

Appendix F

Traffic and Parking Impacts

TECHNICAL MEMORANDUM

From: URS Consultant Team

To: Charlene Zimmer

Topic: Traffic & Parking

1.0 Existing Roadway System Characteristics

The Nicollet Central corridor creates a north-south connection through the Cities of Minneapolis and Columbia Heights. The streets are considered arterials north and south of downtown, and Nicollet becomes a transit mall in the downtown core. The corridor also has high volume bus routes that serve a variety of trip purposes throughout the day.

1.1 Key Roadway Segments in the Corridor

The traffic and parking analysis is focused on a high level (AA type) evaluation of the corridor. The areas to be evaluated include key segments in the corridor that coincide with ridership evaluation. The key segments are divided by Nicollet (south), downtown, and Central on the north. Nicollet Avenue on the south typically has a two or three lane section with parking. The downtown section is a two lane transit mall that has high bus volumes and some taxi traffic. The north segment is typically a four lane section with additional street parking in some areas. Table 1 includes details of the key segments in the corridor.

Table 1 – Key Corridor Segments

<i>Segment</i>	<i>Segment Name</i>	<i>Street</i>	<i>No of Lanes</i>	<i>Details</i>
41 st Ave NE to Lowry Av NE	A	Central Avenue	2 NB/2 SB	Median left turn lane, parking lane/bumpouts
Lowry Ave NE to Broadway Ave NE	B	Central Avenue	2 NB/2 SB	Parking lanes/bumpouts on both sides
Broadway Ave NE to 8 th St NE	C	Central Avenue	2 NB/2 SB (Central) 3 NB/3 SB (Henn/1 st)	Parking lanes/bumpouts on both sides
8 th St NE to Washington Ave S	D	Central Avenue or 1 st /Hennepin	2 NB/2 SB	Parking lanes, bumpouts, bike lanes, and sharrows in some areas on both sides of Central and 1 st /Hennepin

Table 1 – Key Corridor Segments (Continued)

Washington Ave S to Grant St	E	Nicollet Mall	1 NB/1 SB	Nicollet Mall area, transit, pedestrians, and bikes only
Grant St to Lake St	F	Nicollet Avenue	1 NB/1 SB	Median left turn lane, parking lanes/bump-outs both sides
Lake St to 38 th St	G	Nicollet Avenue	1 NB/1 SB	Parking lanes/bump-outs on both sides
38 th St to 46 th St	H	Nicollet Avenue	1 NB/1 SB	Parking lanes/bump-outs on both sides, bike lanes south of 40 th

Source: Nicollet Central AA Project Data

1.2 Key Intersections in the Corridor

The team has selected key intersections that will be reviewed based on existing data available to provide a qualitative impact assessment of the addition of modern streetcar or enhanced bus to the corridor. The existing network already accommodates high frequency bus service and the actual “amount” of transit service will remain relatively the same. The difference will be in the operation of enhanced bus or modern streetcar in the corridor and how the improved transit facilities may impact vehicle traffic. Table 2 includes the key intersections in the corridor.

Table 2 – Key Intersections in the Corridor for Modern Streetcar/Enhanced Bus

<i>Segment</i>	<i>Corridor Mainline</i>	<i>Cross Street</i>
A/B	Central Avenue	Lowry Ave
B/C	Central Avenue	Broadway Ave
D	Central Avenue	Hennepin Ave
D	Central Avenue	4 th St
D	Central Avenue	University Ave
D	Central Avenue	Washington St
F	Nicollet Avenue	Franklin St

Table 2 – Key Intersections in the Corridor for Modern Streetcar/Enhanced Bus (Cont.)

F/G	Nicollet Avenue	Lake St
G	Nicollet Avenue	35 th /36 th St
H	Nicollet Avenue	46 th St

Source: Nicollet Central AA Project Data

1.3 Related Studies/Other Corridor Area Improvements

Midtown AA

The Midtown Corridor AA study is running concurrent with this project. From the traffic analysis perspective, the only potential interface point is in the area of Nicollet Avenue and Lake Street. The Lake Street corridor has recently been reconstructed and carries significant vehicle traffic and bus traffic. As both studies continue to progress to the next phases, additional traffic evaluation and co-ordination will need to be completed. If the Midtown Corridor alignment is located in the “trench”, there will not be an at-grade crossing of the two transitways. However, increased pedestrian activity would be anticipated in the area. If both lines cross at some point, the Nicollet Avenue and Lake Street intersection will be a key evaluation point.

Washington Avenue Reconstruction

Hennepin County is currently leading a study and planned improvement of Washington Avenue between Hennepin and 5th Ave S. This is the segment planned for construction with the study extending further east in downtown Minneapolis. The Draft Traffic Operations analysis (by Alliant Engineering) has presented preliminary findings on the planned changes. Washington Avenue is currently three lanes in each direction and the current alternatives under evaluation (Hennepin to 5th) have two eastbound lanes, three westbound lanes, left turn lanes, and a right turn eastbound at 4th St.

Some observations from the Draft Washington Avenue report that impact the Nicollet Central corridor:

- The Washington Avenue intersections at Hennepin Avenue and 3rd Avenue are cited in the challenging category.
- The PM peak hour analysis supports three westbound lanes. Two eastbound lanes were found to be acceptable (with the new 4th St ramp).
- Washington Avenue at 3rd Avenue intersection was found in the study to be more congested than the Washington Avenue and Hennepin Avenue intersection.

2.0 Traffic Impacts in the Nicollet Central Corridor

2.1 Modern streetcar and Enhanced Bus Operations

Existing Transit Operation

The existing transit in the Nicollet Central corridor is provided by Metro Transit buses. Buses operate high frequency service on routes 10 (Central Avenue) and 18 (Nicollet Avenue). Buses stop at about every other block at intersections in the corridor and pull off in a parking lane. The typical impact to traffic in the corridor is from buses merging back into the driving lane.

Enhanced Bus

The enhanced bus operation will have longer vehicles with more efficient boarding than the typical bus. The enhanced bus will operate in the same lanes as vehicle traffic and have improved stop amenities. The stops will only be located at every other block to provide more efficient travel speeds. Impacts of the Enhanced Bus alternative are anticipated to be similar to bus impacts in the corridor. Autos will have some additional travel impacts for stops at stations located in the travel lane. These would be expected to be 20 to 30 second dwells at the station every 7.5 to 10 minutes (pending schedule).

Modern streetcar Operation

The proposed modern streetcar operation will be in a shared travel lane with vehicles. Modern streetcar stops will be at the same locations as the enhanced bus at every other block. Vehicles will have some additional travel impacts for stops at stations located in the travel lane. Modern streetcar operates on a fixed rail system with electric power. Modern streetcars are planned to run as a single vehicle that is 65 to 70 feet in length. These vehicles are much shorter than a single light rail vehicle and operate in other cities in mixed traffic. These would be expected to be 20 to 30 second dwells at the station every 7.5 to 10 minutes (pending schedule).

Transit Signal Priority

The Enhanced Bus and Modern streetcar alternatives provide the opportunity to implement Transit Signal Priority (TSP) to improve traffic signal progression for transit vehicles. TSP provides transit an advantage by providing an early or extended green to the mainline transit corridor to help keep transit vehicles moving on schedule. TSP in addition to signal coordination in a corridor helps make transit vehicles move more efficiently in the corridor. The traffic signals are programmed to provide a range of early and/or extended green. TSP applications for Enhanced Bus or Modern streetcar would most likely be implemented by using an emitter technology (Metro Transit is currently using a similar system on Central Avenue). TSP is a different mode of operation than full Preemption, where transit receives the “green” while other phases are truncated.

2.2 Segment Traffic Impacts

The segment traffic analysis was developed based on existing conditions data and data from Access Minneapolis for Nicollet and Central Avenue. This study does not include traffic data projections from the regional travel demand model. The Access Minneapolis study was an extensive evaluation of the City Street network and produced planning level average daily traffic volumes for 2030. For this corridor evaluation, we determined that a high level focus on design hour volumes for the existing conditions and a design year projection (2030) would provide data on the growth impacts in the corridor. The PM peak hour was used as the design hour volume in the corridor. Existing traffic volumes at intersections in the corridor were obtained from the City of Minneapolis traffic count data website and the approach volumes developed for sections of the streets (a smaller section than the analysis segments). Growth rates were applied to the existing design hour volumes to develop the 2030 design hour volumes. The growth rates were based on ADT data from existing conditions and 2030 Access Minneapolis.

This data is summarized and evaluated in Table 4 for the design hour (designated as the PM peak hour). Most of the corridor has reserve link capacity under existing conditions and 2030 design year.

Table 4 – Key Corridor Segment Planning Level Volume to Capacity Estimates for Design Hour (PM Peak)

Segment	Limits	SB Volume to Capacity		NB Volume to Capacity	
		Existing	2030	Existing	2030
A	41 st St to Lowry Ave	0.70	0.75	0.60	0.65
B	Lowry Ave to Broadway St	0.40	0.45	0.55	0.60
C	Broadway St to 8 th St	0.65	0.70	0.70	0.75
D	8th St to Washington Ave	See River Crossing Alternatives			
E	Washington Ave to Grant St	See River Crossing Alternatives			
F	Grant St to Lake St	0.50	0.50	0.55	0.60
G	Lake St to 38 th St	0.50	0.55	0.40	0.40
H	38th St to 46 th St	0.55	0.60	0.45	0.50

Sources: Access Minneapolis (2030 data), City of Minneapolis Traffic Count Website

The existing and design year evaluation was prepared based on design hour link data. This created a volume to capacity for the roadway links based on the traffic counts, projections and number of lanes on the link. The volume to capacity provides a planning level evaluation of roadway links as described below.

- A volume to capacity ratio of less than 0.80 represents a roadway that operates efficiently in the design hour. There may be times where the roadway links and intersections experience some congestion.
- A v/c ratio of 0.8 to 1.0 represents roadways that experience increased congestion in the design hour. High levels of roadway and intersection congestion are present during the design hour.

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- A v/c ratio over 1.0 represents roadways that experience failing levels of service for segments and intersections during the design hour and at other times during the day.

Most of the roadway links would be less than 0.80 and operate efficiently. Some of the links have higher congestion levels and would have impacts in both the existing and design year conditions.

2.3 Key Intersection Impacts

The Enhanced Bus or Modern streetcar alternative would run in mixed traffic on both the Nicollet Avenue and Central Avenue corridors. The current alignment for the Alternative Analysis is planned for stops approximately every two blocks. The Central Avenue north corridor could be left or right lane running. Nicollet Mall would run on the current roadway alignment. The Nicollet Avenue south section would run on the through lane (northbound and southbound). The key intersection impacts are shown in Table 5. Synchro data from the City of Minneapolis traffic signal retiming projects was reviewed for the existing conditions.

The Central Avenue corridor currently has two through lanes in each direction on the north side and would have transit in mixed traffic in either the left or right lane. The mixed traffic lane would be expected to have some delays to general traffic at stop locations (possible 20 to 30 second dwell), but there is sufficient roadway capacity for vehicles to pass. Stops located in the left lane would require left turning vehicles to cross the transitway to enter the left turn lanes. Stops located in the right lane would require right turning vehicles to stop behind transit vehicles before turning right (when stops are located near-side). The overall traffic impact may be some slowing of traffic, but major congestion on the street network would not be anticipated, as the transit vehicle size and frequency is similar to existing transit service. The change in stops to every two blocks may produce overall improvements in operation. Additional traffic analysis as the alignments move forward will need to be completed.

The Nicollet Avenue south corridor has a single through lane in each direction. Sections of the corridor include on street parking and shared left turn lanes. Vehicles would not have to cross transitways to turn right or left, but would slow down for turns.

Table 5 – LOS Impacts at Key Intersections in the Corridor

<i>Mainline Intersection</i>	<i>Comments</i>
Central Av & Lowry	Central is the coordinated phase and provides sufficient green time for N-S transit movements. There is some queuing and congestion on Lowry, but not expected to create failing movements. Transit would run with the concurrent N-S green and the mean stop time at a traffic signal is anticipated to be 20 seconds.
Central Av & Broadway	Central is the coordinated phase and provides sufficient green time for N-S transit movements. There is some queuing and congestion on Broadway, but not expected to create failing movements. Transit would run with the concurrent N-S green

	and the mean stop time at a traffic signal is anticipated to be 25 seconds.
Central Av & 4 th	Central is the coordinated phase and 4 th is one-way westbound. Minimum queues on the NB and SB approaches. Transit would run with the concurrent N-S green and the mean stop time at a traffic signal is anticipated to be 15 seconds.

Table 5 – LOS Impacts at Key Intersections in the Corridor (Continued)

Central Av & Hennepin	Central is a four lane two way street at this intersection and the coordinated phase. Hennepin remains part of a one way pair in this area. There is minimum queuing on Central and Hennepin may have some queues in the PM peak. Transit would run with the concurrent N-S green and the mean stop time at a traffic signal is anticipated to be 20 seconds.
Central Av & University	Central is the coordinated phase and University is one-way eastbound. Minimum queues on the NB approach, SB is near 300 ft in the PM peak. Overall, low impact. Transit would run with concurrent N-S green and the mean stop time at a traffic signal is anticipated to be 20 seconds.
Central & Washington Av	Transit would turn through the intersection and the mean stop time at a traffic signal is anticipated to be 20 seconds.
Nicollet Av & Franklin	Franklin is the coordinated phase and receives more green time. Shorter green times on Nicollet result in PM LOS at D for N-S movements with potentially longer queues. Transit would run with the concurrent N-S green and the mean stop time at a traffic signal is anticipated to be 25 seconds.
Nicollet Av & Lake St	Lake St is the coordinated phase and receives more green time. Nicollet has LOS D/C for the N-S movements but minimal queuing. Transit would run with the concurrent N-S green and the mean stop time at a traffic signal is anticipated to be 30 seconds.
Nicollet Av & 35 th / 36 th St	35 th /36 th is the coordinated phase, but they receive about equal thru greens. LOS E (35 th)/C (36 th) in the PM for the N-S movements. Transit would run with the concurrent N-S green the mean stop time at a traffic signal is anticipated to be 20 seconds.
Nicollet Av & 46 th St	46 th St is currently the south end station. The operations of the transit vehicles will need to be determined for evaluating potential impacts

Source: City of Minneapolis Traffic Count Website, City Synchro Files (from signal timing projects)

2.4 Mississippi River Crossing Alternatives

This study is evaluating the transit corridor crossing the Mississippi River on either 1st/Hennepin bridge or the 3rd Avenue (Central) Bridge. The 1st/Hennepin would require a crossing of Washington Avenue from Nicollet Mall and impact one or two intersections (pending alignment). The 3rd Avenue crossing would require the transit vehicles to turn from Nicollet Mall to Washington Avenue and then turn onto 3rd Avenue to cross the bridge. The current street configuration on Washington Avenue has three lanes in each direction. The proposed would have three westbound lanes (the outer lane a shared through/right turn and two eastbound lanes with a dedicate right turn lane at 4th. All intersections would have exclusive left turn lanes. Hennepin County is currently evaluating three alternative bike lane configurations that could impact transit operations.

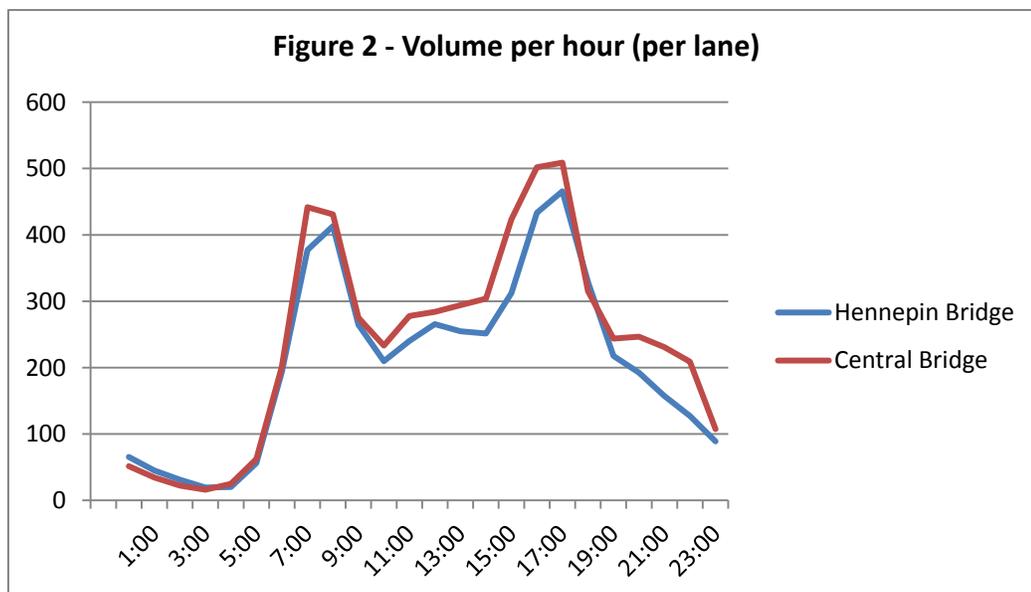
The 1st/Hennepin river crossing includes:

- Higher capacity two way pair that can run a “loop” for the transit alternative
- The Modern streetcar alternative would travel through the Washington/Hennepin intersection

The 3rd Avenue S river crossing includes:

- The 3rd/Central bridge has two-way traffic connecting downtown across the river.
- The Modern streetcar alternative would need to turn from Nicollet to Washington Avenue and then to the 3rd/Central bridge. The alignment would require traveling through additional intersections on Washington Avenue increasing travel times.
- The Washington and 3rd intersection is the most congested in the corridor (based on studies of Washington Avenue).

Figure 2 provides a comparison of the hourly traffic volumes per lane throughout a sample day. This is based on counts from the City of Minneapolis website (obtained in 2011).



Source: City of Minneapolis Traffic Count Website

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Table 6 provides a summary comparison of the bridge crossing alternatives. The team has met with representative of the City, Hennepin County, and the consultant team working on Washington Avenue. Washington Avenue is considered to be a congested arterial during the peak hours and one of the busiest downtown streets (with Washington and 3rd S considered the most congested intersection). From a traffic and transit perspective, the Hennepin/1st crossing would be more direct and minimize the transit turns and crossings on Washington Avenue and provide greater travel time reliability.

Table 6 – Comparison of Bridge Crossing Alternatives

<i>Design Element</i>	<i>Hennepin/1st</i>	<i>3rd/Central</i>
Street Network	One way pairs, 3 lanes NB, 3 lanes SB	Two way street, 2 lanes NB, 2 lanes SB
Transitway Alignment (from downtown)	Nicollet Mall west to Hennepin, Hennepin/1 st one way pair. Supports future system expansion.	Nicollet Mall east to 3 rd St, north across bridge on Central. Does not support future expansion
Intersections crossed on Washington	Hennepin, may cross Nicollet Mall pending alignment	Nicollet, Marquette, 2 nd Av S, 3 rd Av S
Traffic operations	One intersection crossing of Washington Avenue. The Hennepin bridge has two one-way pairs with 3 lanes in each direction. It carries less traffic per lane than Central Ave	Three intersections to cross on Washington Ave. The turn at Washington/3 rd is most congested in peak hours. The Central bridge carries slightly higher volumes of traffic (per lane per hour) vs. Hennepin. AM and PM directional V/C are higher.
Planning volume to capacity for river crossing segment	v/c (AM Peak) = 0.40 NB/0.55 SB v/c (Midday) = 0.35 NB/0.30 SB v/c (PM Peak) = 0.65 NB/0.45 SB	v/c (AM Peak) = 0.25 NB/0.80 SB v/c (Midday) = 0.35 NB/0.35 SB v/c (PM Peak) = 0.75 NB/0.45 SB
Traffic impacts	The Hennepin/1 st route provides a more direct connection with the alignment traveling through only one intersection on Washington Avenue. By traveling through fewer congested intersections, traffic impacts are expected to be reduced.	The Central/3 rd route travels through more congested intersections on Washington Avenue and also has a greater traffic impact on Central Avenue.

Source: City of Minneapolis Traffic Count Website, City Synchro Files (from signal timing projects)

3.0 Parking Impacts in the Nicollet Central Corridor

The Nicollet Central corridor has extensive street parking on the roadway network. The addition of enhanced bus or modern streetcar will impact the street parking in the corridor as additional space maybe needed for stops. The potential impacts to street parking in the corridor are summarized in Tables 7, 8, and 9. The tables include a range of potential impacts to parking spaces based on the addition of the new stops in the corridor. The range based on a number of factors including the presence of an existing bus stop, location of driveways, and whether the enhanced bus or modern streetcar stops would be shared with other bus service in the corridor. The detailed impacts will need to be determined as the project moves forward and will also be influenced by the final alignment and mode. The alignment of the modern streetcar or Enhanced bus may be in either the left or right lane on the four lane sections (Central Avenue). The station stops with right lane running has a larger impact on parking than left lane running. Left lane running typically will not directly impact parking lanes. The right lane running sections would have bumpouts into the parking lanes.

Table 7 – Central Avenue (Segments A, B, and C) Estimated Reduction of On-Street Spaces at Stops

Segment	Northbound				Southbound			
	Enhanced Bus		Modern streetcar		Enhanced Bus		Modern streetcar	
	Min	Max	Min	Max	Min	Max	Min	Max
41 st Av NE to Lowry (A)	12	24	8	28	9	18	6	21
Lowry to Broadway (B)	12	24	8	28	9	18	6	21
Broadway to 8 th St (C)	0	0	0	0	0	0	0	0
Subtotals	24	48	16	56	18	36	12	42

Source: Nicollet Central AA Station Layout

Table 8 – Central Avenue & Hennepin/1st (Segments D and E) Estimated Reduction of On-Street Spaces at Stops

Segment	Northbound				Southbound			
	Enhanced Bus		Modern streetcar		Enhanced Bus		Modern streetcar	
	Min	Max	Min	Max	Min	Max	Min	Max
8 th St to Washington (D)	9	18	6	21	9	18	6	21

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Washington to Grant St (E)	Nicollet Mall							
Subtotals	9	18	6	21	9	18	6	21

Source: Nicollet Central AA Station Layout

Table 9 –Nicollet Avenue (Segments F, G, and H) Estimated Reduction of On-Street Spaces at Stops

Segment	Northbound				Southbound			
	Enhanced Bus		Modern streetcar		Enhanced Bus		Modern streetcar	
	Min	Max	Min	Max	Min	Max	Min	Max
Grant St to Lake St (F)	12	24	8	28	12	24	8	28
Lake St to 38 th St (G)	12	24	8	28	12	24	8	28
38 th St to 46 th St (H)	15	30	10	35	15	30	10	35
Subtotals	39	74	26	91	39	74	26	91

Source: Nicollet Central AA Station Layout

4.0 Conclusions

The Nicollet-Central corridor provides a primary north-south connection through the City of Minneapolis. The traffic and parking analysis is focused on a high level alternative analysis evaluation of key intersections and segments in the corridor. The Nicollet section from 46th to Nicollet Mall has a two to three lane roadway section with parking in a commercial and residential area, The “eat street” section is a destination area and access is important for local businesses. The downtown segment is the Nicollet Mall and serves transit and pedestrians. The northern section of the corridor on Central Avenue widens to a four lane section with parking.

The next steps on the project will include more detailed traffic and parking evaluation at the intersection level.

- The traffic analysis will need to be completed for key intersections in the corridor to better define the impacts of streetcar/enhanced bus on individual intersection operations. Center or side running operation will impact intersections differently and will need to be evaluated.
- The location of stops on the alignment (near or far side) will impact intersection and corridor queues and operations. This will need to be part of the corridor evaluation and based on the alignment (center vs. side running).
- Special attention to intersection design and operations will be where a streetcar turns or transitions through an intersection and may require exclusive traffic signal phasing.
- Parking impacts will be evaluated in greater detail at the next phase. This again will be based on the alignment and stop size/location. On-street parking is important to many businesses in the corridor and the impacts will be better defined as the project moves to the next phase.