Memorandum

To: Matt Van Schouwen, City of Sioux Center
Murray Hulstein, City of Sioux Center

Date: November 21, 2014

From: Greg Karssen, Mark Perington – Snyder & Associates, Inc

CC: (*Brian Catus, Iowa DOT District 3 – Final memo*)

RE: US 75 Corridor Crash History and Traffic Safety
US 75 Corridor Study
Sioux Center, IA
CS-TSF-7055(625)--85-84
S&A Project No.: 113.0372

Background
US 75 crash data were analyzed through the study corridor for a 10-year analysis period of 2004-2013. During this time period, US 75 had a generally consistent corridor providing three lanes including a two-way left turn lane (TWLTL), posted speed limit between 30-35 mph, three traffic signals and an annual average daily traffic (AADT) volume of approximately 12,000 vehicles per day (vpd).

Crash Rates and Iowa DOT Statewide Crash Averages
US 75 is part of the US Highway System and is classified as a "Principal Arterial" by Iowa DOT. In order to compare crash safety performance, crash history is compared by crash rates on similar corridors. Crash rates are expressed as a combination of crash frequency ("how many crashes?") and exposure ("how much traffic?"), which accounts for the potential for collisions. On a corridor segment, this is expressed as crashes per hundred million vehicle miles of travel (cr/HMVMT), taking into account segment length and segment traffic volume. At an individual intersection, crash rates are expressed as crashes per million entering vehicles (cr/MEV).

- The Statewide average crash rates for *corridor segments* on Municipal Primary – US Highway segments in Iowa is 284 cr/HMVMT, 88 fatal+injury cr/HMVMT and 1.13 fatal cr/HMVMT.

  The crash rate for a Municipal Primary US Highway is significantly lower than the crash rate for a "City Street". This is because a Municipal Primary highways in urban areas typically have fewer intersection/driveway access points and a higher degree of mobility. The average crash rate for City Streets is 412 cr/HMVMT.

- The statewide average *intersection* crash rate for a Municipal Primary intersection with a City Street is 0.9 cr/MEV.

Crash History

Corridor Crash Data

For the 10 year analysis period, there were 173 crashes reported (approximately 17 crashes per year) for the corridor between 10th Street S and 8th Street N.

Table 1 - Iowa Statewide Crash Rate Averages and US 75 Corridor Crash History

Category	Municipal Primary Crash Rate (cr/HMVMT)	US 75 Crash Rate (cr/HMVMT)
Total Segment Crashes	284	**313**
Fatal + Injury Crashes	88	**103**
Fatal Crashes	1.13	**0**

Intersection Crash Data

The attached pages summarize crash history (frequency, severity, rate, major cause, crash type) for each intersection. Approximately 70% of the corridor crashes occurred at city street intersections, with the rest occurring either mid block or at driveways. Intersection crash rates are summarized in Table 2, with highlighted rows indicating the higher relative frequency/crash rate intersections.

Table 2 - Intersection Crash Rates

Intersection	Crash Frequency	Crash Rate (cr/MEV)
7th Street N	17	0.32
6th Street N	4	0.09
5th Street N	4	0.09
4th Street N	14	0.29
3rd Street N	22	0.42
2nd Street N	16	0.31
1st Street	4	0.08
2nd Street S	3	0.06
3rd Street S	4	0.09
4th Street S	2	0.04
5th Street S	6	0.13
6th Street S	2	0.04
7th Street S	1	0.02
8th Street S	1	0.02
9th Street S	21	0.36

Crash Data Discussion

Table 1 indicates that the corridor crash rate is above the statewide average for Municipal Primary US Highways. Meanwhile, Table 2 shows that all of the intersections along the corridor are below the statewide average for “Municipal Primary & City Street” intersections of 0.9 cr/MEV. The reason for this apparent contradiction is explained by the density of streets/accesses on the corridor. There is a city street approximately every 400 ft, with other access (residential, commercial or public facility driveways) occasionally in between. The crashes are then spread across the numerous intersections, but

as a continuous corridor represent a higher rate. The crash density (14 crashes/mile/year) therefore correlates with the corridor crash rate as being higher than the Statewide average for Municipal Primary US Highways (14 cr/mi/yr compared to 9.75 cr/mi/yr).

In addition, the highest intersection crash rates along the corridor occur at the e locations: at the signalized intersections with the highest volume intersecting streets (Co Hwy B40 at 9th St S and 7th St N) and through the downtown commercial district between 1st Street and 4th Street N (including signalized intersection at 3rd Street N). Lastly, while the crash rate is higher than statewide average for Municipal Primary US Highways, it is also noted that in Sioux Center, US 75 is also signed as "Main Ave" and has some characteristics of a city street with intersections each block as well ss driveways. In this comparison US 75 is below the statewide City Streets crash rate averages (313 cr/HMVMT compared to 412 cr/HMVMT).

With regards to crash severity, the majority of crashes on US 75 were property damage only (67%), however the fatal+injury crash rate was above the statewide average for Municipal Primary US Highways (103 cr/HMVMT compared to 88 cr/HMVMT), and below that of City Streets (103 cr/HMVMT compared to 117 cr/HMVMT).

Discussion of Major Causes/Crash Types

The most frequent Major Causes reported for crashes were:

- Following Too Close (88)
- Failure to Yield/Left or Right Turn (42)
- Ran Traffic signal (11)

The most frequent Crash Types reported were

- Rear End Crash (101)
- Broadside/Right Angle (35)
- Angle/Oncoming Left Turn (16)

The Crash Types and Major Causes are clearly related, with Rear End crashes correlating with Following Too Close cause, and Broadside and Angle crash types associated with major causes Failure to Yield and Ran Traffic Signal. Injury and PDO crashes had similar crash types, both 50-60% Followed Too Close/Rear End and 20-30% Failure to Yield/Turning crashes.

In addition, the observed crash characteristics are consistent with a congested corridor:

- Congestion on the major route leads to an increased density on the street with a steady "platoon" of vehicles with reduced headways between vehicles, resulting in inadequate perception/reaction time for a driver to brake and leading to rear end crashes.
- Congestion on the major route can result in driver frustration as a minor street driver seeks out an adequate "gap" in traffic to make a turn to the major route. This can lead to a driver selecting in inadequate gap in traffic to make a turn, increasing the risk of a collision.
- Both of the above instances can lead to "Ran Traffic Signal" crashes, either for turning vehicles selecting a gap or turning as the signal changes to red, or a through vehicle that tries to "sneak through" an intersection after it turns to red.

Potential Future Crash Experience

If traffic increases with the existing three lane configuration, the existing crash patterns are expected to continue. The frequency/rate may will likely rise as volumes increase, and the predominant Major Cause and Manner of Crash will remain, as they are indicative of a congested corridor.

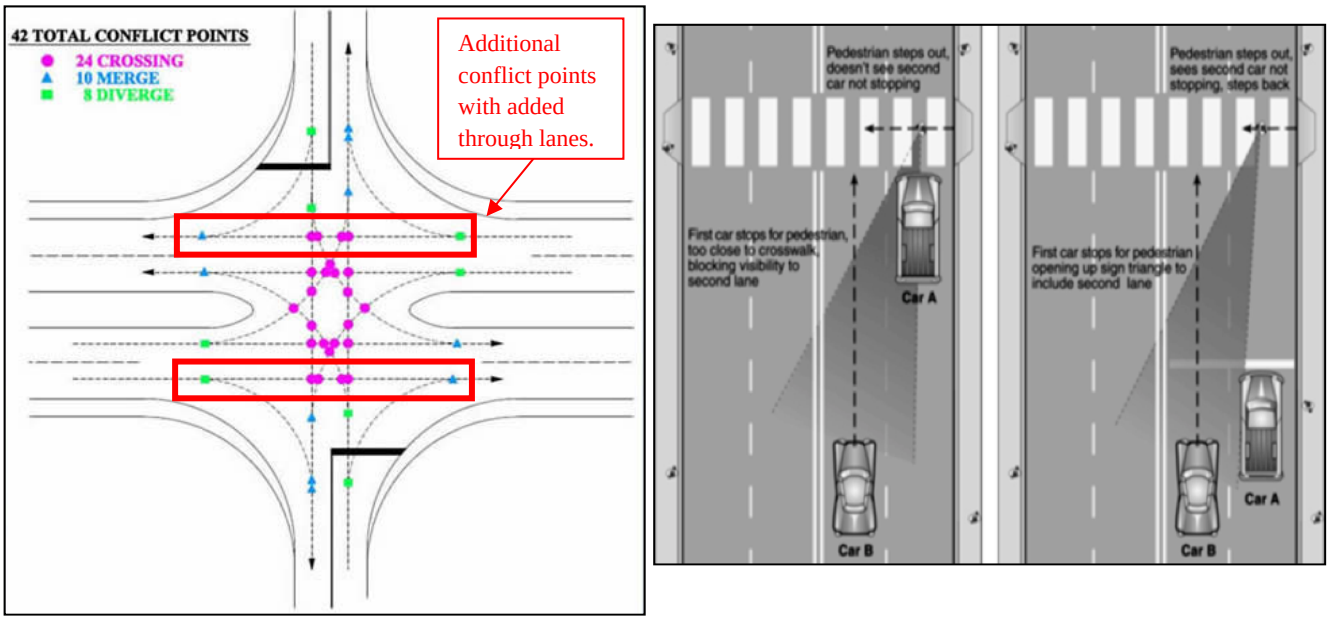
Potential countermeasures for the existing three-lane corridor include:

- Reducing access points
    - Consolidate or eliminate access points, primarily in the downtown area at midblock locations between city street intersections.
    - Install Median – this allows access points to remain but if they are at a mid-block location they would be restricted to right-in/right-out access only.
- Upgrade/Modify traffic signals
    - Signal and controller modifications to provide flexibility for protected only left turn movements during peak times to reduce angle/broadside crashes.
    - Benefit: reduce opportunities for drivers to select an inadequate gap on a permissive left turn movement and reduce angle/broadside crashes.
    - Dis-benefits: reduces amount of signal cycle that can be allocated to predominant through movements, particularly with a single through lane in each direction.

If the corridor is widened to a five-lane configuration providing two through lanes in each direction and a center left turn lane, the crash experience would have many of the similar characteristics, with Rear End and Failure To Yield/Turning crashes typical of urban corridors. Minnesota DOT crash data research showed an increase in the average crash rate from 280 cr/HMVMT to 330 cr/HMVMT for urban 3-lane and 5-lane roads, respectively. However, they also noted that is a generalization and the specific roadway characteristics will vary, and the most significant characteristic is number of access points per mile. Potential negative crash impacts of a five-lane configuration include:

- Two-lanes in each direction increases the number of:
    - Gaps that a turning vehicle must identify. A major street left turning vehicle needs to cross two opposing lanes, and a minor street turning vehicle must cross two near-side lanes and one far side lane or cross street vehicle crosses four lanes and turn lane instead of two lanes and turn lane.
    - Conflict points (locations where vehicles in conflicting directions can meet). These necessarily increase due to additional lanes for a turning or crossing vehicle to traverse. The additional potential conflict points are seen in Figure 1.
- A crossing pedestrian has a wider width/greater number of lanes to cross. In addition, a pedestrian crossing multiple lanes has a potential conflict where the outside/curb lane traffic may slow down/yield to the pedestrian but the inside lane driver might not yield to the pedestrian. The manner of these “multiple threat” crashes are illustrated in Figure 1.

Figure 1 – Intersection Conflict Points – Vehicles and Pedestrians



(Sources: Missouri DOT; Pedsafe.org, FHWA)

Potential countermeasures that could be implemented if a five-lane cross section is constructed include:

- Traffic calming along the corridor to maintain appropriate speed limit compliance
- Reduction of access points and/or installation of medians at mid block crossings or higher volume intersections. Installation of a traffic signal at other downtown intersections, if warranted, would assist in the higher volume side street traffic turn movements. At lower volume intersections, a median is less beneficial as there would be fewer vehicles waiting to turn and less pressure to choose an inadequate gap.
- Construction of a "pedestrian refuge island" in the center median can provide a location for a pedestrian to safely wait after crossing one direction of traffic, instead of looking in both directions before crossing. Another option is construction of a mid-block pedestrian traffic signal.

Following Page: Figure 2 showing "Stacked" Crash Locations along US 75 Corridor with Crash Severity

Attached: Corridor and Individual Intersection Crash History Summaries

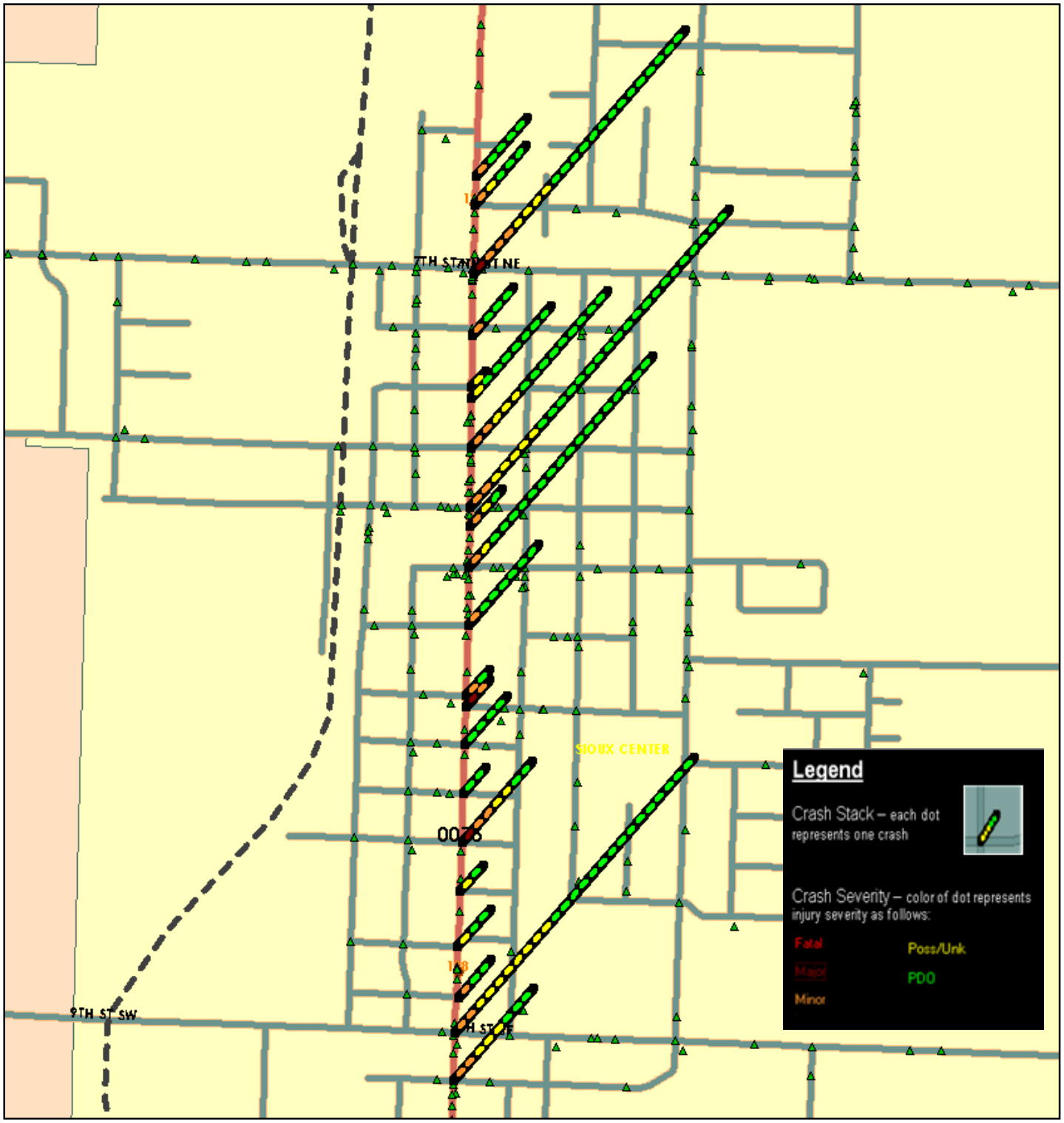



Figure 2 – US 75 "Stacked" Crash Location and Severity – Year 2004-2013