overall fatal crashes occurred between the hours of 9 P.M and 6 A.M., but 68% of all DUI-related fatal crashes occurred within the same hours.[6] On the I-290 mainline, 14 of 67 (21%) fatal or incapacitating injury crashes were identified as DUI-related. Further discussion of DUI will be given in the following detailed analysis of severe crashes in the I-290 study area.

[5] 23 CFR 924, Federal Highway Administration, December 24, 2008

[6] National Highway Traffic Safety Administration FARS Encyclopedia report (accessed from website).

4.2 Terminology

Type "K" Crash: A crash in which one or more fatalities occurred.

Type "A" Crash: A crash in which one or more incapacitating injuries occurred. One or more of the vehicle occupants could not leave the scene of the crash without medical assistance. "A" crashes are also referred to by federal law as "serious" injury crashes.

Type "B" Crash: A crash in which there were no incapacitating injuries, but where one or more of the vehicle occupants had visibly apparent injuries.

Type "C" Crash: A crash in which there were no visibly apparent injuries, but where a possible injury had occurred because of a complaint of pain by one or more of the vehicle occupants.

Type "P" (Property Damage Only) Crash: A crash where there were no injuries, but where property damage occurred to one or more vehicles and/or a roadside object or barrier.

4.3 5% Crash Locations

An inventory of the 5% of highways with the most pressing safety needs is prepared annually by each state per the requirements of HSIP. These highway segments and spot locations represent a minimum of 5% of the statewide highway inventory, and were selected by a formula that weights Type K and A crashes more heavily than minor crashes. The "Five Percent Report" (Federal Highway Administration Highway Safety Improvement Program, Illinois Department of Transportation, September 2009) was referenced for 5% crash locations, which included locations identified within the I-290 study area. The symbol ▲ will is used in this section to indicate crashes that occurred within a 5% segment designated by that report.

5% locations occurred at MP 17.8 – 18.3 between Mannheim Road and Addison Creek, 20.7-21.3 between the Des Plaines River and east of Des Plaines Avenue, and 21.7-22.1 between Harlem and Oak Park Avenues. The 5% segments represent approximately 16% of the centerline miles of I-290 in the study area. The 5% segments will be discussed within the context of overall K and A Crashes below. See Appendix J for a map of 5% locations within the study area.

4.4 Type K Injury Crashes

There were 9 Type K crashes involving 9 fatalities in the 2006-2008 reporting period in the focused study area. All 9 Type K crashes occurred on I-290 between I-294 and Kostner Avenue. The Mainline Severe and 5% Crash Locations exhibit in Appendix K shows the location of the severe crashes in the focused study area and includes the 5% Crash Report locations for reference.

These crashes were distributed throughout the study area with no apparent pattern or clustering of Type K crashes, except that 7 of the 9 Type K crashes were in the westbound direction. There were 4 fixed object collisions, 2 collisions with pedestrians, and 3 crashes of other types. It is notable that the predominant type of crash along I-290 is rear-end collision (64% overall were of this type), but

only one of the Type K crashes was a rear-end collision (which represents 11% of all Type K crashes). Also, there were two pedestrian collisions in nighttime conditions, one under rainy conditions, and both coincidentally at 4 AM on a Sunday. None of the 9 Type K crashes were identified as DUI-related.

4.4.1 Fatal Crashes in 5% Segments

Two of the 9 Type K crashes occurred within a designated 5% Segment. This represents 22% of all Type K crashes on I-290 within the study area. 22% of Type K's occurred along 16% of I-290 centerline miles indicates a Type K occurrence slightly above the average in the 5% segments. It should be noted the fixed object crash that occurred at WB 21.67 also occurred within a high cluster of other crashes, and was within a 5% segment (see below).

Since none of the 9 overall fatal I-290 mainline crashes were identified as DUI-related, it follows that there were no DUI-related fatalities within the 5% Segments.

4.4.2 Fatal Crash Patterns

To determine if there was an overall pattern of crashes at a particular K crash site, all crashes that occurred within a 1/10 mile segment centered on the K crash site were reviewed. High clusters of crashes (greater that 60 crashes within 0.05 mile in each direction of the K crash - indicated by bold type in red) occurred at the following two Type K crash locations:

Table 4-1 - High Crash Clusters near Type K crashes

MP	Location	K Crash Type	Predominant Crash Type
WB 21.67	0.03 mi. e. of Harlem	Fixed Object	Rear End
WB 23.62	0.08 mi. e. of Central	Fixed Object	Rear End

Both these fixed object crashes occurred at an approach to an interchange (at Harlem and Central Avenues), and were not of the predominant rear end crash type within the 1/10 mile segments. Both occurred under nighttime, uncongested conditions, while 90% of the other crashes in the clusters were in the congested period from 6 AM – 11 PM and 69% of the other crashes in the clusters were in daylight, dawn or dusk conditions. Under the prevailing uncongested conditions at night, higher speeds may have contributed to the severity of these crashes, in which the vehicle left the roadway and struck a fixed object.

A detailed listing and description of Type K crashes on I-290 from 2006-2008 is provided in

Table 4-3 and Table 4-2 below.

Table 4-3 - I-290 Eastbound Type K Crashes

Record No.	Time of Day	Peak Period	Weather	Road Condition	Type of Crash	DUI	Lighting	Mile Station	No. of K's	No. of Vehicles	1/10 mile cluster*
62149232	5:26 PM	YES	Clear	Dry	Fixed object	No	Daylight	18.40	1	1	36
64613417	4:24 AM	No	Rain	Wet	Pedestrian	No	Darkness, Lighted Road	22.43	1	1	9

Table 4-4 - I-290 Westbound Type K crashes

Record No.	Time	Peak Period	Weather	Road Condition	Type of Crash	DUI	Lighting	Mile Station	No. of K's	No. of Vehicles	1/10 mile cluster*
70864236	3:05 AM	No	Rain	Wet	Fixed object	No	Darkness, Lighted Road	23.62	1	1	137
63142111	12:11 PM	YES	Clear	Dry	Rear end	No	Daylight	22.99	1	2	35
73600397	5:10 AM	No	Clear	Dry	Over-turned	No	Darkness, Lighted Road	22.52	1	2	9
71477350	1:46 AM	No	Clear	Dry	Fixed object	No	Darkness, Lighted Road	21.67▲	1	1	103
71237796	4:52 AM	No	Clear	Dry	Pedestrian	No	Darkness, Lighted Road	21.00▲	1	1	46
71478218	11:58 AM	YES	Clear	Dry	Fixed object	No	Daylight	18.73	1	1	15
83268409	9:44 AM	YES	Clear	Dry	Head on	No	Daylight	15.93	1	3	6

*Number of crashes that occurred in a 1/10 mile length centered on the Type K crash.

4.5 Type A Injury Crashes

4.5.1 Mainline I-290

There were 58 Type A crashes, containing a total of 68 Type A injuries, in the 2006-2008 reporting period along the I-290 mainline within the focused study area. The Mainline Severe and 5% Crash Locations exhibit in Appendix K shows the location of the severe, Type A crashes in the focused study area and includes the 5% Crash Report locations for reference.

These crashes were evenly distributed throughout the study area with little apparent overall pattern or clustering, however two similar fixed object collisions occurred within close proximity to MP 24.70 and 24.71 in the eastbound direction. There were 18 fixed object crashes, 17 rear end crashes, 8 same-direction sideswipes, 5 collisions with parked vehicles, and 10 crashes of other types. It is notable that the predominant type of crash on I-290 is rear-end collision (64% overall

were of this type), while only 29% of the Type A crashes involved a rear-end collision. Fixed object collisions represented 31% of the Type A crashes. All parked vehicle collisions occurred west of Des Plaines Avenue. 14 of the 58 (24%) of all mainline Type A crashes were identified as DUI-related.

Type A Crashes in 5% Segments

Fourteen Type A crashes occurred within a designated 5% Segment. This represents 24% of all Type A crashes on I-290 within the study area. The 24% of Type A crashes that occurred within 16% of the I-290 centerline miles indicates a Type A crash rate similar in the 5% segments to the I-290 corridor as a whole. It should be noted the "other non collision" crash at EB MP 17.86 and the fixed object crash at EB MP 21.65 also occurred within a high cluster of other crashes, and were within a 5% segment (see below).

4 of the 10 (40%) Type A crashes within a 5% Segment were identified as DUI-related.

Type A Crash Patterns

Type A crashes were examined along with all crashes within a 1/10 mile segment, centered on the crash site, to determine if there was an overall pattern of crashes at a particular site. There were very high clusters of crashes (greater than 60 crashes within 0.05 mile in each direction of the Type A crash) at the following Type A Crash locations:

Table 4-5 - Crash Clusters along I-290 near Type A crashes

MP	Location	A Crash Type	Predominant Crash Type
WB 21.59	0.09 mi. e. of Circle	Sideswipe same dir	Rear End
WB 21.60	0.1 mi. e. of Circle	Rear End	Rear End
WB 23.07	0.13 mi. w. of Austin	Head On	Rear End
WB 23.08	0.12 mi. w. of Austin	Sideswipe same dir	Rear End
WB 23.15	0.05 mi. w. of Austin	Fixed Object	Rear End
WB 23.37	0.17 mi. e. of Austin	Fixed Object	Rear End
WB 23.37	0.17 mi. e. of Austin	Rear End	Rear End
WB 23.62	0.08 mi. e. of Central	Fixed Object	Rear End
EB 17.51	0.09 mi. w. of Mannheim	Fixed Object	Rear End
EB 17.86 ▲	0.26 mi. e. of Mannheim	Other Non Collision	Rear End
EB 19.06	0.04 mi. w. of 17th	Sideswipe same dir	Rear End
EB 21.58	0.12 mi. w. of Harlem	Fixed object	Rear End
EB 21.65 ▲	0.05 mi. w. of Harlem	Fixed object	Rear End

Thirteen Type A crashes occurred within high crash cluster locations: 6 fixed object, 3 same direction sideswipe, 2 rear end, 1 head on and 1 other non collision. Most of the Type A crashes (85%) were <u>not</u> of the predominant rear end crash type within their respective 1/10 mile segments. Nine of the 13 crashes occurred approaching or departing an interchange, with 7 related to the Austin Boulevard and Harlem Avenue ramps. The Type A crashes in the clusters were in a mixture of daytime congested conditions (7 crashes), early evenings on weekends (2 crashes), and late night/early morning uncongested conditions (4 crashes).

There are some correlations between the A crashes and the remaining crashes within their clusters. For example, one of the crashes at WB 23.37 (approaching the Austin Boulevard interchange) was of the predominant rear end type; it also occurred in nighttime conditions, which was the case with 32% of the other crashes in that cluster, a relatively high percentage for overall crashes at night when traffic volumes are at their lowest. The crash at WB 21.60 was a rear end in daytime congested conditions, which correlates with the majority of other crashes within that cluster. The other 6 crashes that occurred in daytime congested conditions (WB 21.59 and 23.07, and EB 17.51, 17.86, 19.06, and 21.65) correlated with the crash experience of the majority of other crashes in each of their associated clusters. However, the remaining 4 crashes (at WB 21.59, 23.37-fixed object, and 23.62, and EB 21.58) appeared to have less correlation with the remaining crash experience within their clusters. Unlike the majority of their peer group, these crashes were at night or early morning, in uncongested conditions, and not of the predominant rear end crash type.

Under the prevailing uncongested conditions for six of these crashes, higher speeds may have contributed to the severity of the crashes, in which the vehicle left the roadway or struck another vehicle in traffic.

Table 4-6 - I-290 Westbound Type A Crashes

Record No.	Time	Peak Period	Weather	Road Condition	Type of Crash	DUI	Mile Station	No. of A's	No. of Vehicles	1/10 mile cluster *
81505612	1:55 AM	No	Clear	Dry	Fixed object	No	25.14	1	2	19
83344853	6:10 AM	YES	Rain	Wet	Fixed object	No	25.04	1	1	28
81676967	5:00 AM	No	Clear	Dry	Fixed object	No	24.50	2	1	27
70864236	3:05 AM	No	Rain	Wet	Fixed object	No	23.62	2	1	136
64001803	1:30 AM	No	Clear	Dry	Rear end	No	23.37	1	2	71
72809528	2:30 AM	No	Clear	Dry	Fixed object	YES	23.37	1	1	71
63929871	8:26 AM	YES	Clear	Dry	Fixed object	YES	23.15	2	1	89
61351821	8:40 AM	YES	Clear	Dry	Sideswipe same direction	No	23.08	1	2	67
80116668	9:20 AM	No	Snow	Snow or Slush	Head on	No	23.07	1	2	65
63142111	12:11 PM	YES	Clear	Dry	Rear end	No	22.99	2	2	35
82799479	4:10 AM	No	Clear	Dry	Rear end	No	22.62	1	2	23
74648304	2:20 AM	No	Clear	Wet	Sideswipe same direction	YES	22.36	2	2	22
70468608	1:48 AM	No	Clear	Dry	Fixed object	YES	22.20	1	1	27
63889901	3:20 AM	No	Clear	Dry	Rear end	No	22.12 ▲	1	5	33
63934293	5:25 AM	No	Clear	Dry	Rear end	No	21.60	1	3	115
70621453	4:00 AM	No	Clear	Dry	Sideswipe same direction	No	21.59	1	2	111
83831701	1:55 AM	No	Clear	Dry	Fixed object	YES	20.94 ▲	1	2	51
63881338	2:48 AM	No	Clear	Dry	Other non collision	No	20.92 ▲	1	1	44
83711093	6:10 AM	YES	Clear	Dry	Rear end	YES	20.07	1	2	39
82462664	1:35 AM	No	Clear	Dry	Parked motor vehicle	YES	19.81	1	2	15

73480055	9:58 AM	No	Clear	Dry	Parked motor vehicle	No	19.28	1	2	13
82267683	10:26 AM	No	Clear	Dry	Other non collision	No	17.85 ▲	1	1	11
74751579	8:30 AM	YES	Clear	Dry	Parked motor vehicle	YES	17.65	1	2	12
70811245	6:55 AM	YES	Rain	Wet	Sideswipe same direction	No	17.56	1	2	42
60627296	5:02 AM	No	Clear	Dry	Pedestrian	No	17.43	1	3	36
74667502	6:20 AM	YES	Snow	Snow or Slush	Parked motor vehicle	No	16.51	1	2	35
63398952	3:40 AM	No	Clear	Dry	Fixed object	No	16.45	1	1	33
64494313	3:40 AM	No	Clear	Dry	Rear end	YES	16.40	1	2	17
64002439	7:03 AM	YES	Rain	Wet	Fixed object	No	16.21	1	1	16
64722457	8:35 AM	YES	Clear	Dry	Pedestrian	No	16.19	5	2	18
63975619	4:00 AM	No	Clear	Dry	Fixed object	YES	16.10	1	1	24

*Number of crashes that occurred in the 1/10 mile segment centered on the particular Type A crash.

Table 4-7 - I-290 Eastbound Type A Crashes

Record No.	Time	Peak Period	Weather	Road Condition	Type of Crash	DUI	Mile Station	No. of A's	No. of Vehicles	1/10 mile cluster*
61354189	4:55 AM	No	Clear	Wet	Fixed object	No	16.02	1	1	13
74266040	4:09 AM	No	Clear	Dry	Fixed object	YES	16.58	1	1	17
63939698	9:54 AM	No	Clear	Dry	Pedestrian	No	17.40	1	2	32
80070980	11:52 AM	No	Snow	Ice	Fixed object	No	17.43	1	1	48
63984389	11:10 AM	No	Clear	Dry	Fixed object	No	17.51	1	1	155
82220526	1:23 AM	No	Clear	Dry	Rear end	No	17.78 ▲	1	2	33
61454765	12:47 PM	No	Clear	Dry	Other non collision	No	17.86 ▲	1	1	60
71489058	9:48 AM	No	Clear	Dry	Rear end	No	18.79	1	2	20
80093271	9:13 AM	No	Snow	Snow or Slush	Sideswipe same direction	No	19.06	1	2	61
74732876	12:35 PM	No	Clear	Dry	Rear end	No	19.55	1	5	34
60820354	1:30 AM	No	Clear	Dry	Rear end	No	19.61	1	3	55
70795596	7:25 AM	YES	Clear	Dry	Sideswipe same direction	No	19.83	1	2	32
72239692	1:40 AM	No	Clear	Dry	Rear end	No	19.84	1	3	38
71358758	2:00 AM	No	Clear	Dry	Rear end	No	19.96	1	2	29
74717554	3:04 AM	No	Clear	Dry	Parked motor vehicle	YES	20.93 ▲	1	2	40
70228028	2:50 AM	No	Clear	Dry	Rear end	YES	20.99 ▲	1	2	54
65038689	4:30 AM	No	Clear	Unknown	Fixed object	No	21.58	1	1	79
73938680	7:30 AM	YES	Clear	Dry	Fixed object	No	21.65	1	1	72
83876474	2:10 AM	No	Clear	Dry	Rear end	YES	21.79 ▲	1	2	28
60518057	11:00 AM	No	Clear	Dry	Sideswipe same direction	No	22.14 ▲	2	2	8
83270884	1:55 AM	No	Clear	Dry	Sideswipe same direction	No	22.58	1	2	10
82481318	8:20 AM	YES	Clear	Dry	Rear end	No	22.59	1	2	10
82778937	7:50 AM	YES	Clear	Dry	Head on	No	23.95	1	6	7
61332219	1:30 AM	No	Clear	Dry	Fixed object	No	24.70	1	1	29

63928733	12:20 PM	No	Clear	Dry	Fixed object	No	24.71	1	2	28
70013404	1:18 AM	No	Rain	Wet	Rear end	No	24.98	1	3	7
83121525	1:35 AM	No	Clear	Dry	Overturned	No	25.14	1	1	19

* Number of crashes that occurred in the 1/10 mile segment centered on the particular Type A crash

4.5.2 Cross Roads, Frontage Roads, and Ramps

Cross Roads

For the period 2006-2008 I-290 crossroads had a total of 19 Type A crashes and no Type K crashes. The most common Type A crashes were Rear-End (7) and Turning (6) with lesser amounts of Angle, Pedestrian and Fixed Object crashes. The prevalent crash conditions were clear weather with dry road conditions. 58% (11 of 19) of Type A crashes occurred between 8 PM and 6 AM. Table 4-8 shows Austin Boulevard had the greatest number of crashes (114) in the 1/10 mile high cluster analysis followed by Harlem Avenue with 108 crashes in the 1/10 mile high cluster analysis.

Table 4-8 - I-290 Cross Road Type A Crashes

Ramp Name	Time	Peak Period	Weather	Road condition	Type of Crash	DUI	Mile Station	1/10 mile cluster
25TH Ave	2:57 AM	NO	Clear	Dry	Rear end	No	6.85	37
17TH Ave	11:29 AM	NO	Clear	Dry	Rear end	No	2.47	46
17TH Ave	1:47 AM	NO	Clear	Dry	Angle	No	2.53	79
9TH Ave	2:04 AM	NO	Clear	Dry	Rear end	No	2.50	79
1ST Ave (IL 171)	9:00 AM	NO	Clear	Dry	Turning	No	7.93	11
Circle Ave	12:25 PM	NO	Clear	Dry	Pedestrian	No	0.87	1
Harlem Ave	3:33 AM	NO	Clear	Dry	Rear end	No	20.12	108
Harlem Ave	2:20 AM	NO	Fog/smoke/haze	Dry	Rear end	No	20.21	57
Harlem Ave	2:25 AM	NO	Clear	Dry	Rear end	No	20.21	57
Austin Blvd	7:33 AM	YES	Clear	Dry	Turning	No	8.20	114
Austin Blvd	4:48 AM	NO	Clear	Dry	Turning	No	8.22	114
Central Ave	12:15 PM	NO	Clear	Dry	Rear end	No	12.85	29
Central Ave	2:52 AM	NO	Rain	Wet	Fixed object	No	12.85	29
Oak Park Ave	10:40 AM	NO	Unknown	Wet	Angle	No	5.21	14
Ridgeland Ave	8:30 AM	YES	Clear	Dry	Pedestrian	No	8.69	15
Laramie Ave	3:20 AM	NO	Clear	Dry	Angle	No	6.13	34
Cicero Ave (IL 50)	4:40 AM	NO	Rain	Wet	Turning	No	55.03	54
Cicero Ave (IL 50)	6:40 AM	YES	Clear	Dry	Turning	No	55.09	65
Cicero Ave (IL 50)	5:30 AM	NO	Clear	Dry	Turning	No	55.09	65

Fourteen DUI crashes were reported along the crossroads; however, none were of the A Type crash.

Frontage Roads

The I-290 study area contains 11.28 miles of frontage roads, some of which are used in conjunction with entrance and exit ramps to and from major crossroads. For the period of 2006 through 2008 there were no Type K and 4 Type A crashes on I-290 frontage roads. The data shows the Type A frontage road crashes were in scattered locations and conditions; with only 4 Type A crashes, there are very few data points to observe any trends or pinpoint problem areas for high severity crashes along the frontage roads. However, two of the crashes did occur in high clusters of other crashes; these crashes occurred in separate locations on Harrison Street between 17th and 5th Avenues. There were no DUI related Type A injury crashes reported on the frontage roads.

Table 3-8 - I-290 Frontage Road Type A Crashes

Record Number	Time	Peak Hour	Weather	Road condition	Type of Crash	Mile Station	Units	1/10 mile cluster
B	10:19 AM	N	Clear	Wet	Pedalcyclist	0.05	1	71
B	1:56 AM	N	Clear	Dry	Sideswipe same direction	0.06	1	72
G	6:07 AM	Y	Clear	Dry	Fixed object	0.24	1	34
O	9:33 AM	N	Clear	Ice	Rear end	0.99	1	5

Ramps

The I-290 study area contains 48 ramps (24 entrance and 24 exit ramps) to and from major crossroads. For the period of 2006 through 2008 there were no Type K and 8 Type A crashes on the I-290 ramps. The data shows the Type A ramp crashes were in scattered locations and conditions; with only 8 Type A crashes, there are very few data points to observe any trends or pinpoint problem areas for high severity crashes along the ramps; however, it is noted that all Type A crashes occurred before noon, and that 6 of the 8 crashes were rear-end. Ramp metering signals are present along the I-290 study area ramps. Location information to determine 1/10 mile crash clusters was not available from the ramp data. There were no DUI related Type A injury crashes reported on the ramps.

Table 4-9 - I-290 Eastbound Ramp Type A Crashes

Ramp Name	Time	Peak Hours	Weather	Road condition	Type of Crash	Ramp	# of Units	Ramp Direction
I-88 to EB I-290	7:34 AM	Y	Clear	Dry	Rear End	Entrance	2	EB
EB I-290 C-D	11:26 AM	N	Clear	Dry	Fixed Object	Exit	1	EB
EB I-290 to Harlem Avenue	11:35 AM	N	Clear	Dry	Rear End	Exit	3	EB
Harlem Avenue to EB I-290	4:30 AM	N	Clear	Dry	Rear End	Entrance	2	EB
EB I-290 to Austin Blvd	10:50 AM	N	Clear	Dry	Rear End	Exit	2	EB

Table 4-10 - I-290 Westbound Ramp Type A Crashes

Ramp Name	Time	Peak Hours	Weather	Road condition	Type of Crash	Ramp	# of Units	Ramp Direction
Central Avenue to WB I-290	9:30 AM	N	Clear	Dry	Rear End	Entrance	3	WB
Austin Blvd to WB I-290	10:50 AM	N	Clear	Dry	Rear End	Entrance	2	WB
WB I-290 to Mannheim Road	3:55 AM	N	Clear	Dry	Fixed Object	Exit	1	WB

4.6 Type B & C Injury Crashes

- There were 68 Type B injuries and 265 Type C injuries associated with crashes along I-290 within the study area during the 2006-2008 reporting period.
- There were 82 Type B injuries and 104 Type C injuries associated with crashes along cross roads within the study area during the 2006-2008 reporting period.
- There were no recorded Type B injuries and 42 Type C injuries associated with crashes along frontage roads within the study area during the 2006-2008 reporting period.
- There were 42 Type B injuries and 31 Type C injuries associated with crashes along ramps within the study area during the 2006-2008 reporting period.

5.0 Crash Causes and Factors

There are a multitude of potential contributing factors to each crash, and one cannot automatically attribute a single contributing factor to a crash unless detailed and accurate information points the analysis in that direction. The actions of the driver are directly or indirectly implicated as a contributing factor in over 90% of all crashes according to national studies[7]. The condition and characteristics of the vehicle or vehicles usually can be attributed to a small fraction of all crashes. As stated previously in the study methodology, the roadway environment (including the physical roadway and external environmental conditions) contributes in whole or in part to about 28% of all crashes. Law enforcement, driver training, implementation of vehicle safety features, mobilization and access to trauma facilities, and other improvements are critical to improving safety, and programs exist at the local, state and national levels to address these safety factors that are not directly related to the roadway environment. This study will briefly focus on those elements of the roadway environment that are likely to have contributed to the crashes that occurred on I-290 and its ramps, cross roads and frontage roads during the 2006-2008 reporting period.

Crash causes were examined previously in Section 2.2.4 for eastbound and westbound I-290 freeway segments. Following are some general observations for the causes of freeway crashes, plus additional commentary on contributing crash factors for frontage roads, cross roads and ramps.

Observations:

- The dominant crash type along I-290 is rear end (64% overall). As seen in Figures 4-1 through 4-4 below, these rear end crashes occurred mostly in the times of congested travel between 6 AM to 11 PM, with rear end collisions comprising 80% or more of congested travel crashes in several roadway segments. National studies[8], as well as local observance of the I-290 corridor, can correlate this high frequency and percentage of rear-end crashes with stop and go conditions where traffic can be at a standstill and then open up, requiring increased driver attentiveness to react to those conditions. Also, vehicles tend to have reduced headway (space between vehicles) during congested conditions, requiring quicker driver reaction times than would be required if vehicles were adequately spaced for safety. The roadway environment's contribution to rear end crashes in congested conditions is likely the lack of available capacity to accommodate the travel volumes, thus resulting in Level of Service E or F where approaching breakdown or breakdown conditions occur.

  Under wet, snowy or icy conditions, the lack of available traction due to worn road surfaces, inadequate shoulder space to store plowed snow, inadequate superelevation of curved highways, and winter storm conditions where it is difficult to keep the snow and ice cleared

[7] Rumar (1985)

[8] Zhou and Sisiopiku (1997); Golob and Recker (2001).

from the roadway can also contribute to rear end collisions. These conditions can contribute to rear end collisions regardless of level of congestion, but their presence exacerbates the rear end safety hazard when congestion is present.

- In the uncongested period between 11 PM and 6 AM, travel speeds tend to be higher and the mix of crashes changes from a dominance of rear-end crashes to a mixture of fixed object, sideswipe and rear end crashes. The "other" category of crashes tends to be a higher percentage of crashes in uncongested conditions, although in all segments "other" crashes were less than 20% of the total and in most segments were 10% or less (See Figures 4-2 and 4-4).

- Most of the serious injuries and fatalities (Type K and A crashes) were *not* associated with the predominant rear end crash type. Seven of the nine Type K (fatal) crashes involved a vehicle leaving the roadway or striking a pedestrian; since pedestrians are disallowed on the roadway except in the case of a disabled vehicle, it is likely that these pedestrian collisions were also a result of a vehicle leaving the travel lane to collide with a pedestrian near a stopped or disabled vehicle. Inadequate shoulder widths are present on more than 80% of the I-290 roadway; narrow shoulder widths could be a contributing factor to several of the Type K crashes; also, the presence of fixed objects within the roadway clear zone, improperly designed barriers or non-breakaway sign posts, or the lack of barriers to shield objects were likely contributing factors to fixed object crashes, including the more severe Type K and A crashes where leaving the roadway occurs in a large percentage of the crashes.

- There were spikes in the crash occurrences at eastbound I-290 near Harlem Avenue and westbound I-290 near Austin Boulevard as well as Harlem Avenue. The presence of left hand ramps at Austin Boulevard and Harlem Avenue may be a contributing factor to increased occurrence of crashes. A Federal Highway Administration study[9] indicated a crash rate associated with left hand exit ramps of 1.74 per million vehicles, over twice the rate as the next highest type. The same study indicated crash rates associated with left hand on (entrance) ramps at 0.74 per million vehicles, among the highest of the various types studied. These study crash rates were for locations where the cross road was overhead of the freeway, similar to the arrangement at Harlem Avenue and Austin Boulevard. Federal and state design policy discourages the use of left hand ramps, and the intermixing of ramp types, at local access interchanges; consistency of driver expectations and reduction in weaving maneuvers to access or to leave the ramps are cited as factors in disfavoring ramps of this type. All other interchanges in the I-290 corridor are of the more common right-hand type.

- Many of the serious injuries and fatalities occurred in advance of an interchange. In the westbound direction, there were 5 Type A crashes near the Austin Boulevard interchange which also had a highly clustered number of lesser severity crashes. Where clusters of crashes occurred near Type K and A crashes, most were minor rear end incidents, so that the causes of crashes in the overall cluster are not necessarily correlated with the causes of severe crashes. Signage, lighting and roadway geometry can be roadway environment factors for crashes in

[9] Safety Effectiveness of Highway Design Features, FHWA

advance of an interchange. Inadequate lane widths do not appear to be a factor in sideswipe or other crashes within weaving maneuvers in advance of an interchange, since all travel lanes of I-290 meet the 12' lane width policy for high traffic freeways.

- Most of the serious injuries and fatalities occurred under clear weather and dry roadway conditions, so there was not a clear pattern of roadway surface or weather conditions contributing to severe crashes.

- 5 of the 9 (56%) Type K crashes and 32 of the 58 (55%) Type A crashes occurred during the uncongested period between 11 PM and 6 AM. The occurrence of a majority of severe crashes during darkness may be a contributing factor, although the I-290 corridor is relatively well lit and the reports for Type K and A crashes on the I-290 mainline indicated lighting was present at the crash site. It should be noted that all Type K and A pedestrian collisions occurred between dusk and dawn, and there was no DUI associated with these pedestrian collisions.

- Of the 86 mainline and crossroad severe injury Type K & A crashes reported, 14 (21%) crashes involved DUI as a contributing factor. The incidence of DUI in these types of crashes was predominately during the late evening and early morning hours, with 11 of the 14 DUI's having occurred 11 PM and 6 AM. The incidence of DUI in severe crashes and during late evening and early morning hours followed state and national trends, although it should be noted that the percentage of identified DUI involvement in severe crashes on I-290 appears to be lower than state or national experience[10].

- The difference in crash rates or severity between the identified 5% segments and the I-290 study area overall appears to be slight. This indicates the presence of many segments along I-290 that may be approaching 5% status.

- At cross roads, the most common types of crashes were rear end, turning and angle. These types of crashes are typical of signalized intersections, which are present on most of the cross roads. Signalization introduces stop and go conditions, and many of the intersections have poor levels of service resulting from congestion during peak travel times.

  Generally, congestion at the crossroad interchanges that are operating at or over capacity was a primary crash factor. Further adding to poor operations is the absence or lack of sufficient turn lane storage capacity at several of the cross road interchanges in the I-290 focused study area. When turn lanes are insufficient in length to store the existing demand, traffic waiting to turn spills into through lanes, increasing rear end and side swipe crash potential.

  Varying cross road lane widths though the 1st Avenue and Austin Boulevard interchanges do not provide consistent traffic channelization. This likely contributes to the existing poor operating conditions and increases crash potential as vehicles are required to shift thought the intersection into a different lane alignment.

[10] NHTSA FARS Encyclopedia report

- There were several parked vehicle and sideswipe crashes along the frontage roads. Narrow parking lanes and narrow overall roadway widths may have contributed to the incidence of these types of crashes.

- The ramps had a relatively low number of crashes. The predominant rear end crash type may be explained by the same congestion factors present for the mainline, with the addition of ramp metering signals which introduce another mixture of stop and go conditions to the roadway environment.

Figure 5-1 - Eastbound - Peak Periods & Midday Crash Types by Segment

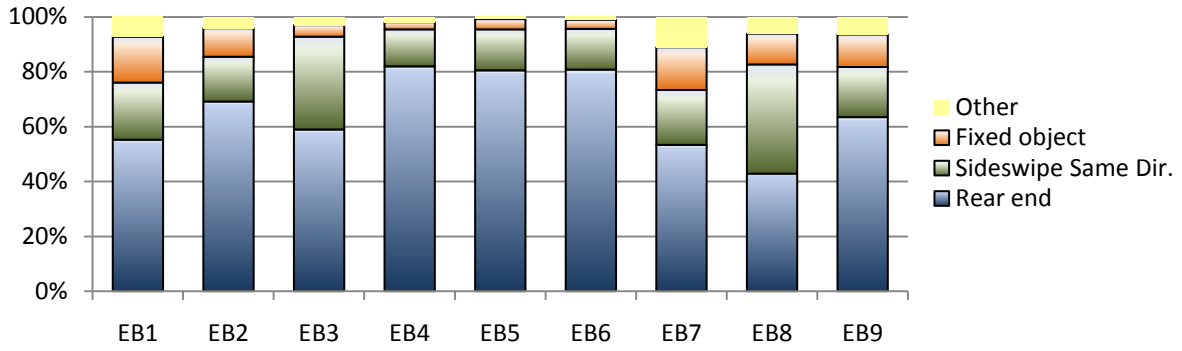


Figure 5-2 - Eastbound - Overnight Off-Peak Crash Types by Segment

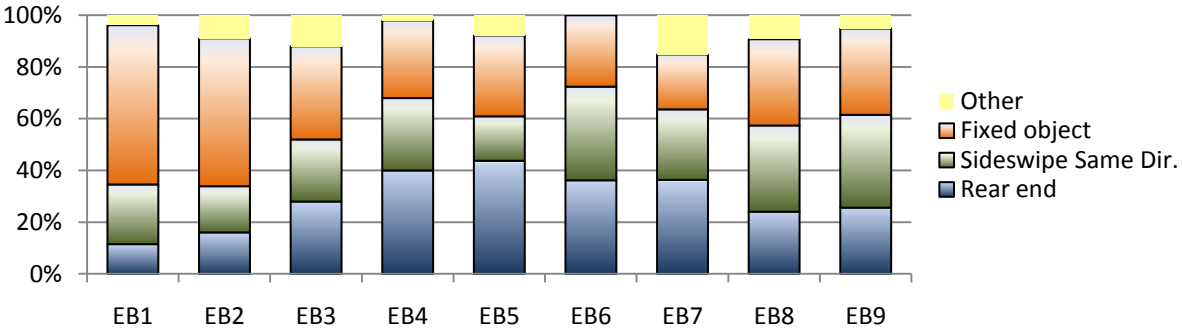


Figure 5-3 - Westbound - Peak Periods & Midday Crash Types by Segment

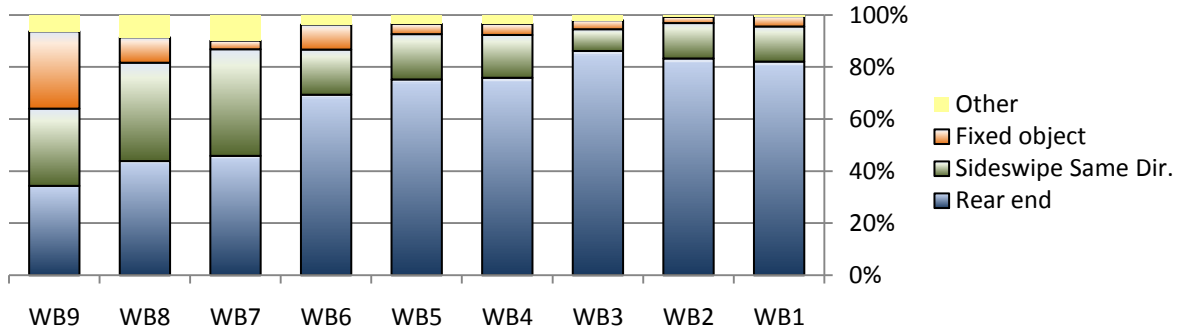
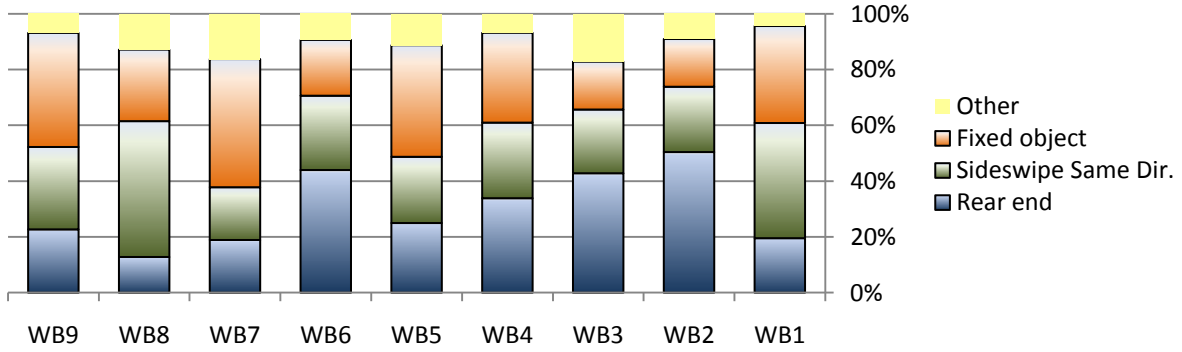


Figure 5-4 - Westbound - Overnight & Off Peak Crash Types by Segment



Detailed studies of the crash factors and proposals for effective countermeasures will be performed in forthcoming Phase I study activities. The AASHTO Highway Safety Manual (anticipated to be published in 2010) and other tools available from the Federal Highway Administration's Office of Safety provide a range of potential safety countermeasures that can be considered, and their effectiveness in addressing identified safety problems. A general discussion of countermeasures is included below.

6.0 Potential Countermeasures

The identified safety deficiencies above support a need to address safety in the overall project purpose. Potential countermeasures are anticipated to be studied in greater detail as the I-290 Phase I study progresses.

The Federal Highway Administration's Office of Safety is developing Crash Reduction Factors (CRF) for different countermeasures to be applied to freeway projects. The CRF's take a range of national experience with measurement of before-and-after safety performance of in-place countermeasures and applies projected reduction factors to their implementation. The use of countermeasures also must be balanced with other factors, such as community and environmental concerns and the geometric requirements of the project. For instance, it is possible that some countermeasures would be less costly or less impacting to the surrounding environment than others, but would provide approximately the same projected safety benefit; in most cases, the less costly or less impacting countermeasure would be chosen if safety is not compromised. CRF's for arterial roads and intersections have already been developed, and could be applied to those elements of an I-290 improvement project.

Example countermeasures include the providing of less abrupt ramp angles to avoid sideswipe collisions near ramp terminals, or to provide barriers or wider shoulders to reduce the number and severity of off-road collisions with fixed objects or disabled vehicles. There are a multitude of potential safety treatments available for highway projects, including low-cost improvements as well as more expensive, long term fixes.

List of References

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Road Safety Assessment Technical Training Manual, IDOT

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