Report for

City of Wausau, Wisconsin

Downtown Traffic Analysis

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INTRODUCTION

1.01 BACKGROUND

In the year 2000, Strand Associates, Inc., was hired by both the Wisconsin Department of Transportation (WisDOT) and the City of Wausau to investigate traffic issues associated with downtown Wausau. This collaboration resulted in two reports and one addendum. The first report concerned itself with alternatives for the 1st Street/Washington Street intersection. This report later had an addendum looking at refinements to the selected intersection configuration. The second report was called the Business 51 Circulation Study and concerned itself with the conversion of many one-way streets in the Central Business District (CBD) to two-way operation.

Since these reports were completed, there has been a substantial amount of redevelopment that has occurred in the CBD, and there are many future redevelopment proposals being considered. This has caused City Officials to want to reevaluate many of the findings and recommendations of the Business 51 Circulation report in light of the new development that has occurred and is likely to occur.

Therefore, Strand Associates, Inc., has been hired by the City of Wausau to investigate the following issues and concerns:

1. Review previous recommendation to convert 1st Street and McIndoe Street to two-way operation from Grant Street to 6th Street.

2. Investigate converting 3rd Street to one-way southbound operation from Grant Street to Scott Street.

3. Investigate opening Washington Street to allow one-way eastbound traffic from the hotel parking lot to 3rd Street.

4. Determine the effectiveness of changing a through-left lane to a dedicated left-turn lane and protected left-turn phasing for the northbound-to-westbound movement at the 1st Street and Scott Street intersection.

5. Investigate the effect of converting 2nd Street to two-way traffic operation between Scott Street and Grant Street, and to allow on-street parking.

6. Investigate the effects of a proposed development on the 1st Street/McIndoe Street intersection.

7. Investigate converting the 3rd Street/McIndoe Street intersection to a roundabout.

This report investigates each of the above items. A section is devoted to each topic with a recommendation provided at the end of each section.

SECTION 2
1ST STREET CONVERSION TO TWO-WAY OPERATION

2.01 BACKGROUND

This section reviews the conversion of 1st Street and McIndoe Street to two-way operation from Grant Street to 6th Street (Figure 2.01-1). This conversion was first recommended in the Business 51 Circulation Study that Strand Associates, Inc., submitted to the City in 2000.

Figure 2.01-1 Conversion of 1st Street and McIndoe Street to Two-way Operation

2.02 ISSUES

Currently, there is substantial development and redevelopment being considered on McIndoe Street as well as new development occurring on 1st Street. There is concern within the city of how this development would affect the recommendations for two-way conversion presented in 2000. Specific questions follow:

- How will the Scott Street/1st Street intersection operate with two-way conversion and additional trips generated by these potential developments?
- How will the added trips from potential development affect the operation of the stop-controlled intersections of McClellan and Grant Streets with 1st Street?
- How will the existing two-lane urban roadway handle two-way traffic operation and added trips from potential development?

2.03 TRAFFIC VOLUMES

This study performed a preliminary review of the potential addition of 360 residential units to the intersection of McIndoe Street and 1st Street as well as 70,000 square feet (sq ft) of "multiuse" on the north side of McIndoe Street between 1st and 3rd Streets. The study also included the traffic effects from the Dudley Building currently being constructed. Both morning and evening operation was reviewed. However, the evening traffic volumes were substantially greater than morning and therefore controlled[1]. Therefore only the evening peak-hour operations are discussed in the remainder of this section. A summary of our findings and conclusions follows.

[1] Morning turning movements at the 1st/Scott intersection amounted to only 51 percent of the evening peak-hour turning movements at this intersection.

A. Redirected Traffic from Two-way Conversion of 1st Street

We reviewed the turning-movement counts at the Washington Street/1st Street intersection, the Scott Street/1st Street intersection, the McClellan Street/1st Street intersection, and the Grant Street/1st Street intersection. Potentially up to 300 vehicles could travel north on 1st Street during the evening peak hour if all of 1st Street and McIndoe Street were converted to two-way operation. This is roughly an additional 3,000 vehicles per day on 1st Street. This volume represents a maximum diversion number if the majority of traffic destined to the northeast uses 1st Street and McIndoe Street. It is likely that some of this traffic is destined for the Central Business District, so the actual experienced volumes probably will be lower.

B. Added Traffic from Possible Development on 1st Street and McIndoe Street

We examined the hourly and daily trip generation rates for some redevelopment of existing land uses that are being considered for the redevelopment area to the west of 1st Street and north of McIndoe Street. This redevelopment included 360 residential units along with 70,000 sq ft of nondisclosed "multiuse." For the purpose of analysis, we assumed 35,000 sq ft of this multiuse was General Office, 21,000 sq ft was Light Industrial, and 14,000 sq ft was Specialty Retail.

Using these assumptions, the proposed developments would generate about 300 vehicles per hour in the evening peak hour and about 3,260 trips daily. Table 2.03-1 shows these trip generation rates.

Land Use **Daily Trips**	Size	Unit	ITE Code	Rate	Total Trips
Residential Condos/Townhomes	360	Dwelling	230	5.86	2,110
Multiuse Property					
General Office	35,000	GFA	710	11.01	385
Light Industrial	21,000	GFA	110	6.97	146
Specialty Retail	14,000	GFA	814	44.32	620
Subtotal Multiuse Property					1151
Total DailyTrips					**3,261**
Hourly Trips					
Residential Condos/Townhomes	360	Dwelling	230	0.52	187
Multiuse Property					
General Office	35,000	GFA	710	1.49	52
Light Industrial	21,000	GFA	110	0.98	21
Specialty Retail	14,000	GFA	814	2.71	38
Subtotal Multiuse Property					111
Total Hourly Trips					**298**

Table 2.03-1 Trips From Possible McIndoe Street Development

C. Traffic Volumes from the Dudley Building

The Dudley Building is being constructed in the northwest quadrant of the Scott Street and 1st Street intersection. This building could house up to 500 employees. Using the ITE Trip Generation Manual, this building could generate about 230 trips during the evening peak hour and up to 1,660 daily trips. The parking for the Dudley Building is distributed among five locations within the Central Business District, so the building only contributes about 60 trips to 1st Street during the evening peak hour[2].

D. Resulting Traffic Volumes

Combining the redirected trips from changing 1st and McIndoe Streets to a two-way, with the trips generated from the possible McIndoe Street development, provides the estimated traffic volumes shown in Figure 2.03-1.

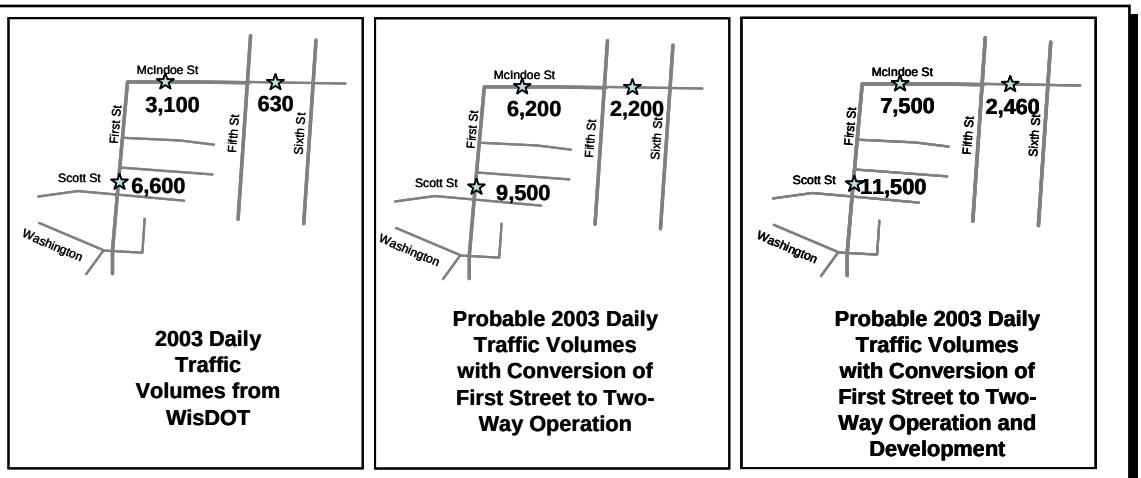

Figure 2.03-1 Resulting Daily Traffic Volumes

E. Traffic Volumes Compared to Typical Volumes Experienced by Different Classes of Roadway

Different urban classes of roadways typically experience different levels of traffic. The WisDOT's Facilities Development Manual (FDM) indicates a two-lane urban arterial can carry between 9,000 to 22,500 vehicles per day (vpd) before falling below an LOS D[3]. Urban Roadways typically fall into the following classes.

[2] Trip generation was distributed to network from each parking lot location, assuming 55 percent of the spaces dedicated to the Dudley Building employees would clear during the evening peak hour. (Note: the 55 percent is midpoint of the range provided by ITE's Traffic Engineering Handbook for an office building parking lot.)

[3] This range is affected by a variety of factors, including the number of signals, the green times allocated to the primary corridor, truck percentage, the number of access points, and other factors.

1. Local Street

Local streets generally carry 1,000 vpd or less. Local streets permit direct access to adjacent properties, and generally through movements are discouraged. Neighborhood and residential streets fall into this category.

2. Collector

The collector system provides both land access and traffic circulation within residential neighborhoods and commercial/industrial areas. Typical daily traffic volumes range from 1,000 to 10,000 vpd.

3. Minor Arterial

These streets connect with and augment the principal arterial system. Typical daily traffic volumes range from about 10,000 to 15,000 vpd. Minor arterials accommodate trips of moderate length at somewhat lower levels of mobility. This system begins to place more emphasis on travel movement and less emphasis on land access.

4. Principle Arterial–Nonfreeway

These streets are designed to carry high volumes of subregional traffic between population and employment centers. They emphasize mobility and are typically designed with some measure of access control. While having access control, they still typically have at-grade intersections at reasonable spacing. A principle arterial will typically be at least a four-lane roadway carrying volumes greater than 15,000 vpd.

One can see from Figure 2.03-1 that the volumes on 1st Street and McIndoe Street fall well within the typical volumes experienced by an urban collector or minor arterial, with the one exception occurring on McIndoe Street between 5th and 6th Streets. This block is currently on a connecting highway and is classified as an arterial street although it does have residential land uses adjacent to the roadway. This portion carries about 630 vpd. With the conversion of 1st Street and McIndoe Street to two-way operation, more traffic that is oriented to the northeast could be directed toward 6th Street[4]. With this redirection, this block could experience traffic volumes up to 2,500 vpd. Typically traffic volumes of 1,500 vpd or more are considered undesirable on a residential street yet are fully appropriate and even low for an arterial.

[4] The study assumed about half of the traffic oriented to the northeast would use 3rd Street, and the other half would use Sixth Street.

2.04 TRAFFIC OPERATIONS

The operation of an intersection is described as its level of service (LOS). LOS ranges from A (very good) to F (very poor) with each level corresponding to a certain amount of average delay a vehicle experiences. The delay is average as some vehicles will experience more delay while others will experience less. Most communities establish LOS D as the minimum acceptable LOS.

We analyzed the possible operations of the 1st Street intersections with the redirected and new traffic using Synchro, Signal2000, and HCS computer software. Described below are the intersection operations with the added traffic.

A. 1st Street and Scott Street

This intersection will operate at an all-around LOS C with an average vehicle delay of about 21 seconds during the evening peak hour. While the LOS is acceptable, queues will become longer. The south and east approaches will experience slightly more delay. All approaches will experience maximum queues of between 200 and 300 feet. This intersection is discussed in more detail in Section 5 of this report.

Some of the microsimulation modeling performed suggested that the south approach of the intersection could perform better if it was marked as a dedicated left and dedicated through lane instead of the shared through/left and dedicated through lane that currently exists. This lane designation option should be explored further.

B. 1st Street and McClellan Street

Side-road vehicles on McClellan Street will experience more delay during the evening peak hour. These vehicles will experience an LOS D with an average of 30 seconds of delay. This is a poorer operation level yet not necessarily uncommon during rush hour for side streets that join arterials and collectors.

If 2nd Street is converted to two-way operation, these vehicles would have an alternate route to access Scott Street.

C. 1st Street and Grant Street

Side-road vehicles on Grant Street will experience more delay during the evening peak hour. These vehicles will experience an LOS D with an average of 28 seconds of delay. This is a poorer operation level yet not necessarily uncommon during rush hour for side streets that join arterials and collectors.

If 2nd Street is converted to two-way operation, these vehicles would have an easier alternate route to access Scott Street.

D. 1st Street and the Dudley Building Entrance

Delays for vehicles exiting the Dudley Building parking lot should be similar to what is experienced at the adjacent side roads. Because only about 105 parking spaces are being planned for the Dudley Building site, exiting volumes from this entrance should be moderate. Queuing from the Scott Street/1st Street intersection will extend from 200 to 250 feet, which on occasion will block the exit for the Dudley Building parking lot. When the exit is blocked, vehicles will have to wait for a green phase on 1st Street before they will be able to exit the parking lot.

2.05 OTHER CONSIDERATIONS

Converting 1st Street to two-way operation between Grant Street and McIndoe Street will require changing lane configurations. This block is oriented on an angle so that the lanes feed the southbound lane of the next (southerly) block. Providing a northbound lane on this block will either require reconstructing the east curb line or removing one of the southbound through lanes on the McClellan Street to Grant Street block to accommodate the lane shift through striping. Relocating the east curb line is probably the best option. Accommodating the lane shift through striping is less desirable, yet would accomplish the objective. This lane striping concept is illustrated in Figure 2.05-1.

Figure 2.05-1 Lane Shift to Accommodate Two-Way Operation

2.06 CONCLUSIONS

1. The conversion of 1st and McIndoe Streets to a two-way operation will increase traffic volumes on 1st Street and McIndoe Street by 50 to 100 percent. While this is a larger increase, the traffic volumes are still within the range typically handled by urban streets. The lower portion of 1st Street, from McClellan Street south, will need to function as a four-lane roadway while the upper portions of 1st Street and McIndoe Street can function as two-lane roadways.

2. The one exception to the above statement is the block of McIndoe Street between 5th and 6th Streets. The traffic volumes on this connecting highway could increase from about 630 vehicles per day to about 2,460 vehicles per day, an increase of approximately 400 percent.

3. The conversion of 1st and McIndoe Streets to a two-way operation and the possible new development will add similar amounts of traffic, each contributing about 300 vehicles in the peak hour.

4. The added traffic from these two factors will cause operation levels to deteriorate somewhat. Overall LOS at the 1st Street and Scott Street intersection will remain satisfactory (LOS C), but queues may grow to between 200 and 300 feet during periods of the peak hour.

5. The south approach of the 1st Street and Scott Street intersection should be monitored. It may be necessary to redesignate the left lane to a dedicated left lane instead of a shared through/left lane. Microsimulation results are discussed in Section 5.

6. The side-road delay on McClellan and Grant Streets as they join 1st Street will increase, bringing the LOS to D. While this is a poorer operation level, it is not uncommon during rush hour among urban side streets that join arterials and collectors. These delays may decrease if 2nd Street is converted to two-way operation from Scott Street to Grant Street.

7. The intersection of McIndoe Street and 1st Street will need to be reviewed further once details regarding the potential developments become available.

SECTION 3
3RD STREET CONVERSION TO ONE-WAY SOUTHBOUND OPERATION

3.01 BACKGROUND

Third Street runs north/south parallel to the Wisconsin River. It is a one-lane one-way street northbound between Washington Street and Grant Street as it currently distributes CBD-destined traffic originating from the west. North of Grant Street, it is a two-way roadway. In 2004, 3rd Street carried about 2,300 vpd. The one-way portion of 3rd Street has angle parking on the street.

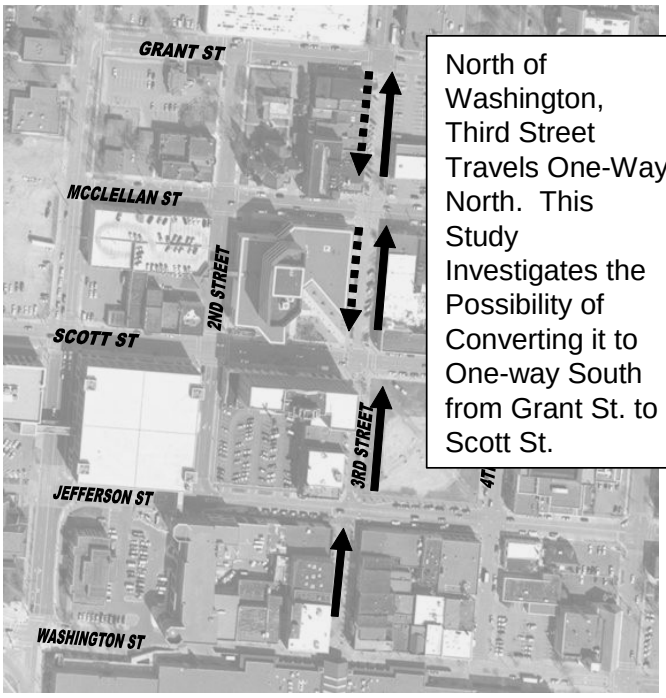

Figure 3.01-1 3rd Street Between Jefferson and Grant Streets

The North Downtown Area Master Plan, commissioned by the Wausau Main Street Program and prepared by Schreiber/Anderson Associates, Inc., in association with BEST Real Estate Group, Inc., suggested converting 3rd Street to one-way southbound operation between Grant Street and Scott Street. Currently Third Street travels one-way to the north between Washington and Grant Streets. Beyond Grant Street, 3rd Street is a two-way roadway. The report suggests that changing the direction would improve access to the CBD. Figure 3.01-1 shows an aerial view of 3rd Street between Scott Street to the south and Grant Street to the north.

3.02 ISSUES

There will be several effects caused by the conversion. They include:

- Rerouting of vehicles traveling outbound from the CBD.
- Change in operation of the Scott Street/Third Street Intersection.
- Change in operation of the Grant Street/Third Street Intersection.
- Effects to the angle parking between Jefferson and Grant.
- Signal needs at the Scott Street/Third Street Intersection.

3.03 EXISTING CONDITIONS

The WisDOT publishes traffic volumes in its Traffic Volume Data book. According to this book in 2004 3rd Street carried 2,300 vehicles per day (vpd) north of Franklin Street. This is a relatively low traffic volume for a commercially-oriented street.

The City of Wausau collected PM peak-hour turning-movement counts at the 3rd Street/Grant Street intersection, where 3rd Street turns from a two-way street to a one-way street. These counts are illustrated in Figure 3.03-1. They indicate that about 103 vehicles are using 3rd Street to travel north during the PM peak hour. This traffic will be shifted to adjacent streets, such as 1st Street or 4th Street until the traffic reaches McIndoe Street. Here the traffic may continue to use 3rd Street northbound or may travel to 6th Street.

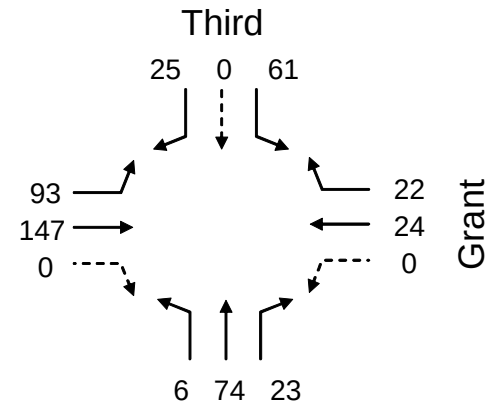

Figure 3.03-1 Existing 3rd Street and Grant PM Peak-Hour Turning Movements

From Jefferson Street to Grant Street, the geometry of 3rd Street is set up for one-way operation with angle parking on one side of the roadway. The location of the parking shifts from the east side to the west side, depending on the block. Figure 3.03-2 conceptually illustrates the roadway geometry.

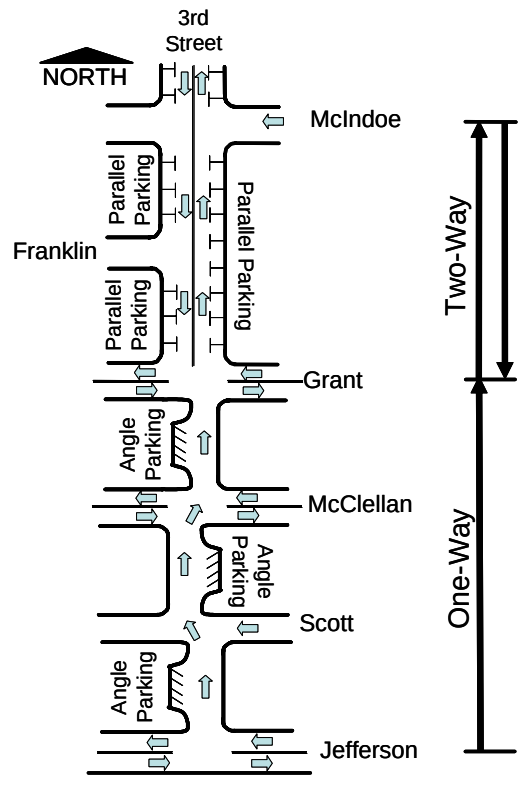

Figure 3.03-2 Existing 3rd Street Conceptual Geometry

3.04 EVALUATION

Each of the intersections along 3rd Street between Grant Street and Scott Street would be affected by the travel direction conversion. The intersections of 3rd Street with Grant Street, McClellan Street, and Scott Street were evaluated to determine how they currently operate, and whether operations would seriously deteriorate with the proposed conversion of 3rd Street.

A. Traffic Redirection

As mentioned, vehicles that travel north on 3rd Street will be redirected to other adjacent roadways. This means that up to 1500 vpd of northbound traffic will be redirected to 1st Street (if converted to two-way operation), 4th Street, and 6th Street. Conversely, 3rd Street will draw southbound vehicles from 1st Street and 5th Street. It is likely that this section would draw between 1300 and 1700 vpd from these adjacent streets. Most of this traffic would be specifically destined for businesses located on 3rd Street, while some may use 3rd Street as an alternate access to Scott Street.

B. Traffic Operations

To project turning movements with the travel direction change, we estimated an average daily traffic for 3rd Street and converted it to an hourly southbound movement. Left- and right-turning movements were then placed to mirror the movements that now occur with the northbound movement.

With these assumptions, both the existing conditions and the proposed direction change move traffic satisfactorily. Table 3.04-1 compares the operation levels at each of the previously mentioned intersections. The overall intersection delay remained essentially the same at the intersections of 3rd Street/Grant Street and 3rd Street/McClellan Street. At the intersection of 3rd Street/Scott Street, the overall intersection delay increased by about 5 seconds. None of these changes in operation levels are significant and basically provide comparable operation levels to what exist today.

2006 Overall Operation	Existing One-Way Northbound Operation	One-Way Southbound Operation
3rd Street/Grant Street Intersection	A 8.3*	A 8.4*
3rd Street/McClellan Street Intersection	A 8.0*	A 7.7*
3rd Street/Scott Street Intersection	A 6.1*	B 11.2*

* All numbers represent average delay in seconds

Table 3.04-1 Operation Levels of the 3rd Street Intersections

C. Parking Configuration

As mentioned, 3rd Street has angle parking stalls oriented to the north between Jefferson Street and Grant Street. Most of these parking stalls can be reoriented to southbound traffic by restriping the stalls. Depending on the end treatments at the end of each block, it is possible that there could be a parking loss of zero to two stalls per block.

D. Signal Modifications

This study examines converting 3rd Street to one-way south operation only to Scott Street. If 3rd Street is converted to one-way southbound only to Scott Street, there will need to be modifications made to both the signal, the signing, and the intersection. These modifications include:

- A right-turn-only signal indication should be affixed to the signals for the southbound direction.

- A left-turn-only signal indication should be affixed to the signals for the northbound direction. This signal could be run split phase with the southbound signal, or run concurrently with the southbound signal phase. If it is run concurrently, we recommend pavement markings to direct both north- and southbound traffic into the appropriate westbound lanes.

- Do not enter signs should be installed in the opposite side of the intersection for both northbound and southbound traffic.

- Consideration of installing bump outs that discourage drivers from traveling through and across the intersection in the wrong direction.

3.05 CONCLUSIONS

Changing the travel direction on 3rd Street appears to have minimal effect on traffic operations or volumes. The change would relocate northbound traffic to adjacent streets that likely would be offset by southbound traffic drawn from other adjacent streets. Therefore, if the City desires to explore the effects of changing the travel direction on 3rd Street to change the primary access to the CBD, there should be no adverse effects.

SECTION 4
OPENING WASHINGTON STREET EASTBOUND

4.01 BACKGROUND

Washington Street runs perpendicular to the Wisconsin River and provides a major access road to the parking ramp for the mall. Washington Street operates with two-way traffic between 1st Street and a hotel parking lot east of the mall parking ramp entrance/exit. Past the hotel parking lot entrance, Washington Street is closed to traffic. Figure 4.01-1 shows an aerial view of Washington Street between 1st Street to the west and 3rd Street to the east. The hotel parking lot is visible in the center of the photo, while the mall is the building at the bottom.

Figure 4.01-1 Washington Street Between 1st and 3rd Streets

Sometimes vehicles exiting the parking ramp and desiring to travel north or east enter the hotel parking lot to the north and use it to access 3rd Street. According to turning movements taken by the City of Wausau, about 26 vehicles cut through the hotel parking lot during the evening peak hour. This amounts to about 30 percent of the exiting traffic from this ramp, and could be up to 260 vehicles per day. Figure 4.01-2 illustrates the turning-movement counts during the evening peak hour.

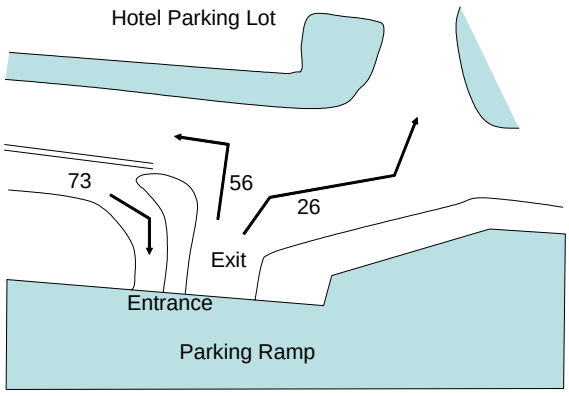

Figure 4.01-2 Parking Ramp Turning Movements

Currently there are two exit lanes at this location to the mall parking ramp. In theory, vehicles exiting from the ramp should turn left, yet some turn toward the hotel parking lot. This leads to some confusion amidst vehicles leaving the parking ramp. Figure 4.01-3 illustrates this conflict.

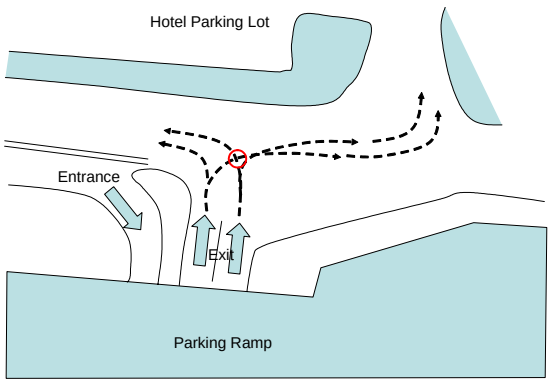

Figure 4.01-3 Parking Ramp Exit Conflict

The City of Wausau would like to investigate the possibility of opening Washington Street to eastbound traffic to connect it with 3rd Street. Figure 4.01-4 shows a picture of the parking ramp exit.

Figure 4.01-4 Parking Ramp Exit

4.02 ISSUES

There are several considerations with the opening of Washington Street to traffic. These include the following:

- How would the redirected traffic affect 3rd Street traffic volumes?
- How would the opening affect a delivery area used by the mall? (See Figure 4.02-1.)
- Would the opening of the street eliminate the confusion that occurs when two vehicles exit the ramp simultaneously?

Figure 4.02-1 Loading Dock

4.03 ALTERNATIVES

There are three alternatives for Washington Street. One signs and marks the parking ramp exit so that vehicles in the left exit lane can only turn left.

The second option opens Washington Street beyond the parking ramp exit to one-way traffic. With this alternative, the east exit lane would need to be signed for right turns only, and the west exit lane would be signed for left turns only. In addition to this, the pavement would need to be altered to provide a continuous eastbound lane[1]. Failure to provide this continuous eastbound lane would lead to vehicles violating lane designations and traveling around the island.

The third option requires the same lane modifications as the second, but the signing for vehicles exiting the parking ramp is different. The manned left exit allows vehicles to turn left or right. The automated right exit lane requires vehicles to make a right turn. Figure 4.03-1 illustrates the three alternatives.

[1] While much of the pavement for this is there, some alteration to the westbound right turn lane probably will be necessary to obtain a full width eastbound lane.

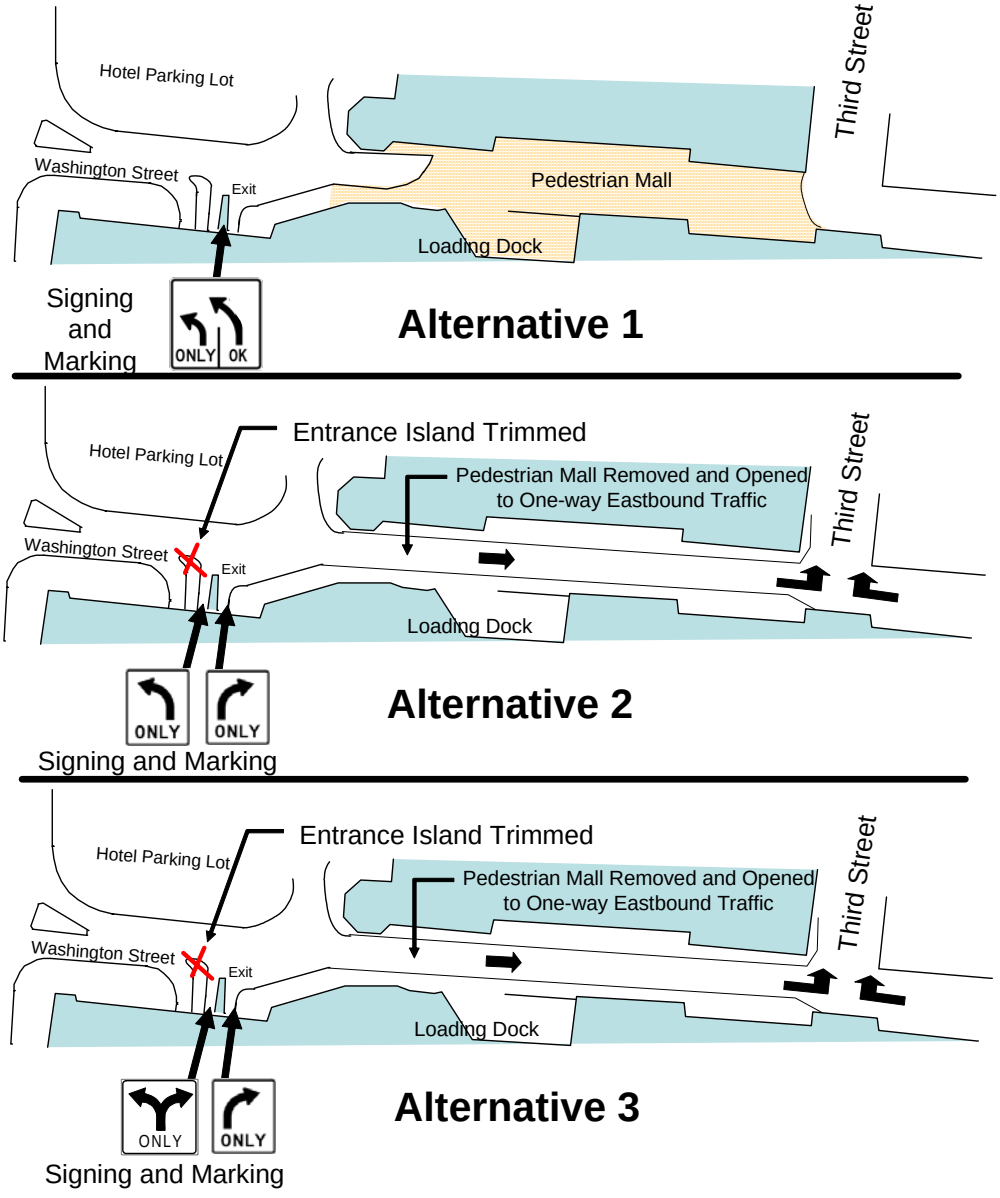

Figure 4.03-1 Alternatives

4.04 ALTERNATIVE EVALUATION

Table 4.04-1 compares the existing conditions with Alternatives 1, 2 and 3.

Evaluation Item	Existing Conditions	Alternative 1	Alternative 2	Alternative 3
Eliminates Confusion at the parking ramp exit ramp	No	Yes	Yes	Yes
Eliminates or reduces traffic cutting through hotel parking lot	No	No	Yes	Yes
Impacts to Pedestrian Mall	None	None	Eliminates pedestrian mall	Eliminates pedestrian mall
Traffic volume added to 3rd Street	None	None	Potentially 200 to 400 vpd	Potentially 200 to 400 vpd
Infrastructure Cost to implement	None	Minimal	Substantial	Substantial
Impacts to Loading Dock	None	None	Potentially more difficult to back into	Potentially more difficult to back into
Traffic Operations in Adjacent Intersections	Satisfactory (LOS C or above)	Satisfactory (LOS C or above)	Satisfactory (LOS C or above)	Satisfactory (LOS C or above)

Table 4.04-1 Comparison of Existing Conditions–Alternatives 1 and 2

Alternatives 2 and 3 restrict turning movements of mall patrons and/or mall employees. The left exit is a manned booth used primarily by mall patrons. The right exit is an automated booth used primarily by mall employees. Therefore Alternative 2 requires that mall patrons be directed to 1st Street and mall employees be directed to 3rd Street.

Conversely, Alternative 3 allows mall patrons the option to travel to either 1st Street or 3rd Street. Mall employees must travel only to 3rd Street or use the manned left lane booth.

Both Alternatives 2 and 3 will affect, and be affected by the loading dock adjacent to the mall. There will be periods where trucks backing up to the loading dock will block eastbound traffic. These eastbound traffic volumes are likely to be quite low, and the truck loading should represent just a minor inconvenience.

4.05 RECOMMENDATION

All three alternatives provide a reasonable solution to the challenges described in the first part of this section. Alternative 1 has less infrastructure costs then Alternatives 2 and 3, yet is not as effective in eliminating cut through traffic in the north parking lot. Alternatives 2 and 3 provide better access for

vehicles destined to the northeast, with Alternative 3 providing more directional choices for mall patrons.

SECTION 5
NORTHBOUND APPROACH LEFT-TURN LANE AND PHASING AT 1ST STREET/SCOTT STREET

5.01 BACKGROUND

Near the Scott Street intersection, 1st Street is a two-way roadway that runs north-south to Grant Street on the west end of Wausau's CBD. North of Grant Street, it is a one-way southbound roadway. Scott Street is a three-lane street that travels one-way to the west. The lane configuration is show in Figure 5.01-1. The intersection is signalized with two phases.

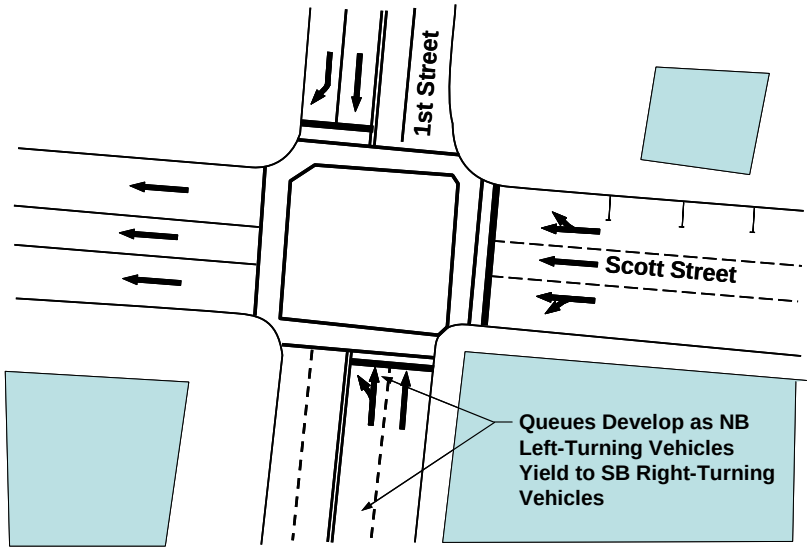

Figure 5.01-1 1st and Scott Street Intersection

During the north-south phase of the signal cycle, the northbound left-turning vehicles must yield to southbound through traffic. Unfortunately, these left-turners also tend to yield to southbound right-turning vehicles, decreasing the efficiency of the northbound lane and leading to queues. Part of this problem may result from the small 20-foot radius in the northwest quadrant of the intersection. This smaller radius encourages southbound to westbound drivers to overtrack into the middle lane as they travel west on Scott Street. Since the southbound right turn is the predominant movement on the north approach, this unnecessary yielding occurs frequently. Figure 5.01-2 shows the evening peak-hour turning movements at this intersection.

Figure 5.01-2 1st and Scott Street Intersection PM Peak-Hour Turning Movements

The City would like to know if there is a more efficient signal timing or lane configuration that would reduce the northbound queues and cause the intersection to operate more efficiently.

5.02 ALTERNATIVES

We investigated the following alternatives that could be implemented to resolve this queuing problem.

- Alternative 1–Existing conditions. With this alternative, the striping, lane designation, and signal phasing remain the same.

- Alternative 2–Stripe the intersection more effectively so that the left-turning movements do not yield to the SB right-turning movements. This would involve installing lane extension lines as described in the MUTCD 3B.08. With this improvement, the north approach would maintain its dedicated right-turn lane and a dedicated through lane. The south approach would have a dedicated left-turn lane and dedicated through lane. The signal phasing would remain two phases. There are two striping options with this alternative. Option A directs all southbound to westbound turners into the right-most westbound lane. This option would best be accomplished by softening (enlarging) the curb radius in the northwest quadrant to make the maneuver easier to accomplish. A right-turn bypass lane could also be used. Option B directs southbound to westbound right turners into both the middle and right most westbound lanes. This requires that northbound to westbound left turners turn into the left-most Scott Street lane. This arrangement is somewhat uncommon and may not produce the same operational benefits of Option A because left turners may still yield to right-turning traffic. These northbound to westbound left turners may also have similar overtracking concerns and travel into the middle lane. This alternative's two options are illustrated in Figures 5.02-1 and 2. It should be noted that with this alternative, and Alternative 3, the north approach has two receiving lanes while the south approach has only one lane feeding it. Similarly, the south approach has two receiving lanes and only one lane feeding from the north.

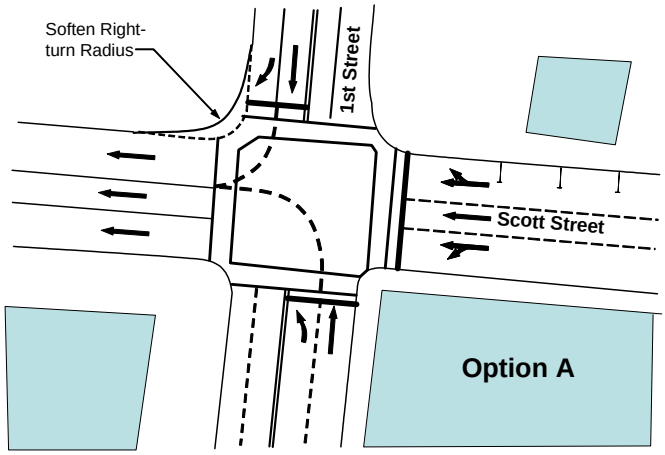

Figure 5.02-1 Alternative 2–Lane Extension Lines – Option A

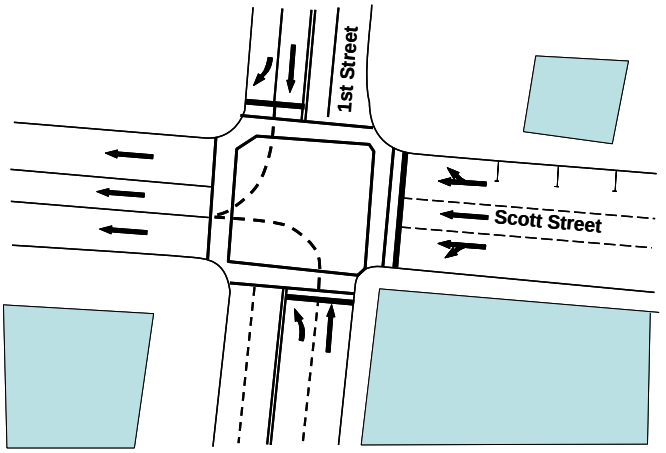

Figure 5.02-2 Alternative 2–Lane Extension Lines – Option B

- Alternative 3 – Add a protected/permitted left-turn phase for the northbound movement and then provide a lead for the northbound movement. With this alternative, the south approach would also be redesignated to include a dedicated left-turn lane and a dedicated through lane. Figure 5.02-3 illustrates the signal phasing associated with this alternative.

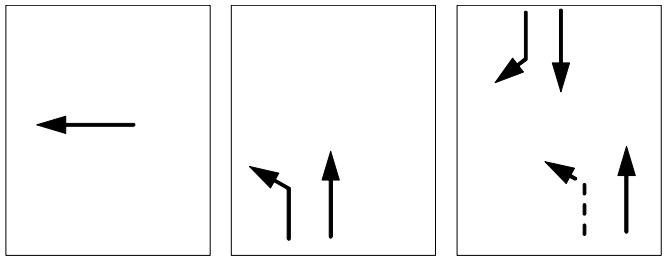

Figure 5.02-3 Alternative 3–Signal Phasing

5.03 ALTERNATIVE EVALUATION

Table 5.03-1 summarizes the traffic operations for all three alternatives from the traffic operations modeling. The analysis used existing traffic volumes only and did not consider any additional traffic from adjacent redevelopment, although additional redevelopment traffic would probably yield similar conclusions. Note that the operations predicted for the existing conditions are better than actual conditions. This is occurring because the modeling program is assuming full use of the northbound left turn lane, when actually the northbound left turn is hindered by the yielding problem previously discussed. Additionally, the traffic modeling software can not model the differences between Options A and B of Alternative 2. It is our opinion that Option A would provide better operations for the northbound left turn lane.

		Alternative 1 Existing Conditions	Alternative 2 Striping and Lane Redesignation	Alternative 3 Protected/ Permitted Signal Phasing
Overall Intersection Operation	LOS	B	B	C
	Delay	13.8 sec	14.2 sec	22.7 sec
NB Left Operation*	LOS	(B*)	B	A
	Delay	(13.4*)	12.8 sec	10.0 sec
	Queue	(89'*)	82'	70'

* Existing Condition Operation is for NB approach (all movements) instead of NB left.
All numbers represent average delay in seconds

Table 5.03-1 Operation Levels for 1st Street and Scott Street Intersection, PM Peak Hour

5.04 CONCLUSIONS AND RECOMMENDATIONS

With Alternative 1 (existing conditions), the analysis suggests that if the intersection was operating properly, and northbound left-turning vehicles were not yielding to southbound right-turning vehicles, operation levels would be satisfactory. The operations modeling also indicates that

queues would only be of moderate length. Yet this is not the case and the queuing experienced at the intersection is greater than what the modeling software predicts.

Conversely, Alternative 3 (protected permitted phasing) seems to address the northbound left-turn queuing concerns yet decreases the intersection LOS to C and adds almost 10 seconds of overall delay. Additionally, Alternative 3 would require retrofitting the existing signals with five-section heads to implement the protected/permitted phasing, with requires more infrastructure investment.

Therefore, we recommend implementing Alternative 2. We believe that Option A would provide better operations than Option B, yet either could provide an improvement. This alternative requires smaller amounts of infrastructure investment and may help direct travelers more effectively than the current lane configuration. Additionally, this alternative does not appear to decrease the performance of the intersection. If Alternative 2 does not provide the desired operations, Alternative 3 could be implemented.

SECTION 6
2ND STREET CONVERSION TO TWO-WAY TRAFFIC

6.01 BACKGROUND

2nd Street runs north/south parallel to the Wisconsin River. It is a one-way street northbound as it currently distributes CBD-destined traffic originating from the west. Currently, 2nd Street carries about 1,800 vpd between Scott Street and McClellan Street and about 900 vpd between McClellan Street and Grant Street. The portion of 2nd Street between McClellan Street and Grant Street is about 33 feet wide, while from Scott Street to McClellan Street, it is about 40 feet wide.

The City is considering converting 2nd Street north of Scott Street to two-way operation. Some national urban planners have suggested that two-way traffic operation may provide better access to retail businesses in a CBD.

Figure 6.01-1 shows an aerial view of 2nd Street between Scott Street to the south and Grant Street to the north.

Figure 6.01-1 2nd Street Between Scott and Grant Streets

6.02 ISSUES

There are a couple of factors considered in this evaluation:

- How will two-way operation on 2nd Street affect the operation of the 2nd Street and Scott Street intersection?
- What changes will be needed to the signals to accommodate this direction change?
- How will two-way operation on 2nd Street affect the parking garage entrance/exit that is located on 2nd Street as well as the bank drive through?
- Does two-way conversion preclude street parking?
- Does the 2nd Street/Scott Street intersection lane marking need to be changed?

6.03 ALTERNATIVES

There are two alternatives for 2nd Street. The first alternative keeps the existing conditions; it allows the existing one-way northbound operation to continue. The second alternative converts 2nd Street to two-way operation between Scott Street and Grant Street.

With this alternative, signal heads will need to be provided to accommodate the southbound movement. This would entail adding three signal heads for the southbound movement, with a right turn only indication. Additionally, lane markings would need to be adjusted to those shown in Figure 6.03-1. This will cause a dual left turn lane in the northbound direction, requiring a three phase signal sequence for the intersection.

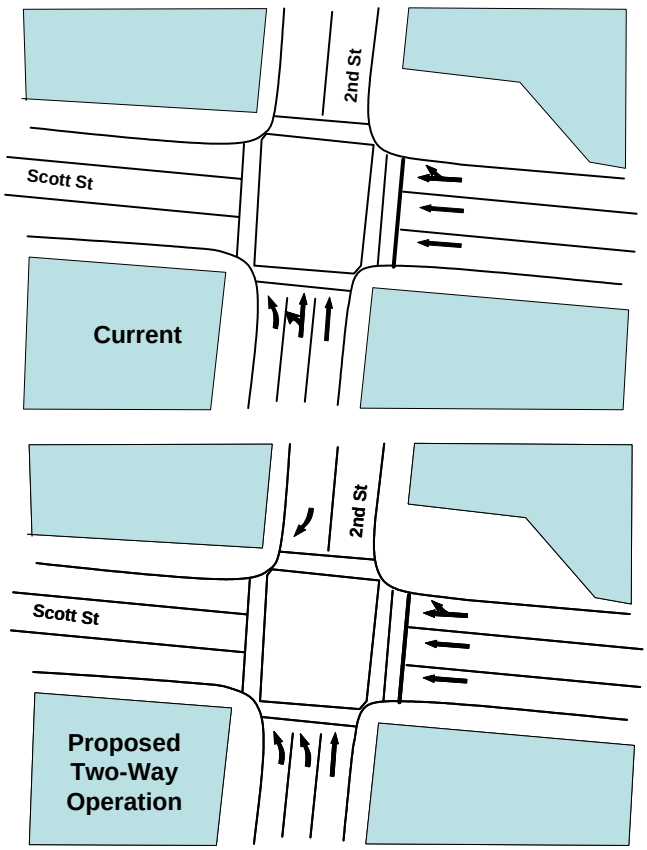

Figure 6.03-1 Change in Pavement Markings at Scott St/2nd Street

6.04 ALTERNATIVE EVALUATION

The three intersections that would be most affected by this change are the intersections of 2nd Street/Grant Street, 2nd Street/McClellan Street, and 2nd Street/Scott Street. These intersections were examined to determine how they currently operate and if operations would seriously deteriorate with the proposed conversion of 2nd Street to two-way traffic.

Operationally, both alternatives move traffic satisfactorily. Table 6.04-1 compares the operation levels for both alternatives at the 2nd Street/Grant Street, 2nd Street/McClellan Street and 2nd Street/Scott Street intersections. Essentially all intersections operate the same with or without two-way conversion except for the 2nd Street/Scott Street intersection. Because of the additional

2006 Overall Operation	Existing One-Way Operation (Alternative 1)	Two-Way Operation (Alternative 2)
2nd Street/Grant Street Intersection	B 11.6*	B 11.3*
2nd Street/McClellan Street Intersection	A 7.9*	A 8.4*
2nd Street/Scott Street Intersection	B 10.6*	C 22.0

* All numbers represent average delay in seconds.

Table 6.04-1 Operation Levels of the 2nd Street Intersections

signal phase required by the dual left turn lane on the south approach, this intersection drops from LOS B to LOS C with an additional 11 seconds of delay. Even with this additional delay, the intersection operates within acceptable levels of service.

The conversion of 2nd Street to two-way operation could also lead to some awkward turning movements into the M&I Bank drive-thru entrance because of the its location in relation to the McClellan Street intersection. This is shown in figure 6.04-1.

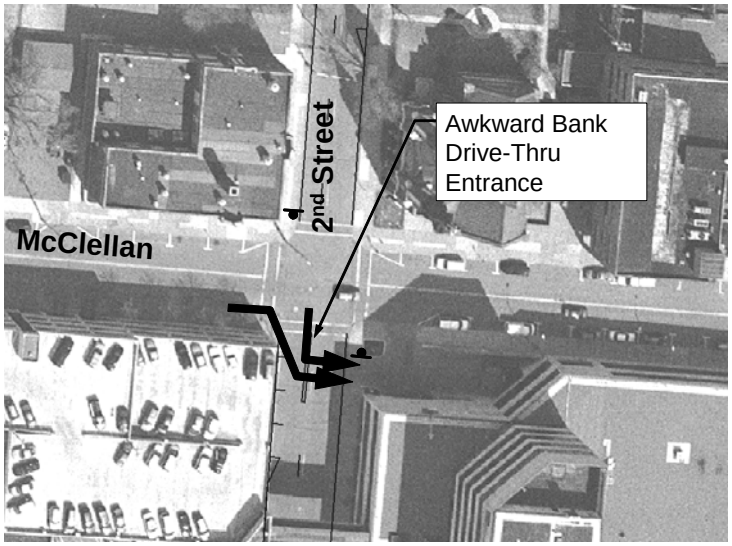

Figure 6.04-1 2nd Street Turning Movements Near M&I Bank

6.05 PARKING

In addition to two-way conversion, the City of Wausau is also interested in adding on-street parking spaces on the roadway between Scott Street and Grant Street. More parking spaces can be provided if parking is located on the east side of the street between Scott Street and McClellan Street. Between McClellan and Grant Streets, the parking spots should also be located on the east side of the street and begin past the Church of the Resurrection. Six on-street parking spaces would be available on the block between Scott Street and McClellan Street and five on-street parking spaces would be available on the block between McClellan Street and Grant Street. Figure 6.05-1 illustrates the locations of potential on-street parking spaces.

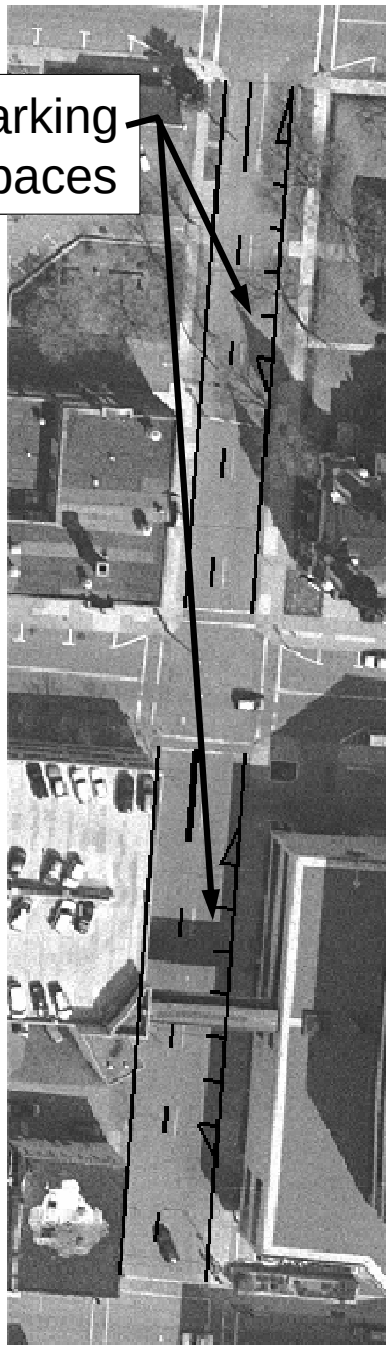

Figure 6.05-1 Proposed Cross Section of 2nd Street With Parking

6.06 RECOMMENDATION

If the City desires to convert 2nd Street to two-way operation, there should be no significant detriment to the system. The operational levels at two of the intersections will remain essentially the same. The 2nd Street/Scott Street intersection will drop one level of service and add about 11 seconds of delay. Service levels will remain at what is typically considered acceptable for an urban intersection. If the two-way conversion is implemented, the signals at Scott Street will need to be modified to accommodate the southbound movements and the lane markings will need to be modified.

SECTION 7
DEVELOPMENT AND INTERSECTION CONFIGURATION AT 1ST STREET/MCINDOE STREET

7.01 BACKGROUND

1st Street runs north-south parallel to the Wisconsin River and is the western boundary of the study area. It is a two-lane one-way street southbound from McIndoe Street to Grant Street then continues south as a two-way street.

McIndoe Street runs east/west perpendicular to the Wisconsin River. It is a one-way street westbound as it currently helps to distribute CBD-destined traffic originating from the north. In 2004, McIndoe Street carried an average of 2,800 vpd.

Figure 7.01-1 Intersection of 1st Street and McIndoe Street

The City of Wausau has proposed to open both 1st Street and McIndoe Street to two-way traffic. This analysis assumes this change will occur.

A development is proposed at the corner of 1st Street and McIndoe Street that will generate additional traffic at the intersection. Figure 7.01-1 shows an aerial view of the intersection of 1st Street and McIndoe Street.

7.02 ISSUES

The City of Wausau wants to ensure that the appropriate intersection treatment is provided at this intersection that both accommodates trips generated from the new development and accommodates two-way operation. Intersection treatments investigated include conventional stop-controlled as well as a roundabout.

It is unclear how properties might be developed and/or redeveloped and the type of access they will require. For this study, we modeled the 1st Street/McIndoe intersection as a four-legged intersection, adding an approach on the west side. The intersection configuration should be reevaluated once redevelopment site plans are further along.

7.03 TRIP GENERATION

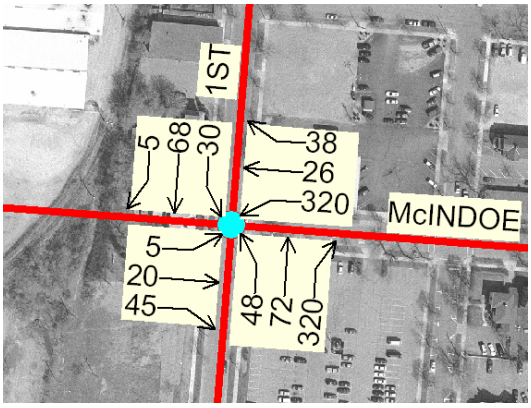

Figure 7.03-1 Traffic Distribution

Based on the proposed land use of the development, a total of 298 trips would be generated by the site during the PM peak hour. Approximately 144 of these trips would leave the development and 154 would enter the development during the evening peak hour. The development trips were evenly distributed between both the west and north approaches of the intersection. Of the entering and exiting trips, the analysis assumed about 65 percent would be oriented from and to the south of the development. The remaining 35 percent would be oriented to the north and east on McIndoe. The development type is still unknown, and the actual distribution is likely to vary, yet these assumptions provide a reasonable traffic scenario for planning purposes. The study's assignment of the trips onto the surrounding roadway is shown in Figure 7.03-1.

7.04 ALTERNATIVES

There are three alternatives for the intersection of 1st Street and McIndoe Street.

A. Conventional Intersection with All-Way Stop Control

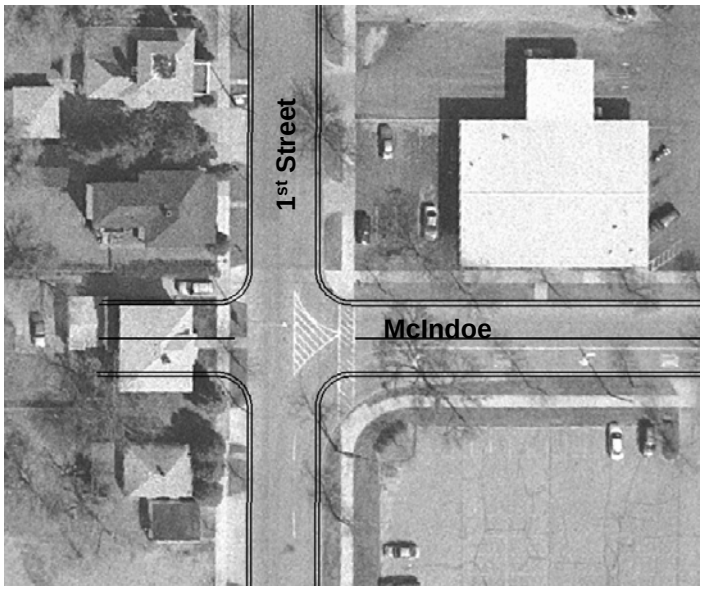

Figure 7.04-1 Conventional Four-Legged Intersection Alternative

With new development to the west of the intersection, the configuration of 1st Street and McIndoe Street will likely need adjustment. This could include adding a leg on the west approach to access the redeveloped properties. Therefore the first alternative adds a leg to the west approach, with stop control at each leg of the intersection. Each leg has a single approach entering and exiting the intersection. The acquisition and/or dedication of right-of-way to the west of the intersection would be required if a new roadway or driveway there is planned as part of the development. This configuration is shown in Figure 7.04-1.

B. Conventional Intersection with Signal Control

The second alternative has the same intersection configuration as the first but uses a signal to control operations. It is unlikely the current intersection volumes would warrant a signal. When actual redevelopment options are proposed and signal control is desired, a signal warrant analysis

should be performed to see if signals are justified. As with Alternative 1, the potential configuration for this intersection alternative is shown in Figure 7.04-1.

C. Roundabout Intersection

Figure 7.04-2 illustrates Alternative 3, a roundabout. This roundabout shows single-lane entrances on all four approaches. There would be multiuse sidewalks surrounding the roundabout accommodating both pedestrians and bicyclists. Bicyclists may enter the roundabout as either a pedestrian on the path or as a vehicle within the roundabout.

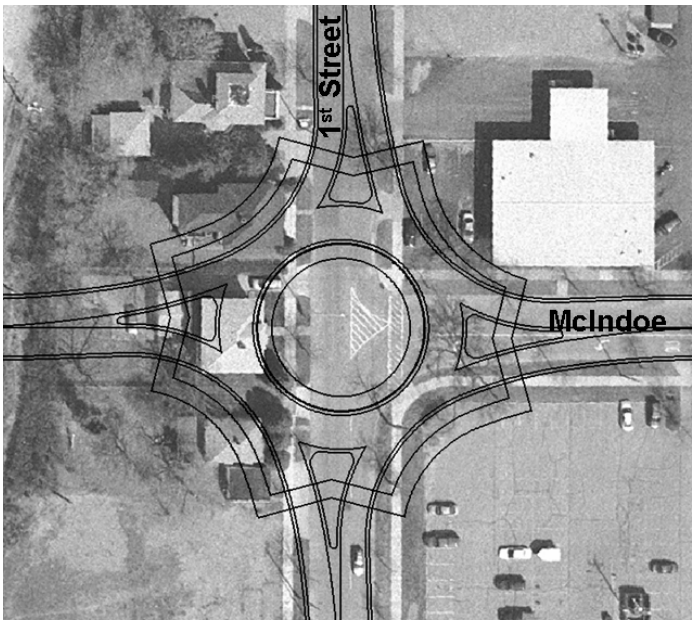

Figure 7.04-2 Roundabout Intersection Alternative

The roundabout illustrated in Figure 7.04-2 has an inscribed circle diameter of about 135 feet. This is the minimum diameter that will accommodate the WisDOT design vehicle for a state route – WB 65. If a smaller design vehicle was allowed by WisDOT, or this intersection was taken off the state system, the inscribed circle diameter could be reduced to about 100 feet. Even with a reduced diameter, the impacts would remain similar to what is portrayed.

7.05 ALTERNATIVE EVALUATION

Traffic flow through the intersection would be affected by each alternative. The intersection of 1st Street with McIndoe Street was examined to determine how the different alternatives would operate with the increased number of trips and the two-way operation.

A. Traffic Operations

Table 7.05-1 compares the operation levels for each alternative at the previously mentioned intersection.

1st Street/McIndoe Street Intersection	All-Way Stop Control (Alternative 1)	Signalized Control (Alternative 2)	Roundabout Configuration (Alternative 3)
2006 Overall Operation	C	B	B
	18.2*	12.4*	12.2*

* All numbers represent average delay in seconds

Table 7.05-1 Operation Levels of the 1st Street and McIndoe Street Intersection

With the new trips generated by the development, the overall intersection delay is 18.2 seconds with the conventional four-legged intersection with stop control at each approach. Most of the delay is experienced by the northbound and westbound traffic. The addition of a signal with a permitted/protected phasing for the vehicles making left turns from the westbound approach decreases the overall intersection delay from all-way stop control by 5.8 seconds. The construction of a one-lane roundabout decreased the overall intersection delay by 6.0 seconds on average compared to the current intersection operation.

In essence, all three alternatives operate acceptably, with the signalized and roundabout alternatives operating one level of service (LOS) better than the stop-controlled option.

B. Right-of-Way

The conventional four-legged intersection requires the least amount of right-of-way, consisting primarily of what is needed for the west approach. This amounts to about 0.23 acres that the City could consider having the developer dedicate when/if the property is redeveloped.

The roundabout requires more right-of-way. About 0.06 acres would be needed in the northeast quadrant, 0.07 acres in the southeast quadrant, and about 0.38 acres in the west half of the roundabout. Additionally, care will be needed in the final design of the roundabout to avoid impacts to the building in the northeast quadrant of the intersection.

C. Other Considerations

Generally, roundabouts are considered a safer option when compared to signalized intersections. Roundabouts have a history of safety and often are used as a safety improvement over a traditional intersection. Some safety characteristics of a roundabout follow:

- Up to a 90 percent reduction in fatalities.
- Up to a 76 percent reduction in injury crashes.
- A 30 to 40 percent reduction in pedestrian crashes.
- About 75 percent fewer conflict points than a typical four-way intersection.

One reason for the safety benefits of the roundabout is the slower speeds they promote. The slower speed helps reduce the severity of many crash types. The slower speeds also enhance the livability of the surrounding area.

7.06 RECOMMENDATION

We do not recommend changing the control at this intersection with the current volumes. When the adjacent parcels are redeveloped, we recommend that the roundabout be reconsidered in relation to the development site plans. If it is possible to implement the roundabout, it should be done. The roundabout will require more right-of-way, yet it provides better traffic operations, increased safety, and enhanced visual interest.

If this portion of 1st Street and McIndoe is converted to two-way operation, traffic control will need to be changed. We recommend providing four-way stop control. This provides a LOS C for the controlling movements. Traffic modeling indicates that if one approach is given freeflow movement (such as the westbound approach), the other approaches operate at LOS E or F.

SECTION 8
3RD STREET/MCINDOE STREET ROUNDABOUT

8.01 BACKGROUND

3rd Street runs north/south parallel to the Wisconsin River. It is a one-way street northbound between Washington Street and Grant Street as it currently distributes CBD-destined traffic originating from the west. North of Grant Street, it is a two-way roadway. In 2004, 3rd Street carried about 2,300 vpd. The one-way portion of 3rd Street has angle parking on street.

Figure 8.01-1 Intersection of 3rd Street/McIndoe Street

McIndoe Street runs east/west perpendicular to the Wisconsin River. It is a one-way street westbound as it currently helps to distribute CBD-destined traffic originating from the north. In 2004, McIndoe Street carried an average of 2,800 vpd. Several developments are being considered on 1st Street as well as McIndoe that could increase the traffic on McIndoe. The City is investigating converting McIndoe to two-way operation, which is discussed in Section 2 of this report. This analysis assumes this two-way conversion will take place.

Along with the conversion of McIndoe to two-way operation, the City is considering changing the traffic control at this intersection and investigating a roundabout. Converting the intersection of 3rd Street and McIndoe Street to a roundabout is one option being considered. Figure 8.01-1 shows an aerial view of the intersection of 3rd Street/McIndoe Street.

8.02 ISSUES

The conversion of this intersection to roundabout control will have several effects. For this location, traffic operations, safety, and right-of-way needs are the most pertinent evaluation factors.

8.03 ALTERNATIVE DESCRIPTION

Alternative 1 would keep the existing conditions. 3rd Street would have a stop control, while McIndoe Street would be freeflow.

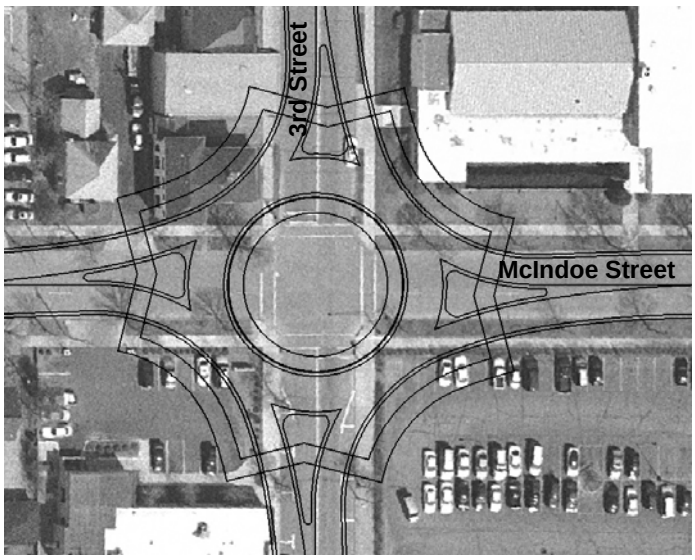

Figure 8.03-1 Roundabout Intersection Alternative

Alternative 2 installs a roundabout at this location. The roundabout would have a single lane entry on all four approaches. The

roundabout would have a sidewalk that surrounds it on all four quadrants. The roundabout would have about a 135-foot inscribed circle. This is the minimum diameter that will accommodate the WisDOT design vehicle for a state route – WB 65. If a smaller design vehicle were allowed by WisDOT, or this intersection was taken off the state system, the inscribed circle diameter could be reduced to about 100 feet. Even with a reduced diameter, the impacts would remain similar to what is portrayed. Figure 8.03-1 illustrates a single-lane roundabout at this location.

8.04 ALTERNATIVE EVALUATION

A. Traffic Operations

Operationally, both alternatives move traffic satisfactorily. Table 8.04-1 compares the operation levels for both alternatives at the previously mentioned intersection. With current traffic volumes and two-way traffic on McIndoe Street, the overall intersection delay is about 4.3 seconds with McIndoe experiencing no delay and the 3rd Street approaches experiencing greater delay. If substantial development occurs on McIndoe and First Streets along with the two-way conversion, this delay will increase to 6.4 seconds. Much of this future delay will occur at the northbound approach, where there is an average of 31.1 seconds of control delay, which corresponds to a LOS D. With the construction of a one-lane roundabout, the overall intersection delay increased by 5.5 seconds on average compared to the future intersection operation with development. Yet the delay decreases substantially for the northbound approach. They distribute the delay between all four approaches. Because of this, roundabouts often provide a substantial increase in capacity.

3rd Street/McIndoe Street Intersection	Existing Intersection Configuration (Alternative 1)	Roundabout (Alternative 2)
2006 Overall Operation	B	B
	6.4*	11.9*

* All numbers represent average delay in seconds

Table 8.04-1 Operation Levels of the 3rd Street/McIndoe Street Intersection

B. Safety

As mentioned in Section 7, roundabouts have a history of safety and often are used as a safety improvement over a traditional intersection. Among the safety characteristics of a roundabout are:

- Up to a 90% reduction in fatalities
- Up to a 76% reduction in injury crashes
- 30%-40% reduction in pedestrian crashes
- 75% fewer conflict points than a typical four-way intersection.

One reason for the safety benefits of the roundabout is the slower speeds they promote. The slower speed help reduce the severity of many crash types. The slower speeds also enhance the livability of the surrounding area.

C. Right-of-Way Impacts

About 13,200 square feet (about 0.35 acres) of new right-of-way would need to be purchased to implement a roundabout at this location. The way the roundabout is currently configured, the right-of-way needs would be equally distributed throughout the quadrants. Some shifting of the roundabout could occur, yet the right-of-way acreage is likely to remain comparable.

As this roundabout is drawn, it would require relocations in the Northeast, Northwest, and possibly the southwest quadrants. Possibly modifications could be made to the roundabout to avoid the northeast and southwest quadrants. It would be difficult to implement a roundabout at this location without a relocation in the northwest quadrant. This could substantially add to the improvement costs.

8.05 RECOMMENDATION

While the benefits of a roundabout are many, there would be substantial right-of-way impacts installing one at this location. Since this location has satisfactory traffic operations and does not appear to have a significant crash problem, the impacts associated with right-of-way acquisition do not appear to outweigh the benefits of the roundabout.

We do suggest, however, that when and if the northwest quadrant of this intersection is redeveloped, that a roundabout be reconsidered for this intersection. If the quadrant was redeveloped, many of the right-of-way impacts would be alleviated and the right-of-way needs associated with the roundabout be incorporated in the layout of the redeveloped parcel.