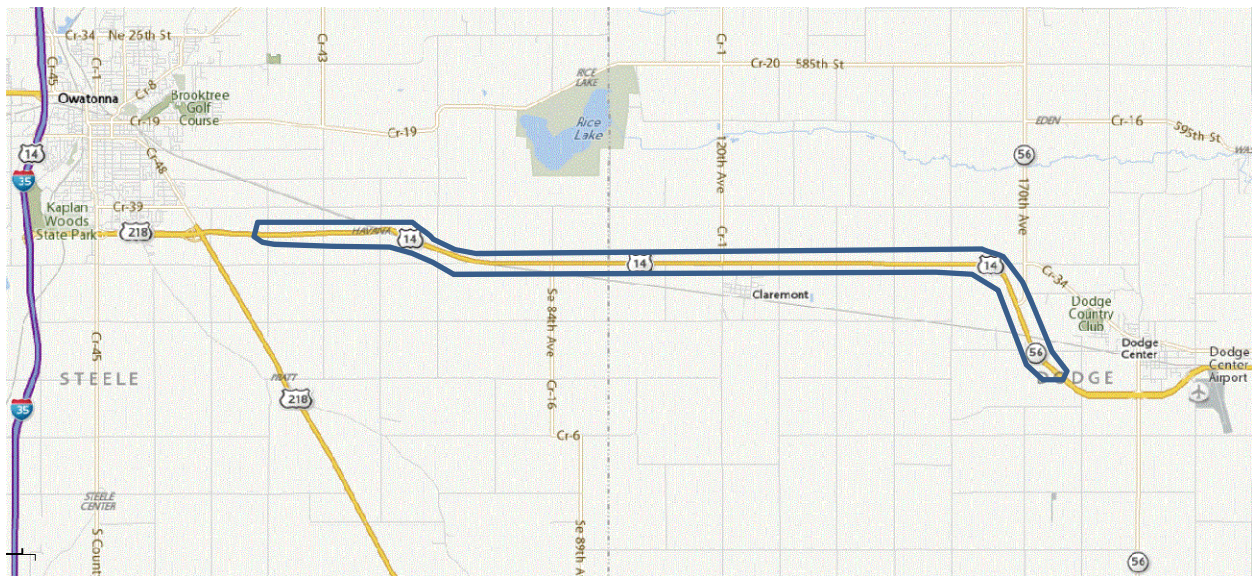




US Highway 14: Owatonna to Dodge Center Road Safety Audit Review Technical Report

September 26, 2013



Prepared By



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1 Introduction

The focus of this Road Safety Audit Review (RSAR) is US Trunk Highway (USTH) 14 between the cities of Owatonna and Dodge Center in Steele and Dodge Counties, Minnesota. Between 2007 and 2011, this 14.4 mile segment of roadway saw 92 crashes, of which three crashes resulted in at least one severe injury and two additional crashes were fatal. This caused concern with local residents and the Minnesota Department of Transportation (MnDOT), and this led MnDOT's decision to conduct a road safety audit. The investigation seeks to accomplish the following items:

1. Determine the primary factors contributing to the crashes.
2. Determine whether or not the quantity and severity of the crashes are above normal.
3. Develop short, medium, and long-term improvement strategies for implementation along this section of USTH 14.
4. Suggest preventative measures to reduce potential crash risk.

MnDOT selected WSB and Associates, Inc. (WSB) to assist with creating an independent review team and to complete a Road Safety Audit Review of USTH 14.

1.1 Road Safety Audit Review (RSAR) Team

Safety experts from several agencies including MnDOT, the Minnesota State Patrol, and private sector entities were assembled to make the review team. The review team is listed below:

Christina Krueger	Minnesota State Patrol
Darwin Yasis	MnDOT Geometrics Engineer
Scott Thompson	MnDOT District 7 Traffic Engineer
Eric Peterson	MnDOT OTST Signing Engineer
Derek Leuer	MnDOT Traffic Safety Engineer
Ross Jentink	WSB Project Engineer
Sean Delmore	WSB Project Manager

Figure 1 – Road Safety Audit Team

1.2 Road Safety Audit Review Process

The section of USTH 14 to be studied was divided into seven segments of relatively equal size. A Briefing Book was compiled with data for use by the RSAR team. The following data were reviewed per segment before the field review to get an understanding of the existing conditions:

- Crash data from 2007-2011 Minnesota Crash Mapping Analysis Tool (MnCMAT)
- Traffic volumes per segment of roadway and intersection
- Crash diagrams for fatal and severe injury crashes

The corridor was driven to familiarize the team with the existing conditions. Immediately afterwards, the Road Safety Audit Review (RSAR) team then conducted two meetings prior to a full-site investigation in order to gain perspective on what local agencies and District transportation officials were looking to improve.

- May 30, 2013, 10:00 AM – A MnDOT District 6 representatives meeting was held to get opinions, corridor background, recommendations, and goals from State transportation professionals.
- May 30, 2013, 1:00 PM – The Community Stakeholder meeting allowed local elected officials and stakeholders a chance to voice their concerns and inform the RSAR team of their experience with the corridor.

After the meetings were held, the RSAR team drove the corridor several times, examining intersections, geometrics, existing traffic control, existing topography, and recording all observations for later processing.

1.3 Meeting With MnDOT District 6

The RSAR team met with MnDOT District 6 staff before the field review took place. The main focuses of the conversations were 1) future plans for the corridor, 2) historical perspective, and 3) collectively identifying safety issues and goals.

1.3.1 Future Plans –

The section of USTH 14 between Owatonna and Dodge Center is the last two-lane section of roadway (14.4 miles) between Mankato and Rochester. The corridor has been studied for expansion to a four-lane expressway and a final Environmental Impact Study (EIS) was completed in 2010. Funding for this planned expansion is being actively pursued, and District 6 has expressed a willingness to fund this expansion in a piecemeal fashion as funding becomes available. A Federal Transportation Investment Generating Economic Recovery (TIGER) Grant for 2014-2015 is being pursued in order to fund the first section of roadway expansion from TH 218 to SE 54th Avenue (2.5 miles). This small expansion is estimated to cost \$16 Million. A mill and overlay is planned for the entire corridor in 2015.

1.3.2 Historical Perspective –

The District 6 staff explained that USTH 14 is a preferred route for I-35 southbound traffic to link to I-90 eastbound heading to Madison, WI and Chicago, IL, and serves the return direction as well. It also connects Rochester to Mankato and these cities are considered regional shopping/commercial hubs. The Mayo Clinic in Rochester adds to the regional traffic. There have been several improvements added to the corridor to improve safety that are listed in section 2.1.1.

1.3.3 Safety Issues and Goals –

Several issues were identified by the District 6 staff:

- Speed – It was observed that the comfortable driving speed is greater than the posted speed limit by 10 miles per hour.
- Commercial vehicles – There is a high percentage of commercial vehicles on the corridor and many use the Claremont ethanol plant. It has also been observed that off-peak hours seem to have very high commercial vehicle volumes. The mix of vehicles can be diverse with commuters, commercial vehicles, and farm vehicles all sharing the corridor.

- Passing – There are limited passing opportunities due to long queues of traffic following trucks and a lack of gaps in opposing traffic to make the maneuver, which relates to traffic volumes of approximately 7500 ADT. Additionally, commercial vehicles typically travel the speed limit causing backups and driver frustration. Commercial vehicles were observed passing left-turning traffic on the shoulders during the RSA Review
- Volumes – USTH 14 seems to be at capacity for the desired level of service in a rural area, according to the D6 staff and county engineers.
- Maintenance and Snow Removal –The corridor is historically difficult to keep clear during significant snowfalls, and commercial vehicles have become stuck impeding plow operations. In the past, blowing and drifting snow has caused MnDOT to close the road until snow removal operations can be completed.
- Railroad Crossing – There is a railroad crossing along the corridor located near SE 54th Avenue that sees regular train traffic on a daily basis.

1.4 Meeting with USTH 14 Stakeholders

The RSAR team also met with stakeholders consisting of local officials and law enforcement personnel. This meeting served as an opportunity for sharing of concerns and observations of the corridor. Many of the issues raised during the first meeting were reiterated, but new concerns were shared including:

- Traffic based on the agricultural industry. The ethanol plant in Claremont, and a soybean grinding facility west of Owatonna and annual harvest trucks all contribute to a significant volume of trucks on the corridor.
- Stakeholders are concerned that as the traffic volumes increase and approach the roadway capacity the likelihood of crashes will increase.
- There are no advanced warning flashers or gate arm system in place for the existing railroad crossing.
- There is a lack of driver response at locations when the four-lane facility reduces to two lanes (little or no reduction in vehicle speeds).
- There is a perceived danger to driving the corridor stemming from the high speeds, and high volume of commercial vehicles on the two lane rural facility.

2 Background

2.1 Corridor History

MnDOT considers USTH 14 a medium priority interregional corridor serving much of southern Minnesota. The area of the audit is two-lane rural roadway with transition areas to four lanes at the east and west end of the study corridor. Access to the corridor is limited to 16 (approximately 1 per mile) at-grade, through-stop intersections between Owatonna and Dodge Center with Claremont, MN being the only incorporated town. A draft Environmental Impact Study concerning a corridor-wide expansion to four lanes was completed in the late 1990s, and the final EIS was completed in 2010. Other areas of USTH 14 have been converted to four lanes including Owatonna to Mankato in the west and Dodge Center to Rochester in the east.



Figure 2 - USTH 14

2.1.1 Recent Safety Improvement Projects

Several safety improvements have been recently implemented including:

- The expansion of USTH 14 to four lanes from Cedar Avenue to the new TH 218 interchange.
- Intersection lighting was added at all eight at-grade county road intersections along USTH 14.
- Driver feedback signs (Your Speed Is XX) were added at the speed transition points, when the speed changes from 65 mph to 55 mph, both eastbound and westbound.
- Commercial vehicles are now using the frontage road for entering/exiting maneuvers at the Claremont ethanol plant.
- Turn lanes were added on USTH 14 at CSAH 1 in Claremont.
- Signs along USTH 14 have been recently replaced during routine maintenance and appear to be MUTCD compliant.

- Smaller buses used in the school district that allow for driveway pickups and reduces exposure of riders to USTH 14 traffic.
- Edgeline rumbles exist on the shoulders and centerline rumbles exist in the bituminous pavement area.

2.2 Crash History

Crash data were collected for the corridor from 2007 to 2011 using the MnCMAT database. From this data, breakouts per segment are organized in Appendix A of the RSAR briefing book. Documentation on other rural two-lane roadway crashes was also collected for comparison purposes.

- The USTH 14 Corridor from the TH 218 Interchange in Owatonna to Dodge Center reported 92 crashes between 2007 and 2011. If the crash rate is normalized to the volume of traffic on this section of highway, the frequency of crashes equates to 0.47 per million vehicle miles traveled (MVM). This is lower than the statewide rural two-lane highway and expressway averages.

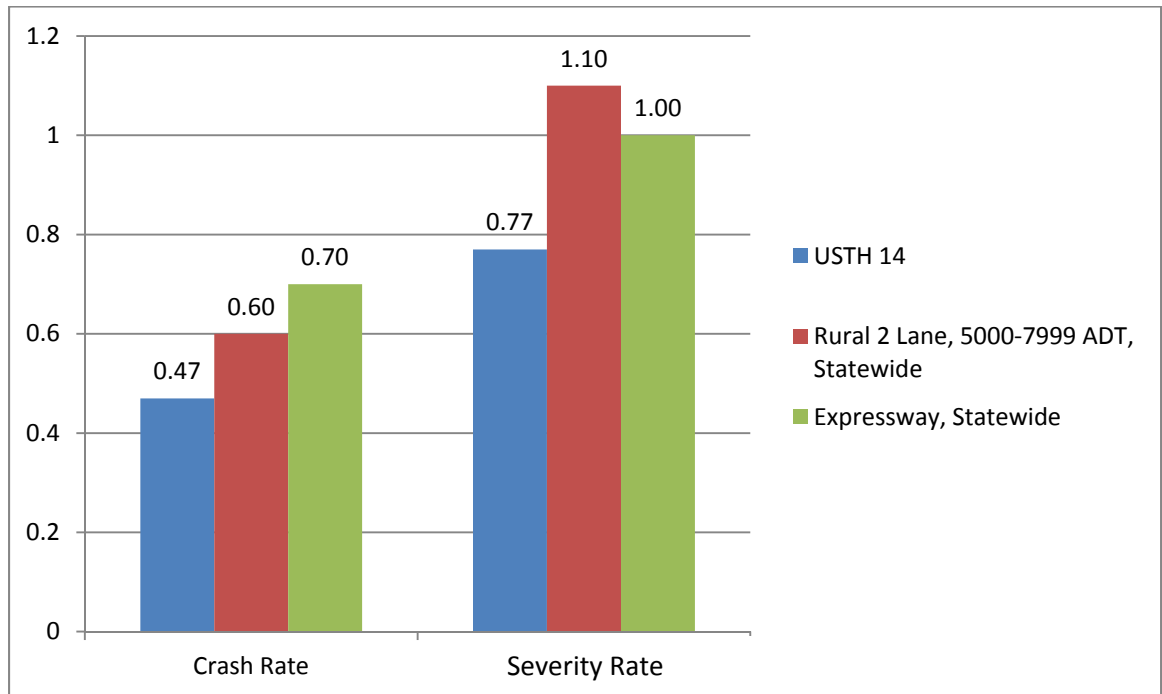


Figure 3 - Crash Rate and Severity Rate

- Out of 92 crashes, two were fatal and another three resulted in serious injury. The remaining 87 involved minor injuries or property damage.
- The severity rate of the corridor is 0.77 which is lower than the rural two-lane statewide average.
- If the K and A crashes are isolated, the analysis shows the rates are 0.010 fatal crashes MVM and the severe crash rate (K + A) 0.025.

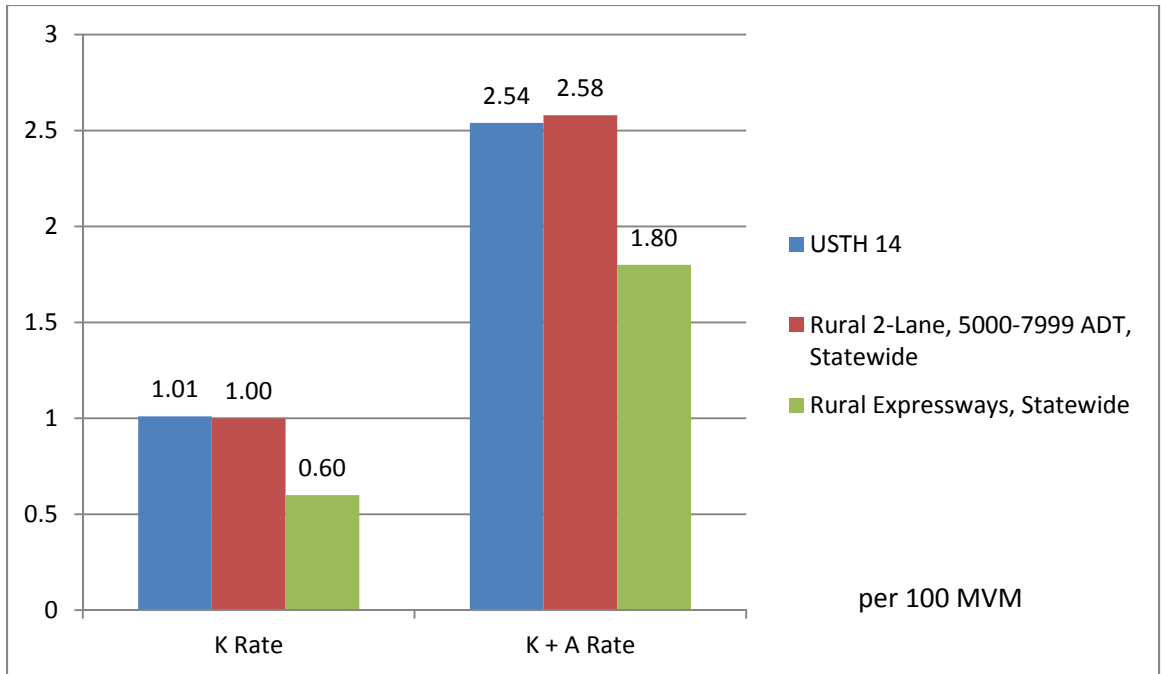


Figure 4 - Severe Crash Breakdown

- The percentage of K and A crashes appear to be much higher than the two-lane rural average in Minnesota, with K crashes (two) at 2.17% of the total and A crashes (four) at 4.35% of the total
- 60% (3) of the K or A crashes were head-on which is over two times the average for Minnesota two-lane rural highways. However, this figure is not statistically significant.

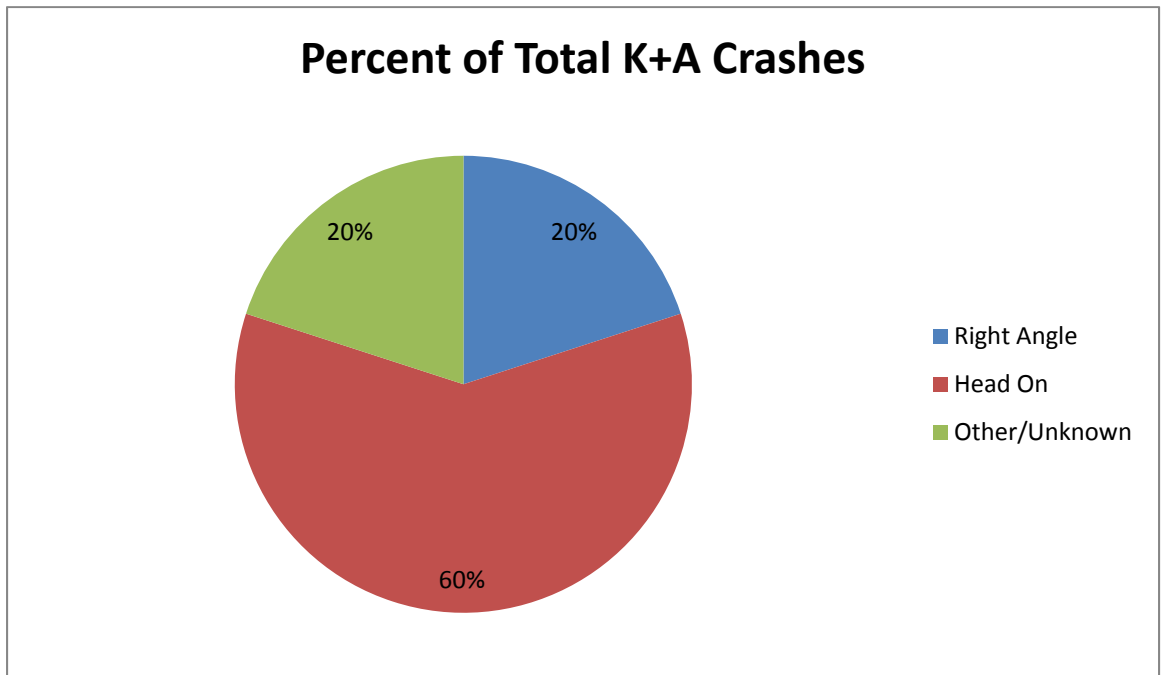


Figure 5 - Crash Type Comparison

From the previous information, it can be concluded that USTH 14 between Owatonna and Dodge Center:

1. Has a crash rate that is below the critical crash rate and average state crash rate for each segment and the entire corridor. Critical crash rates are crash rates that have been statistically adjusted, based on other roads with similar characteristics (i.e., all rural sections of two-lane undivided US roads in the state), to remove the elements of chance and randomness.
2. Has an overall K+A crash rate of 0.025 per million vehicle miles which is slightly below the state average of 0.026 per million vehicle miles for two-lane rural highways carrying the same ADT.
3. Has a fatal crash rate of 0.010 per million vehicle miles traveled which matches similar two-lane highways with 5000-7999 ADT.
4. Three of the five severe crashes recorded resulted from head-on collisions

The characteristics of the crashes were analyzed in the data set for further insight into the leading causes. Factors such as time of day, time of year, roadway condition, driver age and gender were all considered.

There appears to be a higher concentration of crashes over the winter months, with November to March accounting for 62% of the total crashes and 60% of the severe crashes.

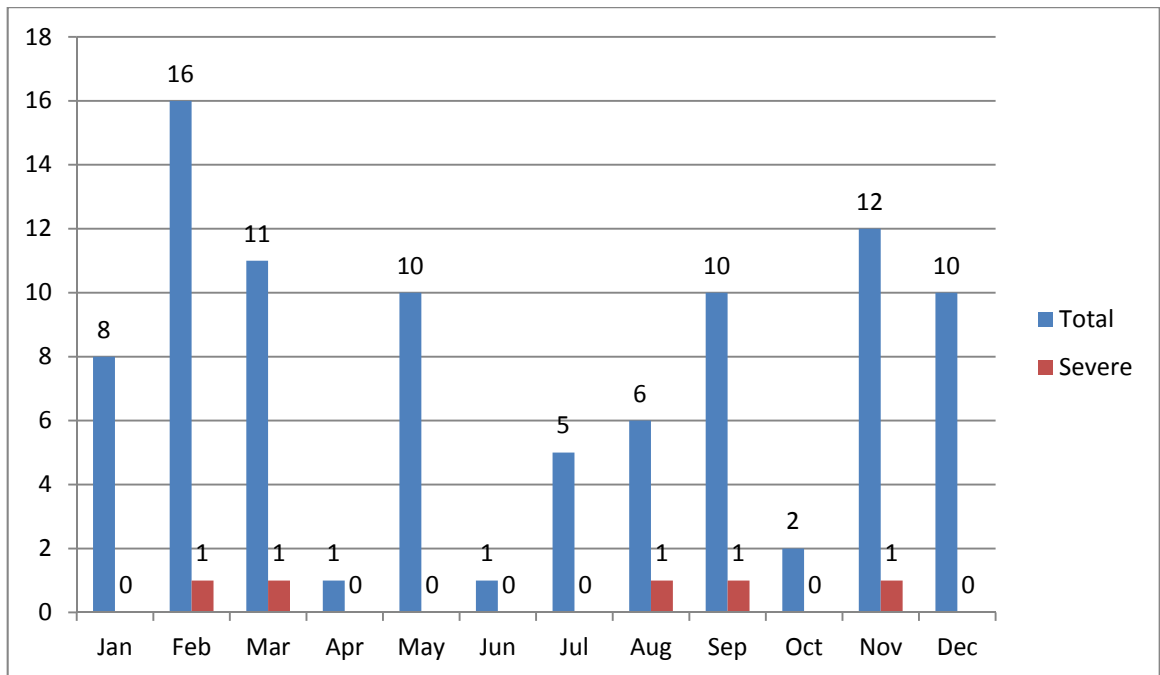


Figure 6 - Crashes by Month

Crashes were more prevalent during the evening rush hours of 3:00 PM to 5:59 PM accounting for 30% of all crashes on the corridor. Two-thirds of the severe crashes occurred during and immediately after evening peak periods from 3:00 PM to 5:59 PM and 6:00 PM to 8:59 PM. This coincides with volume vs. time of day data for the corridor.

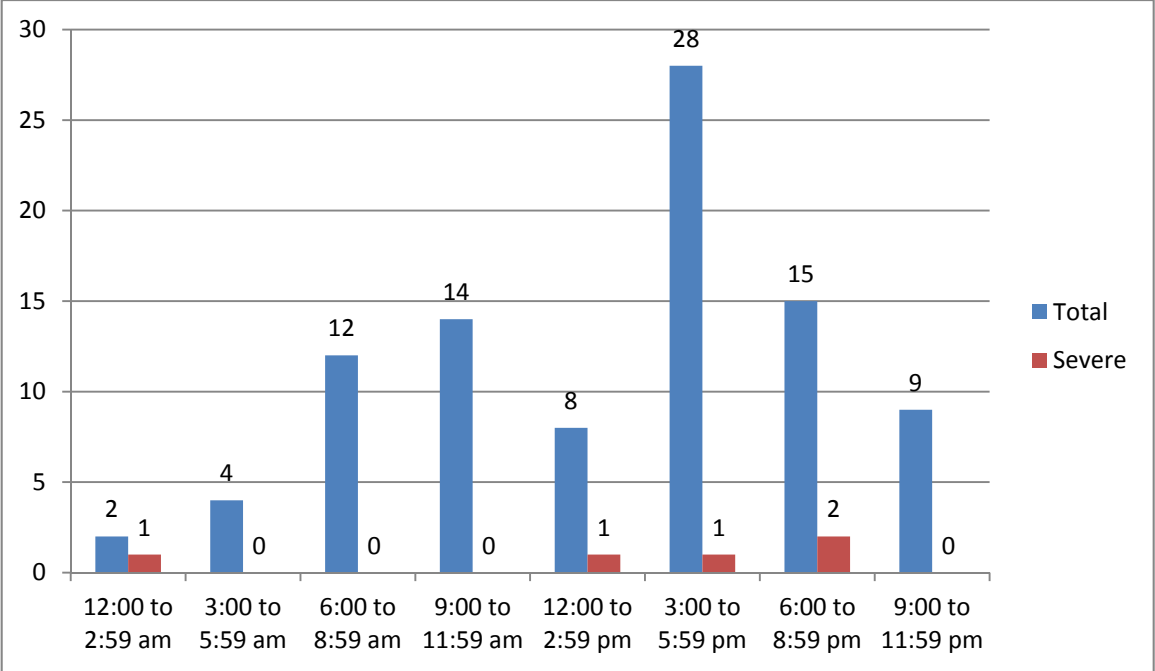


Figure 7 - Crashes by Time of Day

Gender data indicates that of all people involved in all crashes, 90 out of 144 were male, 53 were female and one was classified as unknown. The gender data for severe crashes shows male drivers involved in two severe crashes and women in four.

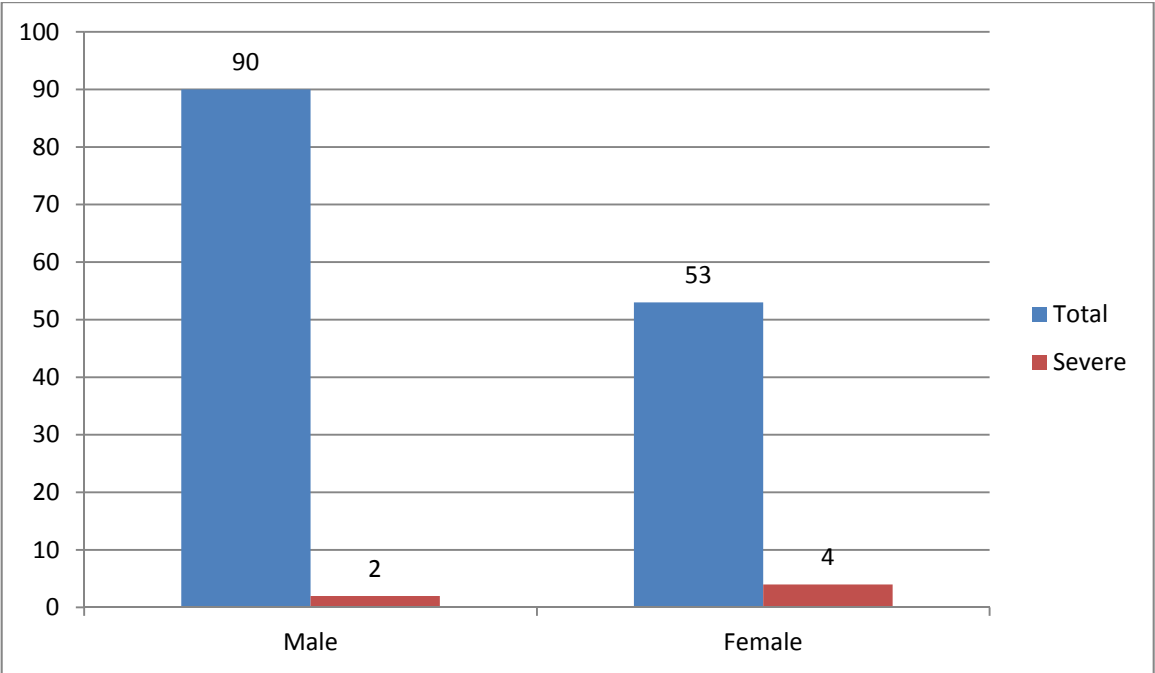


Figure 8 - Crashes by Gender

Age distribution of crashes shows a nearly equal spread of 20% of crashes in each of the 21-29, 30-39, 40-49 age groups. The severe crashes are more prevalent in the 30-39 age groups accounting for nearly 40% of all severe crashes.

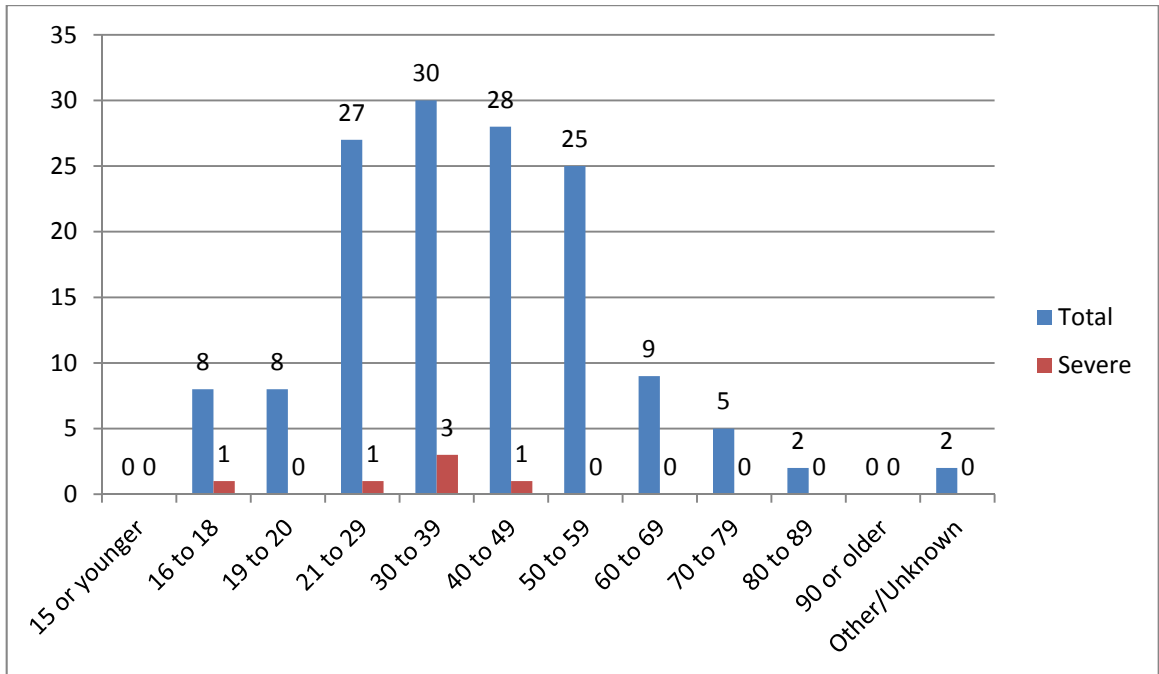


Figure 9 - Crashes by Age

Roadway surface conditions show that nearly half of all crashes occur in dry conditions and ice or snow packed roadways contributed to 34% of crashes, nearly double what is expected. Four of five severe crashes occurred in dry conditions and a single severe crash occurred in icy or snow pack conditions. Snow and ice are contributing factors to crashes leading to many single vehicle crashes with a lower likelihood of severe crashes.

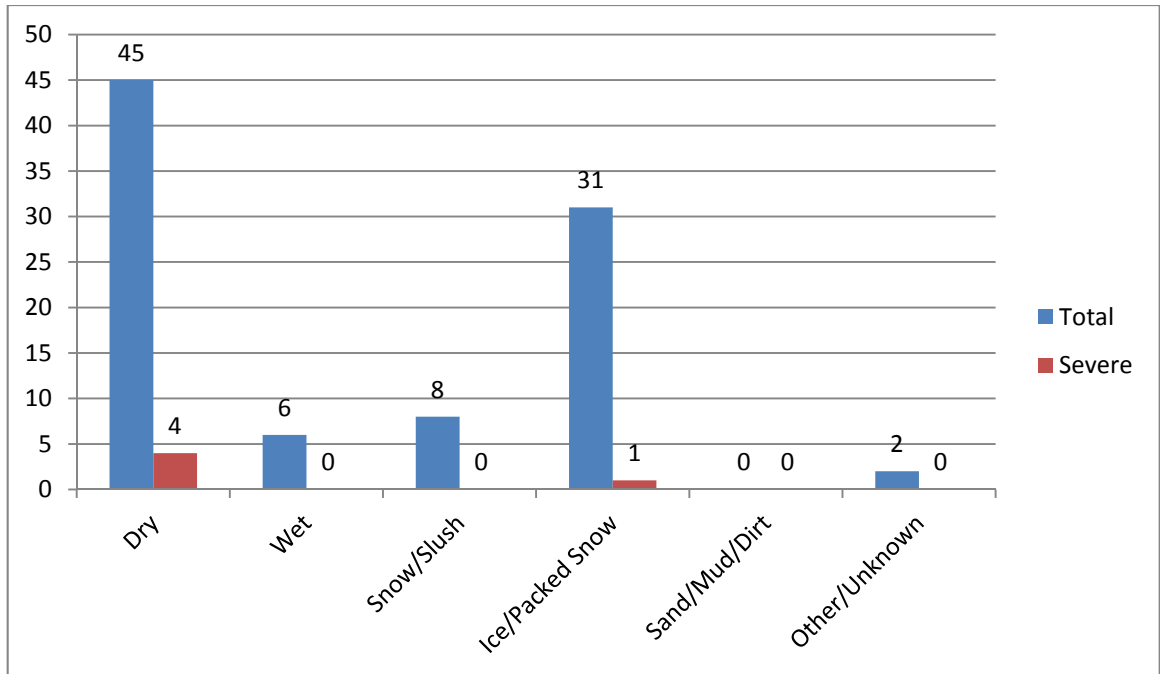


Figure 10 - Crashes by Roadway Condition

2.3 Intersection Analysis

When crash data is broken down by intersection along the USTH 14 corridor, 21 of the 92 crashes occurred at 13 intersections. All of the intersections between Owatonna and Dodge Center have crash rates that are at or are below expected values for total crashes and critical crash rates. The Steel and Dodge County Safety Plans were reviewed for safety. The following were found:

Dodge County

- USTH 14 AT CSAH 16 Ranked - 33rd of 104 Risk - 2 Stars (Moderate Risk)
Improvements Considered:
Install Street Light – Complete

Steel County

- USTH 14 at CSAH 1 Rank - 21st of 104 Risk - 2 Stars (Moderate Risk)
Improvements Considered:
Install Street Light – Complete
Upgrade Signs – 2010 HSIP
Upgrade Markings – 2010 HSIP
- USTH 14 AT CSAH 3 Ranked - 17th of 104 Risk - 2 Stars (Moderate Risk)
Install Street Light – Complete
- USTH 14 AT CSAH 5 (west) Ranked - 26rd of 104 Risk - 2 Stars (Moderate Risk))
Install Street Light – Complete
- USTH 14 AT CSAH 5 (east) Ranked - 40rd of 104 Risk - 2 Stars (Moderate Risk)
Install Street Light – Complete

2.4 Behavioral Factors

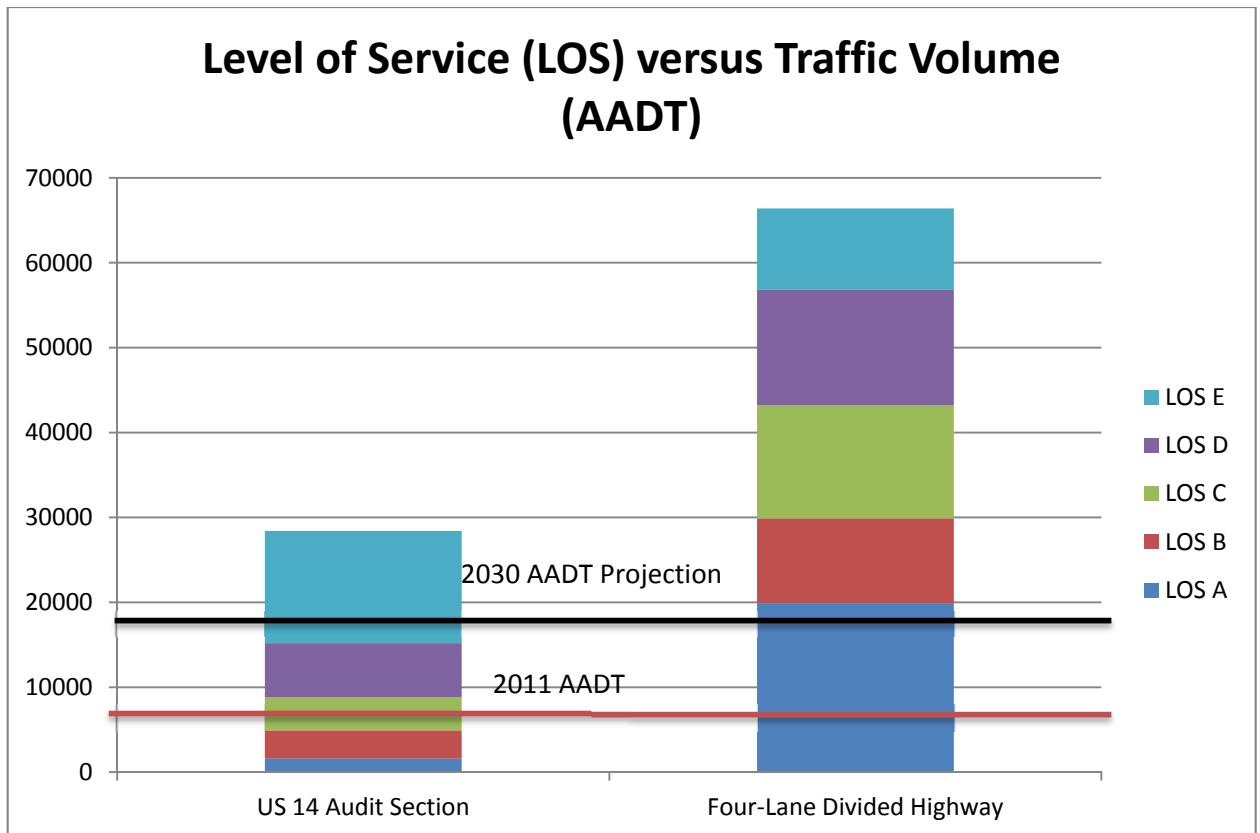
Crash data for USTH 14 between Owatonna and Dodge Center indicates two prevalent contributing factors; illegal or unsafe speeds (16%) and driver inattention (10%). Over 70% of the total crashes on the corridor were classified as 'Other/Unknown'. For the severe crashes, 20% were due to illegal or unsafe speeds, 20% were due to improper lane use and nearly 60% had an unknown cause. It may be necessary to identify why 60% of severe crashes were listed as an unknown cause. Seatbelt use was widespread in all crashes, with only three instances where crash victims were unbelted. These three instances of unbelted drivers did not result in either a K or A severity. Alcohol related crashes are not an issue on this corridor. The frequency of occurrence (1%) is much lower than the district average percentage of crashes (4%) involving alcohol.

2.5 Traffic Volumes

Total traffic volumes along USTH 14 have been slightly decreasing or level from Owatonna to Dodge Center, and commercial vehicle volumes are decreasing at an even greater rate (2007-2011) Expansion of the corridor to a four-lane facility is currently in development as mentioned earlier in the report.

Heavy commercial vehicles account for an average of 15.4% (using 2009 and 2011 data) of total traffic along the corridor which is much higher than I-90 between I-35 and TH 56 which has 9.5% commercial vehicles. This could stem from transit to and from the Madison, Milwaukee, and Chicago areas and the ability to decrease trip distance by 35 miles using USTH 14 out of Rochester versus the I-90 to I-35 route.

Traffic forecasts for the next 20 years (2030) predict that the ADT of the corridor will more than double to 16,800. This projection was taken from the USTH 14 EIS from Owatonna to Dodge Center Final Environmental Impact Statement (EIS) and Final Section 4(f) Evaluation published in 2010, and represents potential volumes with a four-lane freeway system. The EIS states that a full realignment may be necessary over the next 20 years (preferred Alternative 3) that routes USTH 14 south of the Dakota, Minnesota, and Eastern (DM&E) Railroad line. These growth estimates are based on local development assumptions which are typically aggressive. These numbers are highly dependent on the economy, and the current outlook is more conservative than was being projected in the 2010 FEIS. These volumes likely will not be met until some date beyond the 2030 time horizon.



Source: 2010 Highway Capacity Manual

Figure 11 - 20 Year LOS and AADT Projections

The corridor currently operates at a LOS of C based on the 2011 traffic volumes. Though MnDOT does not explicitly detail an acceptable level of service, the existing operation of USTH 14 would be considered acceptable by most standards. By 2030, traffic volumes will grow reducing the overall level of service experienced by travelers. With the four-lane expansion and realignment, the traffic will experience a LOS of A/B.

2.6 Commercial Vehicles

The corridor has a commercial vehicles percentage of 15% traveling this corridor when compared to interstate highway facilities. The number of crashes involving commercial vehicles comprises nearly 7% of the total crashes compared to the district wide average of 4%. Most of the crashes were property damage or non-life threatening injuries, and there was a fatality involving a Heavy Commercial Truck. This means that commercial vehicles were involved in half of the fatal crashes on the corridor from 2007 to 2011. Often times the contributing factor to the crash is related to an error made by a passenger car. There is not enough crash information to make a statistically relevant conclusion on truck impacts.

3 Field Review Summary

3.1 Segments

3.1.1 Roadway Geometry

The RSAR team studied aerial photography of the USTH 14 corridor to review the existing geometry. For most of the roadway, the following conditions can be found:

- 12-foot lanes.
- Paved shoulder for the majority of the corridor, usually 8-10' wide.
- Clear zones are adequate for the majority of the corridor contain no major obstructions.
- Vertical alignment is nearly flat.
- Horizontal alignment is very straight with no sharp curves.
- Less than 20% of the roadway is designated as a no-passing zone.

3.1.2 Field Access

The road system divides properties into a one-square -mile grid (section) system. This allows ample access to farm fields from the local roadways and direct access from USTH 14. However, USTH 14 is not the primary choice of access for most farmers.

3.1.3 Traffic Characteristics

It was observed that during the majority of the daytime hours, passenger vehicles seemed to have a difficult time passing commercial vehicles. This interaction increases during agricultural harvesting season when the volume of commercial vehicles and trucks is significantly higher.

3.2 Intersections

3.2.1 Geometrics

Most of the alignment of USTH 14 is directly east/west which makes the majority of intersections right-angle. There is a single skewed intersection (SE 64th Avenue). It has been noted that crash rates at skewed intersections tend to be higher than those that are perpendicular.

3.2.2 Signing and Striping (Pavement Markings)

Throughout the corridor, the epoxy edge line is in need of repair or upgrade. Improved stop bars and advanced "STOP AHEAD" markings should be considered for side-street stop conditions. A review of the Minnesota Best Practices for Traffic Signing Handbook and the Traffic Safety Fundamentals Book could provide guidance for better signing and safety. There are not any centerline rumble strips through the Claremont area or the sections of concrete pavement in the transition zones. Signing at the intersections, especially stop signs should be reviewed and possibly upgraded to a larger size for better visibility. All signs on the corridor should be compliant with the 2011 Minnesota Manual on Uniform Traffic Control Devices (MnMUTCD). There are two dynamic speed display (DSD) signs on either

end of the corridor at the two-lane to the four-lane transition sections, but the sign on the east end near Dodge Center was not functional during the RSA field review.

4 Suggested Improvement Strategies

4.1 Corridor-Wide Improvements

The majority of the crashes along USTH 14 occur in the segments between intersections, and the severe crashes were mostly related to head-on collisions. Implementing techniques to reduce the number of vehicles crossing over the centerline could reduce the number of severe crashes and likely the total number of crashes as well. There are several techniques to prevent vehicles from crossing the centerline, and they involve changing the cross section of the roadway by adding a buffer, adding a lane (turn, bypass or passing) or redesigning the entire corridor to a four-lane expressway.

4.1.1 Centerline Rumble Stripes

According to MnDOT policy, centerline rumble striping should be re-installed along the entire corridor as part of the planned corridor-wide mill and overlay. Installation should also be considered in the concrete pavement section near Dodge Center. This may reduce the amount of head on crashes as well as add visibility in wet conditions to the centerline striping. Additionally, the residential areas in Claremont are 0.3 miles from USTH 14 which may lessen the noise impact of a vehicle traveling at 55 mph hitting the rumble stripe. The rumble stripes should be compliant with the latest standards from MnDOT.

4.1.2 Four-Foot Centerline Buffer Zone/Tube Delineators

A center buffer zone between lanes, 4-8 feet in width, creates an inside buffer zone between opposing lanes of traffic with rumble strips on the inside lane lines delineating the buffer zone. The installation of tube delineators allows the zone to be signed as no passing, but still allow full access at driveways and side streets.

Median Buffer Roadway Section

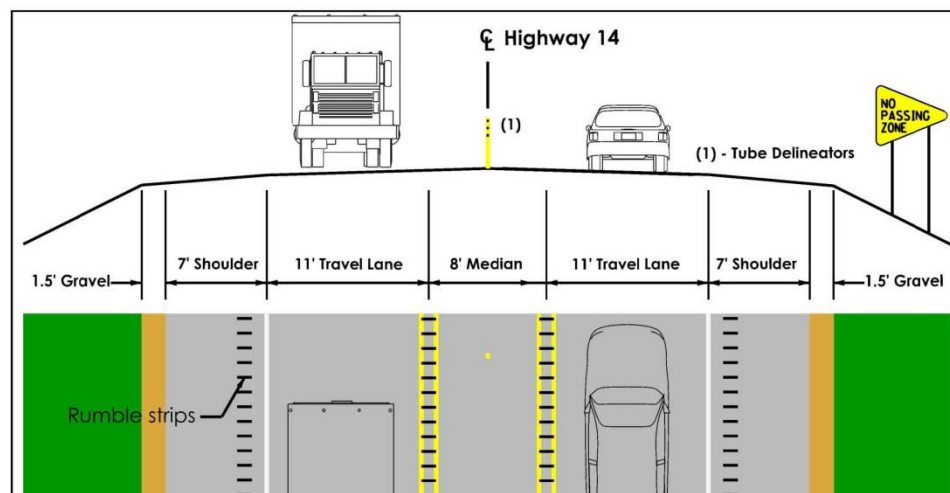


Figure 12 – Center Buffer Zone with Delineators Detail

The Center Buffer Zone was installed on an experimental basis on USTH 14 in Nicollet County near Mankato and the effectiveness is still under investigation. It is worth noting that there have been no crashes during the first 10 months of the Nicollet County deployment. The benefits of the four-foot buffer come from the extra recovery time given to a vehicle that hits the centerline rumble strips and reacts accordingly. This option would require the use of approximately two feet of shoulder for each direction of travel once the lanes are reconfigured.



Figure 13 – Center Buffer Zone with Delineators (USTH 14 west of Mankato)

The use of the delineators in the center of the median is a maintenance concern. The delineator's primary function is to bring attention to the buffer and restrict passing. The use of delineators may not be necessary. The 4-foot buffer zone with rumble strips on the inside lane lines will give drivers two opportunities to regain focus on the road before crossing into oncoming traffic if they leave their lane. The research on USTH 14 near Mankato will likely show clear direction of the use of buffer zones and center-tube delineators.

The existing shoulder pavement section is currently structurally insufficient to carry mainline traffic and may have to be reinforced or reconstructed for long term traffic use.

A cable-style median barrier has been used in other states for delineation/protection in the buffer zone but was not considered as desirable because of the loss of access and the likely maintenance needed to repair damaged segments.

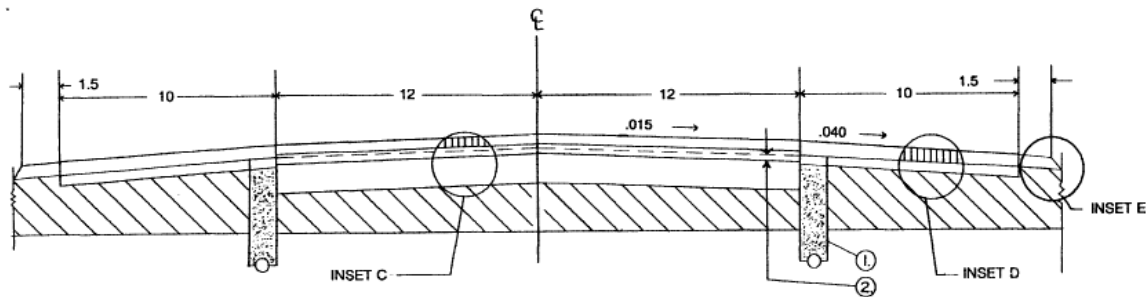
4.1.3 Passing Zones

The public has expressed significant driver frustration created by the perceived inability to pass slow moving traffic and commercial vehicles. A way to improve the passing conditions would be to add dedicated passing lanes mid-corridor to allow vehicles to get past slower moving traffic. There is enough space with the existing roadway to add a 12' lane by taking 6 feet of shoulder from each direction of traffic.

Another technique practiced in Sweden is the "2+1" method that may or may not use cable median barrier. This technique places two full lanes in one direction and one in the other with a median separation of 4-feet in which cable barrier can be placed to prevent vehicles from crossing over to oncoming lanes. This layout allows for vehicles to pass throughout the corridor as the direction of the 2+1 alternates between travel directions, typically, at one to two mile intervals. This technique has been used in Europe and has been found to virtually eliminate head on crashes since it restricts passing to the two-lane sections and adds cable barrier to prevent crossover vehicles.

In sections without centerline delineators, local experience has indicated there may be confusion with drivers entering the 2+1 segment and not knowing what type of roadway facility they are entering ending up driving on the wrong side of the road. Special consideration would need to be given to choosing a location of a 2+1 segment such that you limit the number of intersections crossed and ensure any intersections crossed are low volume. On the study corridor the roadway network is laid out in one-mile grids which would already limit conflicts with side streets and potential wrong way traffic easily accommodating a 2+1 roadway section.

As shown in the cross section below, the existing shoulder pavement section is currently insufficient to carry mainline traffic and would have to be reinforced or reconstructed.



THE TYPICAL SECTION ABOVE SHALL APPLY AS FOLLOWS :
STA. 459+36 - 894+09

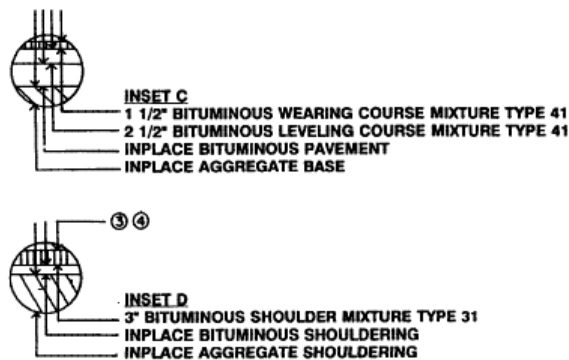


Figure 14 - Existing USTH 14 Pavement Section

4.1.4 Corridor Redesign – Four-Lane Freeway

As mentioned previously, an EIS has been completed for a potential four-lane freeway reconstruction of the entire USTH 14 corridor between Owatonna and Dodge Center mostly on a new alignment south of Claremont. While this realignment may eliminate some safety concerns and greatly improve mobility. Construction is likely to take place over numerous years with numerous smaller projects. While the four-lane facility is constructed, reduced conflict intersections could be a possible safety enhancement to at-grade intersections as the grade separated intersections are phased in.

4.1.5 Winter Maintenance

During winter months, snow packed and ice covered roads were a contributing factor in a number of crashes. Maintenance personnel from District 6 has also commented that maintaining clear pavement conditions during snow storms is difficult, and USTH 14 has required closures in the past. One way to alleviate this is to install living snow fences with shrubs and trees to trap snow that would otherwise drift onto the roadway. The plowing forces needed to provide more frequent plowing of this corridor should be evaluated in an

effort to reduce the likelihood of snow pack buildup and drifting snow during winter months.

4.1.6 Speed Studies

It is evident from stakeholder meetings that the maximum comfortable speed on this corridor is above 55 miles per hour. The use of Global Positioning System (GPS) technology in commercial vehicles for fleet management causes unwillingness in commercial truck drivers to operate at speeds above the speed limit. For many drivers, there is a risk of possible fines or discipline from their employer. There are speed limit reductions entering each end of the corridor from 65 mph to 55 mph. If the speed limit were increased to 60 miles per hour for the 55 mph segment, it may ease some driver frustration while bringing the speed closer to the driver expected speed limit. A study to determine if a 60 mph speed limit is appropriate for this roadway should be considered.

4.1.7 Rail Crossings

The rail crossing near CSAH 80 has not been involved in any crashes based on 2007 to 2011 data, but with regular train traffic crossing USTH 14, consideration for increased signing and augmenting visibility of the crossing should be made. There was one crash at this location prior to 2007, but was not train related and appeared to be more related to the geometric curve and likely inattentive driving.

It is common to have gates at trunk highway crossings with significant train and/or vehicle traffic. As a preventative measure, District 6 should work with the MnDOT Rail Division to determine if gates or additional crossing indications are warranted.

4.2 Intersections

While intersections represent a smaller portion of crash data, there are still improvements that could be made for the 16 at-grade crossings between Owatonna and Dodge Center.

4.2.1 Turn/Bypass Lanes

Based on stakeholder meetings, there seems to be a high amount of passing on the shoulder for vehicles turning left and using the shoulder as a turn lane for right-turning vehicles. Identifying what intersections have the highest turning movements and then adding left- or right-turn lanes or bypass lanes at "T" intersections may improve safety by removing the turning vehicle from the through lane. Bypass lanes at four-legged intersections were also considered - the RSAR team reviewed two reports, "4 Legged Intersections with Bypass Lanes Study" by Gordon Anderson and "Bypass Lane Safety, Operations and Design Study" by Howard Preston in order to determine the safety of bypass lanes. Based on before and after crash data, the study by Preston, et al, published in 1999 recommends that agencies restrict the use of bypass lanes at three- and four-leg intersections due to an apparent increase in the severity of crashes. The report by Anderson directly contradicts this assertion and recommends that agencies can still use bypass lanes if the proper signing and striping is used, and sees no detrimental effects to roadway safety. Both of these studies acknowledge the fact that much of the crash data used could be considered statistically

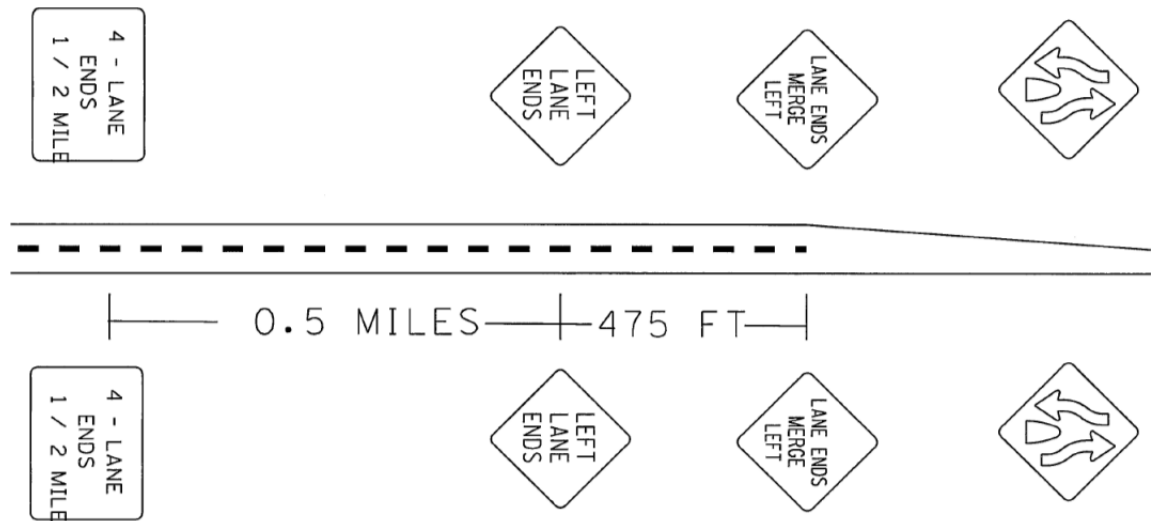
insignificant because of the low numbers involved. Currently, we would not recommend the use of bypass lanes at four-legged intersections due to the lack of solid evidence of enhanced safety. Driver confusion can occur if a left- and right-turning vehicle are side by side and a through vehicle accustomed to using the bypass lane does not react to the slow moving right-turning vehicle, rear ending the vehicle. Similar confusion can occur if a left-turning vehicle is in the through lane and does not properly indicate their turn.

Dedicated left-turn lanes at CSAH 3 and CSAH 5 would improve driver safety and should be considered.

4.2.2 Signing and Striping Improvements

The RSA team noted that many of the stop signs at the minor approaches to intersections were 30" in size. Visibility of signs should be improved by increasing the size to 36" as recommended by the MNMUTCD. Stop bars and "STOP AHEAD" (W3-1) signs could also be implemented at several of the intersections to improve stopped vehicle positioning and safety at the intersections.

Additional signing should be considered at transitions from four-lane to two-lane at both the east and west ends of the project. Currently, the merge left signs are located at the merge point. This signing layout is adequate to meet the MnMUTCD, but additional advanced warning signs can be beneficial to alerting drivers of the upcoming change in facility type. The following lane drop signing layout is being used on I-60 and has been successful:



Not to scale

Figure 15 – Left Lane Drop Advanced Warning

The use of reduce speed ahead signs should be considered for the 65 mph to 55 mph speed reduction zones on both the east and west ends of the corridor.

4.3 Enforcement

A key strategy with any RSA is effective enforcement of traffic laws. Currently, the enforcement of the corridor is handled by the Minnesota State Patrol and the local county sheriff departments. If speed enforcement is identified as a priority, this can be accomplished through greater patrol presence on USTH 14 or effectively using portable dynamic speed display “Your Speed Is” signs. However, the Minnesota State Patrol has stated they do not have the resources for a sustained long-term speed enforcement campaign on this corridor.

4.3.1 Seatbelt Usage

Based on crash data and information from the highway patrol, the percentage of seatbelt usage on the corridor is extremely high. It could be beneficial to work with law enforcement agencies associated with the corridor to ensure seatbelt compliance remains high. Pursuing assistance from the Towards Zero Death (TZD) coalition could generate some ideas for public outreach strategies.

4.4 Commercial/Farm Vehicle Traffic

The amount of heavy commercial and farm vehicles that regularly use USTH 14 is a concern to many of the stakeholders. The ethanol plant in Claremont, as well as seasonal harvest traffic (equipment and semis), can contribute to higher than normal volumes of commercial and farm vehicles. Since the ADT of the corridor is 7500, opportunities to pass slower moving vehicles can be hard to find, and may prompt impatient drivers to perform risky passing maneuvers. Developing education and outreach strategies for local agencies may help the traveling public make better decisions when driving USTH 14.

5 Segment-Based Findings and Suggestions

The RSAR team drove the USTH 14 corridor several times and investigated the roadway by dividing it into seven segments. Segment A was eliminated from the study because the study was focused on the two-lane section. Each of the remaining six segments were examined for potential issues and noticeable safety concerns, and the findings documented by each RSAR member. Subsequently, the team developed a list of segment-specific suggestions for the USTH 14 corridor that is described in the following sub sections.

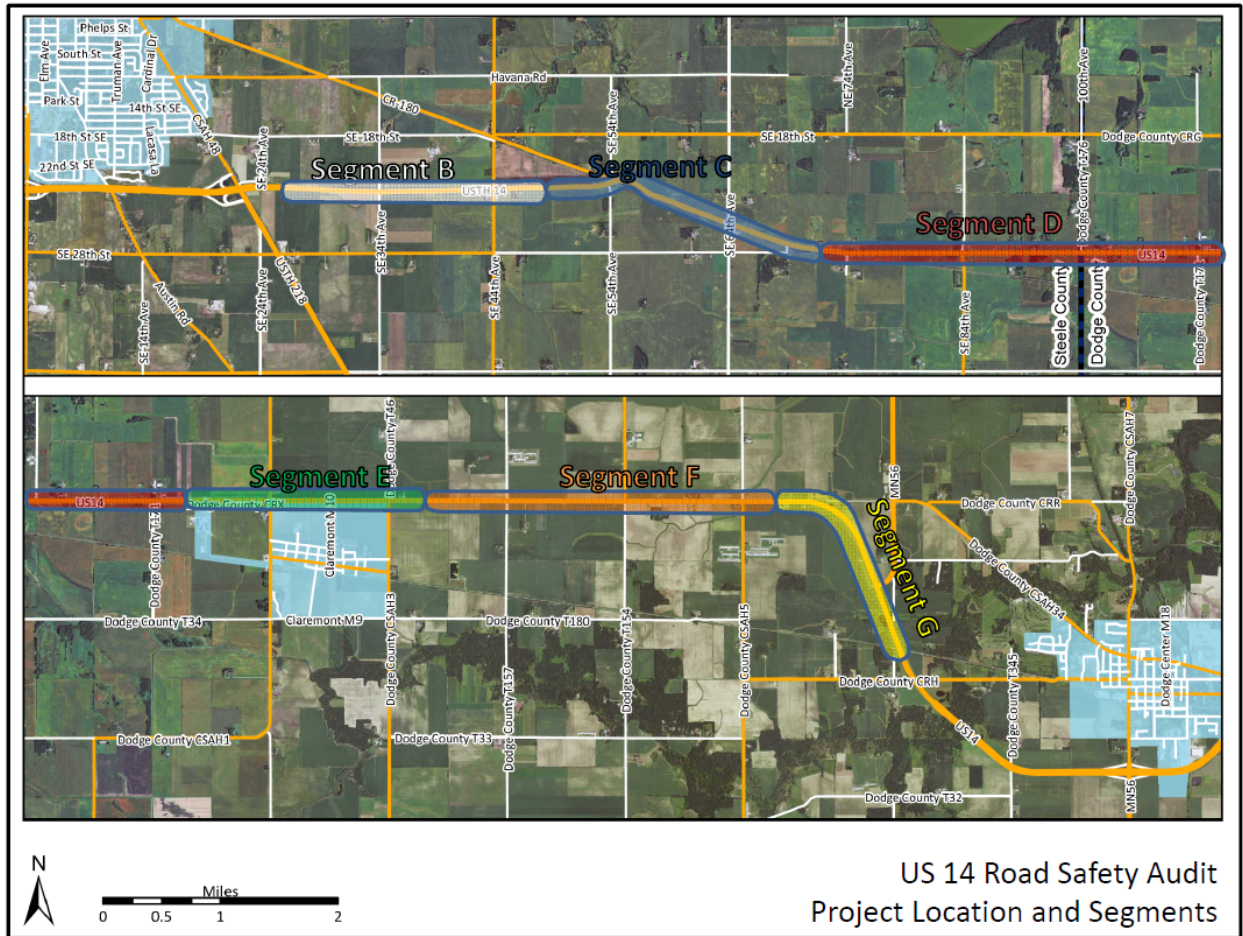


Figure 16 – USTH 14 Segment Locations

5.1 Segment B – Transition Zone from Four-Lane Divided to Two-Lane Undivided (TH 218) to 1000’ East of 44th Avenue SE

On the west end of this segment, the roadway transitions from four to two lanes. The signing and external indications drivers must process to understand all of the approaching changes and hazards in the roadway may contribute to driver confusion. The following should be considered to improve safety:

- The DSD signs are currently placed in the transition zone on each end of the corridor. Relocating the existing DSD signs or adding DSD signs at mid-corridor curve locations or as traffic is entering the Claremont area could improve their effectiveness.
- The eastbound sign was not operational at the time of the audit.
- The static speed limit signs attached to the dynamic portion could be oversized to grab driver attention.
- Add advanced warning signs indicating Left Lane Drops in transition from four-lane to two-lane roadway, see Figure 15.
- Consider changing lane drop from the left lane to the right lane (a more standard practice to maintain lane continuity) and examine if the taper rate of the transition

zone is correct. This may be accomplished with the scheduled 2015 mill and overlay.

5.2 Segment C – 1000’ East of 44th Avenue SE to 0.5 Miles East of 64th Avenue SE

This segment of roadway contains the only at-grade railroad crossing in the corridor as well as one of the two curved sections. Suggestions for this segment include:

- Improving the intersection lighting at 54th Avenue SE to highlight the intersection and the approach to the railroad tracks. Intersection lighting at this location may also improve curve visibility.
- Remove the Bump sign at the railroad tracks as there was no noticeable bump while crossing the tracks (or review for seasonal need).



Figure 17 - Rail Crossing Bump Sign

- There are truck-stopping lanes on the shoulders for hazardous vehicles and busses at the approaches to the railroad tracks near SE 54th Avenue. The eastbound acceleration portion of the stopping lane is only 280’ in length with a 1:5 taper rate. This location is on a curve and adjacent to two intersections in the middle of the railroad crossing with a posted speed limit of 55 mph. The location of the eastbound stopping lane in relation to the curve may make it difficult to see approaching traffic (trucks cannot see behind them with mirrors on an inside lane of a curve). This design should be reviewed to ensure hazardous vehicles can reach safe speeds while merging back into traffic. The westbound direction has an acceleration length of 460’. The MnDOT Rail Division should be consulted to determine the standard design for a stopping lane at a railroad crossing and review any additional needs due to the curve.

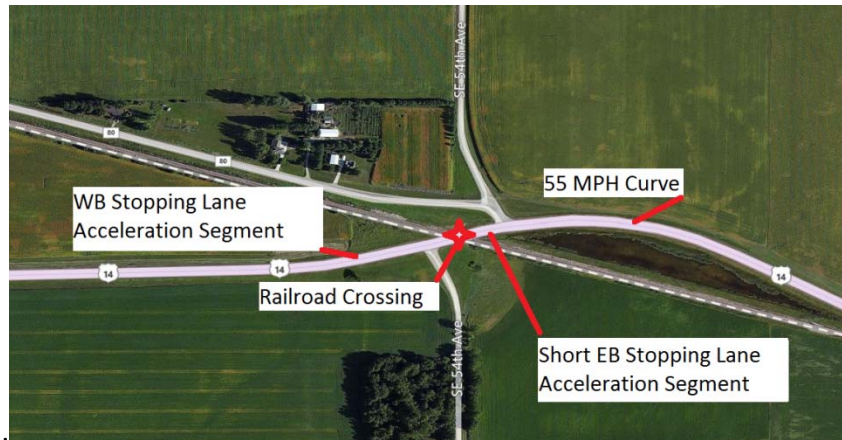


Figure 18 – Truck/Bus Stopping Lane at RR Crossing

- There are no gates at the railroad crossing protecting USTH 14 traffic. District 6 should consider working with the MnDOT Rail Division to identify viable signing and control improvements at this location.



Figure 19 - WB Approach to RR Crossing

5.3 Segment D – 0.5Miles East of 64th Avenue SE to West End of Claremont

This segment of roadway did not present any obvious safety concerns, and the RSAR team does not have any recommendations.

5.4 Segment E – West End of Claremont to East End of Claremont

The heavy commercial vehicle activity in this segment is noticeably higher due to the ethanol plant. This area presents safety issues due to westbound traffic passing the commercial vehicles on the shoulder at CSAH 3 and drivers using the shoulder on

northbound CSAH 1 as a right-turn lane to eastbound USTH 14. Suggested improvements include:

- Adding a right-turn lane for northbound CSAH 1 traffic heading eastbound on USTH 14. It is very evident that traffic is using the shoulder for a right-turn lane at this location.
- Add centerline rumble strips or rumble stripes on USTH 14 at the CSAH 1 bypass zone.
- Add a left-turn lane for CSAH 3 (from EB to NB, or WB to SB or both).

5.5 Segment F – East End of Claremont to USTH 14 Curve (0.5 miles east of CSAH 5 east intersection)

There are bypass issues here similar to Segment E, as well as a clear-zone issue due to culvert headwalls. Suggested improvements include:

- Review new culvert installation and riprap area off of the shoulder on both sides of USTH 14 just east of CSAH 5. There may be a need for guardrail at this location even though the obstruction is outside of the standard clear zone.
- Add a left-turn lane for westbound USTH 14 traffic turning left onto southbound CSAH 5. Vehicles are currently using the shoulder to get around left turning traffic.



Figure 20 - Culvert Headwall

5.6 Segment G – USTH 14 Curve to Transition Zone from Two Lane Undivided to Four-Lane Divided South of TH 56

This segment shares many of the same observed issues as Segment B. The transition from two-lane undivided highway to a four-lane expressway may cause some issues for drivers unfamiliar with the area. Some suggested improvements include:

- Adding a centerline rumble strip or rumble striping to the concrete pavement segment.
- The Dynamic Speed Display signs are currently placed in the transition zone on each end of the corridor. Relocating the existing DSD signs or adding DSD signs at mid-

corridor curve locations or as traffic is entering the Claremont area could improve their effectiveness.

- The static speed limit portion of the DSD signs could be oversized to grab driver attention.
- Add advanced warning signs indicating Left Lane Drops in transition from four-lane to two-lane roadway, see Figure 15.
- Consider changing lane drop from the left lane to the right lane (a more standard practice to maintain lane continuity) and examine if the taper rate of the transition zone is correct. This may be accomplished with the scheduled 2015 mill and overlay.

6 Summary

The crash data for the corridor, when analyzed, indicates head-on crashes are causing the most severe injuries and deaths. The number of severe crashes is as expected when compared to statewide averages. Similarly, the overall crash rate is very low when compared to other trunk highways in the state with similar ADTs. Volumes of heavy commercial vehicles are higher than average. Additionally, the 7500 vehicle per day on this two-lane section of highway does not provide many adequate gaps for safe passing maneuvers. As traffic volumes continue to increase, these gaps will be reduced further, thus increasing the potential for crashes.

The geometry and surface condition of the roadway does not present many apparent safety hazards, but there may be a need to add capacity on the roadway for turning movements. More importantly, adding a centerline buffer zone with yellow tubes and rumble striping throughout much of the corridor may reduce head-on collisions.

Potential improvements to the corridor are classified into three different categories: short term, medium term, and long term. Many of the short-term improvements could be easily installed today. Other short-term and the mid-term improvements are better considered with the scheduled 2015 mill and overlay. Long-term improvements require substantial money and will need continued effort to implement.

The following table illustrates how some of the potential solutions and improvements mentioned in this document could be classified.

Timeline	Improvement
Short Term	Restriping - Existing striping plan
	Centerline rumble strips/stripes
	Signing improvements – increased size & additional lane transition advisory signing
	Improve four to two lane transition areas to ensure smooth taper rates and right- lane drop
	Additional DSD sign or relocation
	Railroad crossing gate arm consideration
	Living snow fences
	Guardrail installation
	Speed studies
	Marketing and outreach efforts relating to heavy commercial vehicle safety
Mid Term	Median buffer zone, 48" – Shoulder reconstruction
	Added passing lanes
	Turn lanes
	Median buffer zone, 8' width – full cross section reconstruction
Long Term	Full reconstruction of corridor to four-lane divided freeway
	Reduced conflict intersections at at-grade intersections while transitioning to freeway section

Figure 21 - Implementation Suggestion Summary