Neenah Downtown Traffic Study

Prepared for:
City of Neenah
Winnebago County
October 2018

MSA

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MSA was selected by the City of Neenah to complete a review of the city's downtown transportation network. The review covers the following areas: traffic data collection, existing roadway network and traffic operations, future operations with existing geometric configurations, a review of the existing and potential parking ramp facilities, and recommendations for further study. This report summarizes the procedures and outcomes completed as part of that study. A project location map can be seen in **Attachment A**.

Traffic Data Collection

MSA took a number of steps at the outset of the review to gather crucial background information about the corridor including traffic counts, a determination of the AM and PM peak hours, a review of volume adjustment factors and balancing the traffic counts within the study area.

Traffic Counts

MSA collected traffic data at the following eleven intersections using traffic cameras over two days in April 2018.

- Main St & Green Bay Rd
- Main St & Torrey St
- Main St & Doty Ave
- Church St & Columbian Ave
- Church St & Doty Ave
- Church St & Wisconsin Ave
- Commercial St & Winneconne Ave
- Commercial St & Columbian Ave
- Commercial St & Doty Ave
- Commercial St & Wisconsin Ave
- Commercial St & Forest Ave

At Main St & Torrey St and Main St & Doty Ave counts were collected and processed for 14 hours (6 AM to 8 PM) for traffic signal warrant analysis. At the remaining intersections, peak hour turning movement counts (6:00 AM to 8:30 AM and 2:30 PM to 6:00 PM) were collected. The raw count value can be seen in **Attachment B**.

Network Peak Hour Determination

To complete the analysis, it is desirable to analyze the overall peak hour for the study area. The Network peak hour is singular AM and PM peak hours where the total volume across all intersections is the highest. By looking at the individual intersection peak hours and combining the volumes, the AM and PM Network Peak Hours were determined. The Network Peak Hours are 7:15AM to 8:15AM and 4:30PM to 5:30PM. See **Attachment C** – Network Peak for comparison of the individual intersections to the network peak.

Seasonal Adjustment Factors

In discussion with City Staff, it was determined that the time of the year the counts were taken was a good representation of the network volumes due to the proximity to schools and large businesses. Therefore, no Seasonal Adjustment Factor was applied to the data.

Count Balancing

A limited amount of traffic volume balances was completed using the intersections of Commercial St & Doty Ave and Commercial St & Columbian Ave as the basis for all balancing. These two intersections were chosen as the baseline because they were collected on different dates and are in close proximity to one another with few outlets (i.e. Parking spots or driveways) for vehicles to stop and create an imbalance between the intersections. After these two intersections were balanced, the resulting adjustments were spread around the other network intersections using engineering judgement and approximate proportions of total vehicles making various movements. The balancing was provided to City Staff for review and approval prior to beginning analysis.

Traffic Signal Warrants

Using the 14 hours of processed traffic count data discussed previously, Traffic Signal Warrants were completed per Wisconsin MUTCD guidelines for two of the study intersections along the corridor, Main St & Torrey St and Main St & Doty Ave. Four warrants were specifically reviewed as part of the study including Warrant 1: Eight-Hour Vehicular Volume, Warrant 2: Four-Hour Volume, Warrant 3: Peak Hour Volume and Warrant 7: Crash Experience. The results were as follows:

Main St & Torrey St

Warrants 1, 3 and 7 were significantly lower than the required thresholds; however, Warrant 2 met the criteria for three of four hours. The fourth hour was relatively close and depending upon the count day, volumes could occasionally be high enough to meet the four-hour warrant. At this time, it is recommended to monitor traffic volumes and development in the area with the expectation of completing signal warrants again in the near future if traffic patterns are impacted by future development. See **Attachment D** for the complete warrant analysis.

Main St & Doty Ave

At this time, none of the four primary Warrants are close to being met as there is minimal side street traffic on Doty Ave. Development in the area and City facilitated adjustments to traffic patterns could potentially increase side street traffic. Without a reconfiguration of primary traffic routes or significant development, and given the low crash history, it is not recommended this intersection be reviewed for further intersection improvements. See **Attachment E** for the complete warrant analysis.

Existing Roadway Network and Traffic Operations

The goal of this part of the review is to combine field observations with the data collected at the outset of the project to best model the existing conditions and create a baseline for measuring traffic operations and comparing potential improvements and changes.

Operational and Capacity Analysis

An operational and capacity analysis was completed for each intersection using Synchro 10 which is based on the procedures, methods, and techniques contained in the Highway Capacity Manual, 6th Edition. In order to more accurately represent the existing conditions in the model, MSA combined City provided observations and information with field and video observations.

Calibration of Existing Conditions

MSA utilized a combination of field and video observations to help verify existing conditions.

Field Observations

MSA observed and took photos of a number of intersections during the peak hours. *Figures 1 and 2* show some of the delay observed in the field.

Figure 1: Intersection of Winneconne Ave & Commercial Street looking south on Commercial Street

Figure 2: Intersection of Wisconsin Ave & Church St looking northeast towards the Church St Ramp

Video Observations

Cameras were also strategically located to maximize views of approaches that were anticipated to experience significant queuing. Review of the video showed backups at the intersections of Main St & Doty Ave, Church St & Wisconsin Ave, Commercial St & Doty Ave and Commercial St & Wisconsin Ave. *Figures 3 and 4* show some of the observed queuing through the cameras.

Figure 3: Intersection of Main St & Doty Ave shows backups from the Wisconsin Ave & Church St intersection extending to the Doty Ave intersection.

Figure 4: Intersection of Commercial St & Doty Ave shows backups from the Wisconsin Ave & Commercial St intersection extending through the Doty Ave intersection to the Columbian St intersection.

Software Calibration

Using this information, the AM and PM existing conditions models were calibrated to more accurately model the real-world conditions drivers are experiencing. The calibration steps included:

- Modification of the timing plans based on video observations of how long the cycle lengths were typically operating
- Inputting Wisconsin standard inputs for HCM analysis into Synchro from the WisDOT Traffic Engineering, Operations & Safety Manual (TEOpS) including:
  - SimTraffic Interval parameters;
  - Saturation Flow Rate adjustments;
  - Peak Hour Factor adjustments to reflect the number of vehicles that desire to access the intersection during the peak 15-minute period without congestion;

The real-world conditions with roughly 15-20 minutes of significant queuing and delay were difficult to duplicate within Synchro because the software values for delay and level of service are averaged over the course of the entire peak hour. However, the SimTraffic Interval Parameters allow for the concentration of volume into a tighter window, and therefore more closely represent the real-world conditions. While the model reflects the average, rather than worst case conditions, that drivers experience, it is useful as a baseline for future improvement discussions.

2018 Existing Conditions Operational Analysis

The Highway Capacity Manual, 6th Edition, assigns a Level of Service to each movement. Level of Service is a quantitative measure that refers to the overall quality of flow at an intersection ranging from very good, LOS "A," to very poor, LOS "F." The delay is measured in seconds per vehicle, which can be used to determine the Level of Service for each movement at a given intersection. **Table 1**, below, shows the delay criteria used for determining the Level of Service at an intersection.

***Table 1**: Highway Capacity Manual Level of Service*

Level of Service	Average Control Delay (sec/veh)	
	Stop Control	Signal Control
"A" (best)	0 to 10	0 to 10
"B" (good)	> 10 and ≤ 15	> 10 and ≤ 20
"C" (desirable)	> 15 and ≤ 25	> 20 and ≤ 35
"D" (delay)	> 25 and ≤ 35	> 35 and ≤ 55
"E" (congestion)	> 35 and ≤ 50	> 55 and ≤ 80
"F" (forced flow)	> 50	> 80

Table 2 shows the anticipated LOS for each of the eleven intersections. It is important to note due to the very concentrated 15-20 minute window of heavy volume mentioned previously, drivers may experience better or worse operations during the peak hour depending when they arrive. A breakdown of some of the reasons behind certain intersections experiencing undesirable LOS values follows the table. The raw Synchro outputs can be viewed in **Attachment F**.

***Table 2:** Existing Conditions Level of Service Table*

Intersection	Traffic Control	Peak Hour	Parameters	West Approach			East Approach			South Approach			North Approach			Overall Intersection
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
Main Street & Green Bay Road	Signal	AM Peak	Lanes		2			1	1		2			2		
			LOS		C			D	B		F			F		D
			Delay (s)		32.5			50.4	10.3		283.5			82.9		50.2
			v/c ratio		-			-	-		-			-		
			Queue (ft)		450			250	100		550			425		
		PM Peak	Lanes		2			1	1		2			2		
			LOS		D			D	B		D			E		C
			Delay (s)		44.4			48.5	11.1		54.0			58.2		33.9
			v/c ratio		-			-	-		-			-		
			Queue (ft)		350			350	100		275			375		
Main Street & Torrey Street	Stop (South Approach)	AM Peak	Lanes	2		1	2			1		1				
			LOS	A		A	A			F		B				A
			Delay (s)	0.0		0.0	0.0			95.7		11.9				6.2
			v/c ratio	0.00		0.00	0.00			0.87		0.01				
			Queue (ft)	0		0	0			150		25				
		PM Peak	Lanes	2		1	2			1		1				
			LOS	A		A	A			F		B				A
			Delay (s)	0.0		0.0	8.8			67.6		10.1				4.6
			v/c ratio	0.00		0.00	0.02			0.75		0.01				
			Queue (ft)	0		0	25			125		25				
Main Street & Doty Avenue	Stop (East Approach)	AM Peak	Lanes		1			1			1			1		
			LOS		A			B			E			D		A
			Delay (s)		0.0			10.1			38.5			33.8		0.8
			v/c ratio		0.00			0.01			0.18			0.05		
			Queue (ft)		25			25			25			25		
		PM Peak	Lanes		1			1			1			1		
			LOS		A			A			F			E		A
			Delay (s)		9.8			9.2			74.3			45.0		4.0
			v/c ratio		0.01			0.02			0.63			0.06		
			Queue (ft)		25			25			75			25		
Church Street & Columbian Avenue	Stop (All-Way)	AM Peak	Lanes		1			1			1			1		
			LOS		B			A			B			A		B
			Delay (s)		12.0			9.1			10.6			8.7		10.9
			v/c ratio		0.48			0.18			0.32			0.06		
			Queue (ft)		75			25			50			25		
		PM Peak	Lanes		1			1			1			1		
			LOS		B			A			A			A		B
			Delay (s)		11.7			9.0			9.3			9.5		10.5
			v/c ratio		0.47			0.15			0.17			0.19		
			Queue (ft)		75			25			25			25		

***Table 2** Continued…*

Intersection	Traffic Control	Peak Hour	Parameters	West Approach			East Approach			South Approach			North Approach			Overall Intersection
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
Church Street & Doty Avenue	Stop (North/South Approaches)		Lanes		1			1			1			1		
		AM Peak	LOS		A			A			B			A		A
			Delay (s)		7.4			7.4			11.2			9.5		6.8
			v/c ratio		0.01			0.01			0.22			0.04		
			Queue (ft)		25			25			25			25		
			Lanes		1			1			1			1		
		PM Peak	LOS		A			A			A			B		A
			Delay (s)		7.4			7.4			10.0			11.0		6.6
			v/c ratio		0.01			0.01			0.10			0.19		
			Queue (ft)		25			25			25			25		
Church Street & Wisconsin Avenue	Signal		Lanes	1	1		1	1		1			1		1	
		AM Peak	LOS	F	A		A	C		D			C		C	D
			Delay (s)	112.3	8.2		8.9	27.3		35.2			29.2		29.1	36.7
			v/c ratio	1.08	0.42		0.03	0.85		0.66			0.05		0.04	
			Queue (ft)	#300	225		25	#525		150			25		25	
			Lanes	1	1		1	1		1			1		1	
		PM Peak	LOS	D	B		A	B		C			C		C	B
			Delay (s)	51.6	12.5		8.6	14.8		28.8			32.7		28.8	19.4
			v/c ratio	0.56	0.46		0.03	0.58		0.49			0.64		0.50	
			Queue (ft)	50	250		25	350		m50			175		50	
Commercial Street & Winneconne Avenue	Signal		Lanes	1	1	1	1	1		1	1		2			
		AM Peak	LOS	C	C	A	C	D		C	C		E			D
			Delay (s)	30.7	25.8	0.0	24.3	43.5		32.4	22.7		55.2			36.6
			v/c ratio	0.78	0.47	0.00	0.12	0.80		0.79	0.53		0.77			
			Queue (ft)	175	200	0	50	#350		#200	250		200			
			Lanes	1	1	1	1	1		1	1		2			
		PM Peak	LOS	C	C	A	C	D		C	C		E			D
			Delay (s)	27.7	24.1	0.0	25.0	43.8		26.5	22.9		63.9			37.3
			v/c ratio	0.73	0.41	0.00	0.13	0.73		0.65	0.57		0.90			
			Queue (ft)	200	200	0	50	#325		100	325		#300			
Commercial Street & Columbian Avenue	Signal		Lanes	1	1		1	1		2			2			
		AM Peak	LOS	D	D		D	D		A			A			B
			Delay (s)	43.0	48.5		47.7	38.0		0.4			0.6			10.6
			v/c ratio	0.40	0.84		0.06	0.26		0.27			0.28			
			Queue (ft)	100	175		25	75		100			25			
			Lanes	1	1		1	1		2			2			
		PM Peak	LOS	D	D		D	D		A			A			B
			Delay (s)	43.4	43.9		47.5	37.8		0.5			5.9			11.0
			v/c ratio	0.45	0.71		0.26	0.25		0.32			0.35			
			Queue (ft)	100	150		50	50		100			150			
Commercial Street & Doty Avenue	Stop (East/West Approaches)		Lanes		1			1			2			2		
		AM Peak	LOS		D			D			A			A		A
			Delay (s)		30.2			26.9			9.1			8.9		1.8
			v/c ratio		0.22			0.10			0.04			0.03		
			Queue (ft)		25			25			25			25		
			Lanes		1			1			2			2		
		PM Peak	LOS		E			E			A			A		A
			Delay (s)		46.2			48.6			9.8			9.6		3.8
			v/c ratio		0.47			0.39			0.04			0.02		
			Queue (ft)		50			50			25			25		
Commercial Street & Wisconsin Avenue	Signal		Lanes	1	1	1	1	1	1	1	1		1	2		
		AM Peak	LOS	E	D	C	C	E	C	B	A		B	C		C
			Delay (s)	68.3	38.2	28.9	32.1	60.3	35.0	15.3	4.2		11.6	25.4		29.3
			v/c ratio	0.93	0.56	0.03	0.17	0.81	0.10	0.17	0.68		0.01	0.74		
			Queue (ft)	#250	200	25	50	#300	25	25	225		25	250		
			Lanes	1	1	1	1	1	1	1	1		1	2		
		PM Peak	LOS	F	D	C	C	D	C	B	D		B	C		D
			Delay (s)	113.0	46.8	31.4	33.1	54.6	34.7	14.0	37.1		18.7	21.3		42.4
			v/c ratio	1.09	0.72	0.08	0.47	0.75	0.08	0.14	0.82		0.13	0.60		
			Queue (ft)	#400	#275	25	100	#275	25	50	#575		25	250		
Commercial Street & Forest Avenue	Signal		Lanes		1			1			2			2		
		AM Peak	LOS		D			D			A			A		A
			Delay (s)		29.2			32.4			4.1			5.6		8.2
			v/c ratio		0.29			0.51			0.21			0.46		
			Queue (ft)		50			'75			50			150		
			Lanes		1			1			2			2		
		PM Peak	LOS		D			D			A			A		A
			Delay (s)		28.4			34.2			6.0			5.4		9.1
			v/c ratio		0.26			0.58			0.42			0.34		
			Queue (ft)		50			100			150			125		

HCM 6th Edition Outputs using Synchro 10 Software, queues reported using Synchro outputs.
#: 95th percentile volume exceed capacity, queue may be longer
m: volume for 95th percentile queue is metered by upstream signal

Identification of Issues

A number of corridor issues were identified through field observation, video review, and Synchro software operational analysis. The primary observations from the downtown area and another from the standalone intersection of Main St & Green Bay Rd are discussed further:

Intersections of Commercial St & Winneconne Ave and Commercial St & Wisconsin Ave

The volume of traffic at both of these intersections on the north, south and west approaches is almost evenly split in both the AM and PM Peak Hours. This creates a situation where the signal cycle length needs to be divided more evenly to allow movements in both directions to progress through the intersection.

Beginning at Commercial St & Winneconne Ave both the eastbound left-turn and northbound through movements have significant volume. As the individual vehicle platoons from these two movements progress north, the allocation of time to service northbound vehicles at Wisconsin Ave is limited due to conflicting traffic on Wisconsin Avenue. The signal cannot provide sufficient time to allow both the eastbound left and northbound through movements from Winneconne Ave to pass before the signal needs to serve volume from Wisconsin Ave. This creates a backup of vehicles at the Wisconsin Ave intersection in both the north/southbound direction and eastbound direction. While this window is generally only 15-20 minutes, it occurs at the beginning and end of the business work day which creates significant queuing and delay during the peak periods. These problems were observed to dissipate within a short time after the peak.

Church St Ramp

The Church St ramp is primarily used for employee parking for the surrounding businesses. One issue with the ramp is that all vehicular traffic, inbound and outbound, flows through one signalized intersection. The major employers operate on a similar standard 8am to 5pm workday, which creates a bottleneck shown in *Figure 2* of several hundred vehicles trying to exit the ramp in the same 15-20 minute window. Combine that with a heavy east/west through movement and there is limited time to split between the various movements.

Main St & Green Bay Rd

The primary concern at Main St & Green Bay Rd is the heavy eastbound through movement and the moderately heavy northbound and southbound movements during the AM Peak Hour. The geometry of the intersection has shared through-turn lanes which requires split phasing with protected turning movements. A review of video indicates the intersection of Main St & Green Bay Rd operates well with all queued vehicles typically clearing the intersection during each phase. However, the geometry necessitates very long cycle lengths to clear those queues. When these cycle lengths are modeled, the combination of high volumes and split phases creates an undesirable overall LOS for the intersection.

2018 Proposed Operational Analysis

MSA used the calibrated existing Synchro model to generate new timing plans for each of the six signalized intersections. **Table 3** below shows the anticipated operations for each of the signalized intersections using the new timing plans, see **Attachment G** for the raw Synchro outputs and **Attachment H** for the proposed timing plans. As the table shows, the existing challenges in the downtown network make it unlikely the public will realize much of an improvement from a LOS standpoint. However, the new timing plans take into account the latest recommendations and standards for intersection clearance intervals

from both a pedestrian and vehicle standpoint. While not overly significant, the additional seconds added for pedestrian crossing and yellow and red time shortens the available green time intervals which in some cased leads to limited improvement.

Table 3: *Proposed 2018 Timing Plan Level of Service Table*

Intersection	Traffic Control	Peak Hour	Parameters	West Approach			East Approach			South Approach			North Approach			Overall Intersection
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
Main Street & Green Bay Road	Signal	AM Peak	Lanes		2			1	1		2			2		
			LOS		D			E	A		D			E		C
			Delay (s)		39.4			65.3	9.9		45.0			60.2		35.0
			v/c ratio		-			-	-		-			-		
			Queue (ft)		475			250	100		250			350		
		PM Peak	Lanes		2			1	1		2			2		
			LOS		D			D	B		D			D		C
			Delay (s)		46.8			51.3	10.7		40.0			51.1		30.2
			v/c ratio		-			-	-		-			-		
			Queue (ft)		400			325	100		225			275		
Church Street & Wisconsin Avenue	Signal	AM Peak	Lanes	1	1		1	1		1			1		1	
			LOS	B	A		A	B		D			D		D	B
			Delay (s)	11.7	7.1		6.0	13.9		46.2			38.2		38.1	15.4
			v/c ratio	0.57	0.39		0.03	0.67		0.72			0.06		0.04	
			Queue (ft)	100	225		m25	#575		m150			25		25	
		PM Peak	Lanes	1	1		1	1		1			1		1	
			LOS	A	B		A	A		C			D		C	B
			Delay (s)	8.1	13.2		9.1	2.0		34.4			40.5		32.7	16.1
			v/c ratio	0.04	0.44		0.03	0.56		0.57			0.68		0.46	
			Queue (ft)	25	250		m25	300		m75			175		75	
Commercial Street & Winneconne Avenue	Signal	AM Peak	Lanes	1	1	1	1	1		1	1		2			
			LOS	D	C	A	C	D		C	C		C			C
			Delay (s)	35.9	27.2	0.0	25.5	50.4		27.1	22.7		32.7			32.1
			v/c ratio	0.82	0.49	0.00	0.12	0.85		0.72	0.53		0.77			
			Queue (ft)	#200	225	0	50	#350		#200	250		125			
		PM Peak	Lanes	1	1	1	1	1		1	1		2			
			LOS	C	C	A	C	D		C	C		D			C
			Delay (s)	30.5	25.1	0.0	26.1	48.2		24.8	23.1		40.4			30.6
			v/c ratio	0.76	0.43	0.00	0.13	0.77		0.60	0.57		0.90			
			Queue (ft)	200	200	0	50	#350		100	325		75			
Commercial Street & Columbian Avenue	Signal	AM Peak	Lanes	1	1		1	1			2			2		
			LOS	D	D		D	D			A			A		B
			Delay (s)	43.0	48.5		47.7	38.0			0.4			0.6		10.6
			v/c ratio	0.40	0.84		0.06	0.26			0.26			0.28		
			Queue (ft)	100	150		25	75			125			100		
		PM Peak	Lanes	1	1		1	1			2			2		
			LOS	D	D		D	D			A			A		B
			Delay (s)	43.4	44.0		47.5	37.9			0.7			5.3		10.8
			v/c ratio	0.45	0.71		0.26	0.25			0.31			0.34		
			Queue (ft)	100	150		50	50			150			50		
Commercial Street & Wisconsin Avenue	Signal	AM Peak	Lanes	1	1	1	1	1	1	1	1		1	2		
			LOS	C	C	C	C	D	C	B	A		B	C		C
			Delay (s)	25.4	26.9	21.8	26.7	39.7	29.4	18.0	8.3		17.5	30.9		25.1
			v/c ratio	0.62	0.40	0.02	0.11	0.60	0.08	0.21	0.76		0.01	0.80		
			Queue (ft)	225	225	m25	50	225	25	50	400		25	250		
		PM Peak	Lanes	1	1	1	1	1	1	1	1		1	2		
			LOS	C	C	C	C	C	C	C	E		D	D		D
			Delay (s)	27.5	28.8	22.6	23.2	32.9	26.2	22.0	61.2		54.7	38.1		40.3
			v/c ratio	0.69	0.47	0.05	0.28	0.47	0.05	0.26	0.93		0.27	0.79		
			Queue (ft)	125	175	m25	75	200	25	50	#675		50	325		
Commercial Street & Forest Avenue	Signal	AM Peak	Lanes		1			1			2			2		
			LOS		C			C			A			A		A
			Delay (s)		28.5			31.7			3.8			5.1		7.7
			v/c ratio		0.28			0.51			0.21			0.45		
			Queue (ft)		50			75			50			150		
		PM Peak	Lanes		1			1			2			2		
			LOS		B			B			A			A		A
			Delay (s)		15.1			17.3			7.4			6.6		8.3
			v/c ratio		0.20			0.45			0.52			0.42		
			Queue (ft)		50			50			125			100		

HCM 6th Edition Outputs using Synchro 10 Software, queues reported using Synchro outputs.
#: 95th percentile volume exceed capacity, queue may be longer
m: volume for 95th percentile queue is metered by upstream signal

Analysis of Future Conditions

As part of the study, MSA was asked to review future year 2038 volumes and operations. A review of anticipated growth rates and operations follows.

Growth rate

MSA requested anticipated growth rates for the Neenah area from the East Central Wisconsin Regional Planning Commission (ECWRPC). Existing volumes from 2010 and anticipated 2045 volumes were provided and used to generate growth rates. A conservative 1.0% growth rate was used across the board, see **Attachment I** for the projected 2038 traffic volumes.

Operations

After applying a 1.0% growth rate to all movements at each of the eleven intersections, the values were entered into Synchro and a general optimization was completed. The raw Synchro outputs can be seen in **Attachment J**. The LOS results are shown in **Table 4**.

Table 4: *2038 Operational Analysis Level of Service Table*

Intersection	Traffic Control	Peak Hour	Parameters	West Approach			East Approach			South Approach			North Approach			Overall Intersection
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
Main Street & Green Bay Road	Signal	AM Peak	Lanes		2			1	1		2			2		
			LOS		D			E	B		D			F		D
			Delay (s)		40.6			61.3	12.1		47.1			85.1		37.8
			v/c ratio		-			-	-		-			-		
			Queue (ft)		550			200	125		200			400		
		PM Peak	Lanes		2			1	1		2			2		
			LOS		F			E	B		D			F		E
			Delay (s)		113.7			78.4	12.2		50.5			127.4		59.0
			v/c ratio		-			-	-		-			-		
			Queue (ft)		600			475	125		275			500		
Main Street & Torrey Street	Stop (South Approach)	AM Peak	Lanes	2		1	2			1		1				
			LOS	A		A	A			F		B				C
			Delay (s)	0.0		0.0	0.0			356.6		13.1				23.5
			v/c ratio	0.00		0.00	0.00			1.55		0.01				
			Queue (ft)	0		0	0			325		25				
		PM Peak	Lanes	2		1	2			1		1				
			LOS	A		A	A			F		B				D
			Delay (s)	0.0		0.0	9.4			472.8		10.6				31.5
			v/c ratio	0.00		0.00	0.07			1.79		0.01				
			Queue (ft)	0		0	25			350		25				
Main Street & Doty Avenue	Stop (East Approach)	AM Peak	Lanes		1			1			1			1		
			LOS		A			B			F			F		A
			Delay (s)		0.0			11.0			68.6			50.5		1.4
			v/c ratio		0.00			0.01			0.35			0.07		
			Queue (ft)		25			25			25			25		
		PM Peak	Lanes		1			1			1			1		
			LOS		B			A			F			F		B
			Delay (s)		10.6			9.7			267.7			76.8		13.9
			v/c ratio		0.01			0.03			1.22			0.11		
			Queue (ft)		25			25			175			25		
Church Street & Columbian Avenue	Stop (All-Way)	AM Peak	Lanes		1			1			1			1		
			LOS		C			A			B			A		B
			Delay (s)		15.6			9.9			12.3			9.3		13.4
			v/c ratio		0.61			0.22			0.40			0.07		
			Queue (ft)		100			25			50			25		
		PM Peak	Lanes		1			1			1			1		
			LOS		B			A			B			B		B
			Delay (s)		15.0			9.8			10.3			10.5		12.6
			v/c ratio		0.60			0.20			0.23			0.25		
			Queue (ft)		100			25			25			25		
Church Street & Doty Avenue	Stop (North/South Approaches)	AM Peak	Lanes		1			1			1			1		
			LOS		A			A			B			B		A
			Delay (s)		7.4			7.4			12.5			10.1		7.6
			v/c ratio		0.02			0.02			0.29			0.05		
			Queue (ft)		25			25			25			25		
		PM Peak	Lanes		1			1			1			1		
			LOS		A			A			B			B		A
			Delay (s)		7.4			7.5			10.7			12.0		6.9
			v/c ratio		0.02			0.01			0.13			0.25		
			Queue (ft)		25			25			25			25		

***Table 4** Continued…*

Intersection	Traffic Control	Peak Hour	Parameters	West Approach			East Approach			South Approach			North Approach			Overall Intersection
				LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
Church Street & Wisconsin Avenue	Signal	AM Peak	Lanes	1	1		1	1		1			1		1	
			LOS	A	A		A	A		E			D		D	B
			Delay (s)	5.6	9.0		7.2	3.9		59.0			44.0		43.9	12.1
			v/c ratio	0.53	0.46		0.04	0.80		0.79			0.07		0.03	
			Queue (ft)	#275	275		m25	#775		m225			25		25	
		PM Peak	Lanes	1	1		1	1		1			1		1	
			LOS	A	B		B	A		E			D		C	C
			Delay (s)	8.4	15.7		10.1	3.8		60.9			53.4		29.8	20.6
			v/c ratio	0.05	0.56		0.05	0.71		0.83			0.84		0.52	
			Queue (ft)	25	300		m25	m350		m75			200		75	
Commercial Street & Winneconne Avenue	Signal	AM Peak	Lanes	1	1	1	1	1		1	1		2			
			LOS	E	C	A	C	F		F	C		F			E
			Delay (s)	76.3	29.1	0.0	30.1	81.7		84.7	32.6		131.9			73.8
			v/c ratio	0.98	0.52	0.00	0.15	0.99		1.00	0.67		1.10			
			Queue (ft)	#400	275	0	50	#500		#350	375		#300			
		PM Peak	Lanes	1	1	1	1	1		1	1		2			
			LOS	D	C	A	C	D		D	C		F			E
			Delay (s)	49.0	22.1	0.0	21.5	46.9		47.7	30.1		172.0			63.5
			v/c ratio	0.93	0.49	0.00	0.16	0.84		0.84	0.76		1.25			
			Queue (ft)	#300	225	0	50	#375		#175	#400		#300			
Commercial Street & Columbian Avenue	Signal	AM Peak	Lanes	1	1		1	1		2			2			
			LOS	D	E		E	D		A			A			B
			Delay (s)	50.6	56.7		57.6	43.4		5.8			0.8			14.3
			v/c ratio	0.47	0.88		0.07	0.27		0.33			0.33			
			Queue (ft)	125	225		25	75		m200			50			
		PM Peak	Lanes	1	1		1	1		2			2			
			LOS	D	D		D	C		A			A			A
			Delay (s)	38.1	38.1		42.4	32.2		0.4			1.3			7.9
			v/c ratio	0.48	0.72		0.27	0.26		0.40			0.44			
			Queue (ft)	125	150		50	50		m100			m75			
Commercial Street & Doty Avenue	Stop (East/West Approaches)	AM Peak	Lanes	1			1			2			2			
			LOS	F			E			A			A			A
			Delay (s)	55.4			39.7			9.6			9.4			2.7
			v/c ratio	0.40			0.14			0.05			0.03			
			Queue (ft)	50			25			25			25			
		PM Peak	Lanes	1			1			2			2			
			LOS	F			F			B			B			B
			Delay (s)	193.9			194.8			10.6			10.4			14.6
			v/c ratio	1.05			0.94			0.06			0.02			
			Queue (ft)	150			125			25			25			
Commercial Street & Wisconsin Avenue	Signal	AM Peak	Lanes	1	1	1	1	1	1	1	1		1	2		
			LOS	D	C	C	C	D	D	A	B		A	C		C
			Delay (s)	39.7	32.6	25.6	32.3	51.2	35.4	3.8	13.3		1.0	20.1		23.9
			v/c ratio	0.81	0.47	0.03	0.16	0.70	0.09	0.17	0.87		0.02	0.94		
			Queue (ft)	100	200	m25	50	#325	25	#75	150		m25	275		
		PM Peak	Lanes	1	1	1	1	1	1	1	1		1	2		
			LOS	E	C	C	C	C	C	C	E		E	D		E
			Delay (s)	76.7	29.7	21.3	22.3	29.1	22.0	22.3	78.8		58.3	52.9		55.7
			v/c ratio	1.01	0.59	0.06	0.41	0.52	0.06	0.38	1.09		0.40	0.95		
			Queue (ft)	#275	200	m25	100	200	25	50	#775		#50	#450		
Commercial Street & Forest Avenue	Signal	AM Peak	Lanes	1			1			2			2			
			LOS	E			F			A			A			B
			Delay (s)	47.7			59.6			4.8			5.4			10.9
			v/c ratio	0.37			0.66			0.23			0.49			
			Queue (ft)	100			125			m100			225			
		PM Peak	Lanes	1			1			2			2			
			LOS	D			E			A			A			A
			Delay (s)	28.3			36.8			6.8			5.9			9.8
			v/c ratio	0.29			0.63			0.51			0.40			
			Queue (ft)	50			100			200			150			

HCM 6th Edition Outputs using Synchro 10 Software, queues reported using Synchro outputs.
#: 95th percentile volume exceed capacity, queue may be longer
m: volume for 95th percentile queue is metered by upstream signal

As **Table 4** shows, if existing intersection geometry remains, there are a number of intersections projected to operate at LOS E or F in the year 2038. However, it is important to note that while these values follow the 1.0% growth rate, a number of variables including new development and the advancement of connected and autonomous vehicles could drastically change the projected 20 year outcomes.

Parking Ramp Facilities

Church Street Ramp

The City requested MSA complete a preliminary review of the existing Church St ramp for feasibility of adding a second access location that does not utilize Church St.

During the site visit, two locations, one on either corner of the backside of the ramp facing the existing Kimberly Clark building were identified as possible locations for a secondary access. See *Figures 5 and 6* and **Attachment K** for a schematic of the two proposed openings.

Figure 5: Northwest corner of existing parking ramp

Figure 6: Northeast corner of existing parking structure

Structural Review

The City provided Architectural details for some of the walls of the ramp which was conceptually reviewed by MSA Structural Engineers. The review concluded that it appears adding a second access is likely feasible from a structural standpoint, however, further review of a full set of structural drawings would be necessary to confirm.

Additional Considerations

While structurally another access may be possible, there are a number of limitations and conflicts that would need to be addressed before it would be worth additional investigation and investment to commission structural design plans to implement change to the structure.

Northwestern Corner:

- Currently the property behind the ramp appears to be owned by Kimberly Clark. The driveway gets narrow, approximately 20-25 feet between the ramp and the building, and a semi loading dock is between both buildings. Approval and likely a permanent access easement would need to be granted for public traffic to utilize the driveway. In addition, impacts to truck access for the facility would also need to be discussed.
- There is a grade difference of approximately 3-5 feet from the back of the ramp to existing grade with limited existing sidewalk width between the structure and parking lot to create a ramp to bring vehicles down to existing grade. At a minimum, the current "on-street" parking stalls behind the ramp would likely be eliminated to provide a ramp up to a potential entrance.

Northeastern Corner:

- Similar to the northeast corner, an opening at this location would also likely require an easement with the adjacent property owners to gain access to Commercial St. However, moving the opening to this location avoids the loading dock mentioned previously.
- There is also a grade difference which would require a smaller ramp between the parking structure and existing ground. There is also a larger sidewalk distance to transition down to existing grade.
- As shown in *Figure 7*, there are three large server or electrical boxes directly behind the potential access that would require relocation. They likely belong to the Alta building and per the architectural plans, require separate concrete equipment pads. Depending on the official use, this could have significant downtime and cost to relocate.

Figure 7: Three existing electrical or server boxes on northeast corner of parking ramp

Recommendation

MSA believes a second access would provide congestion reduction in the downtown, however, at this time there are too many unknowns with easements, feasibility of relocating the large server/electrical boxes and how many vehicles would utilize an access to Commercial St to recommend moving forward with further structural review. If the City would like to pursue further, discussions with the adjacent property owners should be had to discuss feasibility.

Recommendations for Further Review

As requested by the City and based on the findings of this study, the following is a list of proposed action items to further investigate and improve traffic operations within the study area. These recommendations include intersection geometry changes, parking adjustments, road safety assessments and complete traffic flow alternatives.

Intersection Control Evaluations

After reviewing the geometry and operations of the existing intersections, there are three intersections recommended for further review through a more in-depth Intersection Control Evaluation (ICE). The three intersections to perform an ICE is as follows:

Main St & Green Bay Rd

The current split-phase traffic operations are typically not optimal for a signalized intersection and only utilized when limitations to capacity and space require this setup to maintain safe operations. This intersection also has heavy directional traffic depending on time of day. A road diet configuration does not provide sufficient capacity with the existing signal control during these peak times. Additional right-of-way is likely required to better optimize the safety and efficiency of the existing control. Alternatively, a roundabout may provide similar improved operations and safety with a varying amount of right-of-way requirements. An ICE report will determine which configuration will provide the most benefit and least impacts.

Main St & Torrey St

This intersection does not currently meet traffic signal warrants. However, with space for possible future developments on at least three of the four quadrants, it is likely this intersection will meet warrants in the future. Based on the findings of the downtown retiming analysis, the City may wish to promote inbound traffic from Main Street to use Torrey St/Smith St/Columbian Ave. The intersection may need to be reconstructed to achieve this. As part of the reconstruction design process, it is recommended that the intersection geometrics be reviewed for effectiveness of traffic signal and roundabout options both in the current location and alternately shifted to align more closely with Millview Road. This will require consideration of the grade changes coming across the bridge and two different intersection layouts in each location.

Promoting inbound traffic on Torrey St/Smith St/Columbian Ave will impact the intersection of Columbian Ave and Church St. It is recommended that the sight distance concerns at Church Street be considered with the realignment of Torrey St/Smith St/Columbian Ave. This could allow alternative traffic control at the all-way stop intersection of Church St and Columbian Ave.

Again, a more detailed ICE report would provide the ability to review development traffic, geometrics, grades and sight distance impacts for different intersection types to assess the ultimate improvement to this area.

Commercial St & Winneconne Ave

The Commercial St & Winneconne Ave intersection has heavy traffic movements northbound, southbound and eastbound. Because of this unique traffic demand and geometric configuration, it is recommended an ICE report be completed to review the effectiveness of a reconfigured traffic signal and a roundabout. For safety and operational considerations, the realignment of Church Street into a five-legged roundabout and possible access restrictions to surrounding businesses should also be considered.

Parking Ramp Alternatives

The City has identified multiple potential sites for a new parking structure. While this study has provided preliminary feasibility into access to existing and proposed new locations, a more detailed investigation assessing structural feasibility/cost, intended users, traffic patterns, and potential impacts to surrounding intersections would provide a clear picture of what location provides the greatest benefits to the surrounding area and businesses.

Road Safety Assessments

Based on the intersection crash reports provided by the City, a number of intersections experience higher than normal crash rates, especially for right-angle crashes, including Columbian Ave & Commercial St and Doty Ave & Church St. Columbian Ave & Commercial St is a signalized intersection that experiences a significant number of right-angle crashes. Doty Ave & Church St also experiences a number of angle crashes with low overall traffic volume and good existing intersection operations. It is recommended that a more thorough review of these intersections including field and video review and conceptual layouts for possible improvements be completed.

Traffic Flow Alternatives

Traditional improvements typically include adding capacity through additional thru and/or turn lanes. However, improvements to traffic operations are possible in ways beyond just infrastructure changes. In the downtown area specifically, the short blocks and relative grid system can be utilized to try to alter traffic flow patterns.

Currently, the majority of traffic entering the downtown from the west takes Main St to Wisconsin Ave and either makes a left turn at Church St into the parking ramp or a left turn at Commercial St. In coordinated networks, left turns are typically the most problematic movement at any intersection as they conflict with oncoming traffic and often take dedicated time away from the overall progression of traffic.

An alternative to this would be to create an unbalanced cross section potentially utilizing Torrey St/ Smith St/ Columbian Avenue to connect to Commercial Street. In this alternative, eastbound “through” traffic on Main St would be promoted to turn right onto Torrey St by providing two lanes of eastbound capacity and travel to Columbian Ave to connect to Commercial St.

Westbound traffic could continue to use Wisconsin Ave or a similar scenario could be created for westbound traffic on Doty Street. All streets would maintain two-way traffic, but capacity, intersection

control, and traffic signal operations would be designed to promote an informal one-way pair. This could have an added benefit of improving access to on-street parking in the commercial downtown and higher pedestrian awareness and safety where those users are heaviest.

Closing

A thorough review of the existing downtown corridor confirms many of both the City and MSA's initial assumptions entering the review: heavy conflicting volume and tight existing intersection configurations are leading to undesirable operations at a number of intersections within the downtown corridor. While no single change to the existing infrastructure can improve all intersections, the additional studies noted are intended to incrementally improve individual areas with the ultimate goal of maximizing the safety and efficiency of the corridor.

Attachments

Attachment A: Project Location Map
Attachment B: Raw Traffic Count Values
Attachment C: Network Peak
Attachment D: Traffic Signal Warrants – Main St & Torrey St
Attachment E: Traffic Signal Warrants – Main St & Doty Ave
Attachment F: 2018 Existing Conditions Raw Synchro Outputs
Attachment G: 2018 Proposed Raw Synchro Outputs
Attachment H: 2018 Proposed Timing Plans
Attachment I: 2038 Projected Traffic Volumes
Attachment J: 2038 Raw Synchro Outputs
Attachment K: Church Street Ramp Secondary Access Locations

Attachment A

Project Location Map

Legend

Study Intersections

0 125 250

Scale, Feet

MSA

Little Lake Butte des Mortes

Fox River

Kimberly-Clark Corp.

Private Lot

(Church Street Ramp) Marketplace/Alta Lot (Permit Parking)

Alta Resources

Plexus Corp.

Bemis Company, Inc.

Neenah Public Library

W. Canal Street

W. Wisconsin Avenue

E. Wisconsin Avenue

Church Street

Affinity Medical Group

Private Parking

Marketplace Lot (Public/Permit Parking)

W. Doty Avenue

E. Doty Avenue

Presbyterian Lot (Permit Parking)

Main Street

Martens Street

Brien Street

Parking Lot Access

Private Parking

Smith Street

Torrey Street

Sherry Street

W. Columbian Avenue

E. Columbian Avenue

City Hall

Walnut Lot (Permit Parking)

Oak Street

S. Church Street

Walnut Street

W. Franklin Avenue

E. Franklin Avenue

S. Commercial Street

Caroline Street

Washington Avenue

Olive Street

Adams Street

Isabella Street

W. Winnebome Avenue

Maple Street

Bond Street

W. Forest Avenue

E. Forest Avenue

N. Commercial Street

W. North Water Street

E. North Water Street

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Main Street

S. Green Bay Road

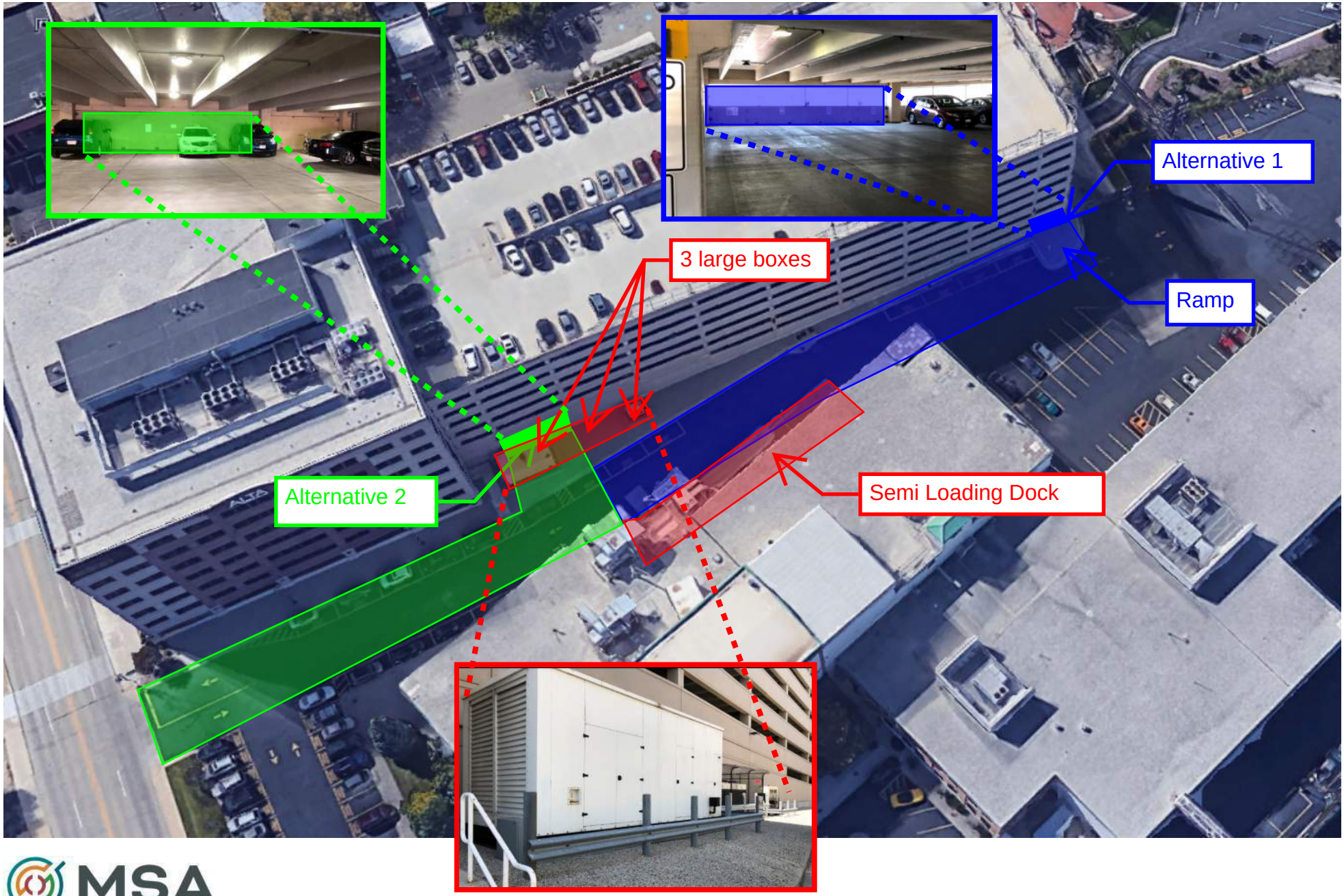
Denhardt Avenue

Plummer Avenue

Andrew Avenue

Richard Avenue

Attachment K: Possible Secondary Ramp Access



MSA