

**Date:** January 22, 2020

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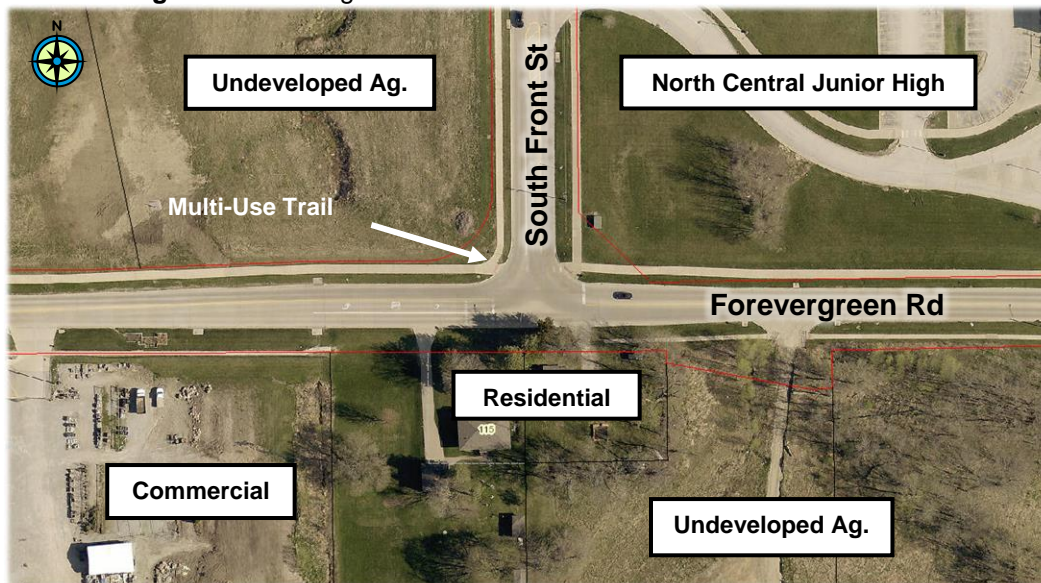
**Re:** Forevergreen Road and South Front Street Traffic Signal Warrant and Roundabout Analysis

This memorandum documents the findings of a traffic signal warrant and roundabout analysis at the intersection of Forevergreen Road and South Front Street as requested by the City of Coralville in the FY21 MPOJC Work Program.

### EXISTING CONDITIONS

**Figure 1** shows an aerial view of the intersection, which is currently stop controlled for all movements. Forevergreen Road is an east-west collector street with one through lane and one dedicated left-turn lane for eastbound traffic only. South Front Street is a north-south collector street that ends at Forevergreen Road. There is a multi-use trail along the north side of Forevergreen Road and both sides of South Front Street. The posted speed limit is 25-mph along Forevergreen Road, and 30-mph along South Front Street. The intersection is bordered by North Central Junior High to the northeast, undeveloped land to the northwest, and residential land to the south as shown in **Figure 1**.

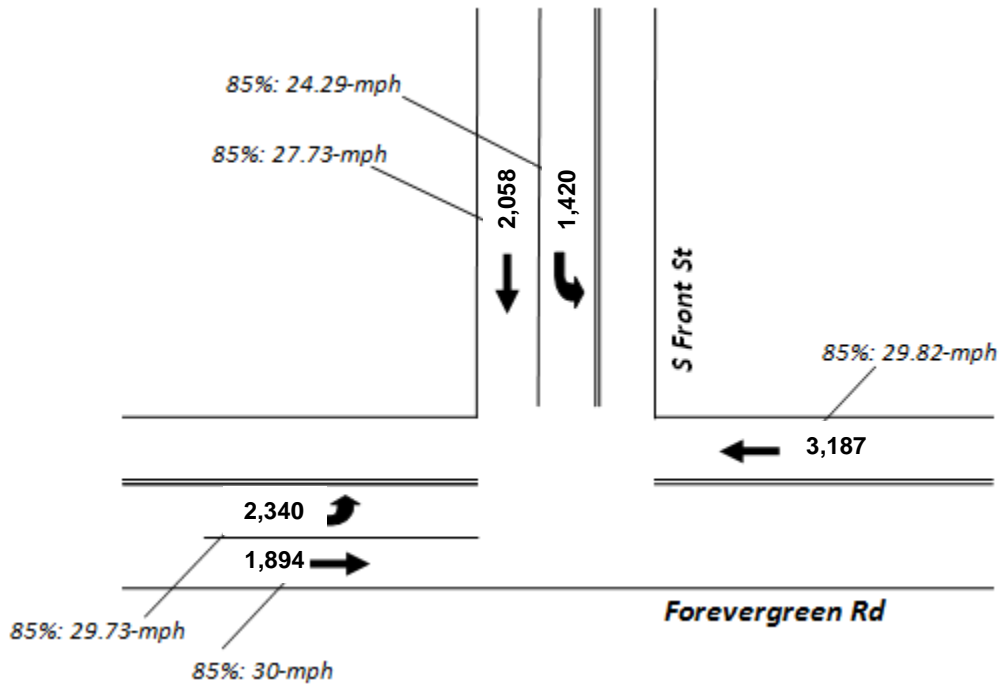
**Figure 1:** Forevergreen Road and South Front Street Intersection



## VEHICULAR TRAFFIC COUNTS

Average entering daily traffic counts and 85<sup>th</sup>-percentile speeds were collected at the intersection from September 22<sup>nd</sup> – 25<sup>th</sup>, 2020, and are shown in **Figure 2**. Forevergreen Road carries a majority of the traffic at the intersection with 4,234 eastbound vehicles and 3,187 westbound vehicles. Southbound South Front Street carries 3,478 vehicles per day. The 85<sup>th</sup>-percentile speeds on South Front Street were recorded between 24- and 27-mph and between 29- and 30-mph on Forevergreen Road.

**Figure 2:** Average Entering Daily Traffic Counts & 85<sup>th</sup>-Percentile Speeds\*



\*The COVID-19 pandemic has impacted travel patterns and mode choice in the Iowa City Urbanized Area since March 2020. In order to account for the change in travel patterns, September ADT counts have been factored up by 4% to account for the variation in vehicular volumes. For more information on the methodology, please contact MPOJC.

## TRAFFIC SIGNAL WARRANT ANALYSIS

A traffic signal warrant analysis was performed at the intersection to determine the need for a traffic signal. At a minimum, at least one of the nine warrants must be met, but the satisfaction of a warrant does not in itself require the installation of a traffic signal.

The nine traffic warrants are as follows (studied warrants are bolded):

- 1. Eight-Hour Vehicular Volume**
- 2. Four-Hour Vehicular Volume**
- 3. Peak Hour**
- 4. Pedestrian Volume (not evaluated)*
- 5. School Crossing (not evaluated)*
- 6. Coordinated Signal System (not evaluated)*
- 7. Crash Experience**
- 8. Roadway Network**
- 9. Intersection near a Grade Crossing (not evaluated)*

Please see the *Manual on Uniform Traffic Control Devices* (MUTCD) for further information on each warrant. Traffic signal warrants 1-3, 7, and 8 of the MUTCD were evaluated with respect to the observed traffic volumes. Warrants 4-6 and 9 were not evaluated for the following reasons:

- *Warrants 4 and 5* were not evaluated due to low pedestrian volumes at the time of evaluation.
- *Warrant 6* was not evaluated due to the absence of traffic signals in the immediate vicinity.
- *Warrant 9* was not evaluated as a rail grade crossing is not within 140' of the intersection as required.

### **Warrant 1 – Eight-Hour Vehicular Volume**

Warrant 1 should be treated as a single warrant. If Warrant 1a is satisfied, then Warrant 1 is considered satisfied, and the combination of Warrant 1a and 1b is not necessary. The same condition is true if Warrant 1b is met, but not Warrant 1a.

#### **Warrant 1a – Minimum Vehicular Volume**

Warrant 1a examines whether a large volume of intersecting traffic is the principle reason for the installation of a traffic control signal. To satisfy Warrant 1a, eight one-hour periods must meet appropriate traffic volumes. With a one-lane approach on Forevergreen Road there must be 500 entering vehicles and the higher volume leg of the minor street, South Front Street, must have 150 vehicles entering the intersection. **Table 1** shows the average 24-hour volumes and whether that specific hour met the minimum volumes for Warrant 1a. As only four one-hour periods are met, **Warrant 1a is not met.**

#### **Warrant 1b – Interruption of Continuous Traffic**

Warrant 1b examines whether traffic on the major street is so heavy that traffic on the minor street suffers excessive delay or conflict upon entering or crossing the major street. To satisfy Warrant 1b, the major street, Forevergreen Road, must have a total of 750 vehicles entering the intersection for eight one-hour periods while the higher volume leg of the minor street, South Front Street, must have a total of 75 vehicles. As shown in **Table 1**, only two one-hour periods are met; therefore **Warrant 1b is not met.**

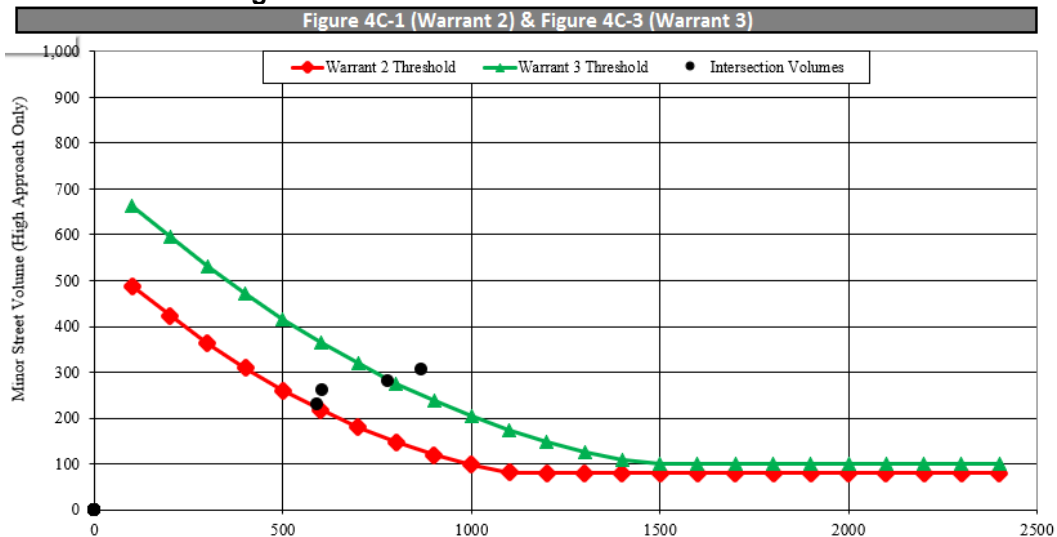
**Table 1: Hourly Entering Vehicle Volumes**

South Front Street and Forevergreen Road													
Coralville, IA		Dates Gathered: Sept 22 - 25, 2020							Warranted?				
Time	Entering Traffic					Total Entering Traffic	Major Street Approach	Minor Street Approach	1A		1B		
	South Front Street		Forevergreen Road						S. Front	Forevergreen	S. Front	Forevergreen	
	Southbound	Southbound (LftnLn)	Eastbound	Eastbound (LftnLn)	Westbound								
100	4	3	2	7	7	23	16	7	No	No	No	No	
200	4	2	2	4	7	19	13	6	No	No	No	No	
300	1	1	2	1	2	7	5	2	No	No	No	No	
400	3	1	1	2	3	10	6	4	No	No	No	No	
500	10	6	2	2	15	35	19	16	No	No	No	No	
600	54	18	16	8	41	137	65	72	No	No	No	No	
700	114	68	66	44	88	380	198	182	Yes	No	Yes	No	
800	173	149	100	98	212	732	410	322	Yes	No	Yes	No	
900	155	109	114	102	198	678	414	264	Yes	No	Yes	No	
1000	105	63	101	86	153	508	340	168	Yes	No	Yes	No	
1100	104	58	107	99	143	511	349	162	Yes	No	Yes	No	
1200	123	88	128	137	174	650	439	211	Yes	No	Yes	No	
1300	168	95	141	156	183	743	480	263	Yes	No	Yes	No	
1400	123	68	115	131	182	619	428	191	Yes	No	Yes	No	
1500	114	77	104	162	183	640	449	191	Yes	No	Yes	No	
1600	153	108	131	209	263	864	603	261	Yes	Yes	Yes	No	
1700	160	121	176	261	343	1061	780	281	Yes	Yes	Yes	Yes	
1800	170	136	212	286	368	1172	866	306	Yes	Yes	Yes	Yes	
1900	136	95	154	198	239	822	591	231	Yes	Yes	Yes	No	
2000	97	74	96	150	175	592	421	171	Yes	No	Yes	No	
2100	41	35	59	99	113	347	271	76	No	No	Yes	No	
2200	25	23	35	54	49	186	138	48	No	No	No	No	
2300	14	15	21	31	31	112	83	29	No	No	No	No	
2400	7	7	9	13	15	51	37	14	No	No	No	No	

**Warrant 2 – Four-Hour Vehicular Volume**

The four-hour vehicular volume warrant is applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal. To meet Warrant 2, traffic volumes on both streets must meet the required volume threshold (red line) for four one-hour periods on an average day. **Figure 3** shows the vehicular volume meets the required threshold for four hours; therefore **Warrant 2 is met**.

**Figure 3: Warrant 2 and Warrant 3 Vehicular Volumes**



### **Warrant 3 – Peak Hour**

The peak hour warrant is intended for use at a location where traffic conditions are such that for a minimum of one hour on an average day, the minor street traffic suffers undue delay when entering or crossing the major street. For Warrant 3 to be satisfied, the plotted point representing the vehicles per hour (combination of both approaches) on Forevergreen Road, the major street, and the corresponding vehicles per hour (highest volume approach) on South Front Street, the minor street, must fall above the curve (green line) in **Figure 3** for any one hour of an average day. As shown in **Figure 3**, the PM peak hour meets the required threshold; therefore **Warrant 3 is met.**

### **Warrant 7 – Crash Experience**

The conditions for this warrant are intended for application where the severity and frequency of crashes are the principal reasons to consider the installation of a traffic signal. Five or more crashes preventable by a traffic signal must occur within twelve consecutive months. As only one collision occurred at the intersection between 2015 and 2019, **Warrant 7 is not met.**

### **Warrant 8 – Roadway Network**

Warrant 8 is used when evaluating whether a traffic signal at the intersection of two or more major routes might be justified to encourage concentration and organization of traffic flow on a roadway network.

A major route as used in this signal warrant shall have one or more of the following characteristics:

- A. It is part of a street or highway system that serves as the principal roadway network for through traffic flow; or
- B. It includes rural or suburban highways outside, entering, or traversing a City; or
- C. It appears as a major route on an official plan, such as a major street plan in an urban traffic and transportation study.

Warrant 8 is met when one or both of the following criteria are met:

- A. The intersection has a total existing, or immediately projected, entering volume of at least 1,000 vehicles per hour during the peak hour of the typical weekday and has 5-year projected traffic volumes, based on engineering study, that meet one or more of Warrants 1,2, and 3 during an average weekday, or
- B. The intersection has a total existing or immediately projected entering volume of at least 1,000 vehicles per hour for each of any 5 hours of a non-normal business day (Saturday or Sunday).

Forevergreen Road and South Front Street are both collector streets serving Coralville and North Liberty and appear on the Iowa DOT's Federal Functional Classification map and the MPOJC's Arterial Streets Plan Map; therefore this intersection meets the major route characteristics.

As shown in **Table 1**, the intersection's existing entering volumes exceed 1,000 vehicles for two hours. As the intersection's existing volumes currently exceed 1,000 and Warrant 2 and 3 are met; **Criteria A is met,** and Criteria B was not analyzed.

As the intersection meets Criteria A; **Warrant 8 is met.**

**Table 2: Warrant Summary**

Warrant	Description	Warrant Met?
1a	Minimum Vehicular Volume	No
1b	Interruption of Continuous Traffic	No
2	Four Hour Vehicular Volumes	Yes
3	Peak Hour Volumes	Yes
4	Pedestrian Volume	N/A
5	School Crossing	N/A
6	Coordinated Signal System	N/A
7	Crash Experience	No
8	Roadway Network	Yes
9	Intersection Near a Grade Crossing	N/A

## CAPACITY ANALYSIS

Existing intersection capacity was analyzed using signalized intersection capacity methods outlined in the latest edition of the *Highway Capacity Manual* (HCM) and using *Synchro 10* software. Using HCM methods, control delay is calculated as seconds of delay per vehicle and a corresponding level of service (LOS) is also shown. Level of service is determined by analyzing operating conditions that are based on several factors, including speed and travel time, traffic interruptions and freedom to maneuver, as well as comfort and convenience.

**Table 3** shows LOS with its control delay ranges at unsignalized, roundabout, and signalized intersections. LOS A indicates optimal operating conditions (free-flow movement), while LOS F represents the worst conditions, i.e. extreme congestion and stop-and-go conditions.

**Table 3: Intersection Delay/ LOS**

Level of Service	Unsignalized/ Roundabout	Signalized
	Average Control Delay (sec/veh)	
A	<10	<10
B	>10-15	>10-20
C	>15-25	>20-35
D	>25-35	>35-55
E	>35-50	>55-80
F	>50	>80

### **Existing Conditions: All Way Stop Control (AWSC)**

**Table 4** shows average delay and LOS under current all-way stop conditions. The intersection functions at LOS B with an average delay of 12.9 sec/veh (LOS B) during the AM peak hour and 14.6 sec/veh (LOS B) during the PM peak hour. During the AM peak hour the westbound movement experiences the greatest delay of 13.8 sec/veh, while the eastbound left-turning movement experiences the greatest delay during the PM peak hour of 17.2 sec/veh (LOS C).

### **Scenario 1: Traffic Signal**

For scenario 1, the intersection was analyzed under signalized conditions with a permissive phase for the eastbound left-turn movement (**Table 4**). Under this scenario, all movements operate at LOS A during the AM peak hour with the greatest delay being 9.7 sec/veh. During the PM peak hour, the eastbound left-turning movement experiences the greatest delay of 18.6 sec/veh (LOS B) with all other movements operating at LOS B or better. Overall, the intersection performs slightly better as compared to existing conditions.

### **Scenario 2: Roundabout**

Under roundabout conditions, all movements operate at LOS A and the average intersection delay is 6.5 sec/veh during the AM peak hour and 7.0 sec/veh during the PM peak hour. The greatest delay is 7.6 sec/veh during the PM peak hour for the westbound movement.

**Table 4: LOS/Delay Comparison**

Direction	Existing Conditions (AWSC)				Proposed Conditions (Traffic Signal)				Proposed Conditions (Roundabout)			
	Control Delay (s/veh)		LOS		Control Delay (s/veh)		LOS		Control Delay (s/veh)		LOS	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
<b>Forevergreen Road</b>												
<b>Eastbound</b>									6.3	7.4	A	A
- Left	12.9	17.2	B	C	8.8	18.6	A	B				
- Through/Right	11.6	11.6	B	B	5.6	8.4	A	A				
<b>Westbound</b>									5.5	7.6	A	A
- Left/Through/Right	13.8	16	B	C	6.4	9.7	A	A				
<b>South Front Street</b>												
<b>Southbound</b>									7.2	5.9	A	A
- Left	13.7	12.8	B	B	8.3	13.1	A	B				
- Through/Right	12.3	11.5	B	B	9.7	14.4	A	B				
<b>Intersection</b>	12.9	14.6	B	B	7.8	12.9	A	B	6.5	7.0	A	A

**CONCLUSION**

Based on the analysis of the MUTCD traffic signal warrants, a traffic signal is warranted at the intersection of Forevergreen Road and South Front Street. Of the warrants; Warrant 2 (four-hour vehicular volumes), Warrant 3 (peak hour volumes), and Warrant 8 (roadway network) are met.

The capacity analysis shows the intersection currently operates well (LOS B) during both peak hours. Under signalized conditions, the intersection experiences a decrease in overall intersection delay of 5.1 sec/veh during the AM peak hour and 1.7 sec/veh during the PM peak hour. Under these conditions, the eastbound left-turning movement and the southbound movement experience a marginal increase in delay (**Table 4**). A roundabout was also analyzed at the intersection. As compared to existing conditions, delay decreased by 6.4 sec/veh during the AM peak hour and 7.6 sec/veh during the PM peak hour. All movements operate at LOS A with overall intersection delay being less than 10 sec/veh.

As the intersection currently operates well at LOS B with no significant collision history, the City of Coralville should consider whether the benefits of a traffic signal or roundabout outweigh the cost, given the marginal improvements in overall intersection delay. We recommend the City of Coralville reevaluate the intersection as traffic volumes increase as a result of planned development in the surrounding area.

Staff is available to answer any questions concerning this study. For more information, please contact Emily Bothell at [Emily-Bothell@iowa-city.org](mailto:Emily-Bothell@iowa-city.org).