Memo

March 10, 2011

TO: WisDOT, NE Region

FR: Pat Hawley, P.E., PTOE
Justin Schueler

RE: STH 23 with CTH G Interchange
Fond du Lac County, Wisconsin
Intersection Control Evaluation Report

Introduction

The Wisconsin Department of Transportation (WisDOT) is planning the construction of a new grade-separated interchange at STH 23 with CTH G in Fond du Lac County, Wisconsin. The new interchange is proposed to replace an existing at-grade intersection as shown in Exhibit 1. RA Smith National has been retained to objectively compare intersection control alternatives for the proposed STH 23 on-ramp and off-ramp intersections with CTH G. This report summarizes the comparison.

Existing Conditions

The existing at-grade, four leg STH 23 intersection with CTH G operates under two-way stop control (STH 23 free flow). Each leg has a single approach lane. Within the study area STH 23 is a two-lane undivided rural arterial highway with an east/west orientation. The posted speed limit is 55 mph and year 2010 AADT volumes are 7600 vehicles per day (vpd). CTH G is a two-lane, undivided rural collector highway with a north/south orientation. The posted speed limit is 55 mph and year 2010 AADT volumes are 1075 vpd.

Future Conditions

Year 2044 weekday morning peak hour volumes were provided by WisDOT and assigned to the proposed interchange configuration as shown in Exhibit 2.

Alternatives Evaluation

The intersection control alternatives evaluated for the proposed STH 23 on-ramp and off-ramp intersections with CTH G included two-way stop control and modern roundabouts as shown in Exhibit 3 and Exhibit 4, respectively. The following criteria were evaluated to objectively compare the effectiveness of the intersection control alternatives.

- Safety
- Traffic Operations
- Right-of-Way
- Operational and Maintenance Costs
- Construction Costs
- Environmental Impacts

The following sections provide an assessment of these considerations and how they will be impacted through the use of two-way stop control or modern roundabouts.

Safety

Ten years (2000 to 2009) of crash data was provided by WisDOT. A crash diagram is provided in Exhibit 5. The crash data is summarized by type and severity in Table 1.

Table 1
2000 to 2010 Crash Data Summary

Year	Crash Type					Severity		Total	AADT Entering Volume (vpd)	Crash Rate (MEV)
	Rear End	Right Angle	Left Turn	Side Swipe	Fixed Object	Property Damage Only	Injury			
2000	0	1	0	0	1	0	2	**2**	8,015^	0.92
2001	1	1	1	1	1	3	2	**5**		
2002	0	1	0	0	0	0	1	**1**		
2003	1	2	1	0	1	1	4	**5**		
2004	0	0	1	0	0	0	1	**1**		
2005+	0	1	0	0	0	0	1	**1**		
2006	1	2	1	1	0	2	3	**5**		
2007	1	1	0	0	1	1	2	**3**		
2008	0	2	1	0	0	2	1	**3**		
2009	0	0	0	1	0	1	0	**1**		
Total (2000-2009)	*4*	*11*	*5*	*3*	*4*	*10*	*17*	***27***		

+ One fatality in 2005; right-angle southbound CTH G and westbound STH 23
^ Year 2005 AADT entering volume estimated based year 2010 forecasts

As shown in Table 1, the number of crashes per year ranges from one to a high of five. The most common crash type was right angle (40%). Based on the available crash data, approximately 63% of the total crashes involved an injury. This is significantly higher than the statewide historic average injury rate of 43% for rural intersections.

The study intersection has an average crash rate of 0.92 crashes per million entering vehicles (MEV). This is lower than the threshold of 1.5 crashes per MEV used by WisDOT to identify possible problem intersections. The high percentage of injury crashes suggests that unsafe operations are occurring under existing conditions and safety improvements are needed.

Under both intersection control alternatives, the grade separation of the proposed interchange would provide safer operations when compared to the existing conditions. However, due to

lower vehicle speeds, a reduction in number of conflict points, and the elimination of potential high-speed right-angle crashes, roundabouts would be expected to provide safer vehicular operations when compared to stop control.

Future Year Peak Hour Operations

A year 2044 operational analysis was conducted for both the stop control and roundabout alternatives based on the future year volumes and the geometry shown in the alternatives exhibits.

Level of Service (LOS) is a quantitative measure that refers to the overall quality of flow at an intersection ranging from very good, represented by LOS 'A', to very poor, represented by LOS 'F'. Level of service is based on average delay per vehicle. The LOS reported for the roundabouts was based on a Rodel analysis. The stop control LOS is based on HCM methodologies using Synchro software. LOS D is typically considered the acceptable minimum for design purposes, which represents average delays less than 35 seconds per vehicle during the peak traffic hour of the day. Based on direction from WisDOT, only the weekday morning peak hour traffic conditions were analyzed. A summary of the operational analysis is provided in Table 2.

Table 2
Year 2044 Stop Control and Roundabout Analysis
Weekday Morning Peak Hour

Intersection	Intersection Control	Approach LOS											
		Northbound			Westbound			Southbound			Eastbound		
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
CTH G with STH 23 Westbound Ramps	Stop Control*	A	A	-	A	A	A	-	A	A	-	-	-
	Roundabout	A			A			A			-		
CTH G with STH 23 Eastbound Ramps	Stop Control*	-	A	A	-	-	-	A	A	-	A	A	A
	Roundabout	A			-			A			A		

Note: Roundabout LOS is reported in Rodel by approach
(-) Indicates movement is not possible
* CTH G is free flow

As shown in Table 2, stop control and roundabouts are expected to operate acceptably at LOS A under the Year 2044 volume conditions at the study intersection.

Right-of-Way Impacts

It was assumed that a grade-separated interchange would be constructed at STH 23 with CTH G, independent of the selected intersection control at the ramp intersections. Both intersection control alternatives can be accommodated within the right-of-way needed for the interchange. Therefore, no additional right-of-way impacts are expected for either intersection control alternative.

Operational and Maintenance Costs

Similar operational and maintenance costs are expected with stop control and roundabouts. The stop control alternative would require beam guard and associated end treatments at the bridge approaches due to the high speeds on CTH G, whereas the roundabouts have lower operating

speeds that would not require beam guard. Street lighting would be recommended for the roundabout alternative, and some additional operational and maintenance costs would be expected. Some additional maintenance costs may be generated with roundabouts if the central islands are landscaped, but low maintenance grasses and plants could be utilized to limit annual costs.

Construction Costs

Construction cost estimates were developed for both intersection control alternatives and include construction of the entire interchange (excluding the bridge structure). The following construction cost estimates were developed using 2011 dollars.

- Stop Control: $4,274,000
- Roundabouts: $4,563,000

In general, cost for roundabouts is about $289,000 more than stop control. This is primarily due to the additional sidewalk, lighting, and curb and gutter required with the roundabouts.

Environmental Impacts

Minor environmental impacts are expected with either intersection control alternative.

Recommendation

Based on the evaluation of the documented criteria, roundabouts are recommended for the STH 23 ramp intersections with CTH G. Both stop control and roundabouts present feasible intersection control options that will provide adequate operations under the future year conditions. Roundabouts provide a key advantage in safety for motorists.

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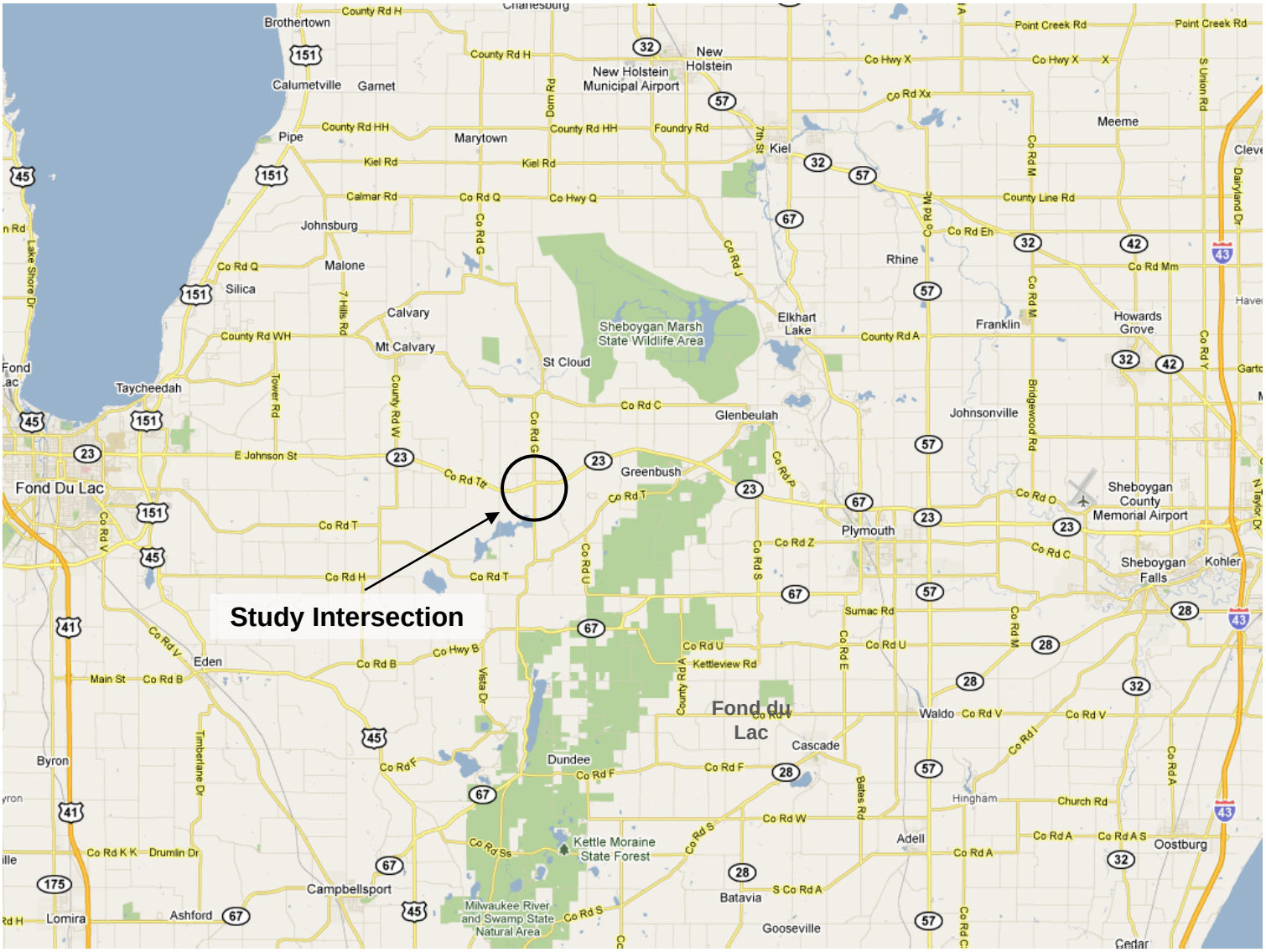
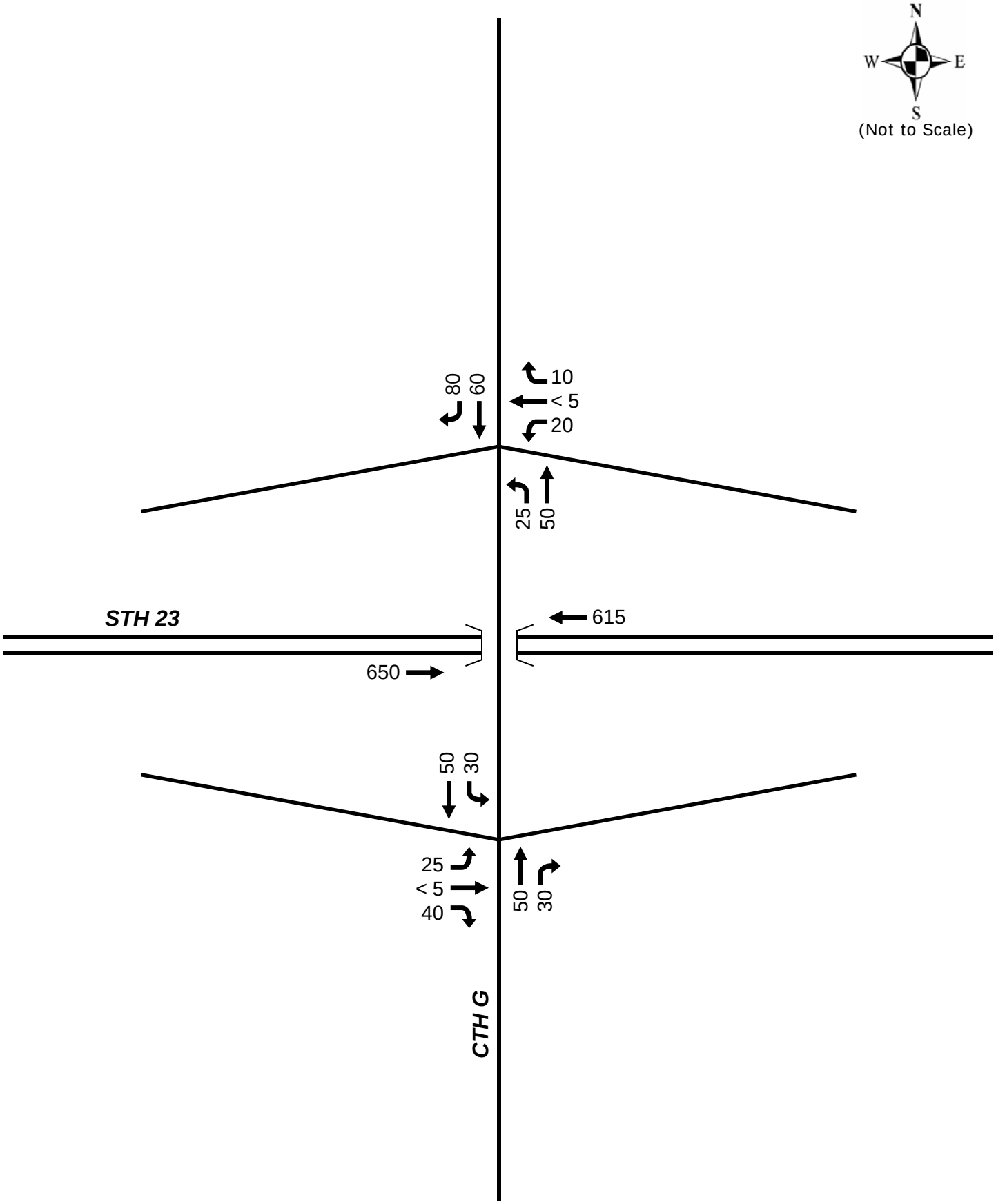
(Not to Scale)



Site Location Map

Exhibit **1**

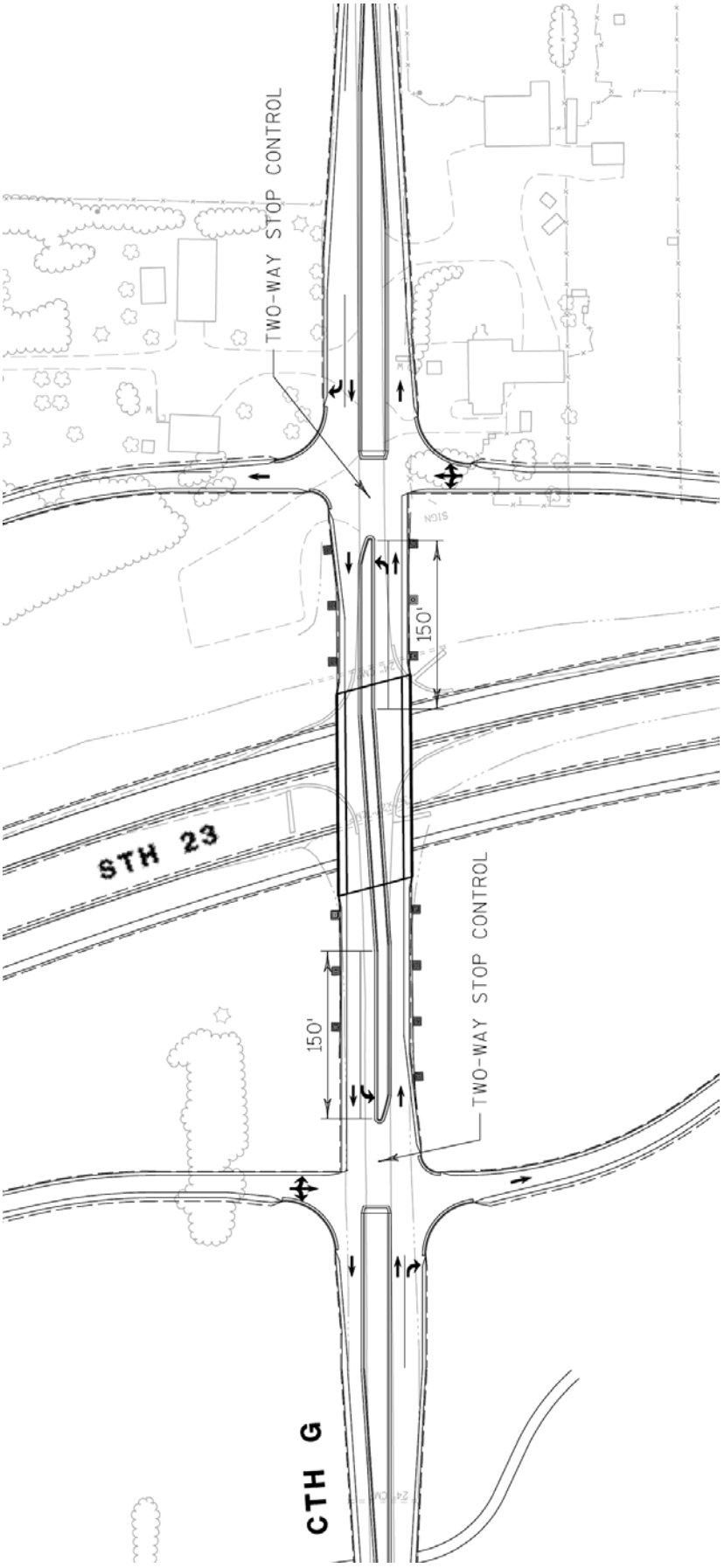


Legend

XX = Weekday AM Peak Hour Volume

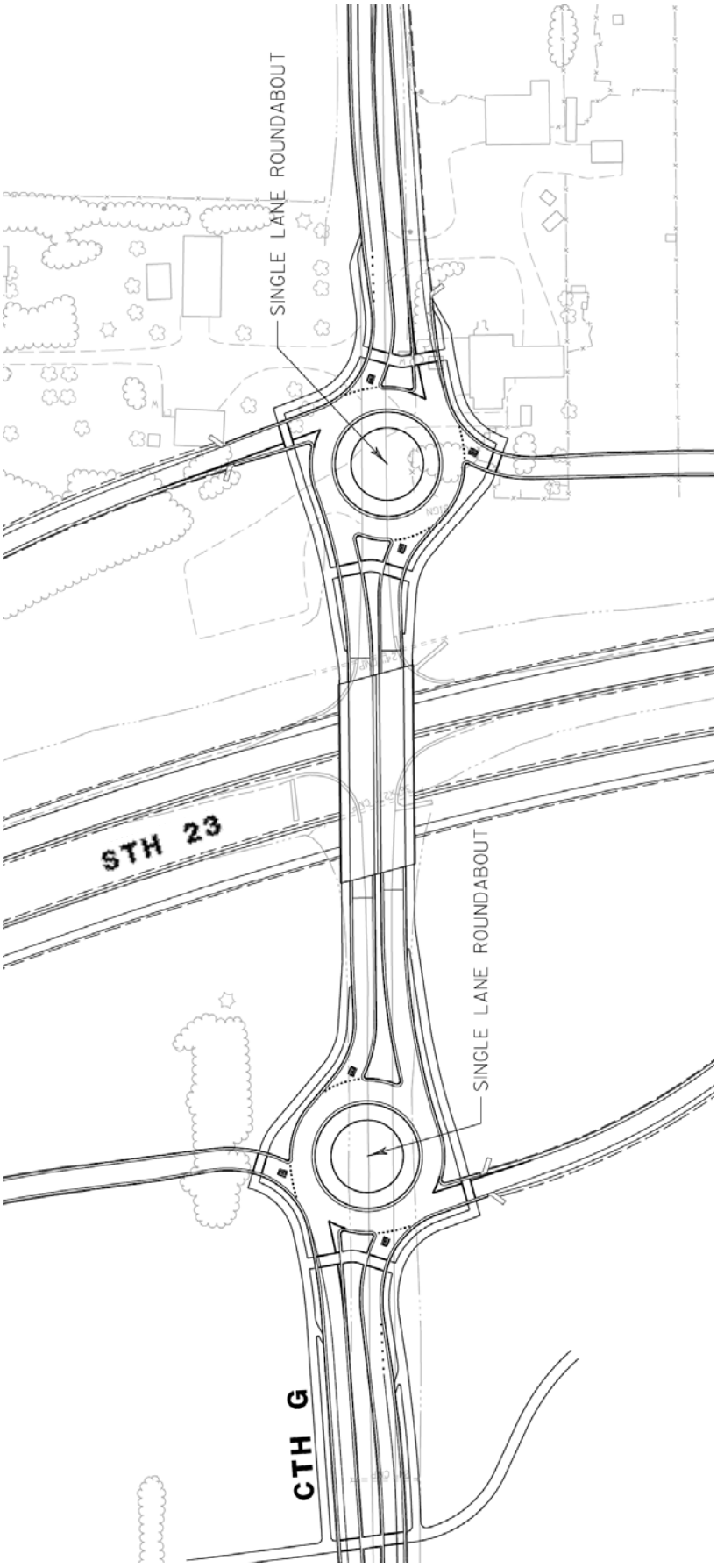
Year 2044 Forecast Traffic

Exhibit **2**



Stop Control Alternative

Exhibit **3**



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(Not to Scale)

Roundabout Alternative

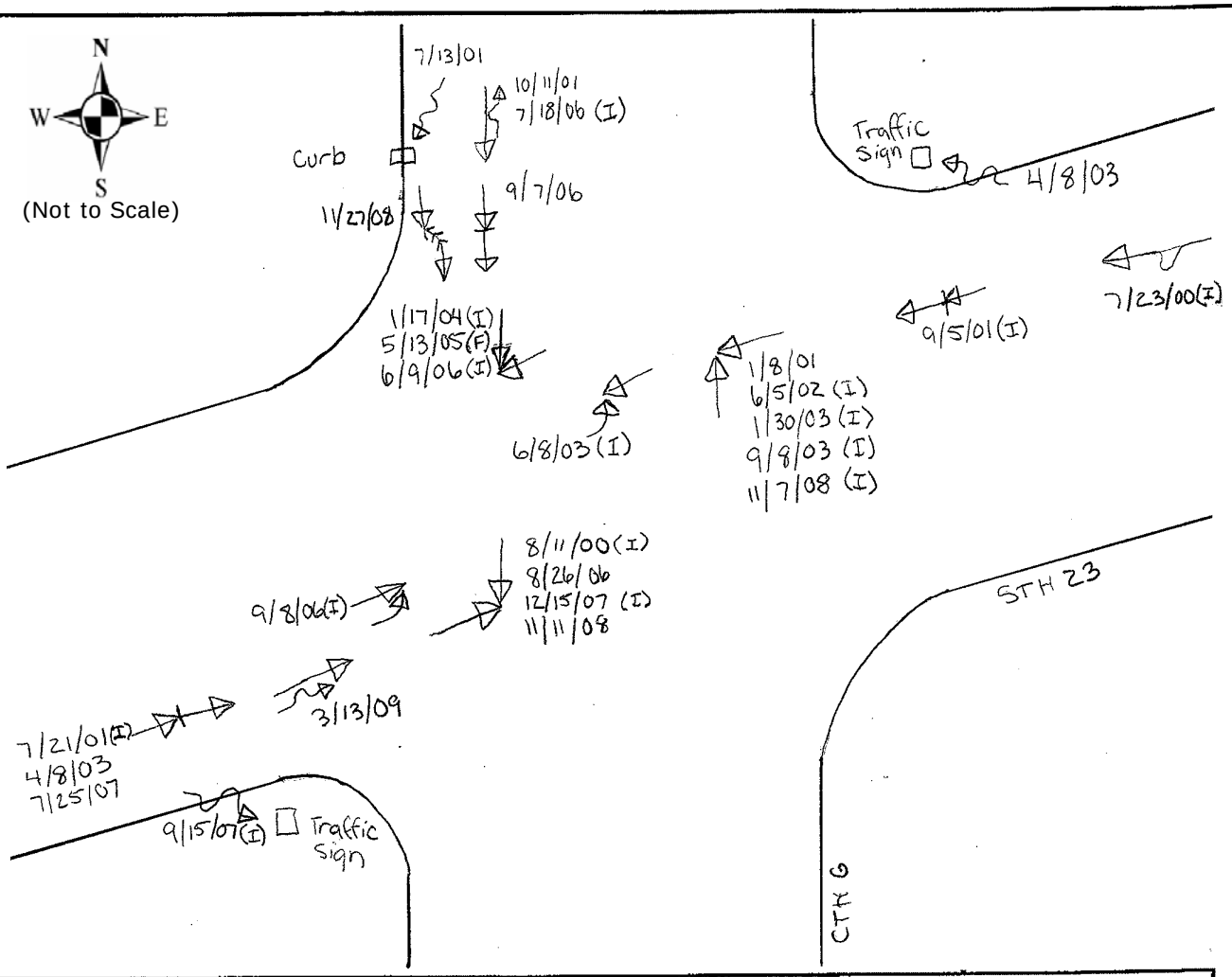
Exhibit **4**

COLLISION DIAGRAM

LOCATION ID: STH 23 with CTH G

COUNTY: Fond Du Lac CITY: Town of Forest

PERIOD 2000 TO 2009 PREPARED BY: NDF



COLLISION SYMBOLS

VEHICLE PATH	REAR-END COLLISION	PAVEMENT CONDITION: D = DRY W=WET I=ICY
BACKING VEHICLE	HEAD-ON COLLISION	WEATHER CONDITION: C=CLEAR R=RAIN F=FOG S=SNOW
NON-INVOLVED VEH.	SIDE SWIPE	LIGHT CONDITION: L=DAYLIGHT N=NIGHT (DARK)
PEDESTRIAN PATH	OUT OF CONTROL	TIME OF DAY (MILITARY)
FIXED OBJECT	OVERTURNED VEHICLE	
PARKED VEHICLE	LEFT TURN COLLISION	
(I) PERSONAL INJURY	RIGHT ANGLE COLLISION	
(F) FATALITY		

CRASH SUMMARY

	PROP. DMG ONLY	INJURY	FATAL	TOTAL
DAYTIME	9	16	0	25
NIGHTTIME	1	0	1	2
TOTAL	10	16	1	27

Crash Diagram (2000 to 2009)

Exhibit **5**