

Example of Road Safety Audit and Feasibility Study

TH 294/Business 71/CSAH 24 Road Safety Audit

Study Location

TH 294/Business 71/CSAH 24

Road Safety Audit

- Background
- Data Collection and Review
- Field Review Observations
- Potential Mitigation Measures

Background

- Purpose and Need for Road Safety Audit
 - Intersection identified by city as safety problem location
 - Road safety audit can identify potential safety solutions
 - Pending Turnback of TH 294 to City
- Road Safety Audit Team
 - Five Mn/DOT experts
 - FHWA safety engineer
 - Willmar police officer
 - SEH traffic engineer

Data Collection and Review

- Meeting with District 8 Traffic Engineer
- Intersection Geometry and Traffic Control
 - 4-lane expressway intersecting 2-lane road
 - 55 mph speed limit on Business 71 and 40 mph speed limit on CSAH 24 and on 23rd Street
 - Turn lanes on Business 71
 - Wide median crossover (about 105 feet from edge to edge of left turn lanes)
 - Business 71 is uncontrolled
 - Stop sign control for CSAH 24 and yield sign control for median crossover

Data Collection and Review

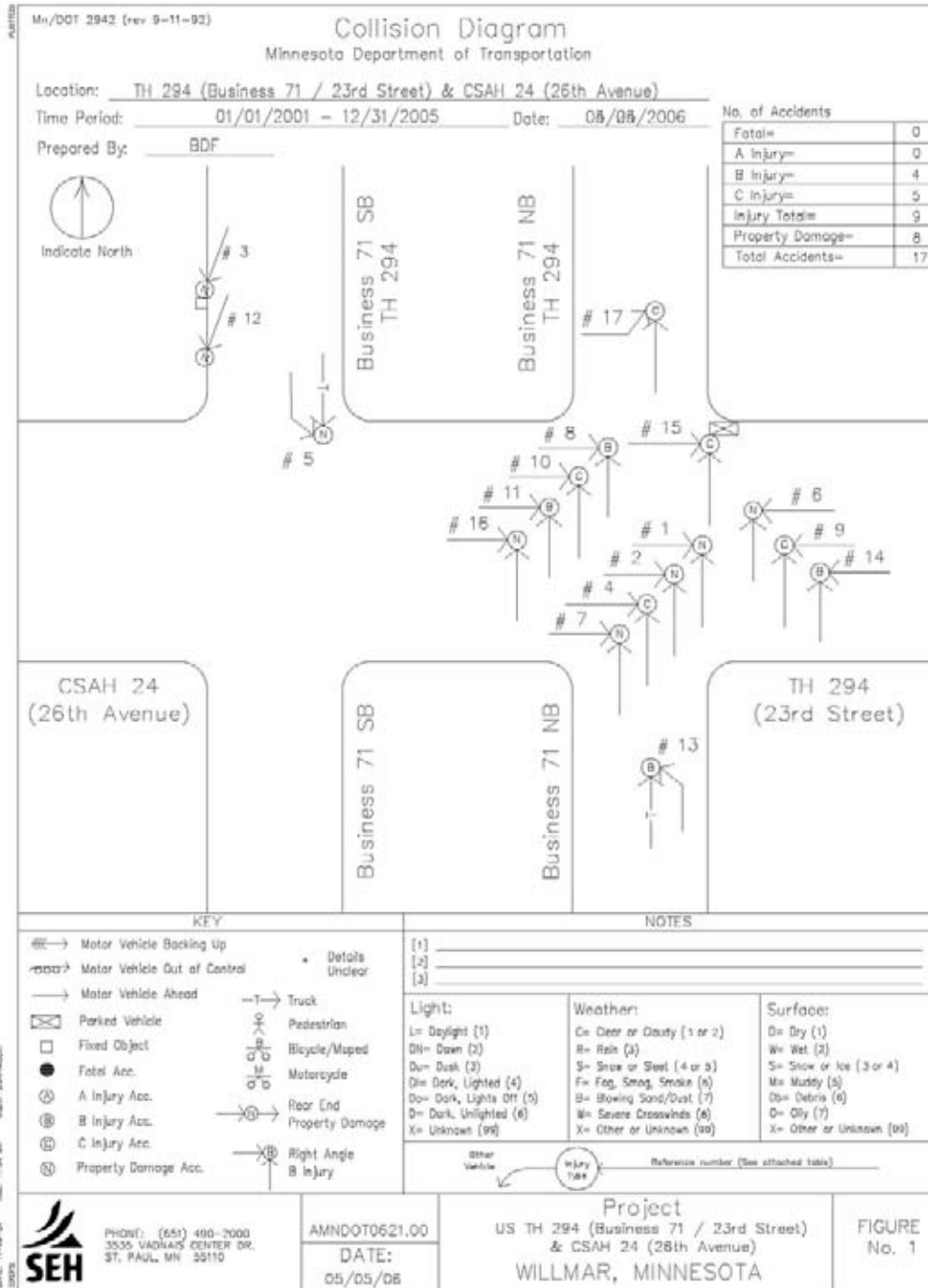
■ Traffic Volumes

- 10,500 vehicles/day on north leg of Business 71
- 14,700 vehicles/day on south leg of Business 71
- 2,400 vehicles/day on west leg of CSAH 24
- 1,900 vehicles/day on east leg of TH 294
- Future traffic increase due to redevelopment of Regional Treatment Center site
- Intersection may be close to meeting MMUTCD signal warrants

Data Collection and Review

■ Crash Data

- 17 crashes in five year period
- 9 crashes involved injuries
- Intersection crash rate is twice the statewide average rate
- 13 crashes were right angle or left turn type
- 10 crashes involved EB and NB vehicles
- Main problem appears to be that EB vehicles are not yielding to NB vehicles
- Problem with crash reporting and tracking due to multiple names for legs of intersection



Field Review Observations



Northeast corner of intersection

Field Review Observations

- Geometric Design and Lighting
 - Intersection skewed (18 degree skew) for CSAH 24 crossing
 - Sight distance limitations to north and south from CSAH 24
 - Curves and grades on CSAH 24 and TH 294 approaches
 - Radius in SE corner is tight for large trucks
 - Wide center median essentially creates two intersections
 - Street lighting exists in two quadrants

Field Review Observations

- Signing and Pavement Markings
 - Lack of *ONE WAY* signing for intersection
 - Undersized signing for expressway intersection conditions
 - Outdated *STOP AHEAD* sign on EB CSAH 24
 - Good route marker/directional signing identifies intersection
 - Approaches have centerline, edge line, and lane line markings
 - No pavement markings in median crossover area
 - No stop line or yield line markings
 - EB *STOP* sign mounted too low
 - Narrow (10 feet wide) thru lanes marked for NB Business 71

Field Review Observations

■ Other Observations

- No separate pedestrian or bike facilities
- No development in any corners of intersection
- Blindspots possibly caused by vehicle hardware/design



Southeast corner of intersection looking northwest

Potential Mitigation Measures

- General

- Grouped into short-term, contingency, and long-term improvements
- Short-term measures may not achieve desired safety benefits

Potential Mitigation Measures

■ Short-Term Improvements

- Upgrade signing sizes and add *ONE WAY* signs to meet current expressway intersection signing standards
- Change EB *STOP AHEAD* sign to symbol sign
- Mark yield lines in the median crossover
- Add *LOOK AGAIN* plates below *YIELD* signs
- Mark stop lines at *STOP* signs
- Add centerline markings in median crossover area
- Increase corner radius in SE corner of intersection to accommodate large trucks

Potential Mitigation Measures

- Contingency Improvement
 - Close median crossover
- Long-Term Improvements
 - Change intersection to a roundabout
 - Change intersection to grade-separated interchange
 - Reconfigure intersection into two offset T-intersections
 - Reconfigure intersection to $\frac{3}{4}$ access intersection and provide U-turn lanes north and south of intersection
 - Install traffic signal and realign NB and SB lanes of Business 71

Potential Mitigation Measures

- Other Considerations
 - Change name of Business 71 and perhaps 23rd Street
 - Provide sidewalks or trails along roadways
 - Change Business 71 to parkway design

Summary

- Alternative choices of improvements provided need more detailed evaluation by District 8 staff
- Short-term improvements provide only limited benefits
- Long-term improvements will be required to significantly reduce crashes

City, County and Mn/DOT
agreed to completing many of
the short-term solutions and see
if that reduced the number of
accidents at this location.

It did not.

In 2008, the consultant firm of CHM2 HILL was hired to conduct a feasibility study on a variety of long-term solutions for this location.

In addition, stop and yield signs with solar powered blinking LED lights were installed.

Intersection Feasibility Analysis



**Business 71/ County Road 24 /
TH 294 / 23rd Street
Intersection**

**Willmar, MN
January 15th, 2009**

Agenda

- Background
- Process
- Alternatives
- Evaluation
- Selected Improvement Strategy
- Proposed Implementation Schedule

Background



- History of crashes at the intersection.
- 2006 Road Safety Audit – identified potential short and long-term modifications.
- 2006 Implementation of Short-Term Improvements:
 - Upgrade existing signs into compliance with current Mn/DOT recommendations
 - Add ONE WAY signs
 - Increase the corner radius in the southwest corner of the intersection
- No significant reduction in crashes.
- 2007 Implementation
 - Add flashing STOP sign
 - Initiated Intersection Evaluation Study

OBJECTIVE: Conduct more comprehensive intersection evaluation – develop, evaluate and screen Alternative Improvement Strategies.

Project Partners



Mn/DOT

Jon Henslin
District Traffic Engineer



Kandiyohi County

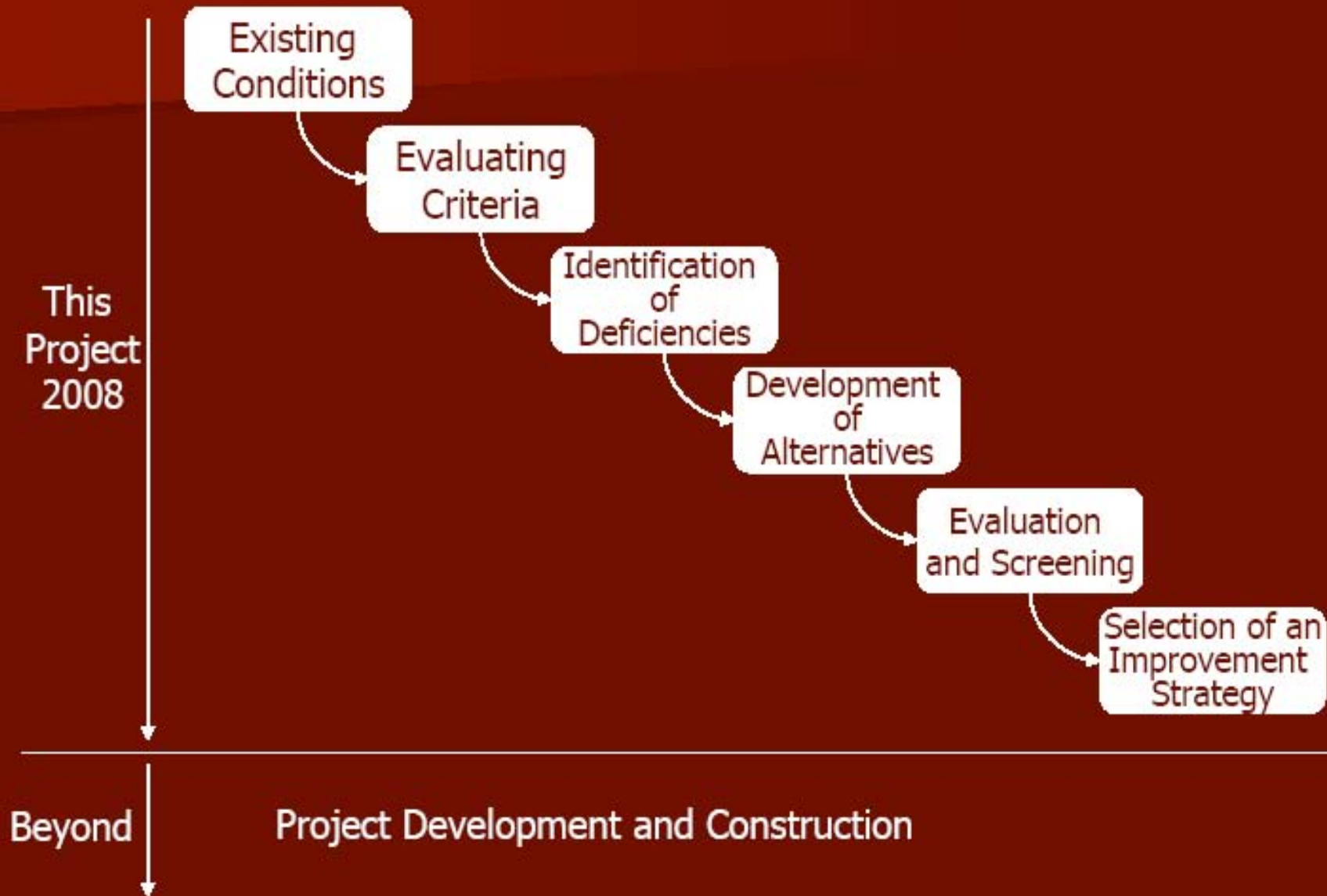
Gary Danielson
Public Works Director



City of Willmar

Mel Odens
Public Works Director

Process Flow Chart

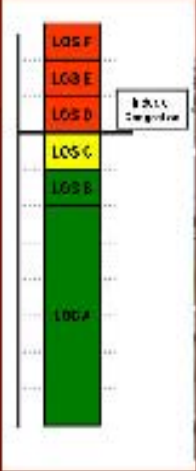
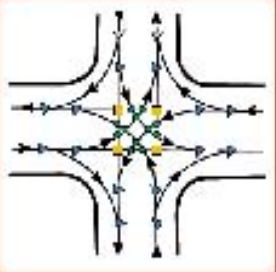


Overview of Existing Conditions



- Geometry:
 - North/south: 4-lanes with right and left turn lanes
 - East/West: 2-lanes
 - Unusually wide median
- Traffic Control
 - Thru (north/south) / STOP (east/west)
- Traffic Volumes
 - North: 10,400 / 15,150
 - South: 14,800 / 21,400
 - East: 1,800 / 2,800
 - West: 2,400 / 3,500
- Crash Characteristics
 - Frequency: 6 crashes /year (vs. 2/year expected)
 - Severity: 1 injury crash /year
 - Rate: Actual = 1.1 (vs. Expected = 0.3)
 - Type: 61% Right Angle (vs. 26% expected)

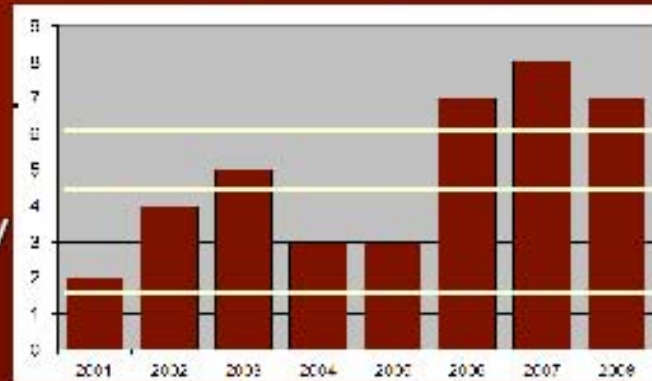
Evaluating Criteria

<p>Traffic Operations</p>	 <p>Level of Service</p>	<p>Safety</p>	<p>Conflicts – Crossing/ Turning/ Merging</p>  <p>Crash Frequency – Crashes/year</p> <p>Crash Rate – Crashes/Million Entering Vehicles</p>
<p>Travel Time</p>	<p>Travel Time and Paths for Public and Emergency Services (minutes)</p>	<p>Implementation</p>	<p>Easy to difficult / short to long term</p>
<p>Access</p>	<p>Full vs. Partial Access</p>	<p>Feasibility</p>	<p>Combination of cost, degree of difficulty and deployment time frame</p>
<p>Cost</p>	<p>Estimated Construction Costs (conceptual level)</p>		

Summary of Deficiencies

Safety

Crash Frequency

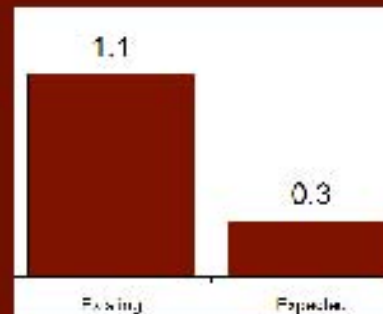


'05-'07 average
4.9 crashes per year
(8 year average)

8-year average
6.0 crashes per year
(2005 – 2007 average)

Expected Frequency
1.7 crashes/year Expected

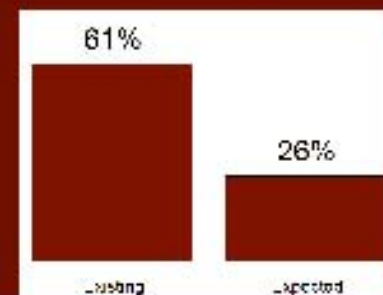
Crash Rate



ACTUAL = 1.1 crashes/million entering vehicles

EXPECTED = 0.3 crashes/million entering vehicles

Crash Types Over-Represented



Right Angle Crashes

Geometry

Extremely wide median creates unusual turning paths, restricted sight lines and driver confusion

Universe of Alternatives

■ GOAL:

- Improve Safety
- Reduce Crash Frequency
- Reduce Fraction of Angle Crashes
- Long-term solution – serve present and future traffic volumes
- Minimize diversions to other roads
- Consistency with roadway functions

■ Basic Types

- At-grade with Partial Access
- At Grade with Full Access
- At Grade with Traffic Signal
- Grade Separated

Universe of Alternatives

■ At-grade with Partial Access

Alternative 1



Right Turns
In/Out Only

(Median Closed)

Alternative 2



Right Turns In/Out
with Northbound
Left-turn to Eastbound
(Median Restricted)

Alternative 3



Right Turns In/Out
with Northbound and
Southbound
Left-turns
(Median Restricted)

- Eliminating Minor Road Crossing Conflicts would reduce Crashes by 80 – 90%

Universe of Alternatives

- At-grade with Full Access

Alternative 4



Off-Set Tee
Intersection

Alternative 5



Roundabout

Alternative 8

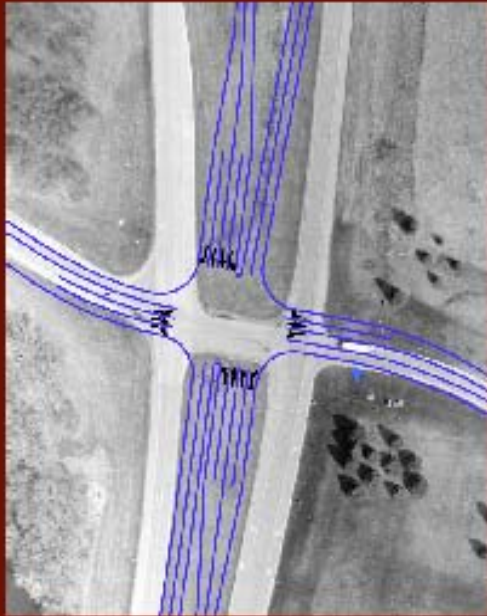


Indirect Left Turn

- There are NO Crossing Conflicts in the Tee Intersection, Roundabouts or Indirect Left Turn designs. Crash reductions of 70 to 90% are expected.

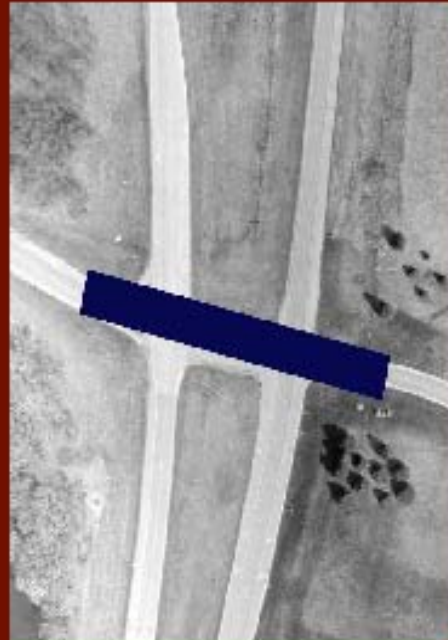
Universe of Alternatives

Alternative 6



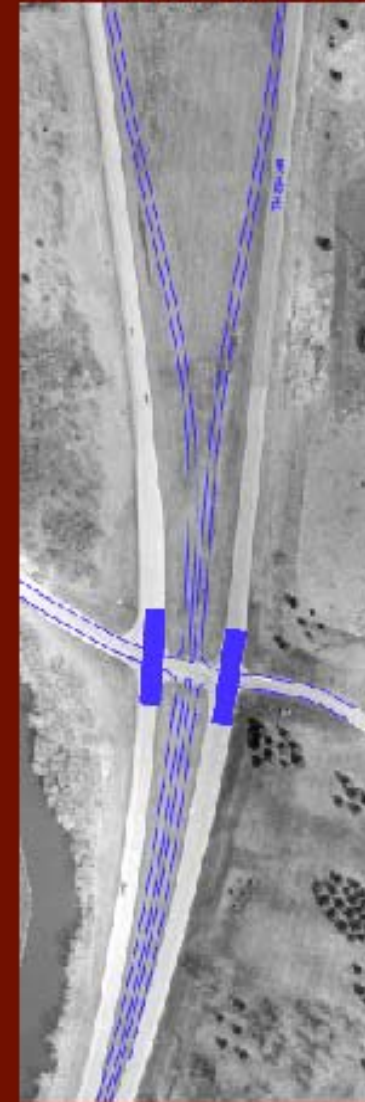
At-Grade with
Signalized Intersection
(Full access with a 25%
reduction in crashes)

Alternative 7



Grade-Separation
(No access To/From
Minor Roads)

Alternative 9



Interchange

Evaluation/Screening of Alternatives

TABLE 4
Intersection Evaluation Matrix

	Existing Full Access - Through/STOP Control	Alternative 1 Median Closure (Full) - Right on Right exit	Alternative 2 Median Closure (Partial) - Left turn to CH 24	Alternative 3 Median Closure (Partial) - Left turn to CH 24 & TH 234	Alternative 4 Offset Tee Intersection	Alternative 5 Roundabout	Alternative 6 Signalized Intersection	Alternative 7 Grade Separation	Alternative 8 Indirect Left Turns	Alternative 9 Interchange
Traffic Operations										
Intersection LCG	A	B (CH Center)	A	A	A	A	B (Bar 71/CH 24/TH 234)	A	A	A
Warrant Analysis	-	-	-	-	-	-	Warrant 2 & 3 Satisfied	-	-	-
Travel Time										
General Public (greater change in hour time)	-	+2.6 minutes (from west)	+2.6 minutes (from west)	+2.6 minutes (from west)	+1 minute	+1 minute	+1 minute	+2.4 minutes (to south)	+1.9 minutes (to west)	+1 minute
Fire/EMT (priority)	-	+2 minutes	No Change	No Change	+1 minute	+1 minute	No Change	+2 minutes	No Change	No Change
Police (pass)	-	+2.4 minutes (to west)	+2.4 minutes (to west)	+2.4 minutes (to west)	+1 minute	+1 minute	No Change	Less time than existing	No Change	No Change
Crash Evaluation										
Conflict Points <input type="checkbox"/> - Crossing Conflict <input type="checkbox"/> - Turning Conflict <input type="triangle"/> - Merge/Diverge Crossing Conflicts	32 4	4 0	7 0	10 0	9 + 9 = 18 0	8 0	32 4		24 0	
Expected Crash Rate (M/Y)	Existing = 1.1 ¹ Expected = 0.2 ²	Expected = 0.1 ²	Expected = 0.2 ²	Expected = 0.2 ²	Expected = 0.2 ²	Expected = 0.2 ²	Expected = 0.2 ²	Unknown	Expected = 0.1 ²	Unknown
Expected Crash Frequency	Existing South Frequency = 5.0 crashes/year	5.8 crashes/year	1.1 crashes/year	1.1 crashes/year	1.7 crashes/year	1.1 crashes/year	4.5 crashes/year	Greater than 5	5.8 crashes/year	Greater than 5
Access	Full 100%	Partial 50%	Partial 66%	Partial 67%	Full 100%	Full 100%	Full 100%	Partial 33%	Full 100%	Full 100%
Right-of-Way Impacts	None	None	None	None	Moderate (All public land - jurisdictional change)	None	None	Minor	None	Moderate (All public land - jurisdictional change)
Feasibility/Issues	Direct-Pool Safety rec'd along multi-lane arterial at grade.	Could accommodate pedestrian thru median and would be no better than existing intersection configuration.	Same as 1	Same as 1	Could accommodate pedestrians and bikes on the existing right-of-way same as 1	Better than alternatives 1-3 - lower speeds (25 around circle) - but still have uncontrolled crossing of multi-lane arterial	Unknown - would require Meds to push button and wait - compliance expected to be OK	Good	Same as 1	Good
Cost Comparison	None - Low	\$50,000 - Low	\$110,000 - Low	\$170,000 - Low	\$500,000 - Moderate	\$1,500,000 - High	\$2,800,000 - High	\$2,200,000 - High	\$800,000 - Moderate	\$5 - 10 million - High
Implementation	None	No RW. Easy Design. No Emission Doc. Low Cost.	No RW. Easy Design. No Emission Doc. Low Cost.	No RW. Easy Design. No Emission Doc. Low Cost.	Right-of-way req'd. Easy Design. Possible Emission. Mod. Cost. Mid-term 3-5 yr	No right-of-way req'd. Mod. Design. No Emission. High Cost. Long term 5-10 yr	No right-of-way required. Easy Design. No Emission. High Cost. Long term 5-10 yr	No right-of-way. No Emission. High Cost. Mid-term 3-5 yr	No right-of-way required. Easy Design. No Emission. Mod. Cost. Mid-term 3-5 yr	Possible Emission. Mod. Design. High Cost. Long term 5-10 yr
Feasibility		Easy to implement, some change travel time. Addresses safety.	Easy to implement, some change travel time. Addresses safety.	Easy to implement, some change travel time. Addresses safety.	Mod RW, environmental effects.	Addresses safety. Full Access. High cost. Moderate implementation	Word Safety rec'd. Highest Cost. Full Access.	High Cost. Restricted Access.	Addresses Safety. Full Indirect Access. Moderate Cost	High Cost. Close spacing to Dick. Center Drive may sub-optimal.

1. Publication 01AVX-02-04-C&D
2. 2004-2006 Minnesota TxDOT Crash Data
1/1/05

3. Based on limited samples of MVCCOT Data
4. ACH-09/15-30 Preliminary Cost

5. 2005 - 2007 Intersection Crash Data

Short List of Priority Strategies

Alternative	Comments	Action
Existing		Retain Short-term solution
1. Median Closure	Large Travel Time & Access Impacts	Eliminate
2. Median Restriction	Large Travel Time & Access Impacts	Eliminate
3. Median Restriction	Moderate Access Impacts, Low Crash Rate, Low Cost	Retain
4. Off-set Tee	Wetland Impacts – Project Delivery Challenge	Eliminate
5. Roundabout	Low Crash Rate, High Cost	Retain
6. Signal	Highest Crash Rate, High Cost	Eliminate
7. Grade Separation	Least Access, High Cost, Long Project Delivery	Eliminate
8. Indirect Left Turns	Lowest Crash Rate, Moderate Cost	Retain
9. Interchange	Highest Cost, Long Project Delivery	Eliminate

Recommended Improvement Strategy

Alternative 3 Median Restrictions



Reasoning:

- Easy/Short implementation
- Low Crash Rate/Frequency (Expected 90% reduction)
- No Crossing Conflicts
- Minimal Cost
- Easy Design
- No Right-of-Way Acquisition
- Opportunity to implement Alternative 8 in future

Implementation

2008

- Intersection Evaluation Study

2009

- Approval of Improvement Strategy by Mn/DOT, Kandiyohi County, and City of Willmar
- Project Development: Preliminary Design, Environmental Documents, Final Design

2010

- Contract Letting/Construction

Current Status

- Mn/DOT has requested “FHWA Request to Experiment” in order to place a “LOOK AGAIN” sign on the stop and yield signs.
- Public meeting will be held on May 13, 2009.
- Hopefully move forward with one of the approved alternatives.