Technical Report
Traffic

1.0 Introduction

1.1 Purpose of Report

This *Traffic Technical Report* has been prepared in support of the Bottineau Transitway Project Draft Environmental Impact Statement (Draft EIS). The objective of this report is to evaluate the Project's potential traffic impacts within the study area. This includes the following:

- Evaluate the Project's potential impacts on traffic operations at existing and proposed signalized intersections at or adjacent to the transitway.
- Identify proposed roadway improvements to address operational issues identified in the traffic analysis.

A project description and further context for this and all other technical reports can be found in the Project Description Technical Memorandum.

2.0 Technical Analysis

2.1 Regulatory Context/Methodology

2.1.1 Legal and Regulatory Context

There are no specific legal or regulatory requirements governing how traffic impacts are identified, analyzed, and addressed as part of the National Environmental Policy Act (NEPA) review. The analysis of impacts conducted for the Bottineau Transitway Project, and documented in this technical report, adheres to industry standards, as described below in Methodology.

2.1.2 Study Area

The analysis of traffic operations for the Bottineau Transitway Project included existing and proposed signalized intersections along the Bottineau Transitway alternative alignments. In addition, several unsignalized crossings of the transitway that are planned to be controlled with automatic gates have been included in the analysis.

2.1.3 Methodology

The approach to the traffic operations analysis is derived from the established methodologies documented in the Highway Capacity Manual (HCM). The HCM contains a series of analysis techniques for evaluating the operations of transportation facilities under specified conditions. The Bottineau Transitway traffic models have been developed using Synchro/SimTraffic and VISSIM, software packages that implement the HCM methodologies. The inputs into the models include lane geometrics, existing and forecast turning movement volumes, intersection traffic control devices, and signal timing characteristics. The level of service thresholds, as defined by the HCM, are shown in Table 1. Based on standard practice in the traffic engineering industry, as well as guidance from the American Association of State Highway and Transportation Officials (AASHTO) and conformance with MnDOT and Hennepin County practice, level of service D/E is considered to be the threshold of acceptable level of intersection operations during the peak hour for urban and suburban areas.

Table 1. Intersection Level of Service Definitions

Level of Service (LOS)	Average Delay (seconds/vehicle)	
	Signalized Intersection	Unsignalized Intersection
A	<10	<10
B	10-20	10-15
C	20-35	15-25
D	35-55	25-35
E	55-80	35-55
F	>80	>55

The traffic operations analysis has also incorporated the requirements and standards documented in the Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD) relative to requirements for signal preemption and gate operations.

All full access intersections with the transitway, (i.e., locations where all vehicular movements are allowed) are assumed to be signalized to provide safe movement of transit light rail vehicles (LRV) and motorized vehicles. In addition, at-grade roadway crossings with transit LRV speeds greater than 35 miles per hour (mph) are required to be equipped with automatic gates, based on the MN MUTCD standards.

2.2 Environmental Consequences

2.2.1 Operating Phase Impacts

No-Build Alternative

The 2030 No-Build analysis results provide a baseline comparison to determine the impacts of the Bottineau Transitway Project. The intersections shown in Table 2 were chosen based on the capacity or near-capacity operations in the existing conditions and the potential for unacceptable operations in the future (LOS E or F). Therefore, intersections that were shown to have acceptable operations (LOS D or better) in the 2030 Build conditions were not also modeled for the 2030 No-Build conditions since no improvements would be required in the 2030 Build conditions and the 2030 No-Build traffic operations would be expected to be the same or better.

The results of the 2030 No-Build analysis for the PM peak hour are shown in Table 2. For more detailed analysis and results discussion, see the Trunk Highway 55 (Olson Memorial Highway) Corridor and Bottineau Segment D2 Traffic Analysis Technical Memoranda in the Appendix.

Table 2. 2030 No-Build PM Peak –Delay and LOS Results

Intersection	Operations	
	Delay (sec/veh)	LOS
CSAH 81 (Broadway Ave) at CSAH 2 (Penn Ave)/McNair Ave	84	F
TH 55 at CSAH 2 (Penn Ave)	150+	F
TH 55 at W Lyndale Ave (I-94 West Ramps)	29	C
TH 55 at E Lyndale Ave (I-94 East Ramps)	26	C

Transportation System Management Alternative

A traffic operations analysis was not performed for the Transportation System Management Alternative (TSM) because the TSM alternative is very comparable to the No-Build alternative from a traffic operations perspective. Therefore, a TSM alternative would not provide additional information relative to identifying impacts of the Bottineau Transitway Project.

Build Alternatives

The analysis approach of traffic impacts resulting from the Build Alternatives is discussed in the following sections for each segment of the alignment. Intersections identified as operating with transit priority would allow an approaching LRV to influence the signal timing (e.g., extended green phase), but no signal phases would be skipped. Intersections identified as operating with preemption indicates that an approaching LRV would never stop at the intersection, which would result in some signal phases being skipped during a preemption event, in order to provide for the LRT phase. The focus of the operations analysis was the PM peak hour because it has the highest volumes and would therefore represent a worst-case condition. For further discussion of priority and preemption operations, see the Transit/Traffic Signal Operating Schemes Technical Memorandum in the Appendix.

Alignment A

A summary of the Alignment A modeling assumptions is shown in Table 3. [1]

Table 3. Alignment A Modeling Summary

Intersection	No-Build Conditions	Build Conditions		Comments
		Transitway Speed (mph)	Intersection Operations	
Arbor Lakes Pkwy at Zachary Ln	Arbor Lakes Parkway construction	35	Signalized; Transit Priority	Proposed parkway assumed to be designed with adequate geometrics to accommodate future transit operations; Not included in modeling.
Arbor Lakes Pkwy at Jefferson Hwy	Arbor Lakes Parkway construction	35	Signalized; Transit Priority	Proposed parkway assumed to be designed with adequate geometrics to accommodate future transit operations; Not included in modeling.
CSAH 130 (Brooklyn Blvd) at Northland Dr	Signalized; No Changes	35	Signalized; Transit Priority	Left-turn lanes added on CSAH 130 (Brooklyn Blvd); Low traffic volumes; Not included in modeling.
CSAH 130 (Brooklyn Blvd) at Boone Ave	Signalized; No Changes	35	Signalized; Transit Priority	Left-turn lanes added on CSAH 130 (Brooklyn Blvd).

[1] The initial operational analysis for Alignment A was completed using Synchro/SimTraffic because the program provides the ability to efficiently analyze a number of different geometric and operational parameters. VISSIM was used to model operational features beyond the capability of the Synchro/SimTraffic software where needed. For additional discussion, see the Bottineau Alignment A Traffic Analysis Memorandum in the Appendix.

Table 3 continued. Alignment A Modeling Summary

Intersection	No-Build Conditions	Build Conditions		Comments
		Transitway Speed (mph)	Intersection Operations	
CSAH 81 (Bottineau Blvd) at CSAH 130 (Brooklyn Blvd)	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd); Second left-turn lanes added on northbound, eastbound, and westbound approaches	55	Signalized; Grade Separated Transitway	
CSAH 81 (Bottineau Blvd) at 73rd Ave	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd)	55	Signalized; Preemption	
CSAH 81 (Bottineau Blvd) at 71st Ave/ CSAH 8 (Broadway Ave)	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd) and westbound 71st Ave; Second left-turn lanes added on southbound and eastbound approaches; Right-turn lane added on westbound approach	55	Signalized; Preemption	

The results of the 2030 analysis for the PM peak hour are shown in Table 4. The CSAH 81 (Bottineau Boulevard)/CSAH 130 (Brooklyn Boulevard) intersection is expected to operate at or near capacity (LOS E). However, this is not due to any effect caused by the operations of the Bottineau Transitway Project because the transitway is proposed to be grade-separated over CSAH 81 (Bottineau Boulevard)/CSAH 130 (Brooklyn Boulevard), which will eliminate any potential influence of transit operation on overall intersection operations at this location. The grade-separated transitway crossing of CSAH 130 (Brooklyn Boulevard) at CSAH 81 (Bottineau Boulevard) is warranted because this intersection is expected to operate near unacceptable operations even with significant capacity improvements as part of the CSAH 81 (Bottineau Boulevard) reconstruction project. The other intersections analyzed are expected to have overall acceptable operations during the peak hour. For more detailed analysis and results discussion, see the Bottineau Alignment A Traffic Analysis Memorandum in the Appendix.

Table 4. 2030 Build PM Peak – Alignment A Delay and LOS Results

Intersection	Operations			Comments
	Operating Scheme	Delay (sec/veh)	LOS	
CSAH 130 (Brooklyn Blvd) at Boone Ave	Transit Priority	41	D	
CSAH 81 (Bottineau Blvd) at CSAH 130 (Brooklyn Blvd)	Grade Separated Transitway	60	E	No impact due to grade separation of the transitway over CSAH 130 (Brooklyn Blvd)
CSAH 81 (Bottineau Blvd) at 73rd Ave	Preemption	31	C	
CSAH 81 (Bottineau Blvd) at 71st Ave/ CSAH 8 (Broadway Ave)	Preemption	50	D	

Alignment B

Alignment B includes CSAH 103 (Broadway Avenue), which is currently in the planning stages for a roadway reconstruction project. The CSAH 103 (Broadway Avenue) corridor roadway project is a planned improvement by Hennepin County, separate from the Bottineau Transitway Project between CSAH 30 (93rd Avenue) and Candlewood Drive. The proposed improvement includes expanding the roadway from a two-lane undivided to a four-lane divided section, with a median wide enough to accommodate the LRT transitway. A date for the start of construction on the CSAH 103 (Broadway Avenue) has not been established, but it has been assumed that the project would be completed before the start of construction on the Bottineau Transitway project.

A summary of the Alignment B modeling assumptions is shown in Table 5. All modeling was completed in VISSIM based on the preemption operations.

Table 5. Alignment B Modeling Summary

Intersection	No-Build Conditions	Build Conditions		Comments
		Transitway Speed (mph)	Intersection Operations	
CSAH 103 (Broadway Ave) at TH 610 North Ramps	Signalized; No Changes	45	Signalized; Transitway does not cross any roadway approaches	Transitway does not cross or impact the ramp operations; Not included in modeling.
CSAH 103 (Broadway Ave) at TH 610 South Ramps	Signalized; No Changes	45	Signalized; Transitway does not cross any roadway approaches	Transitway does not cross or impact the ramp operations; Not included in modeling.
CSAH 103 (Broadway Ave) at 94th Ave	Signalized; No Changes	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at CSAH 30 (93rd Ave)	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at Setzler Pkwy	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at 89th Ave	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at Maplebrook Pkwy	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	Low traffic volumes; Not included in modeling.
CSAH 103 (Broadway Ave) at CSAH 109 (85th Ave)	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at 84th Ave	Unsignalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Unsignalized; Right-In/Right-Out Only	No vehicular movements across the transitway; Not included in modeling

Table 5 continued. Alignment B Modeling Summary

Intersection	No-Build Conditions	Build Conditions		Comments
		Transitway Speed (mph)	Intersection Operations	
CSAH 103 (Broadway Ave) at College Park Drive	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at Candlewood Dr	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at Shopping Center Driveway	Signalized	45	Unsignalized; Right-In/ Right-Out Only	No vehicular movements across the transitway; Not included in modeling
CSAH 103 (Broadway Ave) at CSAH 152 (Brooklyn Blvd)	Signalized	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at 76th Ave	Signalized	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at 75th Ave	Unsignalized	45	Signalized; Preemption	Low traffic volumes; Not included in modeling.
Transitway at Jolly La	N/A	45	Unsignalized; Automatic Gates	Low traffic volumes; Not included in modeling.
Transitway at Lakeland Ave	N/A	45	Unsignalized; Automatic Gates	Low traffic volumes; Not included in modeling.
CSAH 103 (Broadway Ave) at 73rd Ave	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd)	45	Signalized; Preemption	
CSAH 81 (Bottineau Blvd) at 71st Ave/CSAH 8 (Broadway Ave)	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd) and westbound 71st Ave; Second left-turn lanes added on southbound and eastbound approaches; Right-turn lane added on westbound approach	45	Signalized; Preemption	Analyzed as part of Alignment A with the same roadway and transitway configuration; Not reanalyzed as part of Alignment B.

The modeling results for Alignment B are shown in Table 6. For more detailed analysis and results discussion, see the CSAH 103 (Broadway Avenue) Traffic Study Travel Demand Forecasts Technical Memorandum and the Broadway Avenue Modeling Assumptions Technical Memorandum in the Appendix.

Table 6. 2030 Build PM Peak - Alignment B Delay and LOS Results

Intersection	Operations		
	Operating Scheme	Delay (sec/veh)	LOS
CSAH 103 (Broadway Ave) at 94th Ave	Preemption	28	C
CSAH 103 (Broadway Ave) at CSAH 30 (93rd Ave)	Preemption	42	D
CSAH 103 (Broadway Ave) at Setzler Pkwy	Preemption	17	B
CSAH 103 (Broadway Ave) at CSAH 109 (85th Ave)	Preemption	47	D
CSAH 103 (Broadway Ave) at College Park Dr	Preemption	22	C
CSAH 103 (Broadway Ave) at Candlewood Dr	Preemption	17	B
CSAH 103 (Broadway Ave) at CSAH 152 (Brooklyn Blvd)	Preemption	53	D
CSAH 103 (Broadway Ave) at 76th Ave	Preemption	28	C
CSAH 81 (Bottineau Blvd) at 73rd Ave	Preemption	12	B

Alignment C

The operational analysis for Alignment C was completed using VISSIM. A summary of the Alignment C modeling assumptions is shown in Table 7.

Table 7. Alignment C Modeling Summary

Intersection	No-Build Conditions	Build Conditions		Comments
		Transitway Speed (mph)	Intersection Operations	
CSAH 81 (Bottineau Blvd) at I-94 North Ramps	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd); Second left-turn lane added on southbound and westbound approaches; Second right-turn lane added on westbound approach	55	Signalized; Transitway does not cross any roadway approaches	Transitway does not cross or impact the ramp operations; Not included in modeling.
CSAH 81 (Bottineau Blvd) at I-94 South Ramps	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd); Second left-turn lane added on southbound and westbound approaches	55	Signalized; Transitway does not cross any roadway approaches	Transitway does not cross or impact the ramp operations; Not included in modeling.

Table 7 continued. Alignment C Modeling Summary

Intersection	No-Build Conditions	Build Conditions: Transitway Speed (mph)	Build Conditions: Intersection Operations	Comments
CSAH 81 (Bottineau Blvd) at 63rd Ave	Signalized; Second left-turn lane added on southbound, eastbound, and westbound approaches; Through lanes added on CSAH 81 (Bottineau Blvd); Right-turn lanes added on 63rd Ave	55	Signalized; Preemption	
CSAH 81 (Bottineau Blvd) at CSAH 10 (Bass Lake Rd)	Signalized; Second left-turn lane and additional through lane added both directions on CSAH 81 (Bottineau Blvd)	55	Signalized; Preemption	
Transitway at Corvallis Ave	Unsignalized BNSF Crossing; No Changes	55	Unsignalized; Automatic Gates	Low traffic volumes; Not included in modeling.
Transitway at CSAH 8 (Broadway Ave)	Unsignalized BNSF Crossing; No Changes	55	Unsignalized; Automatic Gates	Low traffic volumes; Not included in modeling.
Transitway at 45½ Ave	Unsignalized BNSF Crossing; No Changes	55	Unsignalized; Automatic Gates	Low traffic volumes; Not included in modeling.
Transitway at TH 100	N/A	55	Grade Separated Transitway	Transitway crossing grade separated; Not included in modeling.
Transitway at CSAH 9 (42nd Ave)	Unsignalized BNSF Crossing; No Changes	55	Unsignalized; Automatic Gates	Included in modeling due to concerns of proximity to adjacent traffic signal
CSAH 9 (42nd Ave) at CSAH 8 (Broadway Ave)	Signalized; No Changes	N/A	Signalized; No Changes	Signalized intersection is approximately 530 feet from Transitway
Transitway at 41st Ave/Noble Ave	Unsignalized BNSF Crossing; No Changes	55	Unsignalized; Automatic Gates	Low traffic volumes; Not included in modeling.

The results of the 2030 analysis for the PM peak hour are shown in Table 8. For more detailed analysis and results discussion, see the Bottineau Alignment C Traffic Analysis Memorandum in the Appendix.

Table 8. 2030 Build PM Peak - Alignment C Delay and LOS Results

Intersection	Operations		
	Operating Scheme	Delay (sec/veh)	LOS
CSAH 81 (Bottineau Blvd) at 63rd Ave	Preemption	53	D
CSAH 81 (Bottineau Blvd) at CSAH 10 (Bass Lake Rd)	Preemption	29	C
CSAH 9 (42nd Avenue) at Transitway	Unsignalized; Automatic Gates	2	A

The queues at the CSAH 9 (42nd Avenue) at CSAH 8 (Broadway Avenue) intersection were also evaluated to determine whether there would be any safety issues due to vehicle queues from the signal extending to the at-grade Transitway crossing. The modeling showed that the maximum eastbound queue on CSAH 9 (42nd Avenue) from the CSAH 8 (Broadway Avenue) intersection would be expected to be approximately 210 feet compared to a storage distance of 350 feet. Therefore, no impacts are expected due to the Bottineau Transitway and no improvements are proposed.

Alignment D1

The operational analysis for Alignment D1 was completed using Synchro/SimTraffic. A summary of the Alignment D1 modeling assumptions is shown in Table 9.

Table 9. Alignment D1 Modeling Summary

Intersection	No-Build Conditions	Build Conditions		Comments
		Transitway Speed (mph)	Intersection Operations	
Transitway at TH 55	N/A	35	Grade Separated Transitway	Transitway crossing grade separated; Not included in modeling.
TH 55 at Thomas Ave	Unsignalized; No Changes	35	Signalized; Transit Priority	Low traffic volumes; Not included in modeling.
TH 55 at CSAH 2 (Penn Ave)	Signalized; No Changes	35	Signalized; Transit Priority	Median modifications, approach alignment, and striping improvements assumed on CSAH 2 (Penn Ave).

The results of the 2030 analysis for the PM peak hour are shown in Table 10. Although the TH 55/CSAH 2 (Penn Avenue) intersection is expected to operate at LOS E, this would actually be an improvement over the 2030 No-Build conditions (as summarized in Table 2) due to significantly less delay. The improvement in intersection operations is due to intersection geometric improvements proposed as part of the Bottineau Transitway Project that allow the northbound/southbound phases to operate concurrently, rather than split phased. The intersection geometric improvements are proposed to include median modifications, realignment of the northbound and southbound approach lanes, and additional striping to guide left-turning vehicles through the intersection.

Table 10. 2030 Build PM Peak - Alignment D1 Delay and LOS Results

Intersection	Operations		
	Operating Scheme	Delay (sec/veh)	LOS
TH 55 at CSAH 2 (Penn Ave)	Priority	60	E

Alignment D2

The operational analysis for Alignment D2 was completed using Synchro/SimTraffic and VISSIM. Left-turn movements along the alignment were assumed to be prohibited where left-turn lanes could not be provided, which occurred at the following intersections:

- CSAH 81 (Broadway Avenue) and 29th Avenue (approximately 60 left-turn vehicles in the PM peak hour)
- CSAH 81 (Broadway Avenue) and 26th Avenue (approximately 80 left-turn vehicles in the PM peak hour)
- CSAH 81 (Broadway Avenue) and Penn Avenue (CSAH 2) – eastbound only (approximately 30 left-turn vehicles in the PM peak hour)

As a result of the reduced capacity and left-turn restrictions on CSAH 81 (Broadway Avenue), some drivers may choose to divert to other routes. The Metropolitan Council travel demand model was used to determine the magnitude of expected traffic diversions in 2030 due to the capacity reductions and turn restrictions. The diversion is forecast to be approximately 20 percent of through traffic along CSAH 81 (Broadway Avenue) and CSAH 2 (Penn Avenue). The travel demand model shows that approximately 500 to 1,000 vehicles per day would be expected to divert from CSAH 81 (Broadway Avenue) and CSAH 2 (Penn Avenue) to sections of TH 100, I-94, Lowry Avenue, and CSAH 2 (Penn Avenue) north of CSAH 81 (81).Broadway Avenue). A summary of the Alignment D2 modeling assumptions is shown in Table 11.

Table 11. Alignment D2 Intersections/Segments Analysis Summary

Intersection	No-Build Conditions	Build Conditions: Transitway Speed (mph)	Build Conditions: Intersection Operations	Comments
France Ave/Oakdale Ave at 34th Ave	Unsignalized; No Changes	35	Signalized; Transit Priority	
CSAH 81 (Bottineau Blvd) at Abbott Ave	Signalized; No Changes	35	Signalized; Transit Priority	
CSAH 81 (Broadway Ave) at Victory Memorial Parkway/CSAH 153 (Lowry Avenue)	Signalized; No Changes	30	Signalized; Grade Separated Transitway	Transitway crossing is grade separated; Not included in modeling.
CSAH 81 (Broadway Ave) at 29th Ave	Signalized; No Changes	30	Signalized; Transit Priority	CSAH 81 (Broadway Ave) reduced to one lane in each direction and left turn movements banned.
CSAH 81 (Broadway Ave) at 26th Ave	Signalized; No Changes	30	Signalized; Transit Priority	CSAH 81 (Broadway Ave) reduced to one lane in each direction and left turn movements banned.
CSAH 81 (Broadway Ave) CSAH 2 (Penn Ave)	Signalized; No Changes	30	Signalized; Transit Priority	West leg of CSAH 81 (Broadway Ave) reduced to one lane in each direction and eastbound left turn movement banned; McNair Ave approach closed.
CSAH 2 (Penn Ave) at Golden Valley Rd	Signalized; No Changes	30	Signalized; Transit Priority	Left turn lanes added on CSAH 2 (Penn Ave)
CSAH 2 (Penn Ave) at 16th Ave	Signalized; No Changes	30	Signalized; Transit Priority	Left turn lanes added on CSAH 2 (Penn Ave); Low traffic volumes; Not included in modeling.
CSAH 2 (Penn Ave) at 14th Ave	Signalized; No Changes	30	Unsignalized; Right-In/ Right-Out Only	No vehicular movements across the transitway; Not included in modeling
CSAH 2 (Penn Ave) at Plymouth Ave	Signalized; No Changes	30	Signalized; Transit Priority	Left turn lanes added on CSAH 2 (Penn Ave)
CSAH 2 (Penn Ave) at 12th Ave	Signalized; No Changes	30	Unsignalized; Right-In/ Right-Out Only	No vehicular movements across the transitway; Not included in modeling
CSAH 2 (Penn Ave) at Oak Park Ave	Signalized; No Changes	30	Unsignalized; Right-In/ Right-Out Only	Left turn lanes added on CSAH 2 (Penn Ave); Low traffic volumes; Not included in modeling.
CSAH 2 (Penn Ave) at TH 55	Signalized; No Changes	35	Signalized; Transit Priority	Median modifications, approach alignment, and striping improvements assumed on CSAH 2 (Penn Ave).

The results of the 2030 analysis for the PM peak hour are shown in Table 12. The TH 55/CSAH 2 (Penn Avenue) intersection is expected to operate at LOS E, but with significantly less delay than in the 2030 No-Build conditions (see Table 2). The improvement in operations is due to intersection geometric improvements that allow the northbound/southbound phases to operate concurrently, rather than split phased. These improvements include median modification, realignment of approach lanes, and additional striping. For more detailed analysis and results discussion, see the Bottineau Segment D2 Traffic Analysis Memorandum in the Appendix.

Table 12. 2030 Build PM Peak - Alignment D2 Delay and LOS Results

Intersection	Operations		
	Operating Scheme	Delay (sec/veh)	LOS
France Ave/Oakdale Ave at 34th Ave	Priority	11	B
CSAH 81 (Broadway Ave) at 29th Ave	Priority	7	A
CSAH 81 (Broadway Ave) at 26th Ave	Priority	19	B
CSAH 81 (Broadway Ave) at CSAH 2 (Penn Ave)	Priority	56	E
CSAH 2 (Penn Ave) at Golden Valley Rd	Priority	32	C
CSAH 2 (Penn Ave) at Plymouth Ave	Priority	49	D
CSAH 2 (Penn Ave) at TH 55	Priority	79	E

Alignment D Common Section

The analysis of the intersections in the Alignment D Common Section was completed using VISSIM. Analysis of the intersections on TH 55 from Van White Memorial Parkway through the I-94 ramps is currently being discussed with MnDOT. This discussion includes operation of the TH 55/I-94 ramp intersections with one controller instead of two, and any queuing issues that might impact freeway operations. The operational results for these intersections will be incorporated when available. A summary of the Alignment D Common Section modeling assumptions is shown in Table 13.

Table 13. Alignment D Common Section Modeling Summary

Intersection	No-Build Conditions	Build Conditions		Comments
		Transitway Speed (mph)	Intersection Operations	
TH 55 at Morgan Ave	Signalized; No Changes	35	Signalized; Transit Priority	Low traffic volumes; Not included in modeling.
TH 55 at Humboldt Ave	Signalized; No Changes	35	Signalized; Transit Priority	Low traffic volumes; Not included in modeling.
TH 55 at Van White Memorial Pkwy	Signalized; No Changes	35	Signalized; Transit Priority	
TH 55 at Bryant Ave	Signalized; No Changes	30	Signalized; Transit Priority	
TH 55 at W Lyndale Ave (I-94 West Ramps)	Signalized; No Changes	30	Signalized; Transit Priority	One through lane removed in each direction on TH 55.
TH 55 at W Lyndale Ave (I-94 West Ramps)	Signalized; No Changes	30	Signalized; Transit Priority	One through lane removed in each direction on TH 55.

Alignment D at The Interchange

As part of the modeling analysis for The Interchange project, four alternatives were analyzed for the connection of the Southwest and Bottineau Transitways into The Interchange. The results of the analysis showed that acceptable traffic operations (LOS D or better) could be achieved at the TH 55/7th Street/6th Avenue intersection with one LRT line crossing the intersection at-grade, but that some roadway improvements would be necessary. The modeling showed that at-grade crossings of both LRT lines would result in unacceptable traffic operations, therefore this alternative was not considered to be feasible. The design of The Interchange project was based on the following considerations:

- Track elevations approaching and on The Interchange site
- LRT platform locations and grades
- Location of the LRT crossings relative to the TH 55/7th Street/6th Avenue intersection
- Safety of LRT crossings relative to LRT/vehicle conflicts and control at crossings
- Overall traffic operations at the TH 55/7th Street/6th Avenue intersection

The Interchange preferred alternative provides for a Southwest Transitway crossing of 7th Street either above or below grade and a Bottineau Transitway crossing of the TH 55/7th Street/6th Avenue intersection either at-grade or above grade. The Environmental Assessment for The Interchange documents in detail the stakeholder input and public process that was used to identify the preferred alternative for The Interchange.

As part of the Bottineau Transitway Project, the analysis was carried forward to identify the roadway improvements needed to accommodate an at-grade crossing of the TH 55/7th Street/6th Avenue intersection since this would be the worst case scenario from a traffic operations perspective. A summary of the modeling assumptions for the connection to The Interchange is shown in Table 14.

Table 14. Alignment D at The Interchange Modeling Summary

Intersection	No-Build Conditions	Build Conditions		Comments
		Transitway Speed (mph)	Intersection Operations	
TH 55 at Border Ave/ Oak Lake Ave	No Change		Signalized; Transit Priority	
TH 55/6th Ave at 7th St	Grade Separated Southwest Transitway Crossing; Construction of The Interchange		Signalized; Transit Priority; Roadway widening on 7th Street to provide 2 exclusive northbound left-turn lanes and 1 southbound left-turn lane	
6th Ave at Bradford Ave/HERC Driveway	Grade Separated Southwest Transitway Crossing; Construction of The Interchange		Signalized; Grade Separated Southwest and Bottineau Transitways Crossings; Construction of The Interchange	Grade separated crossings; not included in modeling.

The results of the 2030 analysis for the PM peak hour are shown in Table 15. For more detailed analysis and results discussion, see The Interchange Traffic Technical Memorandum #3 and the TH 55/7th Street/6th Avenue Intersection Traffic Analysis Memorandum in the Appendix.

Table 15. 2030 Build PM Peak - Alignment D at The Interchange Delay and LOS Results

Intersection	Operations		
	Operating Scheme	Delay (sec/veh)	LOS
TH 55 at Border Ave/Oak Lake Ave	Priority	20	C
TH 55/6th Ave at 7th St	Priority	38	D

Summary of Impacts by Alternative

A summary of the critical assumptions in each alignment is shown in Table 16.

Table 16. Modeling Summary for Each Alignment

Intersection	No-Build Conditions	Build Conditions		Comments
		Transitway Speed (mph)	Intersection Operations	
Alignment A				
Arbor Lakes Pkwy at Zachary Ln	Arbor Lakes Parkway construction	35	Signalized; Transit Priority	Proposed parkway assumed to be designed with adequate geometrics to accommodate future transit operations; Not included in modeling.

Intersection	No-Build Conditions	Build Conditions: Transitway Speed (mph)	Build Conditions: Intersection Operations	Comments
Alignment A				
Arbor Lakes Pkwy at Jefferson Hwy	Arbor Lakes Parkway construction	35	Signalized; Transit Priority	Proposed parkway assumed to be designed with adequate geometrics to accommodate future transit operations; Not included in modeling.
CSAH 81 (Bottineau Blvd) at CSAH 130 (Brooklyn Blvd)	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd); Second left-turn lanes added on northbound, eastbound, and westbound approaches	55	Signalized; Grade Separated Transitway	
CSAH 81 (Bottineau Blvd) at 73rd Ave	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd)	55	Signalized; Preemption	
CSAH 81 (Bottineau Blvd) at 71st Ave/ CSAH 8 (Broadway Ave)	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd) and westbound 71st Ave; Second left-turn lanes added on southbound and eastbound approaches; Right-turn lane added on westbound approach	55	Signalized; Preemption	

Table 16 continued. Modeling Summary for Each Alignment

Intersection	No-Build Conditions	Build Conditions		Comments
		Transitway Speed (mph)	Intersection Operations	
Alignment B				
CSAH 103 (Broadway Ave) at CSAH 30 (93rd Ave)	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at Setzler Pkwy	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at 89th Ave	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at CSAH 109 (85th Ave)	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at College Park Drive	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at Candlewood Dr	Signalized; Through lanes added on CSAH 103 (Broadway Ave)	45	Signalized; Preemption	
CSAH 103 (Broadway Ave) at 73rd Ave	Signalized; Through lanes added on CSAH 81 (Bottineau Blvd)	45	Signalized; Preemption	
Alignment C				
CSAH 81 (Bottineau Blvd) at 63rd Ave	Signalized; Second left-turn lane added on southbound, eastbound, and westbound approaches; Through lanes added on CSAH 81 (Bottineau Blvd); Right-turn lanes added on 63rd Ave	55	Signalized; Preemption	
CSAH 81 (Bottineau Blvd) at CSAH 10 (Bass Lake Rd)	Signalized; Second left-turn lane and additional through lane added both directions on CSAH 81 (Bottineau Blvd)	55	Signalized; Preemption	

Table 16 continued. Modeling Summary for Each Alignment

Intersection	No-Build Conditions	Build Conditions: Transitway Speed (mph)	Build Conditions: Intersection Operations	Comments
Alignment D1				
TH 55 at CSAH 2 (Penn Ave)	Signalized; No Changes	35	Signalized; Transit Priority	Median modifications, approach alignment, and striping improvements assumed on CSAH 2 (Penn Ave).
Alignment D2				
CSAH 81 (Broadway Ave) at 29th Ave	Signalized; No Changes	30	Signalized; Transit Priority	CSAH 81 (Broadway Ave) reduced to one lane in each direction and left turn movements banned.
CSAH 81 (Broadway Ave) at 26th Ave	Signalized; No Changes	30	Signalized; Transit Priority	CSAH 81 (Broadway Ave) reduced to one lane in each direction and left turn movements banned.
CSAH 81 (Broadway Ave) at CSAH 2 (Penn Ave)	Signalized; No Changes	30	Signalized; Transit Priority	West leg of CSAH 81 (Broadway Ave) reduced to one lane in each direction and eastbound left turn movement banned; McNair Ave approach closed.
CSAH 2 (Penn Ave) at Golden Valley Rd	Signalized; No Changes	30	Signalized; Transit Priority	Left turn lanes added on CSAH 2 (Penn Ave)
CSAH 2 (Penn Ave) at Plymouth Ave	Signalized; No Changes	30	Signalized; Transit Priority	Left turn lanes added on CSAH 2 (Penn Ave)
CSAH 2 (Penn Ave) at TH 55	Signalized; No Changes	35	Signalized; Transit Priority	Median modifications, approach alignment, and striping improvements assumed on CSAH 2 (Penn Ave).
Alignment D Common Section				
TH 55 at W Lyndale Ave (I-94 West Ramps)	Signalized; No Changes	30	Signalized; Transit Priority	One through lane removed in each direction on TH 55.
TH 55 at W Lyndale Ave (I-94 West Ramps)	Signalized; No Changes	30	Signalized; Transit Priority	One through lane removed in each direction on TH 55.

Table 16 continued. Modeling Summary for Each Alignment

Intersection	No-Build Conditions	Build Conditions: Transitway Speed (mph)	Build Conditions: Intersection Operations	Comments
Alignment D at The Interchange				
TH 55/6th Ave at 7th St	Grade Separated Southwest Transitway Crossing; Construction of The Interchange		Signalized; Transit Priority; Roadway widening on 7th Street to provide 2 exclusive northbound left-turn lanes and 1 southbound left-turn lane	

The summary of intersections expected to operate at LOS E or LOS F operations in the 2030 PM peak hour is found in Table 17 In general, all intersections are expected to have acceptable operations under any of the build alternatives. The LOS E/F operations at the CSAH 81 (Broadway Ave)/CSAH 2 (Penn Ave) and CSAH 2 (Penn Ave)/TH 55 intersections during the peak hour would be expected to occur in 2030 even if the Bottineau Transitway Project is not constructed.

Table 17. Impacts By Alternative

Alternative	Intersections Expected to Operate at LOS E/F
No-Build Alternative	CSAH 81 (Broadway Ave) at CSAH 2 (Penn Ave) CSAH 2 (Penn Ave) at TH 55
TSM Alternative	No impacts
Alternative A-C-D1	CSAH 2 (Penn Ave) at TH 55
Alternative A-C-D2	CSAH 81 (Broadway Ave) at CSAH 2 (Penn Ave) CSAH 2 (Penn Ave) at TH 55
Alternative B-C-D1	CSAH 2 (Penn Ave) at TH 55
Alternative B-C-D2	CSAH 81 (Broadway Ave) at CSAH 2 (Penn Ave) CSAH 2 (Penn Ave) at TH 55

2.2.2 Construction Phase Impacts

Construction phase impacts were not explicitly evaluated relative to traffic operations. It is anticipated that construction of the transitway under any of the alternatives would result in traffic disruption, including lane closures, short-term intersection and roadway closures, and detours that would cause localized increases in congestion.

2.2.3 Indirect/Secondary Impacts

No-Build Alternative

No indirect or secondary traffic impacts are expected relative to traffic operations as anticipated under the No-Build alternative.

Transportation System Management Alternative

No indirect or secondary traffic impacts are anticipated under the Transportation System Management alternative.

Build Alternatives

No indirect or secondary traffic impacts are anticipated under any of the Build alternatives.

2.3 Avoidance, Minimization, and/or Mitigation Measures

In general, all intersections are expected to have acceptable operations under any of the build alternatives. The CSAH 81 (Broadway Avenue)/CSAH 2 (Penn Avenue) and TH 55/CSAH 2 (Penn Avenue) intersections are expected to operate at LOS F under the 2030 No-Build conditions (without the project), therefore no mitigation is required as a result of the Bottineau Transitway project.

The TH 55/7th Street/6th Avenue intersection would require geometric improvements to maintain acceptable LOS operations. 7th St would need to be widened to construct a second exclusive northbound left-turn lane, providing additional capacity to maintain acceptable LOS operations with the projected traffic growth.

No permits relative to traffic operations are required. Operation of the traffic signals along the transitway alignment will continue to be under the jurisdiction of the roadway authority (e.g., city or Hennepin County).

No specific construction mitigation is proposed. The details of construction staging would be developed in future stages of project design. Maintenance of traffic (MOT) plans would be required to be developed by the contractor, and submitted for approval to the roadway authorities. The MOT plans would address construction phasing, maintenance of traffic during construction of the transitway, any road closures, and any traffic detours.

3.0 Cumulative Impacts

The convergence of the Southwest and Bottineau Transitways at The Interchange, and the potential impacts on traffic operations, have previously been analyzed as part of The Interchange project. In addition, the impacts of the completion of Van White Memorial Boulevard on traffic operations were previously analyzed during the Alternatives Analysis of the Bottineau Transitway. No other cumulative impacts relative to traffic operations are expected.

4.0 Summary

The results of the analysis of traffic operations as part of the Bottineau Transitway Project are summarized in Table S-1 and S-2. In general, all intersections are expected to have acceptable operations under any of the build alternatives. The CSAH 81 (Broadway Avenue)/CSAH 2 (Penn Avenue) and TH 55/CSAH 2 (Penn Avenue) intersections are expected to operate at LOS F under the 2030 No-Build conditions (without the project), therefore, beyond the geometric improvements at those two intersections, no additional mitigation is proposed as a result of the Bottineau Transitway Project.

Table S-1. Summary of Impacts and Mitigation Measures

Impact Category	Impacts of Build Alternatives	Avoidance, Minimization, and/or Mitigation Measures
Traffic	**Alternatives A-C-D1 and B-C-D1** The TH 55/CSAH 2 (Penn Avenue) intersection is expected to operate at LOS F in the 2030 PM peak hour.	No mitigation is proposed – this is the same as the No-Build impact.
	Alternatives A-C-D2 and B-C-D2 The CSAH 81 (Broadway Avenue)/ CSAH 2 (Penn Avenue) and TH 55/CSAH 2 (Penn Avenue intersections are expected to operate at LOS E/F in the 2030 PM peak hour.	No mitigation is proposed – this is the same as the No-Build impact.
	All alternatives The TH 55/7th Street/6th Avenue intersection would require geometric improvements to maintain LOS D operations.	Widen roadway to construct second northbound left-turn lane on 7th Street.

Table S-2. Summary of Construction Impacts and Mitigation Measures

Impact Category	Construction Impacts of Build Alternatives	Avoidance, Minimization, and/or Mitigation Measures
Traffic	Construction of the transitway under any of the alternatives would result in traffic disruption including lane closures, short-term intersection and roadway closures, detours, and traffic diversion that would likely cause localized increases in congestion and delay.	No specific mitigation is proposed. The details of construction staging would be developed in future stages of project design.

APPENDIX

Traffic Technical Memoranda

- *Bottineau Transitway Traffic Study Report*, Trunk Highway 55 (Olson Memorial Highway) Corridor, WSB and Associates, November 10, 2009
- *Operations Analysis of LRT near the Terrace Mall*, WSB and Associates, June 2011
- *Operations Analysis of LRT and BRT at the 42nd Avenue Crossing*, WSB and Associates, June 2011
- *The Interchange, 2030 Build Analysis Update Traffic Technical Memorandum #3*, Kimley-Horn and Associates, August 22, 2011
- *Bottineau Segment D2 Traffic Analysis*, Kimley-Horn and Associates, September 19, 2011
- *Transit/Traffic Signal Operating Schemes Technical Memorandum*, Kimley-Horn and Associates, December 6, 2011
- *TH 55/7th Street/6th Avenue Intersection Traffic Analysis*, Kimley-Horn and Associates, February 16, 2012
- *CSAH 103 (Broadway Avenue) Traffic Study Travel Demand Forecasts: Four-Lane and Two-Lane Alternatives*, SRF Consulting Group, April 11, 2012
- *CSAH 81 (Brooklyn Boulevard) Transit Headway Analysis*, Kimley-Horn and Associates, May 24, 2012
- *Bottineau Segment A Traffic Analysis*, SRF Consulting Group, June 18, 2012
- *Bottineau Segment C Traffic Analysis*, SRF Consulting Group, June 18, 2012
- *Modeling Assumptions Bottineau LRT Transitway – Broadway Avenue,* WSB and Associates, October 2012

WSB & Associates, Inc.
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Study Report

To: ***Joe Gladke, PE***
Manager of Engineering and Transit Planning
Hennepin County
417 N. 5th Street North, Suite 320
Minneapolis, MN 55401

From: ***Chad Ellos, PE*** ***cc:*** ***Ross Jentink, PE***
Anthony Heppelmann, PE

Date: ***November 10, 2009***

Re: ***Bottineau Transitway Traffic Study Report***
Trunk Highway 55 (Olson Memorial Highway) Corridor
Hennepin County
WSB Project No. 1484-04

Project Overview

The purpose of this study is to forecast future traffic volumes and document traffic and light-rail transit (LRT) operations along Trunk Highway (TH) 55 in the City of Minneapolis. **Figure 1** shows the project location. It is assumed that LRT will run in the center median along TH 55. Further, the proposed signal systems along TH 55 will be coordinated to allow both preemption and priority traffic signal operating alternatives to assist LRT as it travels through the corridor.

This report documents the existing and future traffic conditions along the Bottineau Corridor in the City of Minneapolis. This report also analyzes the anticipated operational impacts of LRT on the adjacent roadway system.

The study includes an analysis of existing, no-build, and build scenarios. The no-build scenario includes minimal network revisions while the build scenario includes the addition of LRT as well as other network revisions. Twelve key intersections are analyzed in this study. These intersections include:

- TH 55 and Van White Memorial Boulevard
- TH 55 and Bryant Avenue North
- TH 55 and West Lyndale Avenue North
- TH 55 and East Lyndale Avenue North
- TH 55 and Border Avenue/Oak Lake Avenue North
- TH 55/7th Street North and 6th Avenue North
- TH 55/7th Street North and 5th Avenue North
- 7th Street North and Oak Lake Avenue North
- 6th Avenue North and HERC/Metro Transit Access

- 6th Avenue North and 5th Street North
- 6th Avenue North and 4th Street North
- 5th Street North and 5th Avenue North

The existing lane configuration for the key intersections is shown in **Figure 2**. A description of the existing roadway geometry is provided in **Appendix A**.

Traffic Forecasts

The major roadways within the study area are TH 55 (Olson Memorial Highway) and 7th Street North. On the west side of I-94, TH 55 is classified as a principal arterial. The dominant land-uses adjacent to TH 55 in this area are multifamily residential and undeveloped. To the east of I-94, TH 55 and 7th Street North are classified as 'A' minor relievers. The dominant land-uses adjacent to TH 55 and 7th Street North in this area are industrial and commercial.

TH 55 carries 25,000 vehicles per day (2006) west of I-94 and 11,100 vehicles per day (2005) between I-94 and 7th Street North. 7th Street North carries 9,100 to 11,800 vehicles per day (2005) between I-94 and I-394.[1] **Figures 3** and **4** display the existing am and pm peak hour turning movements at the key intersections. Turning movement data was collected in November of 2008 after the reopening of the I-35W Bridge and the 5th Street Bridge.

Peak hour traffic forecasts were developed for the key intersections within the project area by applying an annual growth rate to am and pm peak hour turning movement counts. The annual growth rate was developed based on a comparison of the average daily traffic (ADT) in the Metropolitan Council's 2000 Base Travel Demand Model and the Metropolitan Council's 2030 Travel Demand Model. These models were run using current (2008) Minneapolis Draft Comprehensive 2030 socioeconomic data forecasts.

Some minor changes to the Metropolitan Council's 2030 Travel Demand Model were made in this analysis. Van White Memorial Boulevard from TH 55 to I-394 was added to the network. In addition, the traffic volumes on side streets were adjusted as necessary based on a review of growth in the adjacent areas and the model outputs.

The historical growth in traffic along screenlines and the growth in trip generation associated with the Traffic Analysis Zones were reviewed in order to confirm that the growth factors used were consistent with model outputs. Selected screenlines were reviewed to make sure that the generalized nature of the travel demand model is not misrepresenting traffic in a given area. Minor adjustments were made to the location of Traffic Analysis Zone (TAZ) centroids to better represent the loadings onto the roadway network.

A review of the historical traffic volumes in the entire downtown area revealed a slight decrease in traffic over the past eight years. The Travel Demand Model forecasts increasing population, employment, and trips in the downtown Minneapolis area between the year 2000 and 2030. The following is a summary of this information.

[1] Daily traffic volumes obtained from 2006 Mn/DOT MSA traffic flow maps.

Regional Travel Demand Model

The ADT volumes obtained from the Metropolitan Council's 2000 and 2030 Twin Cities Regional Travel Demand Models were compared in order to develop an annual growth rate for each leg of the key intersections in the study area. As a check of the forecast growth in the study area, three screenlines were evaluated in order to compare historical growth rates. These screenlines also allowed for a comparison of the impacts from changes in the 2030 land-use as reflected in the 2008 Minneapolis Draft Comprehensive Plan's socioeconomic data. The screenlines used in this analysis include:

- West of I-94 – selected roadways between I-394 and 7th Street North including:
  - I-394
  - Glenwood Avenue
  - TH 55
  - 7th Street North

- East of I-94 – selected roadways along the western edge of downtown between Hennepin Avenue and 2nd Street North including:
  - Hennepin Avenue
  - I-394
  - Glenwood Avenue
  - TH 55
  - 7th Street North
  - 2nd through 4th Streets North
  - Washington Avenue
  - West River Road

- Downtown – all of the major roadways entering downtown Minneapolis inside I-94, I-35W, Plymouth Avenue North, and the Mississippi River.

Figure 5 shows the location of these screenlines.

The 2030 socioeconomic data for the downtown Minneapolis area in the 2008 Minneapolis Draft Comprehensive Plan represents a considerable change from the 2030 socioeconomic data in the current Metropolitan Council 2030 Travel Demand Model. **Table 1** below shows a screenline comparison between the 2030 ADT outputs using Minneapolis's socioeconomic data and using Metropolitan Council's socioeconomic data.

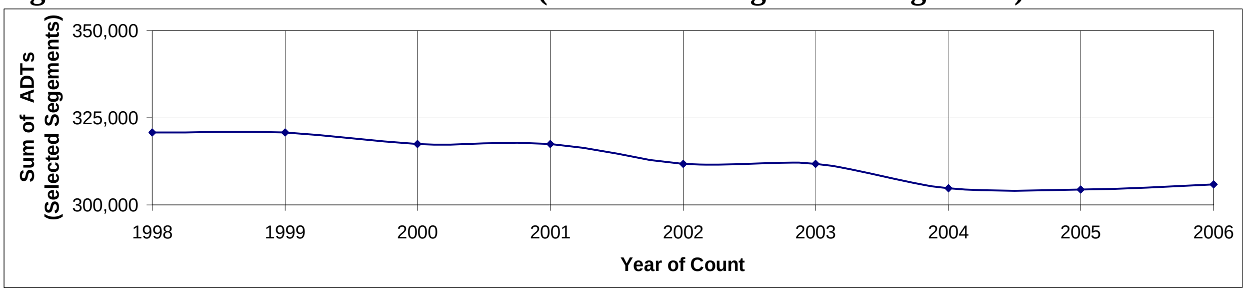
Table 1: Forecast Annual Traffic Growth Rate between 2000 and 2030 based on Comparison of 2000 and 2030 Metro Council Model ADT's on Selected Screenlines

Screenline Location	Metropolitan Council's 2030 Model	Metropolitan Council's 2030 Model with Current Minneapolis 2030 Socioeconomic Data
West of I-94	-0.04 percent/year	0.23 percent/year
East of I-94	0.25 percent/year	0.45 percent/year
Downtown	0.31 percent/year	0.47 percent/year

Historical Traffic Volumes
Historical traffic growth was also reviewed along the same three screenlines. ADT volumes were taken from Mn/DOT maps between 1998 and 2006 to develop a historical trend for the study area. 2007 traffic volumes were not used due to significant temporary changes in travel patterns as a result of the closure of the I-35W bridge and the 5th Street bridge.

Generally, the historical change in ADT decreased between 1998 and 2006. Traffic volumes west of I-94 decreased by approximately 1.0 percent per year. Traffic volumes east of I-94 decreased by approximately 0.30 percent per year. Traffic volumes entering and exiting downtown decreased by approximately 0.6 percent per year. **Figure 6** displays the decreasing trend of traffic entering and exiting the downtown area.

Figure 6: Historical Downtown Traffic (Sum of entering and exiting ADTs)



Socioeconomic Data
The approved 2000 and 2030 Metropolitan Council socioeconomic data used in the Travel Demand Models and the 2008 Minneapolis Draft Comprehensive Plan socioeconomic data were compared to show how the current projected 2030 socioeconomic data from Minneapolis compares with the previous projections used in the Metropolitan Council's 2030 Travel Demand Model. Three areas were defined for this analysis.

- West of I-94 – the area bound by I-94, I-394, Penn Avenue, and West Broadway Avenue.
- East of I-94 – the area along the western edge of downtown bound by I-94, 15th Street West, LaSalle Avenue-8th Street-Hennepin Avenue, Plymouth Avenue North, and the Mississippi River.
- Downtown – all of the area within I-94, I-35W, Plymouth Avenue North, and the Mississippi River.

Figure 5 shows the location of these areas. The results of this comparison are summarized in **Tables 2, 3,** and **4**. The current 2030 socioeconomic data in the approved Metropolitan Council 2030 Travel Demand Model shows that the population and employment of downtown is forecasted to increase by approximately 50 percent and 30 percent respectively between the years 2000 and 2030. The socioeconomic data from the 2008 Minneapolis Draft Comprehensive Plan shows that the population and employment of downtown is forecasted to increase by approximately 130 percent and 20 percent respectively between the years 2000 and 2030. These differences in population and employment result in differences between the traffic forecasts for the two different models.

The 2030 socioeconomic data in the 2008 Minneapolis Draft Comprehensive Plan has greater increases in population and lesser increases in employment than what is currently in the approved 2030 Metropolitan Council Travel Demand Model. The northwest portion of downtown adjacent to the study area is forecasted to experience a much higher increase in population in the 2008 Minneapolis Draft Comprehensive Plan data.

Table 2: Socioeconomic Data

Area	2000 Metropolitan Council Data				2030 Metropolitan Council Data				2030 MPLS Draft Comp Plan Data			
	POPULATION	HOUSEHOLDS	EMPLOYMENT		POPULATION	HOUSEHOLDS	EMPLOYMENT		POPULATION	HOUSEHOLDS	EMPLOYMENT	
			RETAIL	NON-RETAIL			RETAIL	NON-RETAIL			RETAIL	NON-RETAIL
West of I-94	12,903	4,075	195	4,675	12,413	4,098	1,284	2,693	15,011	6,154	1,731	4,676
East of I-94	5,636	3,439	970	31,894	11,734	7,320	3,539	32,302	18,213	11,492	4,392	30,480
Downtown	20,201	11,772	9,322	137,152	31,428	20,900	14,399	179,161	46,900	28,520	14,761	155,513

Table 3: Change in Socioeconomic Data between 2000 and 2030

Area	Approved MET Council Model Data (2030 MET Council - 2000 MET Council)				MPLS Draft Comp Plan Data (2030 MPLS Draft Comp Plan - 2000 MET Council)			
	POPULATION	HOUSEHOLDS	EMPLOYMENT		POPULATION	HOUSEHOLDS	EMPLOYMENT	
			RETAIL	NON-RETAIL			RETAIL	NON-RETAIL
West of I-94	-490	23	1,089	-1,982	2,108	2,079	1,536	1
East of I-94	6,098	3,881	2,569	408	12,577	8,053	3,422	-1,414
Downtown	11,227	9,128	5,077	42,009	26,699	16,748	5,439	18,361

Table 4: Percent Change in Socioeconomic Data between 2000 and 2030

Area	Approved MET Council Model Data % Change ([2030-2000]/2000)				MPLS Draft Comp Plan Data % Change ([2030-2000]/2000)			
	POPULATION	HOUSEHOLDS	EMPLOYMENT		POPULATION	HOUSEHOLDS	EMPLOYMENT	
			RETAIL	NON-RETAIL			RETAIL	NON-RETAIL
West of I-94	-4%	1%	558%	-42%	16%	51%	788%	0%
East of I-94	108%	113%	265%	1%	223%	234%	353%	-4%
Downtown	56%	78%	54%	31%	132%	142%	58%	13%

Year 2030 Forecasts

The 2030 socioeconomic data from the 2008 Minneapolis Draft Comprehensive Plan was used to develop the 2030 traffic forecasts for the study area. Annual growth rates for the key intersections were calculated based on a comparison of the modeled ADT’s in the 2000 and 2030 Regional Travel Demand Model with the inclusion of Van White Memorial Boulevard from TH 55 to I-394. The annual growth rates were applied to the existing turning movement counts taken in the fall of 2008. Based on the future socioeconomic data obtained from the 2008 Minneapolis Draft Comprehensive Plan, the annual growth rates for cross street volumes were reviewed relative to the change in trip generation for the areas they serve.

Figures 7 and **8** display the year 2030 am and pm peak hour turning movement forecasts at the key intersections. Minor adjustments to the forecasted volumes were necessary in order to balance turning movements at the key intersections. These forecasted volumes will be used for the 2030 no-build and 2030 build roadway/LRT alternatives analyses.

Operations Modeling Methodology and Assumptions

VISSIM Methodology

VISSIM is a microscopic, time step and behavior based simulation model developed to model urban traffic and public transit operations. It is approved by Mn/DOT as a method to analyze complex transportation systems involving traffic and transit operations under constraints such as lane configuration, traffic composition, traffic signals, transit stops, etc., thus making it a useful tool for the evaluation of various alternatives based on transportation engineering and planning measures of effectiveness.

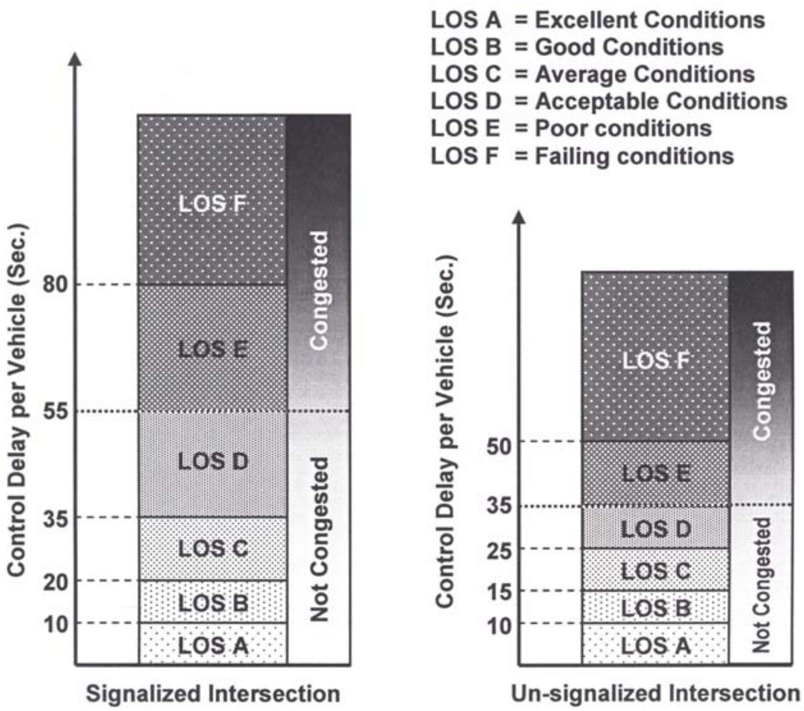
In contrast to less complex models using constant speeds and deterministic car following logic, VISSIM uses the psycho-physical driver behavior model developed by WIEDEMANN (1974). Stochastic distributions of speed and spacing thresholds replicate individual driver behavior characteristics. VISSIM simulates the traffic flow by moving "driver-vehicles" through a network. Every driver, with specific behavior characteristics, is assigned to a specific vehicle. Accordingly, the driving behavior corresponds to the technical capabilities of the vehicle. This allows drivers on multiple lane roadways to react to preceding vehicles and neighboring vehicles on adjacent travel lanes.

Level of Service Analysis Criteria

The traffic operations analysis is based on established methodologies documented in the Highway Capacity Manual (TRB, 2000). The results from this analysis are presented in the form of a letter grade from A to F, called level of service (LOS). The letter grade provides a qualitative assessment of the intersection operations based on the amount of delay per vehicle. The LOS system is set up similar to a report card with "A" representing high quality operations and "F" representing poor operations. At LOS A, motorists experience very little delay or interference. On a roadway or intersection with LOS F conditions, motorists would experience severe congestion and extreme delay, i.e., gridlock.

For intersections, LOS is primarily a function of delay which is dependent on am and pm peak hour turning movement volumes, intersection lane configuration, and traffic control. The intersection analysis was completed using average control delay as defined by the HCM. The threshold values for each LOS for unsignalized intersections are slightly less than for signalized intersections. This variance was created because motorists' expectations of the intersection differ with the type of traffic control. The LOS analysis criteria for signalized and unsignalized intersections are shown in **Figure 9**.

Figure 9: Intersection Level of Service Based on Delay



Source: Highway Capacity Manual (2000)

Although LOS A conditions represents the best possible level of traffic flow, the cost to construct intersections to such a high standard exceeds the benefit to the user. Within an urbanized area, it is generally regarded that LOS D provides an acceptable LOS.

Alternatives Analysis

Six different VISSIM alternatives were modeled to analyze the existing and future roadway system.

1. Existing (2008)
2. 2030 No-Build
3. 2030 Build – Baseline
4. 2030 Build – LRT with Typical Signal Operations
5. 2030 Build – LRT with Priority Signal Operations
6. 2030 Build – LRT with Preemption Signal Operations

Geometrics

Alternative 1 contains the existing roadway network comprised of traffic signals that permit left turns on green. Alternative 2 contains traffic signals that permit left turns on green and slight improvements to the roadway network including the addition of right turn lanes on TH 55 eastbound at Van White Memorial Boulevard and Bryant Avenue. Also, a northbound right turn lane and a southbound left turn lane were added to Van White Memorial Boulevard at TH 55. Alternatives 3 through 6 had the roadway network revised to add additional capacity at intersections or to remove unneeded lanes thus providing needed right-of-way for the proposed

LRT. Protected left turn phases were also added to traffic signals along TH 55. The revisions mentioned below for Alternatives 3-6 assume the improvements mentioned for Alternative 2 have already been constructed.

- **TH 55 and Bryant Avenue North:** The exclusive right turn lane becomes a through-right turn lane.

- **TH 55 and West Lyndale Avenue North:** A second exclusive right turn lane to I-94 EB was added at the bridge replacing the existing combined through/right turn lane. The exclusive right turn lane onto West Lyndale Avenue south was shifted to the south, thus widening the roadway an additional lane.

- **TH 55 Bridge over I-94:** One through lane in each direction was removed.

- **TH 55 and Border Avenue/Oak Lake Avenue North:** One through lane in each direction was removed.

- **TH 55/7th Street North and 6th Avenue North:** One lane in the eastbound direction was removed leaving a through lane, a through-right turn lane, and a right turn lane. A left turn lane was added to the westbound approach and an exclusive right turn lane will take the place of the existing through-right turn lane. This will reduce the westbound lanes traveling through the intersection from three to two. The three lane approach at northbound 7th Street will be resigned to include a left turn lane, a through-left turn lane, and a through lane.

The LRT is assumed to operate in the center of the roadway along TH 55 from Van White Memorial Boulevard through the intersection of 7th Street North and 6th Avenue North. Once the alignment crosses 7th Street, it veers to the south, crossing the eastbound lanes of 6th Avenue, and then operates adjacent to the roadway. The alignment remains side running as it transitions onto 5th Street and enters the station at Target Field. Far-side stations are located at the intersection of TH 55 and Van White Memorial Boulevard.

Operating Assumptions

The LRT is assumed to operate at a frequency of seven-and-a-half minutes during the peak hours with a station dwell time of approximately twenty seconds at Van White Memorial Boulevard. The TH 55 traffic signals are semi-actuated, coordinated in the eastbound and westbound directions with the exception of the 7th Street and 6th Avenue intersection operating as a fully actuated signal in Alternative 6. Traffic signals for Alternatives 1, 2, and 6 use VISSIM’s NEMA controllers. Traffic signals for Alternatives 3-5 use VISSIM’s RBC controllers.

In Alternative 5, LRT is given priority at traffic signals causing minor street phases to end after the minimums are reached and possibly causing major street through phases to be extended beyond their normal maximums in order to minimize LRT delay. Also, once a priority call ends, calls for additional priority will be ignored for one and one half cycle lengths in an attempt to let the traffic signal recover and fully service the minor approaches. During this recovery time, LRT will not be given priority and will have to wait for a green phase.

In Alternative 6, LRT uses preemption by placing an advanced call to the traffic signal warning that a train is approaching. Phases on the side streets are shortened to allow the LRT to run through the corridor without delay at intersections. Through phases not conflicting with the train are allowed to navigate through the intersection while the preemptive call is active. After the preemptive call is satisfied, the next phase the traffic signal brings up will be the first phase across the next barrier.

Results

A summary of the levels of service for each alternative is provided below. Tables in **Appendix B** provide more detail as to the individual movements at each intersection and the queue lengths recorded. Train travel times in Alternatives 4-6 were measured from a checkpoint just west of Van White Memorial Boulevard to a checkpoint just west of the Target Field station.

Alternative 1 – Existing (2008) Volumes, Existing Geometry

Table 5 summarizes the existing LOS at the key intersections based on the existing lane geometry, City of Minneapolis provided signal timing, and 2008 existing traffic volumes as shown in **Figures 3** and **4**. In this alternative, all intersections are currently operating at LOS D or better during the am and pm peak hours. In the am peak hour, the southbound left turning movement at 7th Street and 6th Avenue is operating at LOS E. In the pm peak hour, the eastbound right from TH 55 onto eastbound I-94 operates at LOS E. Also, the northbound left from 7th Street to TH 55 westbound operates at LOS F. These results are consistent with observed conditions.

Table 5: Alternative 1 Peak Hour Intersection LOS

Intersection	AM Peak Hour					PM Peak Hour				
	LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)			LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)		
TH 55 & Van White Mem Blvd	B	10	SBT	D	36	B	10	SBL	D	36
TH 55 & Bryant Ave N	A	3	NBL	D	45	B	17	NBT	D	48
TH 55 & W Lyndale Ave N	B	18	SBL	C	28	C	27	EBR	E	64
TH 55 & E Lyndale Ave N	C	22	NBL	C	32	C	24	EBL	D	36
TH 55 & Border/Oak Lake Ave	A	8	NBT	D	42	B	17	NBL	D	50
TH 55/7th St N & 6th Ave N	C	32	SBL	E	61	D	43	NBL	F	>100
6th Ave N & HERC Access	A	3	NBL	D	44	A	4	SBL	D	53
6th Ave N & 5th St W	A	1	WBT	A	8	A	8	SBT	B	11
6th Ave N & 4th St W	A	2	EBT	B	10	A	2	EBT	A	9
5th St W & 5th Ave N	A	5	SBL	D	38	A	5	SBL	D	47
TH 55/7th St N & 5th Ave N	A	1	EBL	B	12	A	7	EBL	E	37
7th St N & Oak Lake Ave	B	16	SBL	D	42	B	16	NBL	D	43

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Source: WSB & Associates

Alternative 2 – 2030 Volumes, Existing/No-Build Geometry

Table 6 summarizes the LOS based on Alternative 2 lane geometry and forecasted 2030 traffic volumes as shown in **Figures 7** and **8**. In this alternative, all intersections operate at LOS C or better during the am and pm peak hours with the exception of Van White Memorial Boulevard operating at LOS E during the pm peak hour. The worst movements during the pm peak hour at Van White, Bryant, and West Lyndale are due to vehicles backing up and slowing down in an effort to get onto the I-94 eastbound on-ramp. LOS F conditions are also reported for the northbound lefts at TH 55/Border Ave and for northbound lefts at 7th Street and Oak Lake

Avenue. In Alternative 1, the NBL at 7th Street and 6th Avenue was at LOS F conditions using existing/provided signal timings. Signal timings were optimized in Alternative 2 and the result was improved LOS conditions for the NBL at 7th Street and 6th Avenue.

Table 6: Alternative 2 Peak Hour Intersection LOS

Intersection	AM Peak Hour					PM Peak Hour				
	LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)			LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)		
TH 55 & Van White Mem Blvd	C	31	EBR	E	58	E	61	EBR	F	>100
TH 55 & Bryant Ave N	B	12	NBL	D	48	C	28	NBR	E	74
TH 55 & W Lyndale Ave N	C	29	EBR	D	40	C	28	EBR	E	76
TH 55 & E Lyndale Ave N	C	26	EBT	C	31	C	25	WBT	D	41
TH 55 & Border/Oak Lake Ave	B	13	NBL	D	50	C	23	NBL	F	>100
TH 55/7th St N & 6th Ave N	C	25	SBT	D	43	C	22	SBL	D	36
6th Ave N & HERC Access	A	4	SBL	D	46	A	4	SBL	D	45
6th Ave N & 5th St W	A	1	WBT	B	11	C	20	SBT	D	29
6th Ave N & 4th St W	A	3	EBT	B	11	A	4	EBT	B	12
5th St W & 5th Ave N	A	6	SBL	D	44	A	6	SBL	D	46
TH 55/7th St N & 5th Ave N	A	1	EBL	C	15	A	1	EBL	A	9
7th St N & Oak Lake Ave	B	19	NBL	F	99	C	28	NBL	F	>100

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Source: WSB & Associates

Many vehicle queue lengths are longer than the available storage in the am and pm peak hours and are related to the delay at intersections. Movements that have a maximum queue greater than the storage provided are listed in **Table 7**.

Table 7: Alternative 2 Peak Hour Queues Exceeding Capacity

Intersection	AM Peak Hour			PM Peak Hour		
	Movement | Storage (ft) | Queue (ft)			Movement | Storage (ft) | Queue (ft)		
TH 55 & Van White Mem Blvd	EBT	950	1,045	EBT	950	1,660
TH 55 & Bryant Ave N				EBT	750	1,670
TH 55 & W Lyndale Ave N	EBT	500	655	EBT	500	900
TH 55 & E Lyndale Ave N	EBL	200	250	EBL	200	260
	EBT	200	325	WBT	430	545
TH 55/7th St N & 6th Ave N	SBT	450	540	SBT	450	540

K:\01484-04\Admin\Docs\[Report Tables.xls]Alt 2 Queues
Source: WSB & Associates

Alternative 3 – 2030 Volumes, Baseline Build Geometry with Protected Lefts

Table 8 summarizes the LOS based on Alternative 3 lane geometry and forecasted 2030 traffic volumes. In this alternative, all intersections operate at LOS D or better during the am and pm peak hours. By adding protected left turn phases to the traffic signals along the LRT corridor, some intersections experienced additional delay. Delay was reduced by adding capacity along TH 55 between Van White and West Lyndale and through the addition of a second right turn lane onto the I-94 eastbound on-ramp. Also, setting the signal at 7th Street and 6th Avenue to a split-phase for northbound and southbound allowed for two northbound left turn lanes. This helped reduce delay at 7th Street and at Border Avenue due to a better flow of vehicles through the coordinated system. The northbound lefts at 7th Street and Oak Lake continue to have a poor LOS due to poor operations at 7th Street and 6th Avenue causing queues to back up from 6th Avenue to Oak Lake Avenue.

Table 8: Alternative 3 Peak Hour Intersection LOS

Intersection	AM Peak Hour					PM Peak Hour				
	LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)			LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)		
TH 55 & Van White Mem Blvd	C	25	EBL	E	70	C	24	SBL	E	76
TH 55 & Bryant Ave N	C	21	EBL	E	74	B	13	WBL	F	96
TH 55 & W Lyndale Ave N	C	29	SBL	D	46	C	20	SBL	D	48
TH 55 & E Lyndale Ave N	C	24	NBL	D	41	C	26	NBL	D	50
TH 55 & Border/Oak Lake Ave	C	30	WBL	E	71	C	33	WBL	E	73
TH 55/7th St N & 6th Ave N	D	43	WBL	F	>100	D	37	WBL	E	63
6th Ave N & HERC Access	A	5	NBL	D	39	A	4	NBL	D	37
6th Ave N & 5th St W	A	1	WBT	B	10	C	19	SBT	D	28
6th Ave N & 4th St W	A	3	EBT	B	12	A	4	WBL	B	11
5th St W & 5th Ave N	A	6	SBL	B	10	A	6	SBL	B	10
TH 55/7th St N & 5th Ave N	A	1	EBL	B	14	A	1	EBL	A	9
7th St N & Oak Lake Ave	C	27	NBL	F	>100	C	21	NBL	F	94

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Source: WSB & Associates

Alternative 4 – 2030 Volumes with LRT, Typical Signal Operations, Baseline Build Geometry

Table 9 summarizes the LOS based on Alternative 4 lane geometry and forecasted 2030 traffic volumes. In this alternative, all intersections operate at LOS D or better during the am and pm peak hours. The worst delay movements in both the am and pm peak hours are mostly turning and through movements that conflict with the high volume movements and the LRT movement through the intersections. The westbound left turn from TH 55 onto Van White is at LOS F in the am peak hour. This approach could benefit from dual left turn lanes but additional right-of-way would be needed to shift through lanes further to the north. During the am peak hour, the average LRT travel times eastbound and westbound were 4.5 minutes and 4.1 minutes. During the pm peak hour, the average LRT travel times eastbound and westbound were 4.8 minutes and 5.3 minutes.

Table 9: Alternative 4 Peak Hour Intersection LOS

Intersection	AM Peak Hour					PM Peak Hour				
	LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)			LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)		
TH 55 & Van White Mem Blvd	C	29	WBL	F	81	C	27	SBL	E	76
TH 55 & Bryant Ave N	B	12	NBT	E	63	A	9	WBL	E	77
TH 55 & W Lyndale Ave N	D	35	WBL	E	56	C	27	SBL	E	55
TH 55 & E Lyndale Ave N	C	26	NBL	D	48	D	39	WBT	E	55
TH 55 & Border/Oak Lake Ave	C	27	WBL	E	72	D	36	EBL	E	69
TH 55/7th St N & 6th Ave N	D	48	WBL	F	>100	D	51	SBT	E	68
6th Ave N & HERC Access	A	6	NBL	D	39	A	4	NBL	D	38
6th Ave N & 5th St W	A	1	WBT	B	10	C	20	SBT	D	30
6th Ave N & 4th St W	A	3	WBT	B	11	A	4	EBT	C	15
5th St W & 5th Ave N	A	6	SBL	B	13	A	7	SBL	B	11
TH 55/7th St N & 5th Ave N	A	1	EBL	C	15	A	1	EBL	A	8
7th St N & Oak Lake Ave	D	36	EBT	D	48	B	12	NBL	B	19

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Source: WSB & Associates

Alternative 5 – 2030 Volumes with LRT, Priority Signal Operations, Baseline Build Geometry

Table 10 summarizes the LOS based on Alternative 5 lane geometry and forecasted 2030 traffic volumes. In this alternative, all intersections operate at LOS D or better during the am and pm peak hours. The result of adding LRT priority to the traffic signals along the corridor was a slight increase in delay over Alternative 4 results. The issues are still the westbound left turn to Van White, the westbound left turn to I-94 eastbound, and the capacity constrained intersection of 7th Street and 6th Avenue. During the am peak hour, the average LRT travel times eastbound and westbound were 5.1 minutes and 4.4 minutes. During the pm peak hour, the average LRT travel times eastbound and westbound were 4.8 minutes and 5.0 minutes. The resulting difference in LRT travel times between Alternative 4 and Alternative 5 are minor. LRT travel time differences ranged from 36 seconds slower to 18 seconds faster.

Table 10: Alternative 5 Peak Hour Intersection LOS

Intersection	AM Peak Hour					PM Peak Hour				
	LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)			LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)		
TH 55 & Van White Mem Blvd	C	34	WBL	F	>100	C	28	WBL	F	93
TH 55 & Bryant Ave N	B	19	NBL	E	66	B	10	WBL	E	75
TH 55 & W Lyndale Ave N	D	35	WBL	E	63	C	27	SBL	E	61
TH 55 & E Lyndale Ave N	C	27	NBL	D	48	D	40	NBL	E	57
TH 55 & Border/Oak Lake Ave	C	26	WBL	E	71	D	39	NBL	F	99
TH 55/7th St N & 6th Ave N	D	43	WBL	F	>100	D	51	NBT	E	70
6th Ave N & HERC Access	A	5	SBL	D	43	A	4	NBL	D	38
6th Ave N & 5th St W	A	2	WBT	B	10	C	21	SBT	D	31
6th Ave N & 4th St W	A	3	EBT	B	11	A	5	EBR	B	13
5th St W & 5th Ave N	A	6	SBL	B	12	A	6	SBL	B	12
TH 55/7th St N & 5th Ave N	A	1	EBL	B	14	A	1	EBL	A	9
7th St N & Oak Lake Ave	C	24	EBT	C	30	B	13	NBL	C	21

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Source: WSB & Associates

Alternative 6 – 2030 Volumes with LRT, Preemption Signal Operations, Baseline Build Geometry
Table 11 summarizes the LOS based on Alternative 6 lane geometry and forecasted 2030 traffic volumes. In this alternative, all intersections operate at LOS D or better during the am and pm peak hours. The result of adding LRT preemption to the traffic signals along the corridor was a slight decrease in delay over Alternative 4 results. Compared to Alternative 5, preemption operates slightly better in the am peak hour and nearly the same as priority in the pm peak hour. The same issues are still the westbound left turn to Van White, the westbound left turn to I-94 eastbound, and the capacity constrained intersection of 7th Street and 6th Avenue. Since the LRT receives preemption at all traffic signals, the train travel time between checkpoints was constant at 3.1 minutes. This results in approximately one to two minutes faster LRT travel times compared to Alternative 4 and Alternative 5.

Table 11: Alternative 6 Peak Hour Intersection LOS

Intersection	AM Peak Hour					PM Peak Hour				
	LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)			LOS | Control Delay (sec/veh)		Worst Movement | LOS | Control Delay (sec/veh)		
TH 55 & Van White Mem Blvd	C	26	WBL	F	>100	C	30	WBL	F	>100
TH 55 & Bryant Ave N	B	11	NBL	E	72	B	13	WBL	F	87
TH 55 & W Lyndale Ave N	C	24	WBL	F	81	C	21	WBL	E	59
TH 55 & E Lyndale Ave N	C	22	NBL	D	40	D	38	WBT	E	58
TH 55 & Border/Oak Lake Ave	C	26	WBL	D	48	D	35	WBL	E	68
TH 55/7th St N & 6th Ave N	D	41	WBL	E	75	D	47	WBL	E	74
6th Ave N & HERC Access	A	9	SBL	E	56	A	9	SBL	E	57
6th Ave N & 5th St W	A	2	WBT	B	12	C	22	SBT	D	32
6th Ave N & 4th St W	A	3	EBT	B	11	A	5	WBL	C	15
5th St W & 5th Ave N	A	7	SBL	D	46	A	7	SBL	D	51
TH 55/7th St N & 5th Ave N	A	1	EBL	B	13	A	1	EBL	A	7
7th St N & Oak Lake Ave	B	13	SBL	C	33	C	20	NBL	E	55

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Source: WSB & Associates

Conclusions

The purpose of this study is to determine the feasibility of LRT operating at-grade in the center median of TH 55 from Van White Boulevard to 5th Street North. In order to determine the feasibility of at-grade LRT operations WSB developed 2030 traffic forecasts for the nine intersections included in the study. These forecasts were based on applying a growth factor to existing traffic counts for the study area. The growth factor was based on the forecast increase in ADT's between 2000 and 2030 using the Metropolitan Council's Regional Travel Demand Model and the City of Minneapolis's 2008 Comprehensive Plan socio-economic forecasts. The analysis indicated an average traffic growth rate of approximately 0.5% per year on TH 55. The analysis of these traffic forecasts for six different alternatives indicated the following.

- Currently, all intersections in the study area are operating at LOS D or better during the am and pm peak hours. However, there are selected traffic movements that operate at LOS "E" or "F". The two most congested intersections are the TH 55 and Lyndale Avenue intersection and the TH 55 and 7th Street North Intersection. The traffic demand on eastbound TH 55 to turn right onto southbound Lyndale Avenue and eastbound I-94 results in queues that extend back through the Bryant Avenue intersection and LOS "E" for this traffic movement. Also the northbound and southbound left turns on 7th Avenue at TH 55 currently operate at level of service "E" or worse in the peak hours.
- Traffic operations on TH 55 are expected to be worse by 2030 as traffic volumes grow. Traffic on TH 55 is expected to increase at approximately 0.5 % per year. Van White Memorial Boulevard traffic levels are expected to increase significantly upon completion of Van White Memorial Boulevard between I-394 and TH 55 and anticipated development. The forecasted population and traffic growth along Van White Memorial Boulevard south of the study area will create the need for intersection revisions at Van White Memorial Boulevard and TH 55. These revisions, including exclusive right and left-turn lanes on Van White Boulevard, were assumed in the analysis for the 2030 conditions. A second left turn lane from TH 55 westbound to Van White southbound may also be needed to mitigate the delay for this left-turn movement by 2030. The analysis indicates that another right-turn lane is needed on eastbound TH 55 for the right-

turns to southbound Lyndale Avenue and to the eastbound I-94 on-ramp in order to provide an acceptable level of service. Without this extra right-turn lane traffic backs up on TH 55 through the Van White intersection and results in LOS "E" for the eastbound TH 55 traffic.

- The major traffic operations impact of introducing center running LRT on TH 55 is the increased delay experienced by vehicles turning onto, off of, or crossing TH 55. Since through traffic can move concurrently with LRT there will be very little impact on TH 55 through traffic. The model indicates that the biggest problem will occur in the westbound direction as a result of vehicles turning left from TH 55 to southbound Lyndale Avenue / eastbound I-94 ramp. The intersection of 7th Street and 6th Avenue is currently experiencing at-capacity conditions. This intersection consists of two major roadways that funnel traffic into and out-of downtown Minneapolis. Approaches constantly struggle for green time during the peak hours. This makes coordination with the rest of the corridor difficult.
- Priority vs. Preemption – Although the analysis shows that the overall intersection level of service is almost the same between priority and preemption signal operations, preemption does make the critical left-turn movement from westbound TH 55 to southbound Lyndale Avenue / eastbound I-94 ramp worse, creating queues that extend back to 7th Street.
- Because the length of 3-car trains is more than the storage area on TH 55 between southbound Lyndale Avenue and northbound Lyndale Avenue, it is necessary to modify the signal timing for these intersections so trains do not become trapped between the intersections. This adds to the delays for left-turns at these intersections. Dual left turn lanes may be needed in both the eastbound and westbound directions to address this problem if preemption is considered on TH 55.
- Train Travel Times – LRT priority causes the train to experience random delay at some traffic signals within the study area. LRT preemption causes no delay to trains within the study area. The train travel time through the study area is 3.1 minutes with preemption and 4.4 to 5.0 minutes with priority treatment.

Hennepin County
Bottineau Transitway

January 19, 2009

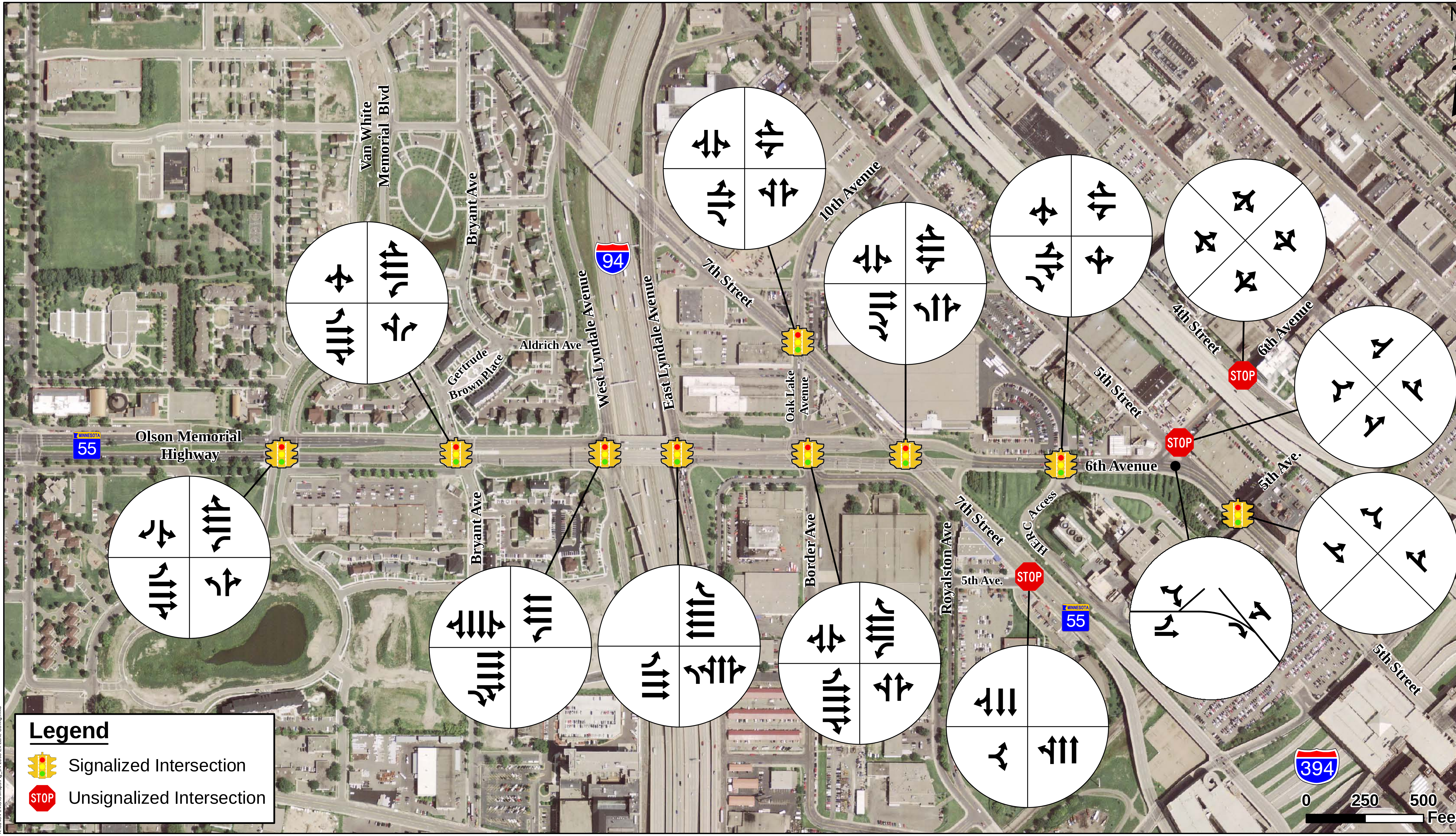
Legend

TH 55 Model Intersections

TH 55 Model Segments

Figure 1
Project Location

WSB & Associates, Inc.

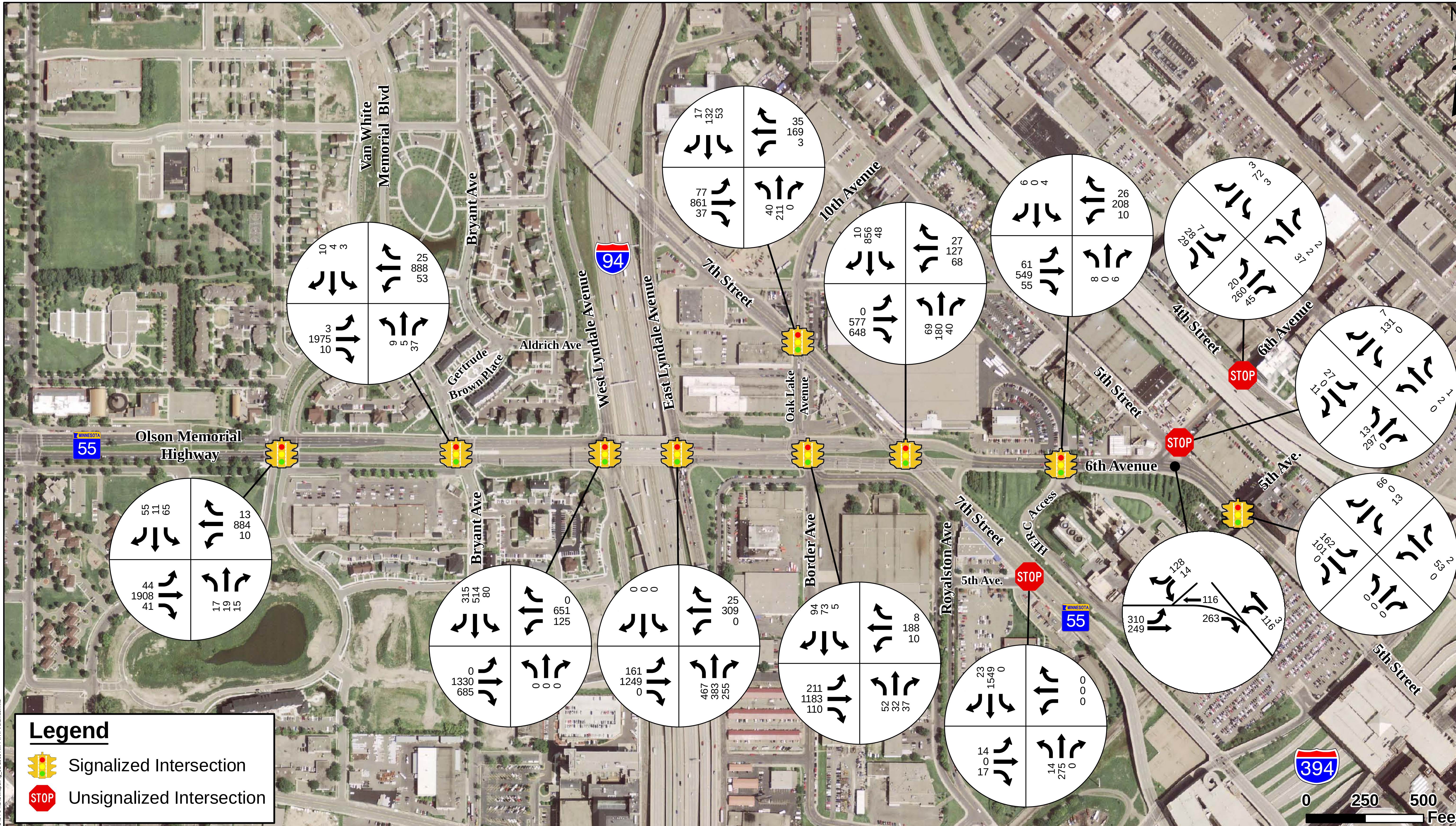


Hennepin County
Bottineau Transitway

Revised: February 2, 2009

Figure 2
Existing Lane Configuration (2008)

WSB & Associates, Inc.



Legend

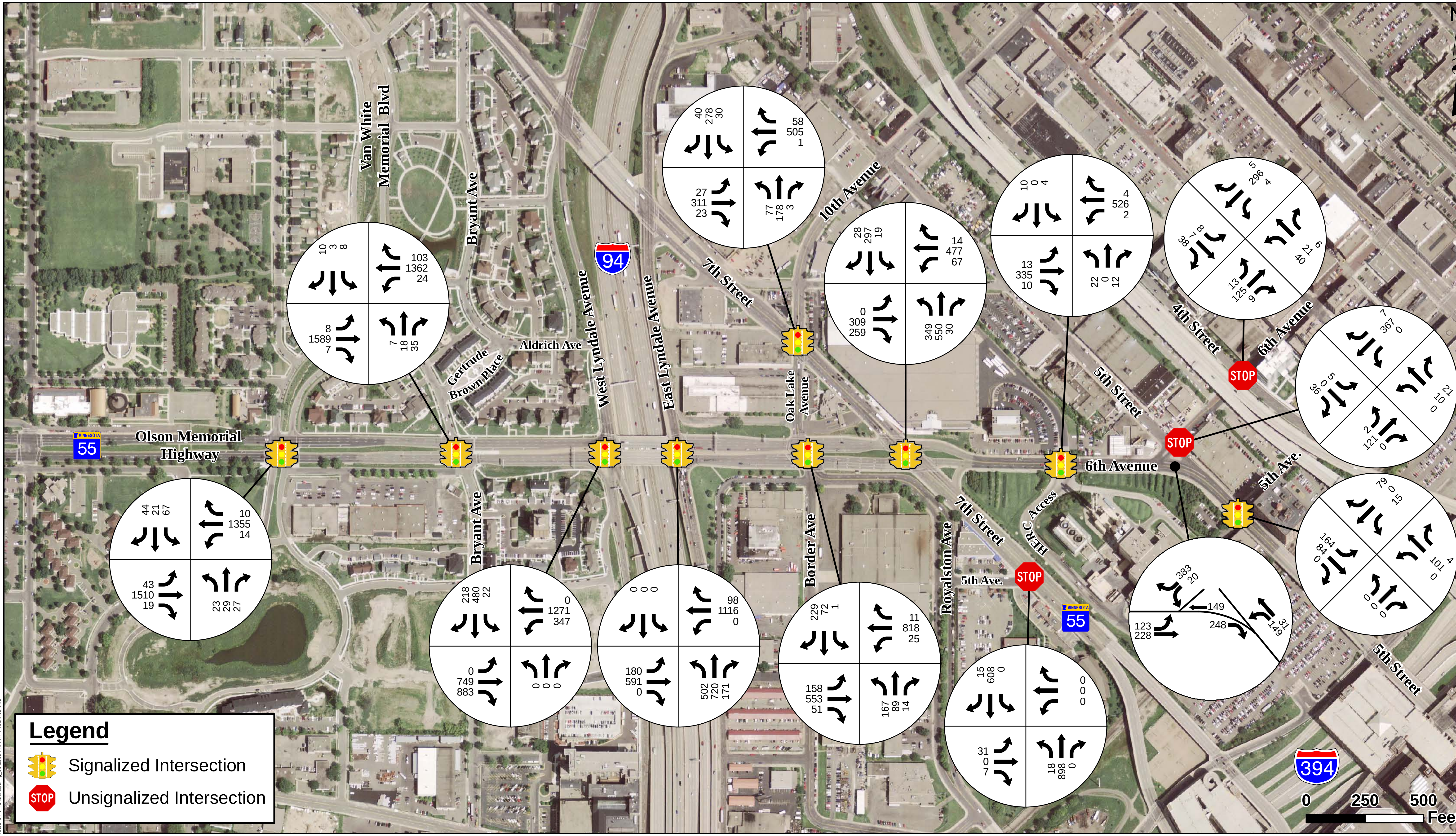
- Signalized Intersection
- Unsignalized Intersection

Hennepin County
Bottineau Transitway

Figure 3
2008 AM Peak Hour Volumes (7:45 - 8:45)

WSB & Associates, Inc.

Revised: January 19, 2009



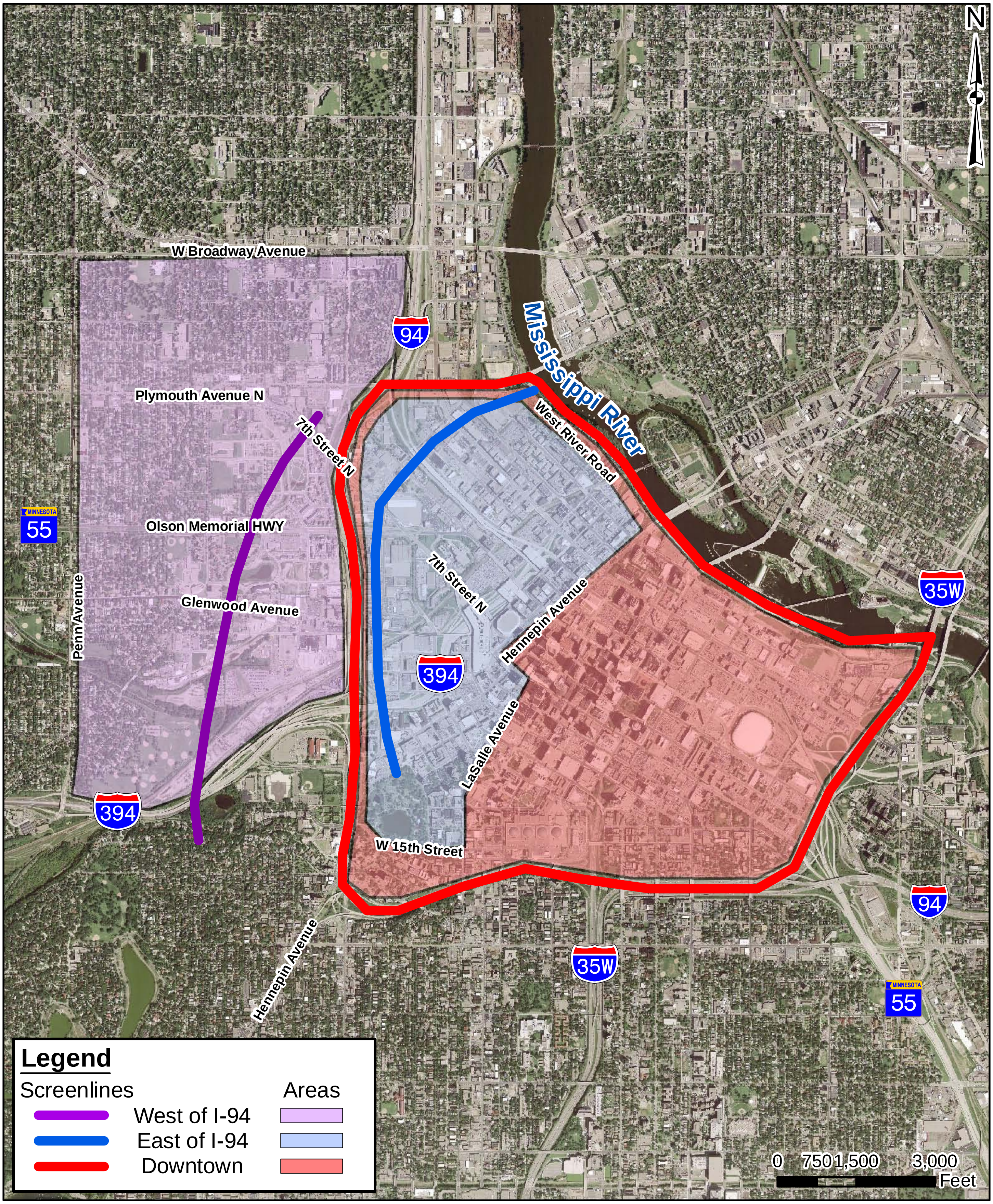
Hennepin

Hennepin County Bottineau Transitway

Revised: January 19, 2009

Figure 4
2008 PM Peak Hour Volumes (4:45 - 5:45)

WSB & Associates, Inc.

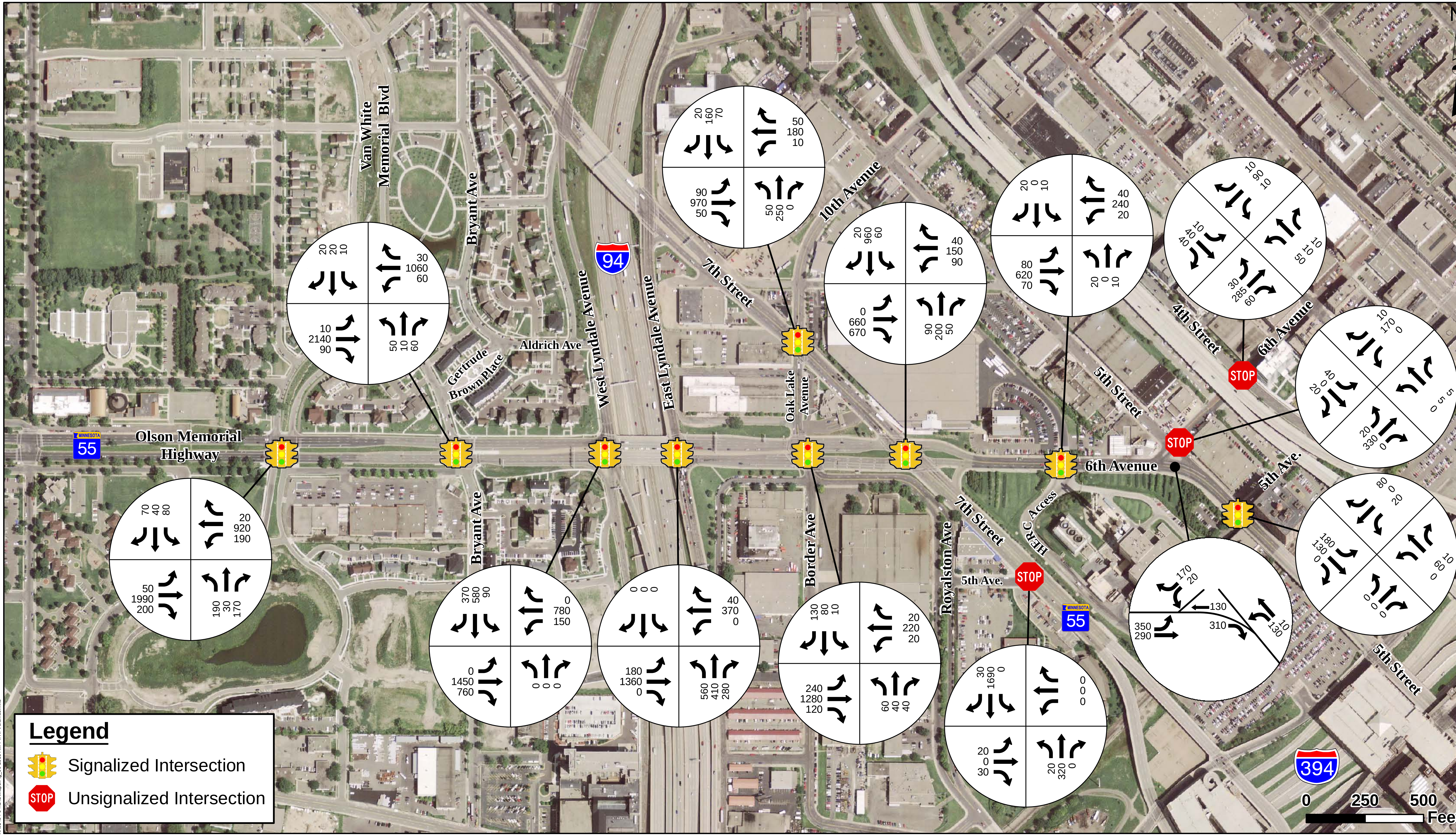


Hennepin County
Bottineau Transitway

January 19, 2009

Figure 5
Analysis Screenlines and Areas

WSB & Associates, Inc.

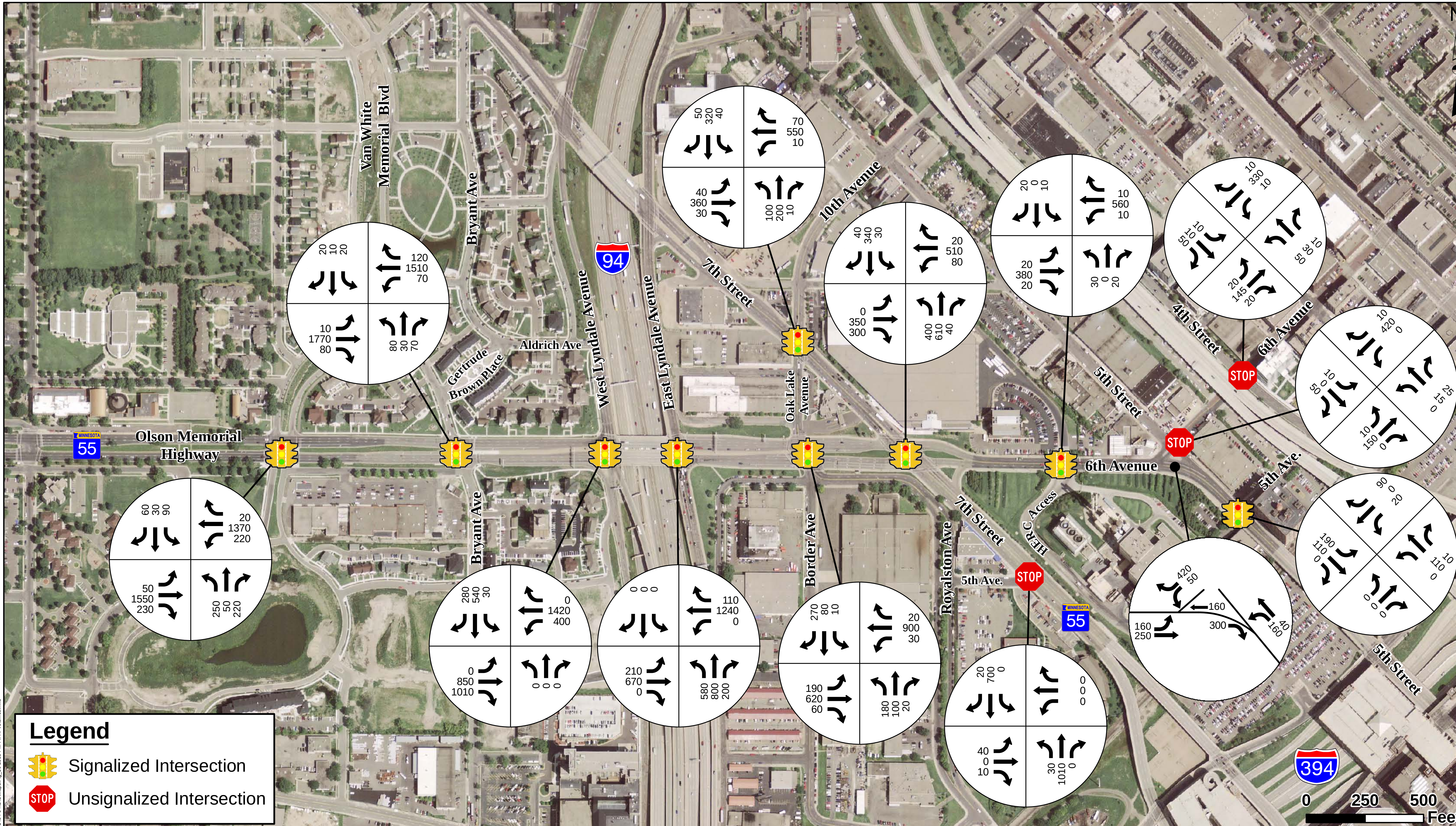


Hennepin County
Bottineau Transitway

Revised: January 19, 2009

Figure 7
2030 AM Peak Hour
Volumes (7:45 - 8:45)

WSB & Associates, Inc.



Hennepin County
Bottineau Transitway

Revised: January 19, 2009

Figure 8
2030 PM Peak Hour
Volumes (4:45 - 5:45)

WSB & Associates, Inc.

Appendix A

Existing Roadway Geometry

- **TH 55** is a six-lane divided roadway west of I-94 and between I-94 and 7th Street North. When TH 55 combines with 7th Street North, south of 6th Avenue North, it becomes a six lane undivided roadway.

- **7th Street North** is a four-lane undivided roadway between I-94 and 6th Avenue North.

- **TH 55 and Van White Memorial Boulevard:** This is a four-legged signalized intersection. TH 55 eastbound and westbound approaches each have a left turn lane, three through lanes, and right turns allowed from the right most through lane. The Van White Memorial Boulevard southbound approach has a right turn lane and a shared through and left turn lane. The Van White Memorial Boulevard northbound approach has a left turn lane and a shared through and right turn lane.

- **TH 55 and Bryant Avenue North:** This is a four-legged signalized intersection with Bryant Avenue North meeting TH 55 on a skew. TH 55 eastbound and westbound approaches each have a left turn lane, three through lanes, and right turns allowed from the right most through lane. Bryant Avenue North northbound and southbound approaches each have only a single lane shared between right, through, and left turning vehicles.

- **TH 55 and West Lyndale Avenue North:** This is a signalized intersection with West Lyndale Avenue North being a southbound one-way roadway. The southbound approach on West Lyndale Avenue North has four through lanes. The two right most through lanes are for traffic destined to I-94 eastbound while the two left most through lanes are for traffic destined to West Lyndale Avenue North southbound. Left turns are allowed from the left most lane while right turns are allowed from the right most lane. The eastbound approach on TH 55 has four through lanes. Right turning vehicles must choose between two destinations, West Lyndale Avenue North southbound or I-94 eastbound. Vehicle turning onto West Lyndale Avenue North southbound utilize a right turn lane preceding the intersection. Vehicle turning onto I-94 eastbound use the right most through lane to turn right once they have entered the intersection. A left-turn movement is not possible for this approach. The westbound approach on TH 55 has a left turn lane and three through lanes. A right-turn movement is not possible for this approach.

- **TH 55 and East Lyndale Avenue North:** This is a signalized intersection with East Lyndale Avenue North being a northbound one-way roadway. The northbound approach on East Lyndale Avenue North has one left turn lane and three through lanes. Left turns are allowed from the left turn lane and the left most through lane while right turns are allowed from the right most through lane. The eastbound approach on TH 55 has a left turn lane and three through lanes. A right-turn movement is not possible for this approach. The westbound approach on TH 55 has four through lanes and a right turn lane. A left-turn movement is not possible for this approach.

- **TH 55 and Border Avenue/Oak Lake Avenue North:** This is a four-legged signalized intersection with Border Avenue/Oak Lake Avenue North meeting TH 55 on a skew. Also, there is a southern frontage road that runs east-west within twenty feet of the intersection. Border Avenue is a one-way southbound roadway. The eastbound frontage road approach at Border Avenue is also a one-way roadway. The westbound frontage road approach is a two-way roadway. **Figure 5** displays the lane alignments at this intersection. The TH 55 eastbound approach has a left turn lane, four through lanes, and right turns allowed from the right most through lane. The TH 55 westbound approach has a left turn lane, three through lanes, and a right turn lane. Border Avenue northbound and Oak Lake Avenue North southbound each have two through lanes. Left turns are allowed from the left through lane while right turns are allowed from the right through lane.

- **TH 55/7th Street North and 6th Avenue North:** This is a four-legged signalized intersection with 7th Street North meeting 6th Avenue North on a skew. The TH 55 eastbound approach has two through lanes and two right turn lanes. The 6th Avenue North westbound approach has three through lanes. Left turns are allowed from the left most lane while right turns are allowed from the right most lane. The 7th Street North southbound approach has two through lanes. Left turns are allowed from the left through lane while right turns are allowed from the right through lane. The 7th Street North northbound approach has a left turn lane and two through lanes. There is also a right turn lane prior to the intersection with a yield condition at 6th Avenue North eastbound.

- **TH 55/7th Street North and 5th Avenue North:** TH 55/7th Street North is the major through roadway at this three-legged side street stop controlled intersection. 5th Avenue North meets TH 55/7th Street North on a skew. The 7th Street North southbound approach has three through lanes with right turns allowed from the right most through lane. The 7th Street North northbound approach has three through lanes with left turns allowed from the left most through lane. The 5th Avenue North eastbound approach has a single shared lane for left and right turning vehicles.

- **7th Street North and Oak Lake Avenue North:** This is a four-legged signalized intersection with 7th Street North meeting Oak Lake Avenue North on a skew. The 7th Street North eastbound approach has two through lanes and a bus stop lane that also acts as a right turn lane. Left turning vehicles are allowed from the left most through lane. The 7th Street North westbound approach has two through lanes. Left turns are allowed from the left through lane while right turns are allowed from the right through lane. Oak Lake Avenue North northbound and southbound approaches each have two through lanes. Left turns are allowed from the left through lane while right turns are allowed from the right through lane.

- **6th Avenue North and HERC/Metro Transit Access:** This is a four-legged signalized intersection. 6th Avenue North eastbound and westbound approaches each have two through lanes. Left turns are allowed from the left through lane while right turns are allowed from the right through lane. In addition, 6th Avenue North eastbound trucks entering the HERC facility have a right turn lane prior to the intersection. Vehicles that are not trucks entering the facility use the right most through lane to turn right once they have entered the intersection. The HERC Access northbound and the Metro Transit Access southbound approaches each have only a single lane to be shared by right, through, and left turning vehicles. Northbound and southbound through traffic is unlikely due to the Metro Transit Access being restricted to busses only.

- **6th Avenue North and 5th Street North:** 6th Avenue North is the major through roadway at this four-legged side street stop controlled intersection. The westbound approach of 5th Street North is a one-way roadway. There is a single shared lane for through and right turning vehicles. The 5th Street North eastbound approach is a two-way roadway with a single shared lane for left and right turning vehicles. The 6th Avenue North northbound approach has a single shared lane for through and left turning vehicles. The 6th Avenue North southbound approach has a single shared lane for through and right turning vehicles. **Figure 6** displays the lane alignments at this intersection.

- **6th Avenue North and 4th Street North:** 6th Avenue North is the major through roadway at this four-legged side street stop controlled intersection. All approaches have a single shared lane for left, through, and right turning vehicles.

- **5th Street North and 5th Avenue North:** Presently, this three-legged intersection is all-way stop controlled due to continued road construction in the area. A signal will be reinstalled once construction is finalized. The 5th Street North westbound approach has a single shared lane for through and right turning vehicles. The 5th Street North eastbound approach has a single shared lane for through and left turning vehicles. The 5th Avenue North southbound approach has a single shared lane for left and right turning vehicles.

APPENDIX B

VISSIM LOS & QUEUE DATA

Alternative 1

Bottineau Corridor
2008 AM Volumes
Existing Geometry

	Intersection	Appr	Count Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Traffic Queueing (feet): Through		Left Turn		Right Turn	
			Lt	Th	Rt	total	L	T	R	total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signal	**TH 55 & Van White Mem Blvd**	NB	17	19	15	51	17	15	17	49	0	-4	2	-2	-4%	NB	36	31	12	D	C	B	26	C				62		49		
		WB	10	884	13	907	8	894	10	912	-2	10	-3	5	1%	WB	16	4	6	B	A	A	4	A	10	B		173				
		SB	65	11	55	131	64	12	52	128	-1	1	-3	-3	-2%	SB	33	36	4	C	D	A	22	C				105				41
		EB	44	1908	41	1993	41	1916	52	2009	-3	8	11	16	1%	EB	15	11	14	B	B	B	11	B			49	346		35		
Signal	**TH 55 & Bryant Ave N**	NB	9	5	37	51	7	5	38	50	-2	0	1	-1	-2%	NB	45	32	12	D	C	B	19	B								
		WB	53	888	25	966	49	893	25	967	-4	5	0	1	0%	WB	17	2	4	B	A	A	3	A	3	A		111		39		
		SB	3	4	10	17	2	3	10	15	-1	-1	0	-2	-12%	SB	37	29	7	D	C	A	15	B				30				
		EB	3	1975	10	1988	3	1993	6	2002	0	18	-4	14	1%	EB	5	3	14	A	A	B	3	A				362				
Signal	**TH 55 & W Lyndale Ave N**	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	125	651	0	776	119	655	0	774	-6	4	0	-2	0%	WB	20	8	0	C	A	A	10	A	18	B		157		138		
		SB	80	514	315	909	80	517	307	904	0	3	-8	-5	-1%	SB	28	28	11	C	C	B	22	C			46	243				
		EB	0	1330	548	1878	0	1333	567	1900	0	3	19	22	1%	EB	0	18	23	A	B	C	19	B			108	603				
Signal	**TH 55 & E Lyndale Ave N**	NB	467	383	255	1105	456	376	261	1093	-11	-7	6	-12	-1%	NB	32	30	20	C	C	C	28	C			65	267				
		WB	0	309	25	334	0	312	23	335	0	3	-2	1	0%	WB	0	15	5	A	B	A	14	B	22	C		89				
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	161	1249	0	1410	178	1225	0	1403	17	-24	0	-7	0%	EB	19	19	0	B	B	A	19	B			61	325		204		
Signal	**TH 55 & Border/Oak Lake Ave**	NB	52	32	37	121	52	35	33	120	0	3	-4	-1	-1%	NB	42	42	6	D	D	A	32	C				129				
		WB	10	188	8	206	8	191	0	199	-2	3	-8	-7	-3%	WB	7	6	0	A	A	A	6	A	8	A		103				
		SB	5	73	94	172	0	69	90	159	-5	-4	-4	-13	-8%	SB	40	41	19	D	D	B	29	C				119				
		EB	211	1183	110	1504	216	1152	118	1486	5	-31	8	-18	-1%	EB	7	4	4	A	A	A	4	A				210		187		
Signal	**TH 55/7th St N & 6th Ave N**	NB	69	180	40	289	67	192	41	300	-2	12	1	11	4%	NB	31	26	6	C	C	A	24	C				103		109		
		WB	68	127	27	222	67	122	26	215	-1	-5	-1	-7	-3%	WB	17	12	5	B	B	A	13	B	32	C		102				
		SB	48	856	10	914	51	873	10	934	3	17	0	20	2%	SB	61	61	48	E	E	D	61	E			227	633				
		EB	0	577	648	1225	0	547	632	1179	0	-30	-16	-46	-4%	EB	0	19	9	A	B	A	14	B			32	255				197
Signal	**6th Ave N & HERC Access**	NB	8	0	6	14	7	0	5	12	-1	0	-1	-2	-14%	NB	44	0	14	D	A	B	32	C				43				
		WB	10	208	26	244	9	201	25	235	-1	-7	-1	-9	-4%	WB	5	1	3	A	A	A	1	A	3	A		43				
		SB	4	0	6	10	2	0	6	8	-2	0	0	-2	-20%	SB	37	0	9	D	A	A	16	B				56				
		EB	61	549	55	665	62	525	61	648	1	-24	6	-17	-3%	EB	3	3	3	A	A	A	3	A				355				
Thru-Stop	**6th Ave N & 5th St W**	NB	13	297	0	310	15	287	0	302	2	-10	0	-8	-3%	NB	1	0	0	A	A	A	0	A								
		WB	0	2	1	3	0	2	0	2	0	0	-1	-1	-33%	WB	0	8	0	A	A	A	8	A	1	A						
		SB	0	131	7	138	0	125	6	131	0	-6	-1	-7	-5%	SB	0	2	3	A	A	A	2	A								
		EB	27	0	11	38	26	0	11	37	-1	0	0	-1	-3%	EB	7	0	5	A	A	A	6	A				27				
Thru-Stop	**6th Ave N & 4th St W**	NB	20	260	45	325	16	260	38	314	-4	0	-7	-11	-3%	NB	1	1	1	A	A	A	1	A								
		WB	37	2	2	41	34	0	2	36	-3	-2	0	-5	-12%	WB	8	0	4	A	A	A	8	A	2	A		56				
		SB	3	72	3	78	2	71	4	77	-1	-1	1	-1	-1%	SB	2	0	2	A	A	A	0	A								
		EB	7	28	29	64	6	32	26	64	-1	4	-3	0	0%	EB	8	10	6	A	B	A	8	A				47				
Signal	**5th St W & 5th Ave N**	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	0	53	2	55	0	52	2	54	0	-1	0	-1	-2%	WB	0	1	3	A	A	A	1	A	5	A		26				
		SB	13	0	66	79	13	0	66	79	0	0	0	0	0%	SB	38	0	8	D	A	A	13	B				82				
		EB	162	101	0	263	152	98	0	250	-10	-3	0	-13	-5%	EB	3	3	0	A	A	A	3	A				155				
Thru-Stop	**TH 55/7th St N & 5th Ave N**	NB	14	275	0	289	13	285	0	298	-1	10	0	9	3%	NB	11	0	0	B	A	A	0	A								
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A	0	A						
		SB	0	1549	23	1572	0	1542	24	1566	0	-7	1	-6	0%	SB	0	0	2	A	A	A	0	A								
		EB	14	0	17	31	13	0	17	30	-1	0	0	-1	-3%	EB	12	0	7	B	A	A	9	A				48				
Signal	**7th St N & Oak Lake Ave**	NB	40	211	0	251	33	219	0	252	-7	8	0	1	0%	NB	39	37	0	D	D	A	37	D			30	148				
		WB	3	169	35	207	0	182	35	217	-3	13	0	10	5%	WB	0	8	6	A	A	A	8	A	16	B		112				
		SB	53	132	17	202	62	124	16	202	9	-8	-1	0	0%	SB	42	32	16	D	C	B	34	C				123				
		EB	77	861	37	975	80	861	35	976	3	0	-2	1	0%	EB	7	9	5	A	A	A	9	A				207				65

Alternative 1

Bottineau Corridor
2008 PM Volumes
Existing Geometry

	Intersection	Appr	Count Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Traffic Queueing (feet) Through		Traffic Queueing (feet) Left Turn		Traffic Queueing (feet) Right Turn	
			Lt	Th	Rt	Total	L	T	R	Total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	23	29	27	79	21	27	28	76	-2	-2	1	-3	-4%	NB	36	34	17	D	C	B	28	C	10	B		74		47		
		WB	14	1355	10	1379	14	1319	8	1341	0	-36	-2	-38	-3%	WB	18	5	4	B	A	A	5	A				111				
		SB	67	21	44	132	65	22	42	129	-2	1	-2	-3	-2%	SB	36	30	5	D	C	A	25	C				144				38
		EB	43	1510	19	1572	44	1519	22	1585	1	9	3	13	1%	EB	18	12	19	B	B	B	12	B			51	328		54		
Signal	TH 55 & Bryant Ave N	NB	7	18	35	60	6	17	34	57	-1	-1	-1	-3	-5%	NB	47	48	37	D	D	D	41	D	17	B		46				
		WB	24	1362	103	1489	23	1319	104	1446	-1	-43	1	-43	-3%	WB	15	2	2	B	A	A	2	A				190				
		SB	8	3	10	21	7	3	8	18	-1	0	-2	-3	-14%	SB	37	39	5	D	D	A	23	C				42				
		EB	8	1589	7	1604	5	1579	4	1588	-3	-10	-3	-16	-1%	EB	8	29	41	A	C	D	29	C			140	626				
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A	27	C						
		WB	347	1271	0	1618	336	1223	0	1559	-11	-48	0	-59	-4%	WB	21	7	0	C	A	A	10	B				281	33	279		
		SB	22	480	218	720	24	485	212	721	2	5	-6	1	0%	SB	38	38	14	D	D	B	31	C			51	193				
		EB	0	749	706	1455	0	737	716	1453	0	-12	10	-2	0%	EB	0	25	64	A	C	E	44	D			356	690				
Signal	TH 55 & E Lyndale Ave N	NB	502	720	171	1393	501	730	173	1404	-1	10	2	11	1%	NB	30	28	24	C	C	C	28	C	24	C	74	303				
		WB	0	1116	98	1214	0	1068	92	1160	0	-48	-6	-54	-4%	WB	0	18	7	A	B	A	17	B			40	241				85
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	180	591	0	771	181	571	0	752	1	-20	0	-19	-2%	EB	36	26	0	D	C	A	28	C			38	269	37	246		
Signal	TH 55 & Border/Oak Lake Ave	NB	167	89	14	270	162	91	15	268	-5	2	1	-2	-1%	NB	50	43	8	D	D	A	45	D	17	B	56	262				
		WB	25	818	11	854	27	778	0	805	2	-40	-11	-49	-6%	WB	8	12	0	A	B	A	12	B				186		35		62
		SB	1	72	229	302	0	76	225	301	-1	4	-4	-1	0%	SB	28	29	17	C	C	B	20	C				244				
		EB	158	553	51	762	151	543	52	746	-7	-10	1	-16	-2%	EB	15	9	5	B	A	A	10	A				140		145		
Signal	TH 55/7th St N & 6th Ave N	NB	349	550	30	929	319	568	30	917	-30	18	0	-12	-1%	NB	183	28	8	F	C	A	81	F	43	D	48	219	478	931		
		WB	67	477	14	558	65	456	18	539	-2	-21	4	-19	-3%	WB	16	14	5	B	B	A	14	B			28	145				
		SB	19	297	28	344	20	296	27	343	1	-1	-1	-1	0%	SB	42	44	19	D	D	B	42	D			46	190				
		EB	0	309	259	568	0	296	258	554	0	-13	-1	-14	-2%	EB	0	9	4	A	A	A	7	A				121				97
Signal	6th Ave N & HERC Access	NB	22	0	12	34	19	0	13	32	-3	0	1	-2	-6%	NB	49	0	18	D	A	B	36	D	4	A		67				
		WB	2	526	4	532	0	517	3	520	-2	-9	-1	-12	-2%	WB	0	2	2	A	A	A	2	A				61				
		SB	4	0	10	14	4	0	9	13	0	0	-1	-1	-7%	SB	53	0	13	D	A	B	25	C				73				
		EB	13	335	10	358	11	332	8	351	-2	-3	-2	-7	-2%	EB	6	4	5	A	A	A	4	A				150				
Thru-Stop	6th Ave N & 5th St W	NB	2	121	0	123	0	124	0	124	-2	3	0	1	1%	NB	0	0	0	A	A	A	0	A	8	A						
		WB	0	10	21	31	0	9	21	30	0	-1	0	-1	-3%	WB	0	10	5	A	B	A	7	A				32				
		SB	0	367	7	374	0	361	6	367	0	-6	-1	-7	-2%	SB	0	11	3	A	B	A	11	B								
		EB	5	0	36	41	7	0	34	41	2	0	-2	0	0%	EB	7	0	10	A	A	B	9	A				28				
Thru-Stop	6th Ave N & 4th St W	NB	13	125	9	147	10	136	4	150	-3	11	-5	3	2%	NB	2	0	0	A	A	A	0	A	2	A						
		WB	40	21	6	67	38	20	7	65	-2	-1	1	-2	-3%	WB	7	9	6	A	A	A	8	A				47				
		SB	4	296	5	305	5	293	6	304	1	-3	1	-1	0%	SB	2	1	1	A	A	A	1	A								
		EB	8	7	38	53	8	8	35	51	0	1	-3	-2	-4%	EB	7	9	7	A	A	A	7	A				51				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A	5	A						
		WB	0	101	4	105	0	99	4	103	0	-2	0	-2	-2%	WB	0	1	1	A	A	A	1	A				45				
		SB	15	0	79	94	15	0	78	93	0	0	-1	-1	-1%	SB	47	0	10	D	A	B	16	B				104				
		EB	164	84	0	248	163	88	0	251	-1	4	0	3	1%	EB	3	3	0	A	A	A	3	A				125				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	18	898	0	916	15	901	0	916	-3	3	0	0	0%	NB	20	11	0	C	B	A	11	B	7	A						
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A								
		SB	0	608	15	623	0	604	12	616	0	-4	-3	-7	-1%	SB	0	0	1	A	A	A	0	A								
		EB	31	0	7	38	29	0	6	35	-2	0	-1	-3	-8%	EB	37	0	10	E	A	B	32	C				51				
Signal	7th St N & Oak Lake Ave	NB	77	178	3	258	78	165	0	243	1	-13	-3	-15	-6%	NB	43	27	0	D	C	A	32	C	16	B	28	163				
		WB	1	505	58	564	0	528	57	585	-1	23	-1	21	4%	WB	0	8	8	A	A	A	8	A				262				
		SB	30	278	40	348	29	274	44	347	-1	-4	4	-1	0%	SB	32	30	25	C	C	C	30	C			41	168				
		EB	27	311	23	361	27	312	26	365	0	1	3	4	1%	EB	6	7	4	A	A	A	7	A				86				67

Alternative 2

Bottineau Corridor
2030 AM Forecast Volumes
Existing Geometry

	Intersection	Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Traffic Queueing (feet): Through		Left Turn		Right Turn	
			L	T	R	total	L	T	R	total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	190	30	170	390	192	33	161	386	2	3	-9	-4	-1%	NB	39	31	8	D	C	A	25	C				68	40	230		
		WB	190	920	20	1130	194	905	19	1118	4	-15	-1	-12	-1%	WB	45	6	10	D	A	B	13	B	31	C		139	31	249		
		SB	80	40	70	190	77	42	69	188	-3	2	-1	-2	-1%	SB	39	37	6	D	D	A	26	C				65				58
		EB	50	1990	200	2240	52	1992	196	2240	2	2	-4	0	0%	EB	29	41	58	C	D	E	42	D			255	1053		60		
Signal	TH 55 & Bryant Ave N	NB	50	10	60	120	47	10	59	116	-3	0	-1	-4	-3%	NB	48	42	22	D	D	C	34	C				93				
		WB	60	1060	30	1150	52	1055	29	1136	-8	-5	-1	-14	-1%	WB	19	5	7	B	A	A	6	A	12	B		124		47		
		SB	10	20	20	50	10	20	19	49	0	0	-1	-1	-2%	SB	46	45	17	D	D	B	34	C				78				
		EB	10	2140	90	2240	5	2155	78	2238	-5	15	-12	-2	0%	EB	3	14	14	A	B	B	14	B			74	567				
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	150	780	0	930	157	775	0	932	7	-5	0	2	0%	WB	34	7	0	C	A	A	12	B	29	C		131	29	225		
		SB	90	580	370	1040	92	582	362	1036	2	2	-8	-4	0%	SB	35	34	14	D	C	B	27	C			66	292				
		EB	0	1450	608	2058	0	1437	625	2062	0	-13	17	4	0%	EB	0	37	40	A	D	D	38	D			259	688				
Signal	TH 55 & E Lyndale Ave N	NB	560	410	280	1250	552	414	286	1252	-8	4	6	2	0%	NB	26	23	15	C	C	B	22	C			58	243				
		WB	0	370	40	410	0	380	39	419	0	10	-1	9	2%	WB	0	19	8	A	B	A	18	B	26	C		169				50
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	180	1360	0	1540	208	1321	0	1529	28	-39	0	-11	-1%	EB	27	31	0	C	C	A	30	C			93	326	29	239		
Signal	TH 55 & Border/Oak Lake Ave	NB	60	40	40	140	57	39	40	136	-3	-1	0	-4	-3%	NB	50	43	4	D	D	A	34	C				134				
		WB	20	220	20	260	21	237	0	258	1	17	-20	-2	-1%	WB	6	7	0	A	A	A	7	A	13	B		71		34		101
		SB	10	80	130	220	0	76	123	199	-10	-4	-7	-21	-10%	SB	30	31	8	C	C	A	17	B				140				
		EB	240	1280	120	1640	241	1243	122	1606	1	-37	2	-34	-2%	EB	13	11	15	B	B	B	12	B			27	242		202		
Signal	TH 55/7th St N & 6th Ave N	NB	90	200	50	340	94	206	51	351	4	6	1	11	3%	NB	42	17	7	D	B	A	22	C				80		131		
		WB	90	150	40	280	86	146	38	270	-4	-4	-2	-10	-4%	WB	25	16	15	C	B	B	19	B	25	C		162				
		SB	60	960	20	1040	70	969	18	1057	10	9	-2	17	2%	SB	43	43	41	D	D	D	43	D			143	594				
		EB	0	660	670	1330	0	629	655	1284	0	-31	-15	-46	-3%	EB	0	17	9	A	B	A	13	B			26	241				198
Signal	6th Ave N & HERC Access	NB	20	0	10	30	18	0	11	29	-2	0	1	-1	-3%	NB	32	0	10	C	A	B	24	C				55				
		WB	20	240	40	300	19	235	41	295	-1	-5	1	-5	-2%	WB	9	2	3	A	A	A	3	A	4	A		60				
		SB	10	0	20	30	11	0	18	29	1	0	-2	-1	-3%	SB	46	0	13	D	A	B	26	C				109				
		EB	80	620	70	770	80	606	65	751	0	-14	-5	-19	-2%	EB	3	3	3	A	A	A	3	A				259				
Thru-Stop	6th Ave N & 5th St W	NB	20	330	0	350	18	323	0	341	-2	-7	0	-9	-3%	NB	1	0	0	A	A	A	0	A								
		WB	0	5	5	10	0	7	2	9	0	2	-3	-1	-10%	WB	0	11	4	A	B	A	9	A	1	A		28				
		SB	0	170	10	180	0	164	11	175	0	-6	1	-5	-3%	SB	0	2	3	A	A	A	2	A								
		EB	40	0	20	60	39	0	19	58	-1	0	-1	-2	-3%	EB	7	0	6	A	A	A	7	A				43				
Thru-Stop	6th Ave N & 4th St W	NB	30	285	60	375	27	278	59	364	-3	-7	-1	-11	-3%	NB	1	1	1	A	A	A	1	A								
		WB	50	10	10	70	48	9	10	67	-2	-1	0	-3	-4%	WB	9	9	6	A	A	A	9	A	3	A		52				
		SB	10	90	10	110	10	90	9	109	0	0	-1	-1	-1%	SB	2	1	1	A	A	A	1	A								
		EB	10	40	40	90	8	41	38	87	-2	1	-2	-3	-3%	EB	7	11	7	A	B	A	9	A				62				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	0	60	10	70	0	60	8	68	0	0	-2	-2	-3%	WB	0	2	1	A	A	A	2	A	6	A		36				
		SB	20	0	80	100	19	0	80	99	-1	0	0	-1	-1%	SB	44	0	10	D	A	B	17	B				107				
		EB	180	130	0	310	167	141	0	308	-13	11	0	-2	-1%	EB	3	3	0	A	A	A	3	A				136				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	20	320	0	340	19	331	0	350	-1	11	0	10	3%	NB	10	0	0	B	A	A	1	A								
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A	0	A						
		SB	0	1690	30	1720	0	1682	28	1710	0	-8	-2	-10	-1%	SB	0	0	1	A	A	A	0	A								
		EB	20	0	30	50	20	0	28	48	0	0	-2	-2	-4%	EB	15	0	7	C	A	A	10	B				54				
Signal	7th St N & Oak Lake Ave	NB	50	250	0	300	40	240	0	280	-10	-10	0	-20	-7%	NB	99	36	0	F	D	A	45	D			41	163				
		WB	10	180	50	240	0	184	60	244	-10	4	10	4	2%	WB	0	9	7	A	A	A	9	A	19	B		112				
		SB	70	160	20	250	78	152	19	249	8	-8	-1	-1	0%	SB	51	46	29	D	D	C	46	D			43	142				
		EB	90	970	50	1110	88	977	47	1112	-2	7	-3	2	0%	EB	9	9	5	A	A	A	9	A				237				93

Alternative 2

Bottineau Corridor
2030 PM Forecast Volumes
Existing Geometry

	Intersection	Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Traffic Queueing (feet) Through		Left Turn		Right Turn	
			L	T	R	total	L	T	R	total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	250	50	220	520	249	50	214	513	-1	0	-6	-7	-1%	NB	41	29	14	D	C	B	29	C				94	59	391		
		WB	220	1370	20	1610	215	1346	20	1581	-5	-24	0	-29	-2%	WB	32	14	21	C	B	C	17	B	61	E	43	255		202		
		SB	90	30	60	180	87	32	58	177	-3	2	-2	-3	-2%	SB	50	41	6	D	D	A	34	C				78				49
		EB	50	1550	230	1830	40	1404	197	1641	-10	-146	-33	-189	-10%	EB	72	112	157	E	F	F	116	F			801	1659		71		
Signal	TH 55 & Bryant Ave N	NB	80	30	70	180	81	28	68	177	1	-2	-2	-3	-2%	NB	62	64	74	E	E	E	67	E			30	210				
		WB	70	1510	120	1700	61	1482	119	1662	-9	-28	-1	-38	-2%	WB	19	6	6	B	A	A	6	A	28	C		276		52		
		SB	20	10	20	50	20	11	19	50	0	1	-1	0	0%	SB	59	52	20	E	D	C	43	D				90				
		EB	10	1770	80	1860	7	1593	72	1672	-3	-177	-8	-188	-10%	EB	14	45	51	B	D	D	45	D			661	1506				
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	400	1420	0	1820	377	1385	0	1762	-23	-35	0	-58	-3%	WB	39	1	0	D	A	A	9	A	28	C		82	85	304		
		SB	30	540	280	850	31	541	271	843	1	1	-9	-7	-1%	SB	44	44	15	D	D	B	35	C			69	261				
		EB	0	850	808	1658	0	764	725	1489	0	-86	-83	-169	-10%	EB	0	20	76	A	C	E	47	D			492	877				
Signal	TH 55 & E Lyndale Ave N	NB	580	800	200	1580	578	799	205	1582	-2	-1	5	2	0%	NB	26	23	15	C	C	B	23	C			73	284				
		WB	0	1240	110	1350	0	1185	107	1292	0	-55	-3	-58	-4%	WB	0	41	9	A	D	A	38	D	25	C	217	521				98
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	210	670	0	880	208	588	0	796	-2	-82	0	-84	-10%	EB	17	3	0	B	A	A	7	A				108		268		
Signal	TH 55 & Border/Oak Lake Ave	NB	180	100	20	300	172	102	19	293	-8	2	-1	-7	-2%	NB	103	59	11	F	E	B	82	F			123	389				
		WB	30	900	20	950	29	868	0	897	-1	-32	-20	-53	-6%	WB	10	22	0	B	C	A	22	C	23	C	61	429		50		101
		SB	10	80	270	360	0	75	262	337	-10	-5	-8	-23	-6%	SB	16	17	10	B	B	B	12	B				330				
		EB	190	620	60	870	162	576	57	795	-28	-44	-3	-75	-9%	EB	14	6	7	B	A	A	8	A				94		103		
Signal	TH 55/7th St N & 6th Ave N	NB	400	610	40	1050	388	632	39	1059	-12	22	-1	9	1%	NB	25	14	7	C	B	A	18	B				183	45	321		
		WB	80	510	20	610	81	482	25	588	1	-28	5	-22	-4%	WB	27	25	9	C	C	A	25	C	22	C	54	239				
		SB	30	340	40	410	37	343	32	412	7	3	-8	2	0%	SB	36	30	19	D	C	B	30	C			26	200				
		EB	0	350	300	650	0	308	288	596	0	-42	-12	-54	-8%	EB	0	29	17	A	C	B	23	C				162				133
Signal	6th Ave N & HERC Access	NB	30	0	20	50	27	0	22	49	-3	0	2	-1	-2%	NB	35	0	11	D	A	B	24	C				78				
		WB	10	560	10	580	11	549	12	572	1	-11	2	-8	-1%	WB	8	2	4	A	A	A	2	A	4	A		75				
		SB	10	0	20	30	11	0	17	28	1	0	-3	-2	-7%	SB	45	0	17	D	A	B	28	C				127				
		EB	20	380	20	420	15	353	16	384	-5	-27	-4	-36	-9%	EB	1	1	4	A	A	A	1	A				54				
Thru-Stop	6th Ave N & 5th St W	NB	10	150	0	160	8	141	0	149	-2	-9	0	-11	-7%	NB	2	-1	0	A	A	A	-1	A								
		WB	0	15	25	40	0	22	19	41	0	7	-6	1	3%	WB	0	9	6	A	A	A	8	A	20	C		40				
		SB	0	420	10	430	0	414	10	424	0	-6	0	-6	-1%	SB	0	29	20	A	D	C	29	C								
		EB	10	0	50	60	10	0	48	58	0	0	-2	-2	-3%	EB	9	0	13	A	A	B	12	B				44				
Thru-Stop	6th Ave N & 4th St W	NB	20	145	20	185	15	140	15	170	-5	-5	-5	-15	-8%	NB	3	1	1	A	A	A	1	A								
		WB	50	30	10	90	48	30	11	89	-2	0	1	-1	-1%	WB	10	9	9	B	A	A	10	A	4	A		62				
		SB	10	330	10	350	9	329	11	349	-1	-1	1	-1	0%	SB	2	3	2	A	A	A	3	A								
		EB	10	10	50	70	10	11	48	69	0	1	-2	-1	-1%	EB	8	12	11	A	B	B	11	B				65				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	0	110	10	120	0	110	8	118	0	0	-2	-2	-2%	WB	0	1	2	A	A	A	1	A	6	A		45				
		SB	20	0	90	110	19	0	88	107	-1	0	-2	-3	-3%	SB	46	0	13	D	A	B	19	B				141				
		EB	190	110	0	300	169	117	0	286	-21	7	0	-14	-5%	EB	3	4	0	A	A	A	3	A				167				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	30	1010	0	1040	29	1021	0	1050	-1	11	0	10	1%	NB	3	0	0	A	A	A	0	A								
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A	0	A						
		SB	0	700	20	720	0	694	16	710	0	-6	-4	-10	-1%	SB	0	0	1	A	A	A	0	A								
		EB	40	0	10	50	40	0	9	49	0	0	-1	-1	-2%	EB	9	0	6	A	A	A	8	A				46				
Signal	7th St N & Oak Lake Ave	NB	100	200	10	310	94	170	0	264	-6	-30	-10	-46	-15%	NB	113	20	0	F	C	A	53	D			64	309				
		WB	10	550	70	630	0	567	85	652	-10	17	15	22	3%	WB	0	26	24	A	C	C	26	C	28	C	52	274				
		SB	40	320	50	410	51	305	54	410	11	-15	4	0	0%	SB	31	31	24	C	C	C	30	C			44	211				
		EB	40	360	30	430	42	361	32	435	2	1	2	5	1%	EB	14	15	5	B	B	A	14	B				126				91

Alternative 3

Bottineau Corridor
2030 AM Forecast Volumes
Baseline Geometry

	Intersection	Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Traffic Queueing (feet): Through		Traffic Queueing (feet): Left Turn		Traffic Queueing (feet): Right Turn	
			L	T	R	total	L	T	R	total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	190	30	170	390	192	32	164	388	2	2	-6	-2	-1%	NB	70	51	24	E	D	C	49	D	25	C		68	81	391		185
		WB	190	920	20	1130	193	898	17	1108	3	-22	-3	-22	-2%	WB	53	4	3	D	A	A	13	B				118	59	333		
		SB	80	40	70	190	74	44	72	190	-6	4	2	0	0%	SB	60	57	6	E	E	A	39	D				105		150		63
		EB	50	1990	200	2240	59	1968	199	2226	9	-22	-1	-14	-1%	EB	70	26	20	E	C	C	27	C			117	582		132		479
Signal	TH 55 & Bryant Ave N	NB	50	10	60	120	49	10	56	115	-1	0	-4	-5	-4%	NB	61	61	6	E	E	A	34	C	21	C		130				41
		WB	60	1060	30	1150	56	1038	32	1126	-4	-22	2	-24	-2%	WB	56	13	14	E	B	B	15	B			31	347		140		
		SB	10	20	20	50	11	19	14	44	1	-1	-6	-6	-12%	SB	62	62	23	E	E	C	50	D				110				
		EB	10	2140	90	2240	4	2148	81	2233	-6	8	-9	-7	0%	EB	74	23	17	E	C	B	23	C			114	662		61		
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A	29	C						
		WB	150	780	0	930	153	787	0	940	3	7	0	10	1%	WB	31	13	0	C	B	A	16	B			39	343	26	145		
		SB	90	580	370	1040	76	690	359	1125	-14	110	-11	85	8%	SB	46	44	22	D	D	C	37	D			92	397				
		EB	0	1450	608	2058	0	1417	641	2058	0	-33	33	0	0%	EB	0	41	9	A	D	A	31	C			177	628				183
Signal	TH 55 & E Lyndale Ave N	NB	560	410	280	1250	558	418	285	1261	-2	8	5	11	1%	NB	41	33	17	D	C	B	33	C	24	C	91	309				
		WB	0	370	40	410	0	392	39	431	0	22	-1	21	5%	WB	0	33	2	A	C	A	30	C			38	217				
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	180	1360	0	1540	203	1314	0	1517	23	-46	0	-23	-1%	EB	28	13	0	C	B	A	15	B			45	216	30	207		
Signal	TH 55 & Border/Oak Lake Ave	NB	60	40	40	140	60	41	35	136	0	1	-5	-4	-3%	NB	55	54	6	E	D	A	42	D	30	C	28	153				
		WB	20	220	20	260	23	255	0	278	3	35	-20	18	7%	WB	71	27	0	E	C	A	31	C				177		70		103
		SB	10	80	130	220	0	81	119	200	-10	1	-11	-20	-9%	SB	0	51	28	A	D	C	37	D			30	205				
		EB	240	1280	120	1640	246	1243	121	1610	6	-37	1	-30	-2%	EB	45	26	20	D	C	C	28	C			85	541	63	421		
Signal	TH 55/7th St N & 6th Ave N	NB	90	200	50	340	97	192	54	343	7	-8	4	3	1%	NB	54	57	9	D	E	A	49	D	43	D	46	172				
		WB	90	150	40	280	84	159	44	287	-6	9	4	7	3%	WB	112	25	7	F	C	A	48	D				114	61	263		51
		SB	60	960	20	1040	67	932	21	1020	7	-28	1	-20	-2%	SB	60	61	48	E	E	D	61	E			267	687				
		EB	0	660	670	1330	0	623	660	1283	0	-37	-10	-47	-4%	EB	0	39	16	A	D	B	27	C			101	466			101	465
Signal	6th Ave N & HERC Access	NB	20	0	10	30	18	0	11	29	-2	0	1	-1	-3%	NB	39	0	12	D	A	B	29	C	5	A		88				
		WB	20	240	40	300	18	240	37	295	-2	0	-3	-5	-2%	WB	5	2	4	A	A	A	2	A				59				
		SB	10	0	20	30	10	0	19	29	0	0	-1	-1	-3%	SB	38	0	13	D	A	B	22	C				109				
		EB	80	620	70	770	75	604	66	745	-5	-16	-4	-25	-3%	EB	4	4	4	A	A	A	4	A				340				
Thru-Stop	6th Ave N & 5th St W	NB	20	330	0	350	17	327	0	344	-3	-3	0	-6	-2%	NB	1	0	0	A	A	A	0	A	1	A						
		WB	0	5	5	10	0	8	2	10	0	3	-3	0	0%	WB	0	10	4	A	B	A	9	A				26				
		SB	0	170	10	180	0	165	11	176	0	-5	1	-4	-2%	SB	0	2	2	A	A	A	2	A								
		EB	40	0	20	60	38	0	20	58	-2	0	0	-2	-3%	EB	8	0	6	A	A	A	7	A				44				
Thru-Stop	6th Ave N & 4th St W	NB	30	285	60	375	25	281	59	365	-5	-4	-1	-10	-3%	NB	1	1	1	A	A	A	1	A	3	A						
		WB	50	10	10	70	48	10	10	68	-2	0	0	-2	-3%	WB	8	9	6	A	A	A	8	A				48				
		SB	10	90	10	110	10	90	10	110	0	0	0	0	0%	SB	3	1	1	A	A	A	1	A								
		EB	10	40	40	90	9	40	39	88	-1	0	-1	-2	-2%	EB	9	12	8	A	B	A	10	A				59				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A	6	A						
		WB	0	60	10	70	0	59	8	67	0	-1	-2	-3	-4%	WB	0	5	3	A	A	A	5	A				47				
		SB	20	0	80	100	21	0	78	99	1	0	-2	-1	-1%	SB	10	0	4	B	A	A	5	A				61				
		EB	180	130	0	310	157	142	0	299	-23	12	0	-11	-4%	EB	6	6	0	A	A	A	6	A				250				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	20	320	0	340	22	327	0	349	2	7	0	9	3%	NB	10	0	0	B	A	A	1	A	0	A						
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A								
		SB	0	1690	30	1720	0	1643	28	1671	0	-47	-2	-49	-3%	SB	0	0	1	A	A	A	0	A								
		EB	20	0	30	50	21	0	28	49	1	0	-2	-1	-2%	EB	14	0	7	B	A	A	10	B				48				
Signal	7th St N & Oak Lake Ave	NB	50	250	0	300	41	246	0	287	-9	-4	0	-13	-4%	NB	124	13	0	F	B	A	29	C	27	C	32	194				
		WB	10	180	50	240	0	180	60	240	-10	0	10	0	0%	WB	0	17	14	A	B	B	16	B				153				
		SB	70	160	20	250	75	155	20	250	5	-5	0	0	0%	SB	23	19	10	C	B	B	19	B				115				
		EB	90	970	50	1110	90	965	48	1103	0	-5	-2	-7	-1%	EB	32	31	9	C	C	A	30	C			104	609				86

Alternative 3

Bottineau Corridor
2030 PM Forecast Volumes
Baseline Geometry

Control	Intersection	Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Traffic Queueing (feet) Through		Traffic Queueing (feet) Left Turn		Traffic Queueing (feet) Right Turn	
			L	T	R	Total	L	T	R	Total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	250	50	220	520	247	51	215	513	-3	1	-5	-7	-1%	NB	74	51	25	E	D	C	51	D	24	C		111	124	634		347
		WB	220	1370	20	1610	214	1358	21	1593	-6	-12	1	-17	-1%	WB	39	4	5	D	A	A	9	A				139	46	322		
		SB	90	30	60	180	89	33	58	180	-1	3	-2	0	0%	SB	76	58	6	E	E	A	50	D				88	37	191		58
		EB	50	1550	230	1830	41	1545	223	1809	-9	-5	-7	-21	-1%	EB	73	26	18	E	C	B	26	C			93	447		105		435
Signal	TH 55 & Bryant Ave N	NB	80	30	70	180	80	28	69	177	0	-2	-1	-3	-2%	NB	61	57	7	E	E	A	39	D	13	B	36	195				54
		WB	70	1510	120	1700	58	1488	119	1665	-12	-22	-1	-35	-2%	WB	96	11	12	F	B	B	14	B			38	489	32	117		
		SB	20	10	20	50	19	10	15	44	-1	0	-5	-6	-12%	SB	67	56	26	E	E	C	51	D				89				
		EB	10	1770	80	1860	0	1788	83	1871	-10	18	3	11	1%	EB	0	8	8	A	A	A	8	A			26	343	42	93		
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A	20	C						
		WB	400	1420	0	1820	389	1373	0	1762	-11	-47	0	-58	-3%	WB	31	7	0	C	A	A	12	B				337	74	322		
		SB	30	540	280	850	25	580	274	879	-5	40	-6	29	3%	SB	48	48	18	D	D	B	39	D			81	336				
		EB	0	850	808	1658	0	851	827	1678	0	1	19	20	1%	EB	0	28	7	A	C	A	18	B			59	293				188
Signal	TH 55 & E Lyndale Ave N	NB	580	800	200	1580	579	804	205	1588	-1	4	5	8	1%	NB	50	38	25	D	D	C	41	D	26	C	149	450				
		WB	0	1240	110	1350	0	1186	110	1296	0	-54	0	-54	-4%	WB	0	20	2	A	C	A	18	B			68	522				
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	210	670	0	880	230	651	0	881	20	-19	0	1	0%	EB	21	9	0	C	A	A	12	B				134	26	208		
Signal	TH 55 & Border/Oak Lake Ave	NB	180	100	20	300	178	105	20	303	-2	5	0	3	1%	NB	73	58	14	E	E	B	64	E	33	C	99	344				
		WB	30	900	20	950	29	864	0	893	-1	-36	-20	-57	-6%	WB	73	22	0	E	C	A	24	C			129	554		86		103
		SB	10	80	270	360	0	74	264	338	-10	-6	-6	-22	-6%	SB	0	34	22	A	C	C	25	C			35	305				
		EB	190	620	60	870	175	617	60	852	-15	-3	0	-18	-2%	EB	57	31	21	E	C	C	36	D			45	268	61	378		
Signal	TH 55/7th St N & 6th Ave N	NB	400	610	40	1050	397	634	39	1070	-3	24	-1	20	2%	NB	45	44	19	D	D	B	43	D	37	D	107	411				
		WB	80	510	20	610	79	477	25	581	-1	-33	5	-29	-5%	WB	63	36	8	E	D	A	38	D			52	260	28	163		34
		SB	30	340	40	410	37	346	33	416	7	6	-7	6	1%	SB	58	59	28	E	E	C	56	E			77	303				
		EB	0	350	300	650	0	323	306	629	0	-27	6	-21	-3%	EB	0	19	4	A	B	A	12	B				214				214
Signal	6th Ave N & HERC Access	NB	30	0	20	50	27	0	22	49	-3	0	2	-1	-2%	NB	37	0	15	D	A	B	27	C	4	A		102				
		WB	10	560	10	580	11	548	12	571	1	-12	2	-9	-2%	WB	4	2	4	A	A	A	2	A				75				
		SB	10	0	20	30	11	0	17	28	1	0	-3	-2	-7%	SB	33	0	12	C	A	B	20	C				101				
		EB	20	380	20	420	16	362	16	394	-4	-18	-4	-26	-6%	EB	6	3	4	A	A	A	3	A				123				
Thru-Stop	6th Ave N & 5th St W	NB	10	150	0	160	8	145	0	153	-2	-5	0	-7	-4%	NB	2	0	0	A	A	A	0	A	19	C						
		WB	0	15	25	40	0	22	18	40	0	7	-7	0	0%	WB	0	10	5	A	B	A	8	A				39				
		SB	0	420	10	430	0	413	10	423	0	-7	0	-7	-2%	SB	0	28	19	A	D	C	28	C								
		EB	10	0	50	60	10	0	48	58	0	0	-2	-2	-3%	EB	9	0	12	A	A	B	11	B				44				
Thru-Stop	6th Ave N & 4th St W	NB	20	145	20	185	16	144	16	176	-4	-1	-4	-9	-5%	NB	3	1	2	A	A	A	1	A	4	A						
		WB	50	30	10	90	48	30	11	89	-2	0	1	-1	-1%	WB	11	9	11	B	A	B	10	B				70				
		SB	10	330	10	350	9	330	11	350	-1	0	1	0	0%	SB	3	3	2	A	A	A	3	A								
		EB	10	10	50	70	10	11	48	69	0	1	-2	-1	-1%	EB	10	11	10	B	B	B	10	B				68				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A	6	A						
		WB	0	110	10	120	0	110	8	118	0	0	-2	-2	-2%	WB	0	5	4	A	A	A	5	A				63				
		SB	20	0	90	110	20	0	89	109	0	0	-1	-1	-1%	SB	10	0	5	B	A	A	6	A				69				
		EB	190	110	0	300	176	118	0	294	-14	8	0	-6	-2%	EB	7	7	0	A	A	A	7	A				245				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	30	1010	0	1040	29	1021	0	1050	-1	11	0	10	1%	NB	5	0	0	A	A	A	0	A	0	A						
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A								
		SB	0	700	20	720	0	715	16	731	0	15	-4	11	2%	SB	0	0	1	A	A	A	0	A								
		EB	40	0	10	50	40	0	9	49	0	0	-1	-1	-2%	EB	9	0	5	A	A	A	8	A				47				
Signal	7th St N & Oak Lake Ave	NB	100	200	10	310	92	182	0	274	-8	-18	-10	-36	-12%	NB	94	15	0	F	B	A	42	D	21	C	58	348				
		WB	10	550	70	630	0	564	86	650	-10	14	16	20	3%	WB	0	15	17	A	B	B	15	B			32	385				
		SB	40	320	50	410	51	306	52	409	11	-14	2	-1	0%	SB	16	17	12	B	B	B	16	B				170				
		EB	40	360	30	430	42	359	32	433	2	-1	2	3	1%	EB	24	22	8	C	C	A	21	C			26	161				84

Alternative 4

Bottineau Corridor

2030 AM Forecast Volumes

Baseline Geometry - Trains go with traffic

Average Train Travel Times
EB - 4.5 minutes
WB - 4.1 minutes

	Intersection	Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Traffic Queueing (feet) Through		Left Turn		Right Turn	
			L	T	R	Total	L	T	R	Total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	190	30	170	390	190	31	161	382	0	1	-9	-8	-2%	NB	67	44	19	E	D	B	45	D				81	75	312		147
		WB	190	920	20	1130	184	937	18	1139	-6	17	-2	9	1%	WB	81	19	19	F	B	B	29	C	29	C	45	313	87	297		
		SB	80	40	70	190	79	40	68	187	-1	0	-2	-3	-2%	SB	63	57	6	E	E	A	41	D				100	27	144		56
		EB	50	1990	200	2240	54	2010	195	2259	4	20	-5	19	1%	EB	73	25	19	E	C	B	26	C			115	601		122		462
Signal	TH 55 & Bryant Ave N	NB	50	10	60	120	46	10	59	115	-4	0	-1	-5	-4%	NB	60	63	6	E	E	A	33	C				108				46
		WB	60	1060	30	1150	50	1050	31	1131	-10	-10	1	-19	-2%	WB	42	11	15	D	B	B	12	B	12	B	28	343		102		
		SB	10	20	20	50	10	19	15	44	0	-1	-5	-6	**-12%**	SB	54	63	19	D	E	B	46	D				86				
		EB	10	2140	90	2240	6	2173	80	2259	-4	33	-10	19	1%	EB	39	10	8	D	B	A	10	B			38	413		37		
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	150	780	0	930	142	787	0	929	-8	7	0	-1	0%	WB	56	18	0	E	B	A	24	C	35	D	141	353	47	195		
		SB	90	580	370	1040	80	685	363	1128	-10	105	-7	88	8%	SB	47	42	18	D	D	B	35	C			86	401				
		EB	0	1450	608	2058	0	1406	633	2039	0	-44	25	-19	-1%	EB	0	52	13	A	D	B	40	D			254	601				282
Signal	TH 55 & E Lyndale Ave N	NB	560	410	280	1250	555	420	284	1259	-5	10	4	9	1%	NB	48	31	14	D	C	B	35	C			99	340				
		WB	0	370	40	410	0	380	37	417	0	10	-3	7	2%	WB	0	38	1	A	D	A	35	C	26	C	41	225				
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	180	1360	0	1540	203	1314	0	1517	23	-46	0	-23	-1%	EB	28	14	0	C	B	A	16	B			43	277	32	210		
Signal	TH 55 & Border/Oak Lake Ave	NB	60	40	40	140	55	37	42	134	-5	-3	2	-6	-4%	NB	52	49	18	D	D	B	41	D				145				
		WB	20	220	20	260	22	242	0	264	2	22	-20	4	2%	WB	72	6	0	E	A	A	12	B	27	C		115		80		103
		SB	10	80	130	220	0	73	118	191	-10	-7	-12	-29	**-13%**	SB	0	46	28	A	D	C	35	C			27	190				
		EB	240	1280	120	1640	242	1245	124	1611	2	-35	4	-29	-2%	EB	57	23	16	E	C	B	28	C			72	643	97	659		
Signal	TH 55/7th St N & 6th Ave N	NB	90	200	50	340	94	209	52	355	4	9	2	15	4%	NB	73	70	13	E	E	B	62	E			57	230				
		WB	90	150	40	280	83	151	37	271	-7	1	-3	-9	-3%	WB	138	21	4	F	C	A	55	D	48	D		92	79	280		31
		SB	60	960	20	1040	65	936	19	1020	5	-24	-1	-20	-2%	SB	78	75	72	E	E	E	75	E			329	678				
		EB	0	660	670	1330	0	640	657	1297	0	-20	-13	-33	-2%	EB	0	33	11	A	C	B	22	C			98	501			95	502
Signal	6th Ave N & HERC Access	NB	20	0	10	30	18	0	11	29	-2	0	1	-1	-3%	NB	39	0	11	D	A	B	28	C				99				
		WB	20	240	40	300	18	235	42	295	-2	-5	2	-5	-2%	WB	7	2	4	A	A	A	3	A	6	A		62				
		SB	10	0	20	30	12	0	17	29	2	0	-3	-1	-3%	SB	39	0	12	D	A	B	23	C				109				
		EB	80	620	70	770	78	610	69	757	-2	-10	-1	-13	-2%	EB	5	6	5	A	A	A	6	A				502				
Thru-Stop	6th Ave N & 5th St W	NB	20	330	0	350	19	324	0	343	-1	-6	0	-7	-2%	NB	1	0	0	A	A	A	0	A								
		WB	0	5	5	10	0	7	2	9	0	2	-3	-1	-10%	WB	0	10	4	A	B	A	9	A	1	A						
		SB	0	170	10	180	0	163	11	174	0	-7	1	-6	-3%	SB	0	2	2	A	A	A	2	A								
		EB	40	0	20	60	38	0	20	58	-2	0	0	-2	-3%	EB	8	0	6	A	A	A	7	A				41				
Thru-Stop	6th Ave N & 4th St W	NB	30	285	60	375	26	277	60	363	-4	-8	0	-12	-3%	NB	1	1	1	A	A	A	1	A								
		WB	50	10	10	70	49	9	10	68	-1	-1	0	-2	-3%	WB	8	11	6	A	B	A	8	A	3	A		53				
		SB	10	90	10	110	11	88	10	109	1	-2	0	-1	-1%	SB	3	1	1	A	A	A	1	A								
		EB	10	40	40	90	9	41	38	88	-1	1	-2	-2	-2%	EB	8	11	8	A	B	A	9	A				61				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	0	60	10	70	0	60	8	68	0	0	-2	-2	-3%	WB	0	5	3	A	A	A	5	A	6	A		46				
		SB	20	0	80	100	20	0	80	100	0	0	0	0	0%	SB	13	0	4	B	A	A	6	A				63				
		EB	180	130	0	310	166	135	0	301	-14	5	0	-9	-3%	EB	6	7	0	A	A	A	6	A				257				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	20	320	0	340	19	332	0	351	-1	12	0	11	3%	NB	10	0	0	B	A	A	1	A								
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A	0	A						
		SB	0	1690	30	1720	0	1663	28	1691	0	-27	-2	-29	-2%	SB	0	0	1	A	A	A	0	A								
		EB	20	0	30	50	21	0	27	48	1	0	-3	-2	-4%	EB	15	0	8	C	A	A	11	B				47				
Signal	7th St N & Oak Lake Ave	NB	50	250	0	300	37	245	0	282	-13	-5	0	-18	-6%	NB	26	17	0	C	B	A	18	B				160				
		WB	10	180	50	240	0	188	57	245	-10	8	7	5	2%	WB	0	16	13	A	B	B	15	B	36	D		184				
		SB	70	160	20	250	78	151	20	249	8	-9	0	-1	0%	SB	47	19	10	D	B	B	27	C				122				
		EB	90	970	50	1110	92	974	46	1112	2	4	-4	2	0%	EB	46	48	19	D	D	B	47	D			217	860				101

Alternative 4

Bottineau Corridor
2030 PM Forecast Volumes
Baseline Geometry - Trains go with traffic

Average Train Travel Times
EB - 4.8 minutes
WB - 5.3 minutes

	Intersection	Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Traffic Queueing (feet) Through		Left Turn		Right Turn	
			L	T	R	Total	L	T	R	Total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	250	50	220	520	248	51	215	514	-2	1	-5	-6	-1%	NB	76	53	25	E	D	C	52	D				106	126	583		260
		WB	220	1370	20	1610	215	1359	20	1594	-5	-11	0	-16	-1%	WB	55	11	11	E	B	B	17	B	27	C	35	427	68	356		
		SB	90	30	60	180	88	33	59	180	-2	3	-1	0	0%	SB	76	63	6	E	E	A	51	D				90	36	185		53
		EB	50	1550	230	1830	42	1550	223	1815	-8	0	-7	-15	-1%	EB	67	27	19	E	C	B	27	C			97	490		109		482
Signal	TH 55 & Bryant Ave N	NB	80	30	70	180	82	28	69	179	2	-2	-1	-1	-1%	NB	59	59	7	E	E	A	39	D			35	192				48
		WB	70	1510	120	1700	62	1468	121	1651	-8	-42	1	-49	-3%	WB	77	7	11	E	A	B	10	A	9	A		396		133		
		SB	20	10	20	50	19	11	16	46	-1	1	-4	-4	-8%	SB	64	54	22	E	D	C	47	D				81				
		EB	10	1770	80	1860	7	1785	82	1874	-3	15	2	14	1%	EB	38	5	6	D	A	A	5	A				229		33		
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	400	1420	0	1820	350	1379	0	1729	-50	-41	0	-91	-5%	WB	50	6	0	D	A	A	15	B	27	C	27	343	116	290		
		SB	30	540	280	850	25	577	270	872	-5	37	-10	22	3%	SB	55	54	24	E	D	C	45	D			90	349				
		EB	0	850	808	1658	0	847	823	1670	0	-3	15	12	1%	EB	0	44	14	A	D	B	29	C			96	385			28	342
Signal	TH 55 & E Lyndale Ave N	NB	580	800	200	1580	542	794	201	1537	-38	-6	1	-43	-3%	NB	54	43	29	D	D	C	45	D			149	511				
		WB	0	1240	110	1350	0	1202	109	1311	0	-38	-1	-39	-3%	WB	0	55	8	A	E	A	51	D	39	D	354	833				
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	210	670	0	880	231	658	0	889	21	-12	0	9	1%	EB	34	4	0	C	A	A	12	B				80	46	225		
Signal	TH 55 & Border/Oak Lake Ave	NB	180	100	20	300	179	103	19	301	-1	3	-1	1	0%	NB	65	42	27	E	D	C	55	D			74	366				
		WB	30	900	20	950	29	869	0	898	-1	-31	-20	-52	-5%	WB	56	35	0	E	D	A	36	D	36	D	149	574		95		103
		SB	10	80	270	360	0	75	260	335	-10	-5	-10	-25	-7%	SB	0	43	53	A	D	D	51	D			83	399				
		EB	190	620	60	870	174	613	60	847	-16	-7	0	-23	-3%	EB	69	13	11	E	B	B	24	C				220	71	286		
Signal	TH 55/7th St N & 6th Ave N	NB	400	610	40	1050	389	624	40	1053	-11	14	0	3	0%	NB	67	64	38	E	E	D	64	E			161	696				
		WB	80	510	20	610	81	490	25	596	1	-20	5	-14	-2%	WB	66	38	10	E	D	B	41	D	51	D	55	314	29	169		37
		SB	30	340	40	410	36	333	32	401	6	-7	-8	-9	-2%	SB	67	68	35	E	E	D	65	E			89	369				
		EB	0	350	300	650	0	328	306	634	0	-22	6	-16	-2%	EB	0	47	12	A	D	B	30	C			50	264			49	263
Signal	6th Ave N & HERC Access	NB	30	0	20	50	27	0	22	49	-3	0	2	-1	-2%	NB	38	0	15	D	A	B	28	C				101				
		WB	10	560	10	580	11	548	12	571	1	-12	2	-9	-2%	WB	3	2	4	A	A	A	2	A	4	A		75				
		SB	10	0	20	30	11	0	17	28	1	0	-3	-2	-7%	SB	33	0	12	C	A	B	20	C				101				
		EB	20	380	20	420	16	373	16	405	-4	-7	-4	-15	-4%	EB	6	3	3	A	A	A	3	A				155				
Thru-Stop	6th Ave N & 5th St W	NB	10	150	0	160	8	147	0	155	-2	-3	0	-5	-3%	NB	2	0	0	A	A	A	0	A								
		WB	0	15	25	40	0	22	18	40	0	7	-7	0	0%	WB	0	9	6	A	A	A	8	A	20	C		42				
		SB	0	420	10	430	0	413	10	423	0	-7	0	-7	-2%	SB	0	30	20	A	D	C	30	C								
		EB	10	0	50	60	10	0	48	58	0	0	-2	-2	-3%	EB	9	0	13	A	A	B	12	B				48				
Thru-Stop	6th Ave N & 4th St W	NB	20	145	20	185	16	144	16	176	-4	-1	-4	-9	-5%	NB	3	1	1	A	A	A	1	A								
		WB	50	30	10	90	48	30	11	89	-2	0	1	-1	-1%	WB	12	9	10	B	A	B	11	B	4	A		67				
		SB	10	330	10	350	9	329	11	349	-1	-1	1	-1	0%	SB	2	3	2	A	A	A	3	A								
		EB	10	10	50	70	10	12	48	70	0	2	-2	0	0%	EB	11	15	12	B	C	B	12	B				69				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	0	110	10	120	0	110	8	118	0	0	-2	-2	-2%	WB	0	5	4	A	A	A	5	A	7	A		56				
		SB	20	0	90	110	20	0	89	109	0	0	-1	-1	-1%	SB	11	0	5	B	A	A	6	A				73				
		EB	190	110	0	300	179	117	0	296	-11	7	0	-4	-1%	EB	8	7	0	A	A	A	8	A				271				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	30	1010	0	1040	28	1022	0	1050	-2	12	0	10	1%	NB	3	1	0	A	A	A	1	A								
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A	1	A						
		SB	0	700	20	720	0	703	16	719	0	3	-4	-1	0%	SB	0	0	1	A	A	A	0	A								
		EB	40	0	10	50	40	0	9	49	0	0	-1	-1	-2%	EB	8	0	5	A	A	A	7	A				46				
Signal	7th St N & Oak Lake Ave	NB	100	200	10	310	94	180	0	274	-6	-20	-10	-36	-12%	NB	19	9	0	B	A	A	12	B				190				
		WB	10	550	70	630	0	575	87	662	-10	25	17	32	5%	WB	0	10	8	A	B	A	10	A	12	B		406				
		SB	40	320	50	410	51	304	51	406	11	-16	1	-4	-1%	SB	18	19	12	B	B	B	18	B				185				
		EB	40	360	30	430	42	361	32	435	2	1	2	5	1%	EB	12	12	5	B	B	A	11	B				112				83

Alternative 5

Bottineau Corridor
2030 AM Forecast Volumes
Baseline Geometry - Priority

Average Train Travel Times
EB - 5.1 minutes
WB - 4.4 minutes

Control	Intersection	Appr	Forecast Volumes L	Forecast Volumes T	Forecast Volumes R	Forecast Volumes Total	Modeled Volumes L	Modeled Volumes T	Modeled Volumes R	Modeled Volumes Total	Error Volumes L	Error Volumes T	Error Volumes R	Volume Error by Approach Total	Volume Error by Approach %	Appr	Total Delay by Movement (Sec/Veh) L	Total Delay by Movement (Sec/Veh) T	Total Delay by Movement (Sec/Veh) R	Level of Service by Movement L	Level of Service by Movement T	Level of Service by Movement R	LOS by Approach (Sec/Veh) Delay	LOS by Approach (Sec/Veh) LOS	LOS by Intersection (Sec/Veh) Delay	LOS by Intersection (Sec/Veh) LOS	Traffic Queueing (feet) Through Ave Queue	Through Max Queue	Left Turn Ave Queue	Left Turn Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	190	30	170	390	185	31	164	380	-5	1	-6	-10	-3%	NB	69	46	22	E	D	C	47	D				89	78	349		140
		WB	190	920	20	1130	173	912	18	1103	-17	-8	-2	-27	-2%	WB	237	16	19	F	B	B	51	D	34	C	139	550	311	580		
		SB	80	40	70	190	73	40	73	186	-7	0	3	-4	-2%	SB	61	58	9	E	E	A	40	D				95		127		60
		EB	50	1990	200	2240	55	2014	201	2270	5	24	1	30	1%	EB	77	22	17	E	C	B	23	C			100	628		123		449
Signal	TH 55 & Bryant Ave N	NB	50	10	60	120	45	12	58	115	-5	2	-2	-5	-4%	NB	66	63	6	E	E	A	35	D				111				49
		WB	60	1060	30	1150	52	1030	31	1113	-8	-30	1	-37	-3%	WB	61	28	24	E	C	C	29	C	19	B	72	453		144		
		SB	10	20	20	50	10	21	15	46	0	1	-5	-4	-8%	SB	62	62	24	E	E	C	50	D				88				
		EB	10	2140	90	2240	6	2162	79	2247	-4	22	-11	7	0%	EB	41	12	9	D	B	A	12	B			42	373		38		
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	150	780	0	930	141	784	0	925	-9	4	0	-5	-1%	WB	63	17	0	E	B	A	24	C	35	D	114	348	54	232		
		SB	90	580	370	1040	83	687	358	1128	-7	107	-12	88	8%	SB	57	50	23	E	D	C	42	D			104	488				
		EB	0	1450	608	2058	0	1397	633	2030	0	-53	25	-28	-1%	EB	0	49	11	A	D	B	37	D			242	641				179
Signal	TH 55 & E Lyndale Ave N	NB	560	410	280	1250	551	421	285	1257	-9	11	5	7	1%	NB	48	32	14	D	C	B	35	C			100	382				
		WB	0	370	40	410	0	381	36	417	0	11	-4	7	2%	WB	0	38	1	A	D	A	35	C	27	C	43	209				
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	180	1360	0	1540	200	1311	0	1511	20	-49	0	-29	-2%	EB	32	15	0	C	B	A	17	B			47	272	36	211		
Signal	TH 55 & Border/Oak Lake Ave	NB	60	40	40	140	55	39	40	134	-5	-1	0	-6	-4%	NB	50	58	25	D	E	C	45	D				142				
		WB	20	220	20	260	22	245	0	267	2	25	-20	7	3%	WB	71	5	0	E	A	A	10	B	26	C		106		77		103
		SB	10	80	130	220	0	76	116	192	-10	-4	-14	-28	-13%	SB	0	51	28	A	D	C	37	D			29	178				
		EB	240	1280	120	1640	237	1249	122	1608	-3	-31	2	-32	-2%	EB	66	20	14	E	C	B	26	C			66	614	113	696		
Signal	TH 55/7th St N & 6th Ave N	NB	90	200	50	340	100	201	51	352	10	1	1	12	4%	NB	62	69	17	E	E	B	59	E			55	190				
		WB	90	150	40	280	84	149	40	273	-6	-1	0	-7	-3%	WB	108	19	5	F	B	A	44	D	43	D		104	63	250		35
		SB	60	960	20	1040	71	942	18	1031	11	-18	-2	-9	-1%	SB	70	65	71	E	E	E	65	E			275	635				
		EB	0	660	670	1330	0	630	667	1297	0	-30	-3	-33	-2%	EB	0	31	11	A	C	B	21	C			95	525			92	528
Signal	6th Ave N & HERC Access	NB	20	0	10	30	18	0	11	29	-2	0	1	-1	-3%	NB	41	0	11	D	A	B	30	C				96				
		WB	20	240	40	300	18	238	39	295	-2	-2	-1	-5	-2%	WB	7	2	5	A	A	A	3	A	5	A		65				
		SB	10	0	20	30	11	0	18	29	1	0	-2	-1	-3%	SB	43	0	13	D	A	B	24	C				101				
		EB	80	620	70	770	73	613	65	751	-7	-7	-5	-19	-2%	EB	4	4	4	A	A	A	4	A				362				
Thru-Stop	6th Ave N & 5th St W	NB	20	330	0	350	18	329	0	347	-2	-1	0	-3	-1%	NB	2	0	0	A	A	A	0	A								
		WB	0	5	5	10	0	7	2	9	0	2	-3	-1	-10%	WB	0	10	5	A	B	A	9	A	2	A		26				
		SB	0	170	10	180	0	167	9	176	0	-3	-1	-4	-2%	SB	0	3	2	A	A	A	3	A								
		EB	40	0	20	60	40	0	18	58	0	0	-2	-2	-3%	EB	8	0	6	A	A	A	7	A				48				
Thru-Stop	6th Ave N & 4th St W	NB	30	285	60	375	25	282	62	369	-5	-3	2	-6	-2%	NB	1	1	1	A	A	A	1	A								
		WB	50	10	10	70	46	10	11	67	-4	0	1	-3	-4%	WB	8	10	6	A	B	A	8	A	3	A		52				
		SB	10	90	10	110	10	89	9	108	0	-1	-1	-2	-2%	SB	4	1	1	A	A	A	1	A								
		EB	10	40	40	90	9	38	40	87	-1	-2	0	-3	-3%	EB	8	11	7	A	B	A	9	A				61				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	0	60	10	70	0	59	9	68	0	-1	-1	-2	-3%	WB	0	5	3	A	A	A	5	A	6	A		44				
		SB	20	0	80	100	20	0	79	99	0	0	-1	-1	-1%	SB	12	0	4	B	A	A	6	A				58				
		EB	180	130	0	310	163	141	0	304	-17	11	0	-6	-2%	EB	5	7	0	A	A	A	6	A				243				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	20	320	0	340	19	330	0	349	-1	10	0	9	3%	NB	13	0	0	B	A	A	1	A								
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A	0	A						
		SB	0	1690	30	1720	0	1677	29	1706	0	-13	-1	-14	-1%	SB	0	0	1	A	A	A	0	A								
		EB	20	0	30	50	20	0	29	49	0	0	-1	-1	-2%	EB	14	0	8	B	A	A	10	B				46				
Signal	7th St N & Oak Lake Ave	NB	50	250	0	300	39	241	0	280	-11	-9	0	-20	-7%	NB	22	17	0	C	B	A	18	B				162				
		WB	10	180	50	240	0	182	58	240	-10	2	8	0	0%	WB	0	15	12	A	B	B	14	B	24	C		161				
		SB	70	160	20	250	78	151	20	249	8	-9	0	-1	0%	SB	29	17	10	C	B	B	20	C				110				
		EB	90	970	50	1110	87	981	47	1115	-3	11	-3	5	0%	EB	26	30	13	C	C	B	29	C			117	668				95

Alternative 5

Bottineau Corridor
2030 PM Forecast Volumes
Baseline Geometry - Priority

Average Train Travel Times
EB - 4.8 minutes
WB - 5.0 minutes

Control	Intersection	Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Traffic Queueing (feet): Through		Traffic Queueing (feet): Left Turn		Traffic Queueing (feet): Right Turn	
			L	T	R	Total	L	T	R	Total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	250	50	220	520	251	47	214	512	1	-3	-6	-8	-2%	NB	76	55	25	E	E	C	53	D				95	127	639		263
		WB	220	1370	20	1610	210	1342	22	1574	-10	-28	2	-36	-2%	WB	93	13	10	F	B	B	24	C	28	C	50	494	122	468		
		SB	90	30	60	180	84	32	60	176	-6	2	0	-4	-2%	SB	71	59	6	E	E	A	47	D				98	33	163		54
		EB	50	1550	230	1830	40	1556	223	1819	-10	6	-7	-11	-1%	EB	69	24	16	E	C	B	24	C			84	453		101		339
Signal	TH 55 & Bryant Ave N	NB	80	30	70	180	82	28	68	178	2	-2	-2	-2	-1%	NB	62	55	8	E	E	A	40	D			36	212				57
		WB	70	1510	120	1700	65	1455	115	1635	-5	-55	-5	-65	-4%	WB	75	7	10	E	A	B	10	A	10	B		436		128		
		SB	20	10	20	50	20	9	17	46	0	-1	-3	-4	-8%	SB	70	56	22	E	E	C	50	D				82				
		EB	10	1770	80	1860	6	1779	81	1866	-4	9	1	6	0%	EB	41	6	8	D	A	A	6	A				265		30		
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	400	1420	0	1820	354	1362	0	1716	-46	-58	0	-104	-6%	WB	52	6	0	D	A	A	15	B	27	C	30	346	118	283		
		SB	30	540	280	850	26	570	272	868	-4	30	-8	18	2%	SB	61	57	22	E	E	C	46	D			93	350				
		EB	0	850	808	1658	0	844	817	1661	0	-6	9	3	0%	EB	0	41	14	A	D	B	28	C			93	344			26	288
Signal	TH 55 & E Lyndale Ave N	NB	580	800	200	1580	528	801	202	1531	-52	1	2	-49	-3%	NB	57	44	29	E	D	C	47	D			165	520				
		WB	0	1240	110	1350	0	1195	109	1304	0	-45	-1	-46	-3%	WB	0	54	7	A	D	A	50	D	40	D	338	843				
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	210	670	0	880	225	657	0	882	15	-13	0	2	0%	EB	33	6	0	C	A	A	13	B				108	44	228		
Signal	TH 55 & Border/Oak Lake Ave	NB	180	100	20	300	179	101	19	299	-1	1	-1	-1	0%	NB	99	47	25	F	D	C	77	E			114	518				
		WB	30	900	20	950	28	857	0	885	-2	-43	-20	-65	-7%	WB	53	31	0	D	C	A	32	C	39	D	120	516		99		103
		SB	10	80	270	360	0	74	258	332	-10	-6	-12	-28	-8%	SB	0	50	50	A	D	D	50	D			81	371				
		EB	190	620	60	870	168	619	59	846	-22	-1	-1	-24	-3%	EB	97	13	10	F	B	B	29	C				195	120	546		
Signal	TH 55/7th St N & 6th Ave N	NB	400	610	40	1050	385	628	40	1053	-15	18	0	3	0%	NB	65	70	48	E	E	D	67	E			174	719				
		WB	80	510	20	610	83	484	23	590	3	-26	3	-20	-3%	WB	64	31	11	E	C	B	35	C	51	D	50	293	29	159		33
		SB	30	340	40	410	34	342	33	409	4	2	-7	-1	0%	SB	69	65	33	E	E	C	63	E			87	349				
		EB	0	350	300	650	0	331	312	643	0	-19	12	-7	-1%	EB	0	49	13	A	D	B	32	C			53	330			52	332
Signal	6th Ave N & HERC Access	NB	30	0	20	50	26	0	23	49	-4	0	3	-1	-2%	NB	38	0	15	D	A	B	27	C				102				
		WB	10	560	10	580	11	552	11	574	1	-8	1	-6	-1%	WB	3	2	5	A	A	A	2	A	4	A		69				
		SB	10	0	20	30	10	0	18	28	0	0	-2	-2	-7%	SB	30	0	12	C	A	B	18	B				100				
		EB	20	380	20	420	15	373	16	404	-5	-7	-4	-16	-4%	EB	4	3	4	A	A	A	3	A				142				
Thru-Stop	6th Ave N & 5th St W	NB	10	150	0	160	7	152	0	159	-3	2	0	-1	-1%	NB	3	0	0	A	A	A	0	A								
		WB	0	15	25	40	0	20	19	39	0	5	-6	-1	-3%	WB	0	10	6	A	B	A	8	A	21	C		46				
		SB	0	420	10	430	0	418	9	427	0	-2	-1	-3	-1%	SB	0	31	19	A	D	C	31	C								
		EB	10	0	50	60	10	0	48	58	0	0	-2	-2	-3%	EB	10	0	13	B	A	B	12	B				49				
Thru-Stop	6th Ave N & 4th St W	NB	20	145	20	185	16	150	15	181	-4	5	-5	-4	-2%	NB	3	1	2	A	A	A	1	A								
		WB	50	30	10	90	50	29	10	89	0	-1	0	-1	-1%	WB	12	9	9	B	A	A	11	B	5	A		60				
		SB	10	330	10	350	8	329	11	348	-2	-1	1	-2	-1%	SB	2	4	2	A	A	A	4	A								
		EB	10	10	50	70	10	10	49	69	0	0	-1	-1	-1%	EB	10	12	13	B	B	B	12	B				59				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	0	110	10	120	0	108	10	118	0	-2	0	-2	-2%	WB	0	5	4	A	A	A	5	A	6	A		58				
		SB	20	0	90	110	20	0	88	108	0	0	-2	-2	-2%	SB	12	0	5	B	A	A	6	A				62				
		EB	190	110	0	300	180	112	0	292	-10	2	0	-8	-3%	EB	7	7	0	A	A	A	7	A				286				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	30	1010	0	1040	30	1020	0	1050	0	10	0	10	1%	NB	3	1	0	A	A	A	1	A								
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A	1	A						
		SB	0	700	20	720	0	720	17	737	0	20	-3	17	2%	SB	0	0	1	A	A	A	0	A								
		EB	40	0	10	50	40	0	8	48	0	0	-2	-2	-4%	EB	9	0	5	A	A	A	8	A				47				
Signal	7th St N & Oak Lake Ave	NB	100	200	10	310	91	177	0	268	-9	-23	-10	-42	-14%	NB	21	9	0	C	A	A	13	B				151				
		WB	10	550	70	630	0	579	83	662	-10	29	13	32	5%	WB	0	10	9	A	B	A	10	A	13	B		490				
		SB	40	320	50	410	52	303	53	408	12	-17	3	-2	0%	SB	17	19	13	B	B	B	18	B				188				
		EB	40	360	30	430	39	362	33	434	-1	2	3	4	1%	EB	12	12	7	B	B	A	12	B				101				82

Alternative 6

Bottineau Corridor
2030 AM Forecast Volumes
Baseline Geometry - Preemption

Average Train Travel Times
EB - 3.1 minutes
WB - 3.1 minutes

	Intersection	Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Traffic Queueing (feet): Through		Left Turn		Right Turn	
			Lt	Th	Rt	total	L	T	R	total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS	Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	190	30	170	390	195	31	166	392	5	1	-4	2	1%	NB	53	41	18	D	D	B	37	D				72	57	290		124
		WB	190	920	20	1130	186	906	19	1111	-4	-14	-1	-19	-2%	WB	116	10	10	F	B	B	28	C	26	C		266	136	480		
		SB	80	40	70	190	77	42	71	190	-3	2	1	0	0%	SB	54	55	6	D	E	A	36	D				88		160		50
		EB	50	1990	200	2240	53	1986	197	2236	3	-4	-3	-4	0%	EB	52	23	17	D	C	B	23	C			102	545		101		331
Signal	TH 55 & Bryant Ave N	NB	50	10	60	120	51	11	56	118	1	1	-4	-2	-2%	NB	72	63	6	E	E	A	40	D				154				41
		WB	60	1060	30	1150	50	1050	29	1129	-10	-10	-1	-21	-2%	WB	70	4	6	E	A	A	7	A	11	B		227		106		
		SB	10	20	20	50	11	19	16	46	1	-1	-4	-4	-8%	SB	59	67	23	E	E	C	50	D				84				
		EB	10	2140	90	2240	5	2146	79	2230	-5	6	-11	-10	0%	EB	52	10	10	D	B	B	10	B			41	420		33		
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	150	780	0	930	145	773	0	918	-5	-7	0	-12	-1%	WB	81	6	0	F	A	A	18	B	24	C		323	72	223		
		SB	90	580	370	1040	84	684	354	1122	-6	104	-16	82	8%	SB	42	39	16	D	D	B	32	C			79	399				
		EB	0	1450	608	2058	0	1417	633	2050	0	-33	25	-8	0%	EB	0	29	8	A	C	A	23	C			135	600				172
Signal	TH 55 & E Lyndale Ave N	NB	560	410	280	1250	552	429	282	1263	-8	19	2	13	1%	NB	40	33	15	D	C	B	32	C			78	342				
		WB	0	370	40	410	0	380	38	418	0	10	-2	8	2%	WB	0	24	1	A	C	A	22	C	22	C	28	190				
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	180	1360	0	1540	204	1310	0	1514	24	-50	0	-26	-2%	EB	50	9	0	D	A	A	15	B				255	60	224		
Signal	TH 55 & Border/Oak Lake Ave	NB	60	40	40	140	57	42	37	136	-3	2	-3	-4	-3%	NB	47	44	22	D	D	C	39	D				133				
		WB	20	220	20	260	21	238	0	259	1	18	-20	-1	0%	WB	48	11	0	D	B	A	14	B	26	C		152		63		103
		SB	10	80	130	220	0	77	124	201	-10	-3	-6	-19	-9%	SB	0	44	30	A	D	C	35	D			30	175				
		EB	240	1280	120	1640	243	1249	119	1611	3	-31	-1	-29	-2%	EB	56	20	16	E	C	B	25	C			59	436	84	667		
Signal	TH 55/7th St N & 6th Ave N	NB	90	200	50	340	95	202	52	349	5	2	2	9	3%	NB	67	65	11	E	E	B	57	E			53	209				
		WB	90	150	40	280	84	145	40	269	-6	-5	0	-11	-4%	WB	75	32	6	E	C	A	42	D	41	D		118	39	186		53
		SB	60	960	20	1040	72	968	17	1057	12	8	-3	17	2%	SB	40	41	38	D	D	D	41	D			153	617				
		EB	0	660	670	1330	0	622	659	1281	0	-38	-11	-49	-4%	EB	0	54	22	A	D	C	38	D			156	485			155	482
Signal	6th Ave N & HERC Access	NB	20	0	10	30	17	0	12	29	-3	0	2	-1	-3%	NB	25	0	13	C	A	B	20	C				76				
		WB	20	240	40	300	19	234	40	293	-1	-6	0	-7	-2%	WB	15	6	6	B	A	A	7	A	9	A		84				
		SB	10	0	20	30	11	0	18	29	1	0	-2	-1	-3%	SB	56	0	12	E	A	B	29	C				92				
		EB	80	620	70	770	74	604	65	743	-6	-16	-5	-27	-4%	EB	9	9	7	A	A	A	9	A				417				
Thru-Stop	6th Ave N & 5th St W	NB	20	330	0	350	18	327	0	345	-2	-3	0	-5	-1%	NB	2	0	0	A	A	A	0	A								
		WB	0	5	5	10	0	10	2	12	0	5	-3	2	20%	WB	0	12	5	A	B	A	11	B	2	A		26				
		SB	0	170	10	180	0	167	9	176	0	-3	-1	-4	-2%	SB	0	2	2	A	A	A	2	A								
		EB	40	0	20	60	41	0	17	58	1	0	-3	-2	-3%	EB	8	0	6	A	A	A	7	A				43				
Thru-Stop	6th Ave N & 4th St W	NB	30	285	60	375	25	283	62	370	-5	-2	2	-5	-1%	NB	1	1	1	A	A	A	1	A								
		WB	50	10	10	70	47	10	10	67	-3	0	0	-3	-4%	WB	8	10	7	A	B	A	8	A	3	A		50				
		SB	10	90	10	110	11	90	8	109	1	0	-2	-1	-1%	SB	3	1	1	A	A	A	1	A								
		EB	10	40	40	90	8	40	39	87	-2	0	-1	-3	-3%	EB	8	11	7	A	B	A	9	A				55				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	0	60	10	70	0	59	8	67	0	-1	-2	-3	-4%	WB	0	2	1	A	A	A	2	A	7	A		39				
		SB	20	0	80	100	20	0	79	99	0	0	-1	-1	-1%	SB	46	0	11	D	A	B	18	B				118				
		EB	180	130	0	310	162	140	0	302	-18	10	0	-8	-3%	EB	4	4	0	A	A	A	4	A				208				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	20	320	0	340	20	329	0	349	0	9	0	9	3%	NB	10	0	0	B	A	A	1	A								
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A	0	A						
		SB	0	1690	30	1720	0	1684	30	1714	0	-6	0	-6	0%	SB	0	0	1	A	A	A	0	A								
		EB	20	0	30	50	20	0	28	48	0	0	-2	-2	-4%	EB	13	0	8	B	A	A	10	B				48				
Signal	7th St N & Oak Lake Ave	NB	50	250	0	300	43	237	0	280	-7	-13	0	-20	-7%	NB	30	25	0	C	C	A	26	C				159				
		WB	10	180	50	240	0	183	58	241	-10	3	8	1	0%	WB	0	8	6	A	A	A	8	A	13	B		160				
		SB	70	160	20	250	73	156	21	250	3	-4	1	0	0%	SB	33	26	14	C	C	B	27	C				142				
		EB	90	970	50	1110	90	976	48	1114	0	6	-2	4	0%	EB	7	8	4	A	A	A	8	A				237				95

Alternative 6

Bottineau Corridor
2030 PM Forecast Volumes
Baseline Geometry - Preemption

Average Train Travel Times
EB - 3.1 minutes
WB - 3.1 minutes

Control	Intersection	Appr	Forecast Volumes L	Forecast Volumes T	Forecast Volumes R	Forecast Volumes Total	Modeled Volumes L	Modeled Volumes T	Modeled Volumes R	Modeled Volumes Total	Error Volumes L	Error Volumes T	Error Volumes R	Volume Error by Approach Total	Volume Error by Approach %	Appr	Total Delay by Movement (Sec/Veh) L	Total Delay by Movement (Sec/Veh) T	Total Delay by Movement (Sec/Veh) R	Level of Service by Movement L	Level of Service by Movement T	Level of Service by Movement R	LOS by Approach (Sec/Veh) Delay	LOS by Approach (Sec/Veh) LOS	LOS by Intersection (Sec/Veh) Delay	LOS by Intersection (Sec/Veh) LOS	Traffic Queueing (feet) Through Ave Queue	Through Max Queue	Left Turn Ave Queue	Left Turn Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Signal	TH 55 & Van White Mem Blvd	NB	250	50	220	520	256	49	216	521	6	-1	-4	1	0%	NB	59	41	20	E	D	C	41	D				84	94	553		152
		WB	220	1370	20	1610	208	1335	18	1561	-12	-35	-2	-49	-3%	WB	117	13	12	F	B	B	27	C	30	C	44	491	150	581		
		SB	90	30	60	180	92	30	60	182	2	0	0	2	1%	SB	84	56	10	F	E	B	55	D				82	44	235		53
		EB	50	1550	230	1830	46	1563	225	1834	-4	13	-5	4	0%	EB	77	26	16	E	C	B	26	C			93	495		115		425
Signal	TH 55 & Bryant Ave N	NB	80	30	70	180	85	30	65	180	5	0	-5	0	0%	NB	66	67	9	E	E	A	46	D			41	229				54
		WB	70	1510	120	1700	59	1444	110	1613	-11	-66	-10	-87	-5%	WB	87	5	6	F	A	A	8	A	13	B		338	27	128		
		SB	20	10	20	50	20	10	15	45	0	0	-5	-5	-10%	SB	63	81	23	E	F	C	54	D				84				
		EB	10	1770	80	1860	7	1770	80	1857	-3	0	0	-3	0%	EB	70	12	14	E	B	B	12	B			43	403		38		
Signal	TH 55 & W Lyndale Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	400	1420	0	1820	328	1331	0	1659	-72	-89	0	-161	-9%	WB	59	5	0	E	A	A	16	B	21	C		339	127	273		
		SB	30	540	280	850	24	586	271	881	-6	46	-9	31	4%	SB	39	38	12	D	D	B	30	C			62	274				
		EB	0	850	808	1658	0	823	803	1626	0	-27	-5	-32	-2%	EB	0	32	13	A	C	B	23	C			80	342				259
Signal	TH 55 & E Lyndale Ave N	NB	580	800	200	1580	545	815	195	1555	-35	15	-5	-25	-2%	NB	43	37	24	D	D	C	37	D			112	493				
		WB	0	1240	110	1350	0	1128	113	1241	0	-112	3	-109	-8%	WB	0	58	2	A	E	A	53	D	38	D	401	849				
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A								
		EB	210	670	0	880	231	630	0	861	21	-40	0	-19	-2%	EB	49	6	0	D	A	A	18	B				211	67	228		
Signal	TH 55 & Border/Oak Lake Ave	NB	180	100	20	300	171	110	17	298	-9	10	-3	-2	-1%	NB	63	41	21	E	D	C	52	D			66	277				
		WB	30	900	20	950	29	817	0	846	-1	-83	-20	-104	-11%	WB	68	36	0	E	D	A	37	D	35	D	183	626		105		103
		SB	10	80	270	360	0	69	261	330	-10	-11	-9	-30	-8%	SB	0	36	48	A	D	D	45	D			72	377				
		EB	190	620	60	870	177	604	62	843	-13	-16	2	-27	-3%	EB	60	12	7	E	B	A	22	C				189	59	362		
Signal	TH 55/7th St N & 6th Ave N	NB	400	610	40	1050	373	629	35	1037	-27	19	-5	-13	-1%	NB	50	40	18	D	D	B	43	D			104	383				
		WB	80	510	20	610	77	451	23	551	-3	-59	3	-59	-10%	WB	74	61	24	E	E	C	61	E	47	D	111	549	30	246		43
		SB	30	340	40	410	38	340	32	410	8	0	-8	0	0%	SB	70	69	39	E	E	D	67	E			91	366				
		EB	0	350	300	650	0	312	301	613	0	-38	1	-37	-6%	EB	0	43	12	A	D	B	28	C			51	240			49	240
Signal	6th Ave N & HERC Access	NB	30	0	20	50	26	0	23	49	-4	0	3	-1	-2%	NB	36	0	12	D	A	B	25	C				98				
		WB	10	560	10	580	11	543	10	564	1	-17	0	-16	-3%	WB	8	7	8	A	A	A	7	A	9	A		136				
		SB	10	0	20	30	11	0	17	28	1	0	-3	-2	-7%	SB	57	0	16	E	A	B	32	C				118				
		EB	20	380	20	420	16	357	16	389	-4	-23	-4	-31	-7%	EB	13	9	11	B	A	B	9	A				224				
Thru-Stop	6th Ave N & 5th St W	NB	10	150	0	160	7	139	0	146	-3	-11	0	-14	-9%	NB	4	0	0	A	A	A	0	A								
		WB	0	15	25	40	0	24	18	42	0	9	-7	2	5%	WB	0	10	5	A	B	A	8	A	22	C		45				
		SB	0	420	10	430	0	412	10	422	0	-8	0	-8	-2%	SB	0	32	20	A	D	C	32	C								
		EB	10	0	50	60	9	0	49	58	-1	0	-1	-2	-3%	EB	11	0	13	B	A	B	13	B				42				
Thru-Stop	6th Ave N & 4th St W	NB	20	145	20	185	17	133	16	166	-3	-12	-4	-19	-10%	NB	2	1	1	A	A	A	1	A								
		WB	50	30	10	90	48	30	11	89	-2	0	1	-1	-1%	WB	15	9	15	C	A	C	13	B	5	A		87				
		SB	10	330	10	350	9	329	10	348	-1	-1	0	-2	-1%	SB	2	3	2	A	A	A	3	A								
		EB	10	10	50	70	10	11	48	69	0	1	-2	-1	-1%	EB	8	12	12	A	B	B	11	B				58				
Signal	5th St W & 5th Ave N	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A								
		WB	0	110	10	120	0	107	11	118	0	-3	1	-2	-2%	WB	0	2	2	A	A	A	2	A	7	A		57				
		SB	20	0	90	110	21	0	87	108	1	0	-3	-2	-2%	SB	51	0	15	D	A	B	22	C				126				
		EB	190	110	0	300	183	110	0	293	-7	0	0	-7	-2%	EB	4	4	0	A	A	A	4	A				188				
Thru-Stop	TH 55/7th St N & 5th Ave N	NB	30	1010	0	1040	31	1018	0	1049	1	8	0	9	1%	NB	3	0	0	A	A	A	0	A								
		WB	0	0	0	0	0	0	0	0	0	0	0	0	0%	WB	0	0	0	A	A	A	0	A	0	A						
		SB	0	700	20	720	0	701	16	717	0	1	-4	-3	0%	SB	0	0	1	A	A	A	0	A								
		EB	40	0	10	50	39	0	9	48	-1	0	-1	-2	-4%	EB	7	0	5	A	A	A	7	A				46				
Signal	7th St N & Oak Lake Ave	NB	100	200	10	310	103	183	0	286	3	-17	-10	-24	-8%	NB	55	29	0	E	C	A	38	D			42	199				
		WB	10	550	70	630	0	572	80	652	-10	22	10	22	3%	WB	0	12	11	A	B	B	12	B	20	C		370				
		SB	40	320	50	410	52	300	54	406	12	-20	4	-4	-1%	SB	35	34	22	D	C	C	33	C			51	204				
		EB	40	360	30	430	43	360	32	435	3	0	2	5	1%	EB	7	10	5	A	B	A	9	A				118				79

To:	Joe Gladke, PE	**Copy:**	N/A
From:	Tony Heppelmann, PE Chad Ellos, PE Dean Chamberlain, EIT		
Date:	June 2011	**File:**	WSB No. 01484-05
Subject:	Operations Analysis of LRT near the Terrace Mall Bottineau Transitway – Robbinsdale 36th Avenue LRT Alignment 34th Avenue LRT Alignment		

Introduction

The purpose of this study was to analyze the operational impacts caused by introducing LRT into the area. Three scenarios were analyzed as part of this study. These scenarios include:

- Existing (No Build)
- 36th Avenue LRT Alignment
- 34th Avenue LRT Alignment

Below is a description of each scenario analyzed.

Existing (No Build)

The Existing scenario represents the 2010 roadway network. Within the study area, eleven key intersections were analyzed, which include:

- 36th Avenue at Halifax Avenue
- 36th Avenue at Grimes Avenue
- 36th Avenue at France Avenue
- 36th Avenue at West Broadway Avenue
- CSAH 81 at 36th Avenue
- CSAH 81 at Abbott Avenue
- 34th Avenue at Halifax Avenue
- 34th Avenue at Grimes Avenue

- 34^{th} Avenue/Oakdale Avenue at France Avenue
- Terrace Mall Access at France Avenue
- 35^{th} Avenue at France Avenue

The study area and existing lane configuration for these key intersections are shown on **Figure 1**.

36^{th} Avenue LRT Alignment

LRT is proposed to run along the south side of 36^{th} Avenue between the existing BNSF railroad tracks and CSAH 81 using right-of-way that would be acquired from current property owners on the south side of 36^{th} Avenue. The LRT line then turns south to run along CSAH 81 using the right-of-way of the existing West Broadway Avenue, which currently serves as a frontage road for CSAH 81. The LRT line would follow the West Broadway Avenue right-of-way until it meets the intersection of Theodore Wirth Parkway, Victory Memorial Parkway, Lowry Avenue, and Oakdale Avenue (under the existing CSAH 81 bridge). The LRT line would bisect the intersection and proceed to run through the median of CSAH 81 into Minneapolis as shown in **Appendix A**.

Because of safety and operational concerns, all LRT at-grade roadway crossings would be under signalized control. A number of road accesses would need to close with this option, including: Halifax and Grimes Avenues south of 36^{th} Avenue, West Broadway Avenue frontage road south of 36^{th} Avenue, and West Broadway Avenue frontage road north of Abbott Avenue. To provide access to the Terrace Mall businesses, an additional signalized intersection could be built on CSAH 81 south of 36^{th} Avenue.

Dedicated right-turn and left-turn lanes on approaches paralleling the transitway would need to be defined in order to allow major through movements to proceed through the intersection concurrently with the LRT movements. The intersection of France Avenue and 36^{th} Avenue would need a dedicated westbound left-turn lane and eastbound right-turn lane. Currently these approaches have shared through-left and through-right lanes. The westbound approach would include a left-turn lane and a shared through/right-turn lane. The eastbound approach would include a right-turn lane and a shared through/left-turn lane. These revisions would provide storage for turning vehicles waiting for the LRT movements to clear the intersection.

Some right-turning movements that cross the tracks would not be allowed to turn on red. These include the northbound right-turn at France Avenue and 36^{th} Avenue, the eastbound right-turn at the new entrance to the Terrace Mall and CSAH 81, and the eastbound right-turn at Abbott Avenue and CSAH 81. The remaining right-turn movements that cross the tracks would need to obey LRT actuated blank-out prohibition signs informing vehicles not to cross the tracks when a train is present or approaching. These movements include the eastbound right-turn at 36th Avenue and France Avenue, the southbound right-turn at the new entrance to the Terrace Mall and CSAH 81, and the southbound right-turn at Abbott Avenue and CSAH 81.

34th Avenue LRT Alignment

For this alignment, LRT is proposed to run down the middle of the current 34th Avenue right-of-way from the BNSF railroad tracks to the intersection of France Avenue. The line would then run through the edge of residential backyards and the southern edge of the North Memorial Out-Patient Clinic land to CSAH 81. At CSAH 81, the LRT line would cross over the southbound lanes of CSAH 81 on a grade-separated crossing and proceed to run in the median of CSAH 81 into Minneapolis as shown in **Appendix B**. This proposed LRT alignment requires further geometric evaluation in order to validate its possible implementation.

To accommodate the LRT line in this alignment, 34th Avenue between Grimes Avenue and France Avenue would be closed. Halifax Avenue would cross the LRT tracks on a grade-separated structure with the LRT line passing below the existing ground elevation, allowing Halifax Avenue to cross without changing the elevation of the roadway. Between Indiana and Grimes Avenues, 34th Avenue would be realigned adjacent to the LRT tracks with a narrower width and retaining walls to match the existing elevations. Due to safety and operational concerns, the intersection of France Avenue and Oakdale Avenue would be rebuilt as a signalized T-Type intersection. West Broadway Avenue would close between Abbott Avenue and the North Memorial clinic at the south end of the Terrace Mall. The southbound right-turn at France Avenue and 34th Avenue would not be allowed to turn on red.

Existing Conditions

Roadway System

The 34th Avenue, 36th Avenue, France Avenue, and CSAH 81 corridors provide access to local neighborhoods and businesses in the City of Robbinsdale and surrounding areas. Commercial retail businesses, office space, medical services, and many single-family residences are located along these corridors and depend on the access provided by these roadways.

CSAH 81 is classified as a minor arterial serving the northwest quadrant of the Twin Cities Metropolitan area. One of CSAH 81's major functions is connecting population centers in the northwest metro area with employment in the City of Minneapolis. CSAH 81 has an average daily traffic (ADT) of 11,700 vehicles according to Mn/DOT 2009 Traffic Flow Maps. 36th Avenue serves as a connector roadway between CSAH 81 and TH 100 (approximately 1 mile to the west) with an ADT of 10,200-16,400 vehicles on various segments in the project area. France Avenue provides an alternate route to North Memorial Medical Center via Oakdale Avenue and has an ADT of 6,900 vehicles in the project area. The remaining streets in the area are local roads providing access to and movement through the nearby residential areas.

Existing Traffic

In order to provide a base condition for the traffic analysis, turning movement counts were collected at the key intersections. Hennepin County provided peak hour turning movement counts along CSAH 81 at 36th Avenue and Abbott Avenue (June 2009). Turning movements at the other key intersections were collected in November and December 2010. For reference, these counts are provided in **Appendix C**.

As mentioned in Technical Memorandum 2, a "worst case scenario" was developed to provide a conservative estimate of the peak hour conditions that currently exist on the roadway system. The peak hour traffic volumes for the 36th Avenue and CSAH 81 corridors were derived from the turning movement counts in *Appendix C*. These peak hour counts were then adjusted to match tube counts on Halifax and Grimes Avenues as well as the two entrances to Terrace Mall on France Avenue taken by WSB in November 2010, which are shown in **Appendix D**. Finally, the traffic flows were balanced to provide system continuity. The resulting peak hour turning movements at the key intersections are also shown on *Figure 1*.

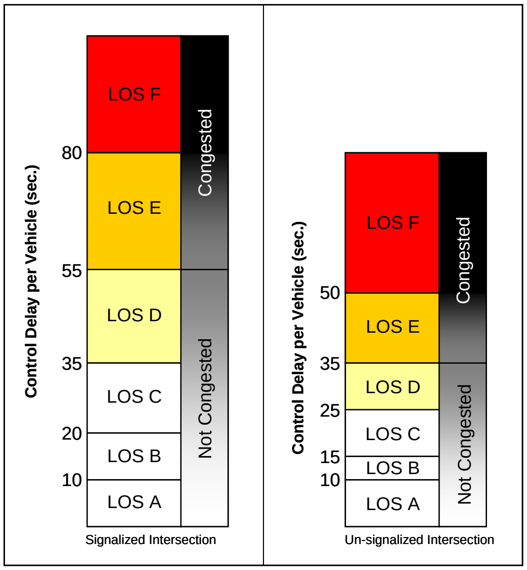
Modeling Methodology

VISSIM computer software was used to model the Existing, the 36th Avenue LRT Alignment, and the 34th Avenue LRT Alignment. VISSIM is a microscopic, time step and behavior based simulation model developed to model urban traffic and public transit operations. It is approved by Mn/DOT as a method to analyze complex transportation systems involving traffic and transit operations under constraints such as lane configuration, traffic composition, traffic signals, transit stops, etc., thus making it a useful tool for the evaluation of various alternatives based on transportation engineering and planning measures of effectiveness.

Level of Service Definition

The traffic operations analysis results are presented in the form of a letter grade from A to F, called level of service (LOS). The letter grade provides a qualitative assessment of the intersection operations based on the amount of delay per vehicle. The LOS system is set up similar to a report card with "A" representing high quality operations and "F" representing poor operations. At LOS A, motorists experience very little delay or interference. On a roadway or intersection with LOS F conditions, motorists would experience severe congestion and extreme delay, i.e., gridlock. The LOS analysis criteria for signalized and unsignalized intersections are shown in **Figure 2**. Although LOS A conditions represents the best possible level of traffic flow, the cost to construct intersections to such a high standard exceeds the benefit to the user. Within an urbanized area, it is generally regarded that LOS D or better provides for acceptable operations.

Figure 2: Delay Based LOS Thresholds



SOURCE: Level of Service thresholds from the Highway Capacity Manual, 2000.
K:\Traffic\Level of Service (LOS)\LOS Delay Graphic.ppt

Existing Operations

A summary of the existing level of service conditions is provided below. **Appendix E** provides more detail as to the individual movements at each intersection and the queue lengths recorded.

Table 1 summarizes the LOS conditions at the key intersections based on the existing lane geometry, Hennepin County and City of Robbinsdale provided signal timing, and 2010 traffic volumes as shown in *Figure 1*. All intersections are currently operating at LOS C or better during the am and pm peak hours. A few movements in the pm peak hour are operating at LOS D as footnoted in *Table 1* and displayed in *Appendix E*. Adequate storage for queuing vehicles was provided at all approaches. These results are consistent with observed conditions.

Table 1: Intersection LOS – Existing (No Build)

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)
Halifax Ave & 36th Ave	A	1	A	1
Grimes Ave & 36th Ave	A	1	A	1
France Ave & 36th Ave	A	7	A	8
W. Broadway Frontage Rd & 36th Ave	A	1	A	3
CSAH 81 & 36th Ave	B	16	C	23[a]
CSAH 81 & Abbott Ave	B	11	B	14[b]
Halifax Ave & 34th Ave	A	4	A	4
Grimes Ave & 34th Ave	A	5	A	4
France Ave & 34th Ave	A	8	B	10
France Ave & Terrace Mall Access	A	1	A	1
France Ave & 35th Ave	A	1	A	2

[a]All left-turn movements and the westbound through movement operate at LOS D.

[b]The eastbound left-turn movement operates at LOS D.

K:\01484-05\Admin\Docs\Tech Memos\[LOS Summary Tables.xls]No Build
Source: WSB & Associates

Traffic Forecasts

The project is located in a historically built-up area in the City of Robbinsdale, which is an inner suburb of Minneapolis. Based the City's comprehensive plan and other known development plans, no increase in traffic within the study area over the next 20 years was assumed. Historical traffic volumes for the study area, provided in **Appendix F**, generally supports this assumption by showing that traffic volumes have stayed relatively unchanged.

Year 2030 traffic forecasts for the LRT alignments do include shifting traffic to other intersections based on closures and revisions to the roadway network. The methodology used to reroute traffic based on each LRT alignment is described below.

36th Avenue LRT Alignment

Due to the closures previously mentioned for this alignment, affected traffic was rerouted to other roadways according to the following assumptions:

- **Halifax and Grimes Avenues south of 36th Avenue**: All traffic originating in the area between 34th and 36th Avenues was rerouted onto 35th Avenue to France Avenue. Two-thirds of the turning traffic at 36th Avenue originating from the area south of 34th Avenue on both streets was rerouted onto 34th Avenue to France Avenue. The remaining one-third of the turning traffic originating south of 34th Avenue was assumed to have taken 33rd Avenue to France Avenue. This split was assumed because existing traffic control on 34th Avenue allows through traffic to proceed to France Avenue without stopping.

- **West Broadway Avenue south of 36th Avenue**: Traffic coming from and destined to the east leg of the existing intersection of 36th Avenue and West Broadway Avenue from Terrace Mall was rerouted to the proposed new intersection on CSAH 81. Traffic coming from and destined to the west leg of the intersection was rerouted to the shopping center entrance on France Avenue between 35th and 36th Avenues (70%), the proposed new intersection on CSAH 81 (20%), or the shopping center entrance at 35th Avenue and France Avenue (10%). Factors contributing to these splits were the ease of entering and exiting the shopping center as well as the assumed destination within the shopping center.
- **West Broadway Avenue north of Abbott Avenue**: Because the traffic on this road is mainly destined for the North Memorial clinic in the south end of the Terrace Mall complex, traffic was diverted to the proposed new intersection on CSAH 81 (75%) and the shopping center entrance at 35th Avenue and France Avenue via Oakdale Ave (25%).
- **West Broadway Avenue south of Abbott Avenue and at Oakdale Avenue**: This segment was not included in the scope of this study.

The results of the shifted traffic are reflected in the forecast turning movements shown in **Figure 3**.

34th Avenue LRT Alignment

Due to the closures previously mentioned for this alignment, affected traffic was rerouted to other roadways according to the following assumptions:

- **Grimes Avenue south of 34th Avenue**: Traffic on Grimes Avenue proceeding to/from the west on 36th Avenue was rerouted to Halifax Avenue to 36th Avenue. Traffic proceeding to/from the east on 36th Avenue and turning to/from the east on 34th Avenue was moved to France Avenue.
- **34th Avenue between Grimes Avenue and France Avenue**: Vehicles on 34th Avenue turning to/from the north on France Avenue were rerouted to 35th Avenue to France Avenue, and vehicles on 34th Avenue proceeding straight to/from Oakdale Avenue were moved to 33rd Avenue to France Avenue.
- **West Broadway Avenue north of Abbott Avenue**: Because the traffic on this road is mainly destined for the North Memorial clinic in the south end of the Terrace Mall complex, traffic was diverted to the proposed new intersection on CSAH 81 (75%) and the shopping center entrance at 35th Avenue and France Avenue via Oakdale Ave (25%).

Figure 4 shows the forecast turning movements resulting from these closures.

Operations Analysis

General LRT Operating Assumptions

The LRT is assumed to operate at a frequency of 7.5 minutes, in each direction, during the peak hours with a station dwell time of approximately twenty seconds. Random arrival times at the North Memorial Station are based on a mean value of 450 seconds (7.5 minutes) with a standard deviation of 90 seconds (representing ± 20%). The desired speed through the study area is 30 mph. Each LRT train consists of three 94 foot cars with an acceleration rate of 3.0 mph per second and a deceleration rate of 1.5 mph per second. LRT is given priority at traffic signals resulting in minor street phases ending after their minimums are reached and possibly allowing major street through phases to be extended beyond their normal maximums in order to minimize LRT delay. Under traffic signal priority, the LRT vehicles may need to slow down and/or stop at intersections thus experiencing some delay through the study area.

Analysis data from the models was collected for both the traffic and LRT traveling through the study area. A summary of the levels of service conditions for each scenario is provided below. *Appendix E* provides more detail as to the individual movements at each intersection, the queue lengths recorded, and LRT travel times through the study area.

Traffic LOS Conditions

<u>36th Avenue LRT Alignment</u>

Table 2 summarizes the LOS conditions based on the revised lane geometry and redistributed traffic volumes as shown in *Figure 3*. Redistributed traffic from closed approaches prompted the optimization of signal timings. All intersections operate at LOS B or better during the am and pm peak hours. A few movements in the pm peak hour are operating at LOS D as footnoted in *Table 2*.

Queue lengths at the new CSAH 81 intersection to the Terrace Mall were reviewed to determine if vehicles were backing up into the CSAH 81 and 36th Avenue intersection affecting signal operations. The maximum queues recorded during the peak hours did not exceed 200 feet and thus were not affecting nearby signal operations. The northbound left-turn storage on France Avenue at 36th Avenue was exceeded a few instances during the pm peak hour. Currently the storage is approximately 150 feet. Left-turning vehicles temporarily block through and right-turning vehicles until the signal turns green allowing the queue to dissipate. This left-turn storage should be monitored and possibly extended should this LRT alignment be implemented. The resulting LOS conditions were similar to the Existing (No Build) conditions.

Table 2: Intersection LOS – 36th Avenue LRT Alignment

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)
Halifax Ave & 36th Ave	A	1	A	1
Grimes Ave & 36th Ave	A	1	A	1
France Ave & 36th Ave	B	12	B	14
W. Broadway Frontage Rd & 36th Ave	A	1	A	1
CSAH 81 & 36th Ave	B	16[a]	B	19[d]
CSAH 81 & Abbott Ave	A	9[b]	B	12[e]
Halifax Ave & 34th Ave	A	2	A	1
Grimes Ave & 34th Ave	A	2	A	1
France Ave & 34th Ave	A	9	B	11
France Ave & Terrace Mall Access	A	1	A	2
France Ave & 35th Ave	A	2	A	3
CSAH 81 & New Terrace Mall Access	A	9[c]	B	14[f]

[a]All left-turn movements and the westbound through movement operate at LOS D.

[b]The northbound left, eastbound left, and eastbound right-turn movements operate at LOS D.

[c]The northbound left, eastbound left, and eastbound right-turn movements operate at LOS D.

[d]The NB, WB, and SB left-turn movements and the WB through movement operate at LOS D.

[e]The northbound left, eastbound left, and eastbound right-turn movements operate at LOS D.

[f]The northbound left, eastbound left, and eastbound right-turn movements operate at LOS D.

K:\01484-05\Admin\Docs\Tech Memos\[LOS Summary Tables.xls]36th
Source: WSB & Associates

34th Avenue LRT Alignment

Table 3 summarizes the LOS conditions based on the revised lane geometry and redistributed traffic volumes as shown in *Figure 4*. Redistributed traffic from closed approaches again prompted the optimization of signal timings. All intersections operate at LOS C or better during the am and pm peak hours. A few movements in the pm peak hour are operating at LOS D as footnoted in *Table 3*. The northbound left-turn storage on France Avenue at 36th Avenue was exceeded a few instances during the pm peak hour. Left-turning vehicles temporarily block through and right-turning vehicles until the signal turns green allowing the queue to dissipate. This left-turn storage should be monitored and possibly extended should this LRT alignment be implemented. The resulting LOS conditions were similar to the Existing (No Build) conditions.

Table 3: Intersection LOS – 34th Avenue LRT Alignment

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)
Halifax Ave & 36th Ave	A	1	A	1
Grimes Ave & 36th Ave	A	1	A	1
France Ave & 36th Ave	A	7	A	9
W. Broadway Frontage Rd & 36th Ave	A	1	A	3
CSAH 81 & 36th Ave	B	17	C	21[b]
CSAH 81 & Abbott Ave	A	9[a]	B	16[c]
Halifax Ave & 34th Ave	A	1	A	1
France Ave & Oakdale Ave	B	11	B	11
France Ave & Terrace Mall Access	A	1	A	1
France Ave & 35th Ave	A	2	A	2

[a]The northbound left-turn movement operates at LOS D.

[b]The WB, SB, and EB left-turn movements and the WB through movement operate at LOS D.

[c]The northbound and eastbound left-turn movements operate at LOS D.

K:\01484-05\Admin\Docs\Tech Memos\[LOS Summary Tables.xls]34th
Source: WSB & Associates

LRT Travel Times

The LRT train travel time through the study area was collected for comparison between the 36th Avenue and 34th Avenue alignments. The travel time was calculated from a point just north of 36th Avenue to just south of Abbott Avenue.

<u>36th Avenue LRT Alignment</u>

The distance following the 36th Avenue LRT alignment was approximately 4,645 feet. On average, it took an LRT train 157 seconds to travel through the study area in the am peak hour and 151 seconds in the pm peak hour. Approximately 50 seconds[1] was related to stopping at the North Memorial Station and 17 seconds (am peak) and 11 seconds (pm peak) were related to intersection delay.

<u>34th Avenue LRT Alignment</u>

The distance following the 34th Avenue LRT alignment was approximately 5,475 feet. On average, it took an LRT train 172 seconds to travel through the study area in the am peak hour and 173 seconds in the pm peak hour. Approximately 50 seconds[2] was related to stopping at

[1] Deceleration, dwell, and acceleration time.

[2] Deceleration, dwell, and acceleration time.

the North Memorial Station and 8 seconds (am peak) and 9 seconds (pm peak) were related to intersection delay.

The 34th Avenue alignment is approximately 830 feet longer than the 36th Avenue alignment. On average, an LRT train traveling on the 34th Avenue alignment takes an additional 15 seconds in the am peak and 22 seconds in the pm peak hour to travel through the study area as compared to traveling on the 36th Avenue alignment. These average travel times are also provided in *Appendix E*.

Additional Analyses

Sensitivity Analysis

Since the traffic forecasts were essentially the same as the existing counts, a sensitivity analysis was also performed to determine if an increase in forecasted traffic would result in acceptable conditions. Even though traffic volumes in the study area are not anticipated to increase in the future, traffic on TH 100 is forecasted to increase. Congestion on TH 100 could lead to an increase in vehicles using CSAH 81 and 36th Avenue during peak traffic hours. Revised 2030 forecasts for this analysis were developed assuming an annual increase of one percent per year. These forecasts were then rerouted using the same methodology as stated previously based on closures and revisions to the roadway network for each LRT alignment scenario.

The results of the sensitivity analysis were similar to the original analysis, producing acceptable conditions under both the 36th Avenue and 34th Avenue scenarios. Tables of these results are provided in **Appendix G**.

Weekend Traffic Analysis

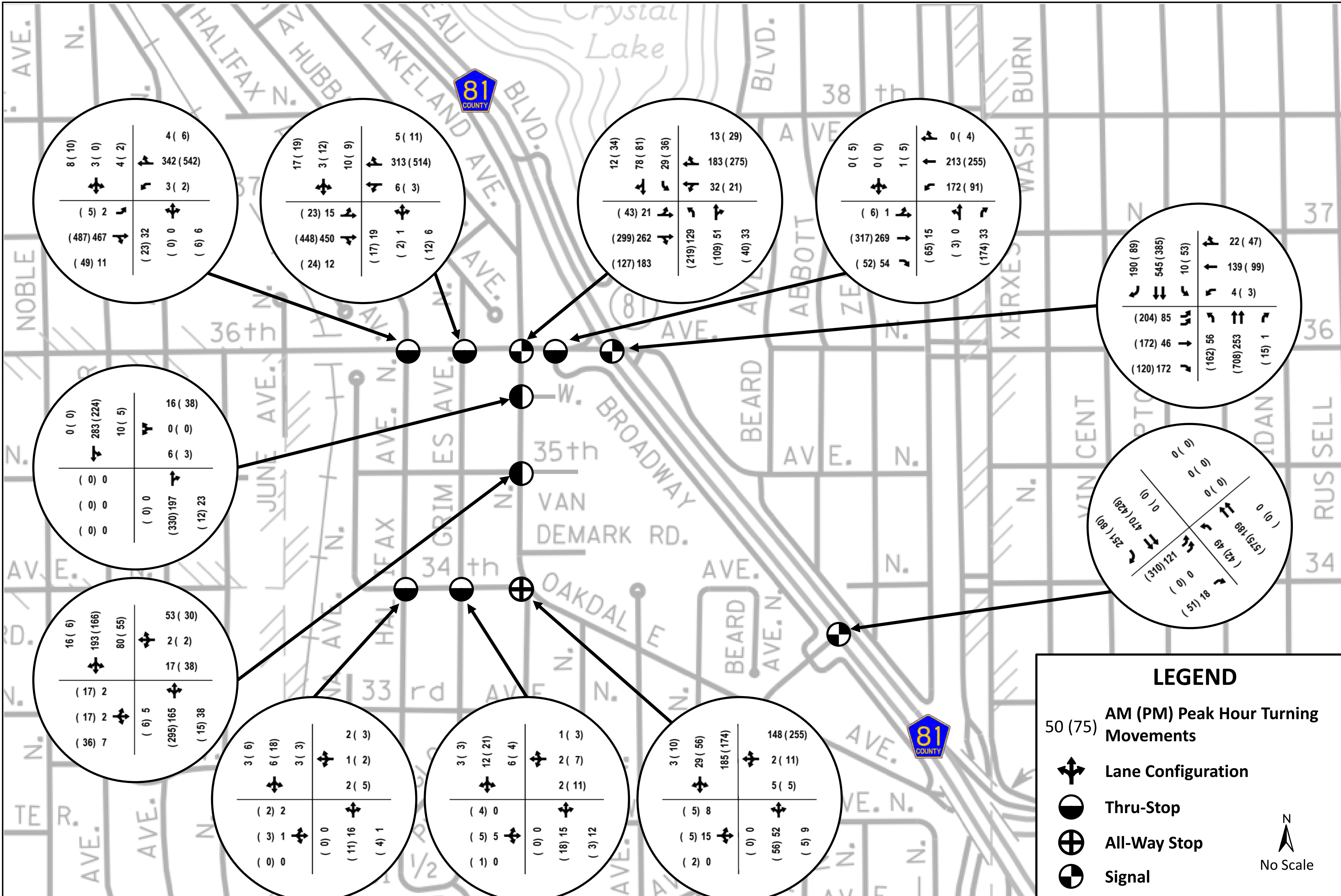
Terrace Mall management was concerned about traffic operations on the weekend since customer volume using the Terrace Mall shopping center was highest on the weekend. Since no current weekend traffic data was available, the following methodology was used to compare the highest weekend hourly traffic to the weekday PM peak hour.

Using Automatic Traffic Recorder (ATR) data from the TH 100 and 36th Avenue freeway ramps, it was concluded that the highest hourly weekday traffic in the area occurs between 4:30 pm and 5:30 pm, the highest hourly Saturday traffic between 3:30 pm and 4:30 pm and the highest hourly Sunday traffic between noon and 1:00 pm. Saturday's peak hour was 78% of the weekday PM peak hour and Sunday's peak hour was 76% of the weekday PM peak hour. It was concluded that traffic in the area on Saturday and Sunday is generally 80% of what could be expected during the weekday PM peak hour.

A review of the ITE trip generation rates for Saturday traffic revealed that the weekday PM peak hour generated approximately the same number of trips as the Saturday peak hour. Therefore, since the roadway network on Saturdays is expected to experience approximately 20% less traffic and the trips produced during the peak hour are essentially the same as the weekday PM peak hour, the operations and LOS conditions at the area intersection is expected to be the same or better than those reported for the weekday PM peak hour. Refer to **Appendix H** for ATR and ITE data used in this analysis.

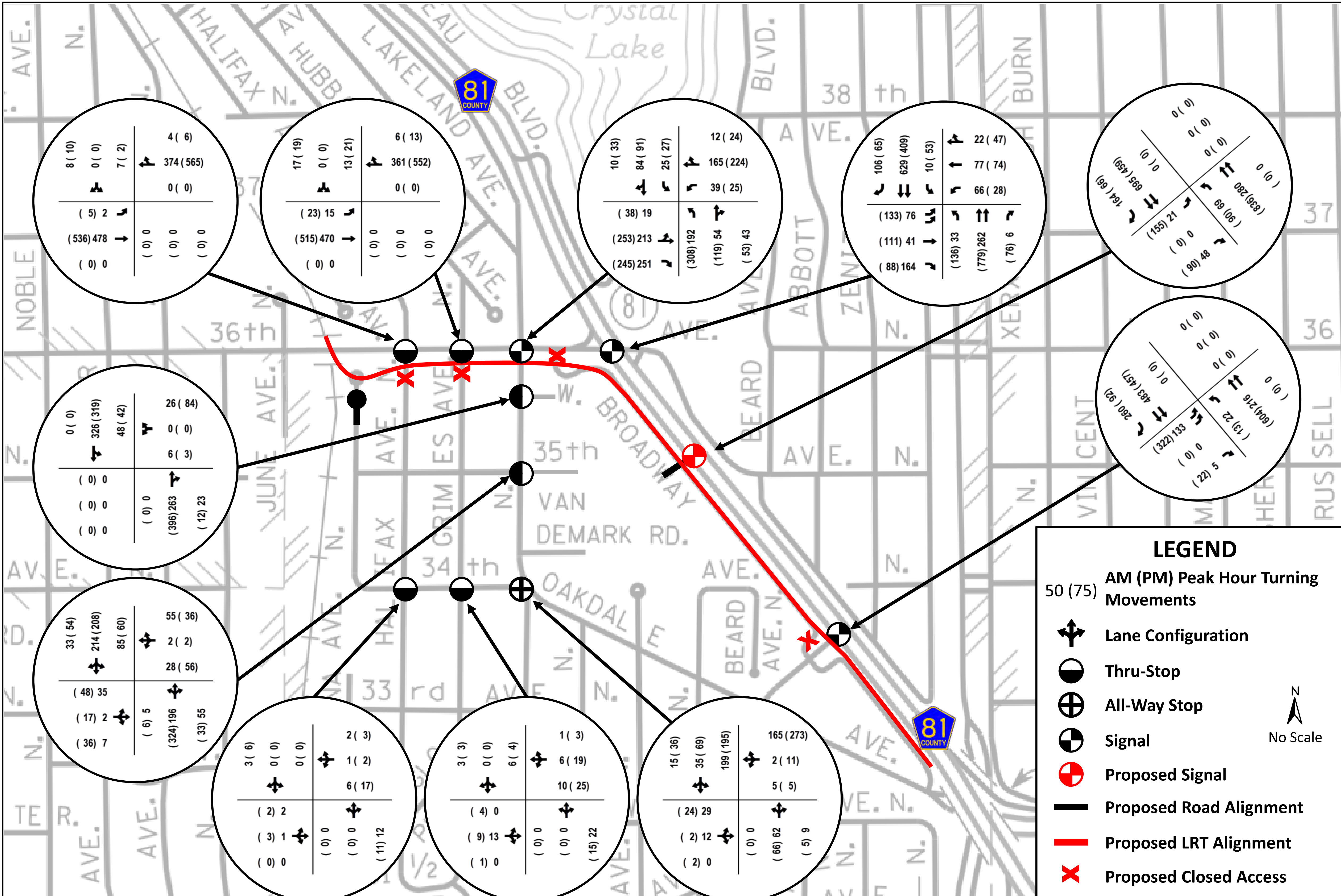
Conclusions

- Both the 36th Avenue and 34th Avenue LRT scenarios produce acceptable LOS conditions and queue lengths at all the area intersections.
- The sensitivity analysis, which included revising the 2030 forecasts to include an annual traffic increase of one percent, produced acceptable LOS conditions and queue lengths at all intersection.
- The 34th Avenue LRT alignment requires further geometric evaluation in order to validate its possible implementation.
- The highest hourly traffic volumes on the weekend are not anticipated to exceed the weekday PM peak hour traffic volumes (highest weekend peak hour is approximately 80% of the weekday PM peak hour).
- With the 36th Avenue LRT alignment, a new intersection on CSAH 81 between 36th Avenue and Abbott Avenue will experience acceptable LOS conditions. Queue lengths at this intersection are expected to be short and thus not effecting operations at the CSAH 81/36th Avenue intersection.



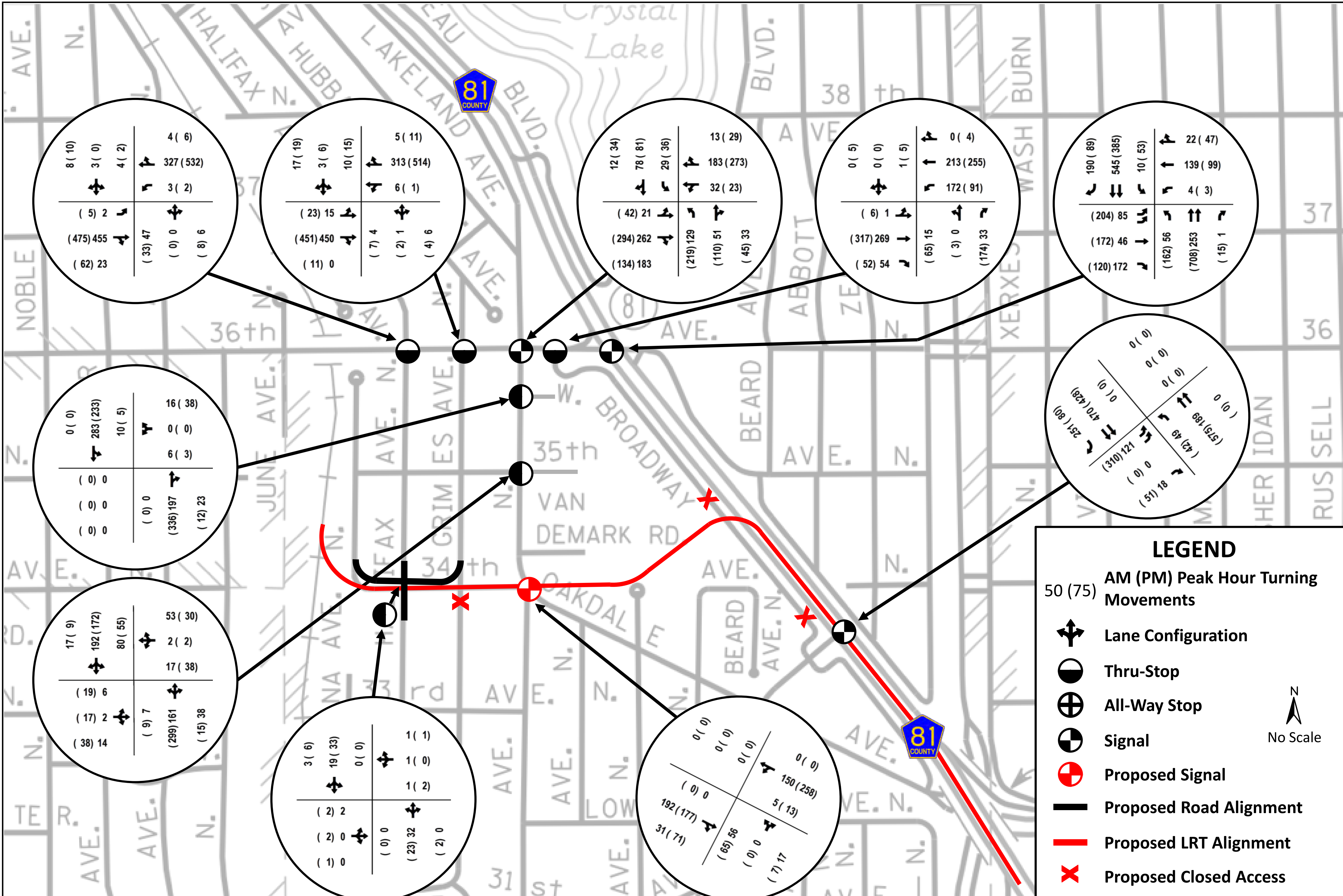
Hennepin County
Bottineau Transitway
Robbinsdale, MN

Figure 1
No Build
Existing Turning Movements and Lane Configuration



Hennepin County
Bottineau Transitway
Robbinsdale, MN

Figure 3
36th Avenue LRT Alignment
2030 Turning Movement Forecasts and Lane Configuration

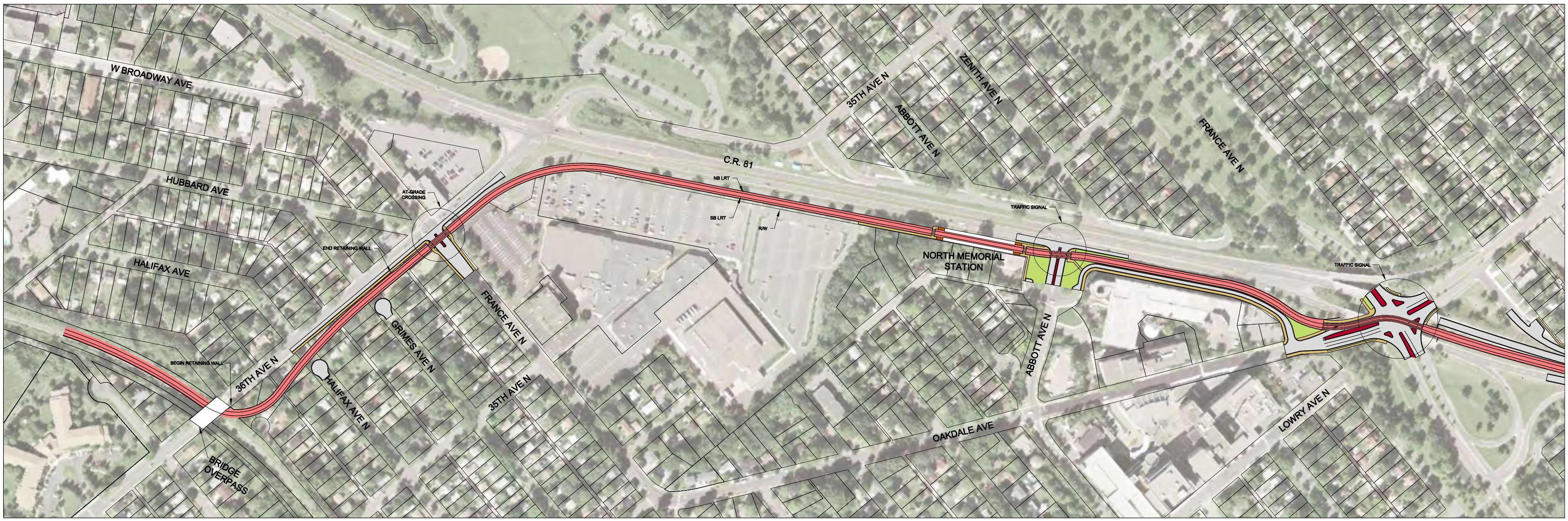


Hennepin County
Bottineau Transitway
Robbinsdale, MN

Figure 4
34th Avenue LRT Alignment
2030 Turning Movement Forecasts and Lane Configuration

Appendix A

36th Avenue LRT Alignment

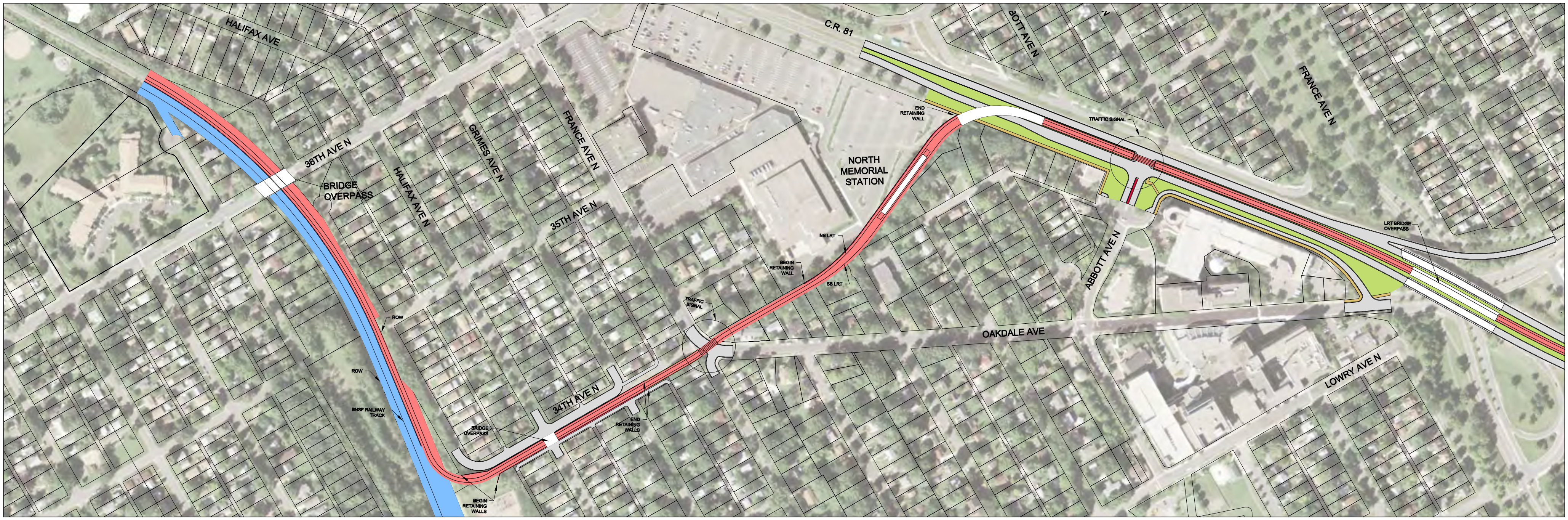


SEGMENT D2 - ROBBINSDALE SUB-ALT 1

2010-5-24

Appendix B

34th Avenue LRT Alignment



SEGMENT D2 - ROBBINSDALE SUB-ALT 3

2010-5-24

Appendix C

Turning Movement Counts

(Taken by WSB or supplied by Hennepin County)

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

36th Ave & Halifax Ave
Turning Movement
Robbinsdale, MN

File Name : 36th ave & halifax ave
Site Code : 00000001
Start Date : 11/30/2010
Page No : 1

Groups Printed- Unshifted

	Halifax Ave From North					36th Ave From East					Halifax Ave From South					36th Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:15 AM	2	0	0	0	2	0	87	1	0	88	0	0	8	0	8	0	95	0	0	95	193
07:30 AM	6	1	1	0	8	1	95	1	0	97	1	0	6	0	7	3	111	0	0	114	226
07:45 AM	1	2	1	0	4	0	89	0	0	89	2	0	6	0	8	4	113	0	0	117	218
Total	9	3	2	0	14	1	271	2	0	274	3	0	20	0	23	7	319	0	0	326	637
08:00 AM	1	0	0	0	1	2	74	0	0	76	1	0	3	0	4	1	106	1	0	108	189
08:15 AM	0	0	2	0	2	1	62	1	0	64	1	0	9	0	10	1	108	1	0	110	186
08:30 AM	2	0	0	0	2	2	76	0	0	78	0	0	5	0	5	3	96	0	0	99	184
*** BREAK ***																					
Total	3	0	2	0	5	5	212	1	0	218	2	0	17	0	19	5	310	2	0	317	559
*** BREAK ***																					
04:15 PM	1	0	1	1	3	2	123	0	0	125	1	0	3	0	4	6	99	2	0	107	239
04:30 PM	2	0	2	0	4	2	132	0	0	134	1	0	3	0	4	6	116	1	0	123	265
04:45 PM	2	0	0	0	2	1	132	2	0	135	3	0	4	0	7	15	127	1	0	143	287
Total	5	0	3	1	9	5	387	2	0	394	5	0	10	0	15	27	342	4	0	373	791
05:00 PM	1	0	0	0	1	3	133	0	0	136	1	0	7	0	8	12	99	1	0	112	257
05:15 PM	5	0	0	0	5	0	128	0	0	128	1	0	7	0	8	11	102	2	0	115	256
05:30 PM	2	0	0	0	2	2	96	1	0	99	0	0	5	0	5	2	103	4	0	109	215
Grand Total	25	3	7	1	36	16	1227	6	0	1249	12	0	66	0	78	64	1275	13	0	1352	2715
Apprch %	69.4	8.3	19.4	2.8		1.3	98.2	0.5	0		15.4	0	84.6	0		4.7	94.3	1	0		
Total %	0.9	0.1	0.3	0	1.3	0.6	45.2	0.2	0	46	0.4	0	2.4	0	2.9	2.4	47	0.5	0	49.8	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

36th Ave & Grimes Ave
Turning Movement
Robbinsdale, MN

File Name : 36th ave & grimes ave
Site Code : 00000002
Start Date : 12/1/2010
Page No : 1

Groups Printed- Unshifted

	Grimes Ave From North					36th Ave From East					Grimes Ave From South					36th Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:15 AM	7	1	2	0	10	1	70	0	0	71	0	1	5	0	6	2	104	3	0	109	196
07:30 AM	4	1	5	0	10	3	97	1	0	101	0	0	8	0	8	3	130	4	0	137	256
07:45 AM	6	0	2	0	8	1	94	1	0	96	1	0	2	0	3	2	126	4	0	132	239
Total	17	2	9	0	28	5	261	2	0	268	1	1	15	0	17	7	360	11	0	378	691
08:00 AM	1	1	2	0	4	1	74	1	0	76	2	0	3	0	5	3	93	3	0	99	184
08:15 AM	6	0	1	0	7	0	63	1	0	64	0	1	1	0	2	0	95	4	0	99	172
08:30 AM	10	1	3	0	14	0	64	0	0	64	0	1	6	0	7	5	72	4	0	81	166
*** BREAK ***																					
Total	17	2	6	0	25	1	201	2	0	204	2	2	10	0	14	8	260	11	0	279	522
*** BREAK ***																					
04:15 PM	3	2	2	0	7	3	118	4	0	125	1	0	4	0	5	8	103	4	0	115	252
04:30 PM	1	3	1	0	5	4	112	1	0	117	2	0	4	0	6	7	112	2	0	121	249
04:45 PM	5	0	3	0	8	1	144	1	0	146	0	1	6	0	7	6	130	10	0	146	307
Total	9	5	6	0	20	8	374	6	0	388	3	1	14	0	18	21	345	16	0	382	808
05:00 PM	5	5	2	0	12	4	120	0	0	124	4	1	2	0	7	5	98	7	0	110	253
05:15 PM	8	2	3	0	13	2	108	1	0	111	4	0	3	0	7	4	110	4	0	118	249
05:30 PM	3	1	1	0	5	3	91	2	0	96	1	2	3	0	6	5	126	5	0	136	243
Grand Total	59	17	27	0	103	23	1155	13	0	1191	15	7	47	0	69	50	1299	54	0	1403	2766
Apprch %	57.3	16.5	26.2	0		1.9	97	1.1	0		21.7	10.1	68.1	0		3.6	92.6	3.8	0		
Total %	2.1	0.6	1	0	3.7	0.8	41.8	0.5	0	43.1	0.5	0.3	1.7	0	2.5	1.8	47	2	0	50.7	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

36th Ave & France Ave
Turning Movement
Robbinsdale, MN

File Name : 36th ave & france
Site Code : 00000003
Start Date : 11/30/2010
Page No : 1

Groups Printed- Unshifted

	France Ave From North					36th Ave From East					France Ave From South					36th Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:15 AM	4	14	14	2	34	4	50	3	0	57	5	4	22	0	31	32	55	1	1	89	211
07:30 AM	3	22	7	4	36	2	46	7	1	56	7	15	37	0	59	51	57	5	0	113	264
07:45 AM	3	16	6	0	25	3	48	13	0	64	10	17	33	0	60	46	56	9	1	112	261
Total	10	52	27	6	95	9	144	23	1	177	22	36	92	0	150	129	168	15	2	314	736
08:00 AM	5	19	7	3	34	3	37	8	0	48	6	8	28	1	43	40	66	5	0	111	236
08:15 AM	1	21	6	1	29	3	26	3	0	32	10	11	31	0	52	46	61	2	1	110	223
08:30 AM	7	9	6	0	22	6	45	6	1	58	5	7	23	1	36	37	52	6	0	95	211
*** BREAK ***																					
Total	13	49	19	4	85	12	108	17	1	138	21	26	82	2	131	123	179	13	1	316	670
*** BREAK ***																					
04:15 PM	13	19	12	1	45	5	50	4	0	59	11	29	59	1	100	32	52	7	0	91	295
04:30 PM	4	25	13	0	42	7	71	5	0	83	8	28	61	0	97	28	76	9	0	113	335
04:45 PM	12	16	4	4	36	6	74	10	2	92	7	34	43	2	86	36	66	10	0	112	326
Total	29	60	29	5	123	18	195	19	2	234	26	91	163	3	283	96	194	26	0	316	956
05:00 PM	11	23	13	1	48	5	58	1	2	66	11	29	71	0	111	29	59	8	2	98	323
05:15 PM	7	17	6	2	32	10	66	5	0	81	12	18	43	1	74	33	57	9	0	99	286
05:30 PM	7	22	12	2	43	10	48	4	1	63	7	15	41	1	64	24	58	4	0	86	256
Grand Total	77	223	106	20	426	64	619	69	7	759	99	215	492	7	813	434	715	75	5	1229	3227
Apprch %	18.1	52.3	24.9	4.7		8.4	81.6	9.1	0.9		12.2	26.4	60.5	0.9		35.3	58.2	6.1	0.4		
Total %	2.4	6.9	3.3	0.6	13.2	2	19.2	2.1	0.2	23.5	3.1	6.7	15.2	0.2	25.2	13.4	22.2	2.3	0.2	38.1	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

36th Ave & W Broadway Ave
Turning Movement
Robbinsdale, MN

File Name : 36th ave & w broadway ave
Site Code : 00000004
Start Date : 12/1/2010
Page No : 1

Groups Printed- Unshifted

	Ent to Parking lot From North					36th Ave From East					W Broadway Ave From South					36th Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:15 AM	0	0	0	1	1	0	46	25	0	71	7	0	4	0	11	10	56	0	0	66	149
07:30 AM	0	0	0	2	2	0	63	34	0	97	5	0	3	0	8	8	80	0	0	88	195
07:45 AM	0	0	0	2	2	0	62	44	0	106	4	0	2	0	6	15	75	0	0	90	204
Total	0	0	0	5	5	0	171	103	0	274	16	0	9	0	25	33	211	0	0	244	548
08:00 AM	0	0	0	0	0	0	44	32	0	76	8	0	3	0	11	8	57	1	0	66	153
08:15 AM	0	0	1	1	2	0	44	30	0	74	10	0	4	0	14	13	57	0	0	70	160
08:30 AM	0	0	0	1	1	0	46	32	0	78	12	0	11	0	23	5	44	0	0	49	151
*** BREAK ***																					
Total	0	0	1	2	3	0	134	94	0	228	30	0	18	0	48	26	158	1	0	185	464
*** BREAK ***																					
04:15 PM	0	1	0	0	1	0	63	27	0	90	43	0	19	0	62	16	73	2	0	91	244
04:30 PM	0	0	0	0	0	2	58	22	0	82	36	0	17	0	53	12	72	0	0	84	219
04:45 PM	2	0	1	1	4	0	68	20	0	88	42	2	14	0	58	16	86	3	0	105	255
Total	2	1	1	1	5	2	189	69	0	260	121	2	50	0	173	44	231	5	0	280	718
05:00 PM	1	0	2	0	3	0	68	20	0	88	52	0	15	0	67	14	70	2	1	87	245
05:15 PM	2	0	2	0	4	2	61	21	0	84	30	1	13	0	44	6	85	1	0	92	224
05:30 PM	1	0	1	1	3	2	65	20	0	87	23	0	8	0	31	9	90	1	0	100	221
Grand Total	6	1	7	9	23	6	688	327	0	1021	272	3	113	0	388	132	845	10	1	988	2420
Apprch %	26.1	4.3	30.4	39.1		0.6	67.4	32	0		70.1	0.8	29.1	0		13.4	85.5	1	0.1		
Total %	0.2	0	0.3	0.4	1	0.2	28.4	13.5	0	42.2	11.2	0.1	4.7	0	16	5.5	34.9	0.4	0	40.8	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

34th Ave & Halifax Ave
Turning Movement
Robbinsdale, MN

File Name : 34th ave & halfax ave
Site Code : 00000007
Start Date : 11/30/2010

Groups Printed- Unshifted

	Halifax Ave From North					34th Ave From East					Halifax Ave From South					34th Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:15 AM	0	0	1	0	1	1	1	0	0	2	0	6	0	0	6	0	0	0	0	0	9
07:30 AM	0	3	5	0	8	0	1	0	0	1	2	2	0	0	4	0	0	0	0	0	13
07:45 AM	1	2	1	0	4	0	0	0	0	0	0	4	0	0	4	0	1	2	0	3	11
Total	1	5	7	0	13	1	2	0	0	3	2	12	0	0	14	0	1	2	0	3	33
08:00 AM	1	0	1	0	2	1	0	0	0	1	0	2	0	0	2	0	2	0	0	2	7
08:15 AM	1	0	0	0	1	0	0	1	0	1	0	7	0	0	7	0	0	0	0	0	9
08:30 AM	0	2	0	0	2	0	0	0	0	0	0	3	0	0	3	0	1	0	0	1	6
Total	2	2	1	0	5	1	0	1	0	2	0	12	0	0	12	0	3	0	0	3	22
04:15 PM	1	3	1	0	5	0	1	1	0	2	0	1	0	0	1	0	1	0	0	1	9
04:30 PM	1	3	1	0	5	2	0	1	0	3	0	2	0	0	2	0	2	1	0	3	13
04:45 PM	1	5	3	0	9	1	1	4	0	6	1	0	0	0	1	0	0	0	0	0	16
Total	3	11	5	0	19	3	2	6	0	11	1	3	0	0	4	0	3	1	0	4	38
05:00 PM	3	4	0	0	7	1	0	1	0	2	1	4	0	0	5	0	0	1	0	1	15
05:15 PM	1	4	1	0	6	1	1	0	0	2	2	3	0	0	5	0	1	0	0	1	14
05:30 PM	1	2	1	0	4	2	3	0	0	5	1	2	0	0	3	0	1	0	0	1	13
Grand Total	11	28	15	0	54	9	8	8	0	25	7	36	0	0	43	0	9	4	0	13	135
Apprch %	20.4	51.9	27.8	0		36	32	32	0		16.3	83.7	0	0		0	69.2	30.8	0		
Total %	8.1	20.7	11.1	0	40	6.7	5.9	5.9	0	18.5	5.2	26.7	0	0	31.9	0	6.7	3	0	9.6	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

34th Ave & Grimes Ave
Turning Movement
Robbinsdale, MN

File Name : 34th ave & grimes ave
Site Code : 00000006
Start Date : 12/1/2010
Page No : 1

Groups Printed- Unshifted

	Grimes Ave From North					34th Ave From East					Grimes Ave From South					34th Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:15 AM	0	1	0	0	1	2	0	1	0	3	1	1	0	0	2	0	8	1	0	9	15
07:30 AM	2	5	2	0	9	0	0	1	0	1	2	7	0	0	9	0	5	0	0	5	24
07:45 AM	0	2	0	0	2	1	1	0	0	2	1	1	0	0	2	0	5	0	0	5	11
Total	2	8	2	0	12	3	1	2	0	6	4	9	0	0	13	0	18	1	0	19	50
08:00 AM	0	5	0	0	5	0	0	0	0	0	1	4	0	0	5	0	1	0	0	1	11
08:15 AM	0	0	1	0	1	0	0	1	0	1	4	3	0	0	7	0	2	0	0	2	11
08:30 AM	0	6	0	0	6	1	0	1	0	2	3	6	1	0	10	0	3	0	0	3	21
Total	0	11	1	0	12	1	0	2	0	3	8	13	1	0	22	0	6	0	0	6	43
04:15 PM	0	7	2	0	9	0	3	2	0	5	5	4	0	0	9	0	0	1	0	1	24
04:30 PM	1	7	2	0	10	1	0	2	0	3	0	3	0	1	4	0	1	0	2	3	20
04:45 PM	1	2	0	1	4	0	1	0	0	1	1	7	0	2	10	1	0	1	3	5	20
Total	2	16	4	1	23	1	4	4	0	9	6	14	0	3	23	1	1	2	5	9	64
05:00 PM	1	4	1	0	6	0	5	5	0	10	0	3	0	0	3	0	1	0	0	1	20
05:15 PM	2	6	0	0	8	0	1	1	0	2	1	5	0	0	6	0	2	1	0	3	19
05:30 PM	0	4	2	0	6	2	6	0	0	8	0	5	0	5	10	0	2	0	2	4	28
Grand Total	7	49	10	1	67	7	17	14	0	38	19	49	1	8	77	1	30	4	7	42	224
Apprch %	10.4	73.1	14.9	1.5		18.4	44.7	36.8	0		24.7	63.6	1.3	10.4		2.4	71.4	9.5	16.7		
Total %	3.1	21.9	4.5	0.4	29.9	3.1	7.6	6.2	0	17	8.5	21.9	0.4	3.6	34.4	0.4	13.4	1.8	3.1	18.8	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

34th Ave & France Ave
Turning Movement
Robbinsdale, MN

File Name : 34th ave & france ave
Site Code : 00000005
Start Date : 12/2/2010
Page No : 1

Groups Printed- Unshifted

	France Ave From North					34th Ave From East					France Ave From South					34th Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:15 AM	3	6	43	1	53	27	1	2	0	30	1	10	0	0	11	1	2	3	0	6	100
07:30 AM	1	6	43	5	55	47	0	1	2	50	3	11	0	2	16	0	6	5	3	14	135
07:45 AM	1	6	60	0	67	41	0	1	1	43	3	16	0	1	20	0	6	2	0	8	138
Total	5	18	146	6	175	115	1	4	3	123	7	37	0	3	47	1	14	10	3	28	373
08:00 AM	0	5	45	1	51	36	0	3	2	41	0	14	0	1	15	0	4	1	0	5	112
08:15 AM	1	12	33	0	46	22	2	0	0	24	3	9	0	0	12	0	2	1	0	3	85
08:30 AM	0	7	41	0	48	27	0	2	0	29	1	11	0	0	12	0	3	1	0	4	93
Total	1	24	119	1	145	85	2	5	2	94	4	34	0	1	39	0	9	3	0	12	290
04:15 PM	3	19	44	0	66	60	3	1	2	66	0	18	0	0	18	0	2	3	0	5	155
04:30 PM	3	7	37	1	48	68	2	2	5	77	3	18	0	4	25	0	2	4	2	8	158
04:45 PM	4	23	41	3	71	60	2	3	4	69	0	12	0	0	12	1	0	1	3	5	157
Total	10	49	122	4	185	188	7	6	11	212	3	48	0	4	55	1	4	8	5	18	470
05:00 PM	1	14	47	0	62	61	4	0	2	67	0	10	0	2	12	1	1	1	0	3	144
05:15 PM	4	11	47	0	62	64	4	0	2	70	2	15	0	0	17	0	3	0	0	3	152
05:30 PM	2	14	39	1	56	60	2	2	2	66	3	13	0	2	18	0	2	4	1	7	147
Grand Total	23	130	520	12	685	573	20	17	22	632	19	157	0	12	188	3	33	26	9	71	1576
Apprch %	3.4	19	75.9	1.8		90.7	3.2	2.7	3.5		10.1	83.5	0	6.4		4.2	46.5	36.6	12.7		
Total %	1.5	8.2	33	0.8	43.5	36.4	1.3	1.1	1.4	40.1	1.2	10	0	0.8	11.9	0.2	2.1	1.6	0.6	4.5	

Hennepin County

Public Works
Transportation Department
1600 Prairie Drive
Medina, Minnesota 55340-5421

File Name : 8033700
Site Code : 08033700
Start Date : 6/30/2009
Page No : 1

Groups Printed- Unshifted - Bank 1 - Bank 2

	CSAH 81 From North					36th Ave. N. From East					CSAH 81 From South					36th Ave. N. From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
06:00 AM	22	63	2	0	87	5	16	1	0	22	0	28	4	0	32	17	6	2	0	25	166
06:15 AM	29	96	1	0	126	7	10	1	0	18	0	16	3	0	19	21	0	7	0	28	191
06:30 AM	24	133	0	0	157	5	31	1	0	37	0	36	6	0	42	23	7	20	0	50	286
06:45 AM	13	153	1	0	167	4	16	0	1	21	0	32	10	0	42	25	4	6	0	35	265
Total	88	445	4	0	537	21	73	3	1	98	0	112	23	0	135	86	17	35	0	138	908
07:00 AM	28	86	2	0	116	5	27	0	0	32	0	45	5	0	50	31	9	5	0	45	243
07:15 AM	30	128	2	0	160	4	21	0	1	26	0	38	8	0	46	27	10	9	0	46	278
07:30 AM	52	147	2	0	201	8	37	1	0	46	0	73	14	0	87	25	7	12	0	44	378
07:45 AM	30	145	2	0	177	8	28	2	0	38	0	68	11	0	79	34	7	12	0	53	347
Total	140	506	8	0	654	25	113	3	1	142	0	224	38	0	262	117	33	38	0	188	1246
08:00 AM	36	139	4	0	179	3	19	0	0	22	1	62	13	0	76	34	10	17	0	61	338
08:15 AM	35	114	2	1	152	3	28	1	0	32	0	50	7	1	58	20	6	15	0	41	283
08:30 AM	16	102	2	0	120	4	23	0	0	27	2	58	17	0	77	18	10	19	0	47	271
08:45 AM	27	109	3	0	139	6	27	1	0	34	2	52	12	0	66	26	10	13	0	49	288
Total	114	464	11	1	590	16	97	2	0	115	5	222	49	1	277	98	36	64	0	198	1180
*** BREAK ***																					
11:00 AM	16	85	9	1	111	7	26	3	1	37	2	94	29	1	126	26	18	18	0	62	336
11:15 AM	16	88	3	0	107	11	20	2	0	33	2	94	22	0	118	20	17	28	0	65	323
11:30 AM	24	83	6	1	114	7	19	2	1	29	1	93	21	1	116	21	14	23	1	59	318
11:45 AM	19	81	6	0	106	14	23	1	0	38	2	107	23	0	132	17	25	27	0	69	345
Total	75	337	24	2	438	39	88	8	2	137	7	388	95	2	492	84	74	96	1	255	1322
12:00 PM	27	81	2	0	110	7	15	0	0	22	1	93	22	0	116	21	19	38	0	78	326
12:15 PM	27	89	5	0	121	10	19	0	0	29	2	83	27	0	112	28	21	37	0	86	348
12:30 PM	25	89	8	0	122	13	19	1	0	33	2	107	20	0	129	32	25	34	0	91	375
12:45 PM	38	118	7	0	163	2	14	1	0	17	0	88	12	0	100	26	23	24	0	73	353
Total	117	377	22	0	516	32	67	2	0	101	5	371	81	0	457	107	88	133	0	328	1402
*** BREAK ***																					
03:00 PM	29	89	6	0	124	7	22	3	1	33	1	147	24	0	172	29	34	50	0	113	442
03:15 PM	27	92	10	0	129	8	13	1	0	22	2	149	38	1	190	34	27	42	0	103	444
03:30 PM	27	102	11	0	140	6	23	0	0	29	0	177	34	0	211	35	33	49	1	118	498
03:45 PM	28	105	11	0	144	9	17	0	0	26	0	152	34	0	186	23	29	42	0	94	450
Total	111	388	38	0	537	30	75	4	1	110	3	625	130	1	759	121	123	183	1	428	1834
04:00 PM	27	101	9	0	137	7	12	0	0	19	2	156	39	5	202	43	31	48	2	124	482
04:15 PM	30	91	11	0	132	10	21	2	2	35	2	151	39	0	192	36	30	65	3	134	493
04:30 PM	26	99	12	0	137	9	20	2	0	31	4	172	38	0	214	21	48	46	0	115	497
04:45 PM	26	92	17	0	135	14	28	0	0	42	3	165	46	0	214	35	34	45	0	114	505
Total	109	383	49	0	541	40	81	4	2	127	11	644	162	5	822	135	143	204	5	487	1977
05:00 PM	25	98	10	1	134	12	37	1	1	51	1	172	56	0	229	32	52	61	0	145	559
05:15 PM	24	96	14	0	134	12	25	0	1	38	7	161	41	1	210	34	41	56	1	132	514
05:30 PM	27	77	20	0	124	8	21	0	5	34	1	158	63	0	222	27	49	41	0	117	497
05:45 PM	20	99	14	0	133	6	29	1	3	39	2	103	32	0	137	32	53	43	2	130	439
Total	96	370	58	1	525	38	112	2	10	162	11	594	192	1	798	125	195	201	3	524	2009
Grand Total	850	3270	214	4	4338	241	706	28	17	992	42	3180	770	10	4002	873	709	954	10	2546	11878
Apprch %	19.6	75.4	4.9	0.1		24.3	71.2	2.8	1.7		1	79.5	19.2	0.2		34.3	27.8	37.5	0.4		
Total %	7.2	27.5	1.8	0	36.5	2	5.9	0.2	0.1	8.4	0.4	26.8	6.5	0.1	33.7	7.3	6	8	0.1	21.4	
Unshifted	830	3172	210	4	4216	237	696	23	17	973	38	3087	747	10	3882	835	695	928	10	2468	11539
% Unshifted	97.6	97	98.1	100	97.2	98.3	98.6	82.1	100	98.1	90.5	97.1	97	100	97	95.6	98	97.3	100	96.9	97.1
Bank 1	20	88	4	0	112	4	9	5	0	18	4	87	20	0	111	34	14	22	0	70	311
% Bank 1	2.4	2.7	1.9	0	2.6	1.7	1.3	17.9	0	1.8	9.5	2.7	2.6	0	2.8	3.9	2	2.3	0	2.7	2.6

Hennepin County
Public Works
Transportation Department
1600 Prairie Drive
Medina, Minnesota 55340-5421

File Name : 8033700
Site Code : 08033700
Start Date : 6/30/2009
Page No : 2

Groups Printed- Unshifted - Bank 1 - Bank 2

	CSAH 81 From North					36th Ave. N. From East					CSAH 81 From South					36th Ave. N. From West					
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
Bank 2	0	10	0	0	10	0	1	0	0	1	0	6	3	0	9	4	0	4	0	8	28
% Bank 2	0	0.3	0	0	0.2	0	0.1	0	0	0.1	0	0.2	0.4	0	0.2	0.5	0	0.4	0	0.3	0.2

Hennepin County

Public Works
Transportation Department
1600 Prairie Drive
Medina, Minnesota 55340-5421

File Name : 8004200-1
Site Code : 08004200
Start Date : 6/25/2009
Page No : 1

Groups Printed- Unshifted - Bank 1 - Bank 2

	CSAH 81 From North					Abbott Ave. From East					CSAH 81 From South					Abbott Ave. From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
06:00 AM	54	43	0	0	97	0	0	0	0	0	0	29	5	0	34	1	0	4	0	5	136
06:15 AM	60	55	0	0	115	0	0	0	0	0	0	23	3	0	26	2	0	9	0	11	152
06:30 AM	89	46	0	0	135	0	0	0	0	0	0	24	5	1	30	2	0	7	0	9	174
06:45 AM	99	77	0	0	176	0	0	0	0	0	0	20	1	0	21	2	0	9	0	11	208
Total	302	221	0	0	523	0	0	0	0	0	0	96	14	1	111	7	0	29	0	36	670
07:00 AM	76	86	0	0	162	0	0	0	0	0	0	25	9	0	34	4	0	16	0	20	216
07:15 AM	61	86	0	0	147	0	0	0	0	0	0	34	13	0	47	7	0	23	0	30	224
07:30 AM	69	125	0	5	199	0	0	0	0	0	0	44	8	0	52	2	0	27	0	29	280
07:45 AM	81	121	0	7	209	0	0	0	0	0	0	44	16	0	60	5	0	40	0	45	314
Total	287	418	0	12	717	0	0	0	0	0	0	147	46	0	193	18	0	106	0	124	1034
08:00 AM	60	134	0	1	195	0	0	0	0	0	0	48	13	0	61	5	0	28	0	33	289
08:15 AM	54	113	0	0	167	0	0	0	0	0	0	42	12	0	54	6	0	19	0	25	246
08:30 AM	42	99	0	4	145	0	0	0	0	0	0	51	7	0	58	7	0	13	0	20	223
08:45 AM	53	98	0	2	153	0	0	0	0	0	0	65	8	0	73	4	0	22	0	26	252
Total	209	444	0	7	660	0	0	0	0	0	0	206	40	0	246	22	0	82	0	104	1010
*** BREAK ***																					
11:00 AM	30	78	0	1	109	0	0	0	0	0	0	62	8	0	70	8	0	37	0	45	224
11:15 AM	26	72	0	3	101	0	0	0	0	0	0	61	3	0	64	13	0	43	0	56	221
11:30 AM	36	80	0	4	120	0	0	0	0	0	0	81	6	0	87	7	0	48	0	55	262
11:45 AM	36	78	0	0	114	0	0	0	0	0	0	71	13	0	84	7	0	37	0	44	242
Total	128	308	0	8	444	0	0	0	0	0	0	275	30	0	305	35	0	165	0	200	949
12:00 PM	38	79	0	2	119	0	0	0	1	1	0	93	7	0	100	6	0	52	0	58	278
12:15 PM	35	95	0	0	130	0	0	0	2	2	0	95	8	0	103	7	0	34	1	42	277
12:30 PM	47	90	0	2	139	0	0	0	0	0	0	79	10	0	89	9	0	38	0	47	275
12:45 PM	37	99	0	1	137	0	0	0	1	1	0	88	7	0	95	12	0	30	0	42	275
Total	157	363	0	5	525	0	0	0	4	4	0	355	32	0	387	34	0	154	1	189	1105
*** BREAK ***																					
03:00 PM	45	74	0	1	120	0	0	0	1	1	0	98	14	0	112	14	0	85	0	99	332
03:15 PM	48	92	0	4	144	0	0	0	0	0	0	104	12	0	116	13	0	65	0	78	338
03:30 PM	28	139	0	1	168	0	0	0	0	0	0	99	6	0	105	13	0	105	0	118	391
03:45 PM	35	119	0	0	154	0	0	0	0	0	0	113	12	0	125	11	0	55	0	66	345
Total	156	424	0	6	586	0	0	0	1	1	0	414	44	0	458	51	0	310	0	361	1406
04:00 PM	28	98	0	1	127	0	0	0	0	0	0	121	14	0	135	7	2	71	0	80	342
04:15 PM	30	104	0	4	138	0	0	0	0	0	0	144	8	0	152	7	0	62	0	69	359
04:30 PM	18	118	0	7	143	0	0	0	0	0	0	148	7	0	155	13	0	79	0	92	390
04:45 PM	24	111	0	2	137	0	0	0	0	0	0	141	14	0	155	13	0	55	0	68	360
Total	100	431	0	14	545	0	0	0	0	0	0	554	43	0	597	40	2	267	0	309	1451
05:00 PM	23	113	0	0	136	0	0	0	0	0	0	135	9	0	144	14	0	81	0	95	375
05:15 PM	23	126	0	0	149	0	0	0	1	1	0	139	12	0	151	11	0	52	0	63	364
05:30 PM	20	124	0	2	146	0	0	0	0	0	0	129	14	0	143	12	0	47	0	59	348
05:45 PM	25	115	0	2	142	0	0	0	2	2	0	109	11	0	120	9	0	22	0	31	295
Total	91	478	0	4	573	0	0	0	3	3	0	512	46	0	558	46	0	202	0	248	1382
Grand Total	1430	3087	0	56	4573	0	0	0	8	8	0	2559	295	1	2855	253	2	1315	1	1571	9007
Apprch %	31.3	67.5	0	1.2		0	0	0	100		0	89.6	10.3	0		16.1	0.1	83.7	0.1		
Total %	15.9	34.3	0	0.6	50.8	0	0	0	0.1	0.1	0	28.4	3.3	0	31.7	2.8	0	14.6	0	17.4	
Unshifted	1382	2968	0	56	4406	0	0	0	8	8	0	2478	283	1	2762	250	2	1298	1	1551	8727
% Unshifted	96.6	96.1	0	100	96.3	0	0	0	100	100	0	96.8	95.9	100	96.7	98.8	100	98.7	100	98.7	96.9
Bank 1	47	107	0	0	154	0	0	0	0	0	0	70	12	0	82	3	0	16	0	19	255
% Bank 1	3.3	3.5	0	0	3.4	0	0	0	0	0	0	2.7	4.1	0	2.9	1.2	0	1.2	0	1.2	2.8

Hennepin County

Public Works
Transportation Department
1600 Prairie Drive
Medina, Minnesota 55340-5421

File Name : 8004200-1
Site Code : 08004200
Start Date : 6/25/2009
Page No : 2

Groups Printed- Unshifted - Bank 1 - Bank 2

	CSAH 81 From North					Abbott Ave. From East					CSAH 81 From South					Abbott Ave. From West					
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
Bank 2	1	12	0	0	13	0	0	0	0	0	0	11	0	0	11	0	0	1	0	1	25
% Bank 2	0.1	0.4	0	0	0.3	0	0	0	0	0	0	0.4	0	0	0.4	0	0	0.1	0	0.1	0.3

Appendix D

Tube Counts

(Taken by WSB)

36th Ave Study - Robbinsdale
Two-way Daily Traffic Counts

Indicates AM Peak Hour
Indicates PM Peak Hour

	Halifax Ave (South of 36th Ave)	Grimes Ave (South of 36th Ave)	Terrace Mall Driveway To France Ave (Between 35th and 36th Aves)	Terrace Mall Driveway To France Ave (At 35th Ave)	W Broadway Ave (North of Abbott Ave)
AM MAX	**55**	**47**	**55**	**192**	**112**
PM MAX	**80**	**70**	**58**	**157**	**146**
00:00 TO 01:00	7	10	0	5	5
00:15 TO 01:15	6	10	0	5	5
00:30 TO 01:30	6	9	0	4	6
00:45 TO 01:45	8	9	0	3	5
01:00 TO 02:00	8	8	0	2	5
01:15 TO 02:15	8	7	0	2	5
01:30 TO 02:30	7	5	0	2	4
01:45 TO 02:45	6	4	0	2	4
02:00 TO 03:00	6	3	0	1	4
02:15 TO 03:15	6	2	0	1	3
02:30 TO 03:30	6	3	0	2	3
02:45 TO 03:45	5	4	0	1	3
03:00 TO 04:00	5	5	1	1	2
03:15 TO 04:15	5	5	1	3	2
03:30 TO 04:30	6	6	1	6	3
03:45 TO 04:45	6	5	1	8	7
04:00 TO 05:00	7	4	0	8	11
04:15 TO 05:15	6	4	0	12	15
04:30 TO 05:30	6	3	0	12	22
04:45 TO 05:45	9	4	0	19	25
05:00 TO 06:00	14	5	0	26	31
05:15 TO 06:15	15	6	0	50	33
05:30 TO 06:30	23	8	1	67	34
05:45 TO 06:45	31	8	4	82	42
06:00 TO 07:00	39	12	5	99	48
06:15 TO 07:15	46	14	9	102	58
06:30 TO 07:30	44	16	13	110	68
06:45 TO 07:45	44	23	14	129	74
07:00 TO 08:00	48	25	18	163	81
07:15 TO 08:15	54	28	25	192	84
07:30 TO 08:30	55	30	29	190	85
07:45 TO 08:45	52	29	30	172	89
08:00 TO 09:00	45	32	30	144	82
08:15 TO 09:15	39	33	29	100	81
08:30 TO 09:30	37	35	38	95	83
08:45 TO 09:45	36	36	42	100	81
09:00 TO 10:00	33	38	45	101	87
09:15 TO 10:15	33	36	49	102	94
09:30 TO 10:30	31	37	40	104	90
09:45 TO 10:45	32	39	44	101	93
10:00 TO 11:00	31	41	48	88	95
10:15 TO 11:15	28	45	46	88	93
10:30 TO 11:30	35	47	50	99	102
10:45 TO 11:45	36	47	49	103	102
11:00 TO 12:00	38	43	55	122	107
11:15 TO 12:15	41	42	53	130	112
11:30 TO 12:30	37	43	55	120	113
11:45 TO 12:45	36	43	58	117	119
12:00 TO 13:00	38	42	46	103	120
12:15 TO 13:15	37	48	48	99	123
12:30 TO 13:30	44	47	52	88	122
12:45 TO 13:45	42	51	46	82	116
13:00 TO 14:00	41	54	52	69	115
13:15 TO 14:15	47	59	54	64	114
13:30 TO 14:30	44	59	42	74	115
13:45 TO 14:45	50	55	43	115	122
14:00 TO 15:00	59	56	41	125	127
14:15 TO 15:15	59	47	34	143	131
14:30 TO 15:30	62	46	43	143	132
14:45 TO 15:45	66	47	42	122	125
15:00 TO 16:00	63	46	43	145	126
15:15 TO 16:15	62	47	40	141	131
15:30 TO 16:30	66	50	27	157	134
15:45 TO 16:45	63	53	25	147	146
16:00 TO 17:00	59	55	18	128	146
16:15 TO 17:15	65	58	22	139	144
16:30 TO 17:30	60	56	25	122	143
16:45 TO 17:45	70	53	26	106	131

17:00 TO 18:00	78	54	30	95	119
17:15 TO 18:15	80	54	25	65	108
17:30 TO 18:30	78	57	23	52	103
17:45 TO 18:45	68	66	18	42	99
18:00 TO 19:00	63	70	16	39	94
18:15 TO 19:15	57	66	15	32	87
18:30 TO 19:30	61	62	15	26	80
18:45 TO 19:45	61	55	13	23	73
19:00 TO 20:00	55	49	8	24	68
19:15 TO 20:15	49	49	9	28	63
19:30 TO 20:30	42	49	11	30	55
19:45 TO 20:45	35	41	12	31	50
20:00 TO 21:00	32	37	14	24	46
20:15 TO 21:15	29	38	12	18	42
20:30 TO 21:30	32	37	9	14	33
20:45 TO 21:45	34	38	9	10	29
21:00 TO 22:00	35	37	8	13	24
21:15 TO 22:15	38	31	11	16	18
21:30 TO 22:30	38	29	9	17	17
21:45 TO 22:45	34	27	7	18	13
22:00 TO 23:00	31	26	5	12	13
22:15 TO 23:15	29	29	2	7	13
22:30 TO 23:30	20	24	1	6	12
22:45 TO 23:45	20	25	1	5	11
23:00 TO 24:00	19	22	1	4	10

Appendix E

Detailed LOS Conditions and Queue Lengths

VISSIM Simulation Summary
Date: Friday, February 04, 2011
No Build (AM Peak Hour)

Intersection		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Appr	Average & Maximum Traffic Queuing (feet)					
Control	Location													Left Turn		Through		Right Turn	
			L	T	R	L	T	R	Delay	LOS	Delay	LOS		Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Unsignalized	**Halifax Avenue &**	NB	9	0	8	A	A	A	9	A			NB						
	36th Avenue	WB	4	0	0	A	A	A	0	A	1	A	WB						
		SB	6	11	6	A	B	A	7	A			SB						
		EB	4	0	1	A	A	A	0	A			EB						
Unsignalized	**Grimes Avenue &**	NB	7	3	5	A	A	A	6	A			NB						
	36th Avenue	WB	2	0	0	A	A	A	0	A	1	A	WB						
		SB	7	11	5	A	B	A	6	A			SB						
		EB	3	1	1	A	A	A	1	A			EB						
Signalized	**France Avenue &**	NB	12	8	4	B	A	A	10	A			NB	6	92	6	92	6	92
	36th Avenue	WB	12	6	3	B	A	A	7	A	7	A	WB	4	63	4	63	4	63
		SB	12	8	5	B	A	A	9	A			SB	3	59	3	59	3	59
		EB	8	7	5	A	A	A	6	A			EB	8	124	8	124	8	124
Unsignalized	**W. Broadway Frontage Rd &**	NB	8	0	7	A	A	A	7	A			NB						
	36th Avenue	WB	3	0	0	A	A	A	1	A	1	A	WB		81		81		81
		SB	0	0	0	A	A	A	0	A			SB						
		EB	1	0	3	A	A	A	0	A			EB		5		5		5
Signalized	**CSAH 81 &**	NB	28	15	3	C	B	A	17	B			NB	6	88	11	120		
	36th Avenue	WB	23	20	5	C	C	A	18	B	16	B	WB	8	81	11	83	8	83
		SB	20	20	6	C	C	A	16	B			SB	1	30	33	204		12
		EB	24	17	6	C	B	A	13	B			EB	10	80	10	82	4	82
Signalized	**CSAH 81 &**	NB	23	0		C	A		5	A			NB	4	61	4	60		
	Abbott Avenue	WB									11	B	WB						
		SB		12	11		B	B	12	B			SB			13	172	12	172
		EB	17		7	B		A	16	B			EB	7	60			6	60
Unsignalized	**Halifax Avenue &**	NB	0	6	2	A	A	A	6	A			NB						
	34th Avenue	WB	0	0	0	A	A	A	0	A	4	A	WB						
		SB	5	6	4	A	A	A	5	A			SB		16		16		16
		EB	0	0	0	A	A	A	0	A			EB						
Unsignalized	**Grimes Avenue &**	NB	0	7	4	A	A	A	6	A			NB		20		20		20
	34th Avenue	WB	0	0	0	A	A	A	0	A	5	A	WB						
		SB	6	7	4	A	A	A	6	A			SB		17		17		17
		EB	0	0	0	A	A	A	0	A			EB						
Unsignalized	**France Avenue &**	NB	0	9	6	A	A	A	9	A			NB	3	87	4	89	2	66
	34th Avenue	WB	7	8	8	A	A	A	8	A	8	A	WB	8	102	10	114	11	109
		SB	8	10	10	A	B	B	8	A			SB	5	71	5	71	5	71
		EB	7	7	0	A	A	A	7	A			EB	1	33	1	33		30
Unsignalized	**France Avenue &**	NB		0	0		A	A	0	A			NB						
	Terrace Mall Access	WB	9		5	A		A	6	A	0	A	WB		12				12
		SB	1	0		A	A		0	A			SB		5		5		
		EB											EB						
Unsignalized	**France Avenue &**	NB	1	0	1	A	A	A	0	A			NB						
	35th Avenue	WB	8	6	6	A	A	A	6	A	1	A	WB		50		50		50
		SB	1	0	0	A	A	A	0	A			SB		17		17		17
		EB	6	12	5	A	B	A	7	A			EB		7		7		7

Source: WSB & Associates
K:\01484-05\Traffic\[LOS Results.xls]2010AM

VISSIM Simulation Summary
Date: Friday, February 04, 2011
No Build (PM Peak Hour)

Intersection: Control	Intersection: Location	Appr	Total Delay by Movement (Sec/Veh): L	T	R	Level of Service by Movement: L	T	R	LOS by Approach (Sec/Veh): Delay	LOS	LOS by Intersection (Sec/Veh): Delay	LOS	Appr	Left Turn: Ave Queue	Left Turn: Max Queue	Through: Ave Queue	Through: Max Queue	Right Turn: Ave Queue	Right Turn: Max Queue
Unsignalized	Halifax Avenue & 36th Avenue	NB	10	0	6	B	A	A	9	A	1	A	NB						
		WB	3	0	1	A	A	A	0	A			WB						
		SB	3	0	7	A	A	A	7	A			SB						
		EB	4	1	1	A	A	A	1	A			EB						
Unsignalized	Grimes Avenue & 36th Avenue	NB	7	6	6	A	A	A	7	A	1	A	NB						
		WB	1	0	1	A	A	A	0	A			WB						
		SB	8	10	6	A	B	A	8	A			SB						
		EB	4	1	1	A	A	A	1	A			EB						
Signalized	France Avenue & 36th Avenue	NB	12	8	5	B	A	A	10	B	8	A	NB	11	119	11	120	11	119
		WB	11	7	4	B	A	A	7	A			WB	6	80	6	80	6	80
		SB	12	8	5	B	A	A	8	A			SB	3	60	3	60	3	60
		EB	11	8	5	B	A	A	7	A			EB	10	97	10	97	10	97
Unsignalized	W. Broadway Frontage Rd & 36th Avenue	NB	9	9	10	A	A	B	10	A	3	A	NB						
		WB	3	1	0	A	A	A	2	A			WB		60		60		60
		SB	5	0	4	A	A	A	4	A			SB						
		EB	2	1	3	A	A	A	1	A			EB		9		9		9
Signalized	CSAH 81 & 36th Avenue	NB	41	10	5	D	B	A	15	B	23	C	NB	30	209	19	205		24
		WB	47	42	9	D	D	A	32	C			WB	14	80	18	82	14	82
		SB	54	21	5	D	C	A	22	C			SB	14	115	25	162		
		EB	52	33	6	D	C	A	34	C			EB	51	243	52	245	42	245
Signalized	CSAH 81 & Abbott Avenue	NB	48	2		D	A		5	A	14	B	NB	10	77	10	76		
		WB											WB						
		SB		7	6		A	A	7	A			SB			8	92	8	92
		EB	45		8	D		A	40	D			EB	43	179			43	179
Unsignalized	Halifax Avenue & 34th Avenue	NB	0	6	4	A	A	A	5	A	4	A	NB						
		WB	0	0	0	A	A	A	0	A			WB						
		SB	5	7	4	A	A	A	6	A			SB		20		20		20
		EB	0	0	0	A	A	A	0	A			EB						
Unsignalized	Grimes Avenue & 34th Avenue	NB	0	7	4	A	A	A	7	A	4	A	NB		16		16		16
		WB	0	0	0	A	A	A	0	A			WB						
		SB	6	7	4	A	A	A	7	A			SB		26		26		26
		EB	1	0	0	A	A	A	0	A			EB						
Unsignalized	France Avenue & 34th Avenue	NB	0	9	7	A	A	A	9	A	10	B	NB	3	92	4	90	2	67
		WB	10	13	10	B	B	B	10	B			WB	17	145	22	156	22	151
		SB	9	10	8	A	B	A	9	A			SB	6	96	6	96	6	96
		EB	8	7	6	A	A	A	7	A			EB		30		30		27
Unsignalized	France Avenue & Terrace Mall Access	NB		0	0		A	A	0	A	0	A	NB						
		WB	6		6	A		A	6	A			WB		39				39
		SB	1	0		A	A		0	A			SB						
		EB											EB						
Unsignalized	France Avenue & 35th Avenue	NB	1	0	1	A	A	A	0	A	2	A	NB						
		WB	9	7	6	A	A	A	8	A			WB		44		44		44
		SB	2	0	1	A	A	A	0	A			SB		18		18		18
		EB	9	10	6	A	B	A	8	A			EB		49		49		49

Source: WSB & Associates
K:\01484-05\Traffic\[LOS Results.xls]2010PM

VISSIM Simulation Summary
Date: Monday, February 07, 2011
LRT: 36th Ave Alignment (AM Peak Hour)

*Average LRT Travel Time**
Northbound **156** *seconds*
Southbound **157** *seconds*

Control	Location	Appr	Total Delay by Movement (Sec/Veh) L	T	R	Level of Service by Movement L	T	R	LOS by Approach (Sec/Veh) Delay	LOS	LOS by Intersection (Sec/Veh) Delay	LOS	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Unsignalized	Halifax Avenue & 36th Avenue	NB											NB						
		WB		0	0		A	A	0	A	0	A	WB						
		SB	9		6	A		A	7	A			SB						
		EB	5	0		A	A		0	A			EB						
Unsignalized	Grimes Avenue & 36th Avenue	NB											NB						
		WB		0	1		A	A	0	A	1	A	WB						
		SB	8		5	A		A	6	A			SB						
		EB	3	1		A	A		1	A			EB						
Signalized	France Avenue & 36th Avenue	NB	21	18	20	C	B	C	20	C			NB	42	202	42	202	42	202
		WB	28	5	5	C	A	A	9	A	12	B	WB	8	96	8	96	8	96
		SB	18	17	9	B	B	A	17	B			SB	8	87	7	84	8	86
		EB	8	8	7	A	A	A	7	A			EB	12	147	13	146	13	147
Unsignalized	W. Broadway Frontage Rd & 36th Avenue	NB											NB						
		WB		0	0		A	A	0	A	0	A	WB				84		84
		SB	0		0	A		A	0	A			SB						
		EB	1	0		A	A		0	A			EB						
Signalized	CSAH 81 & 36th Avenue	NB	53	6	3	D	A	A	11	B			NB	9	71	5	78		
		WB	43	35	6	D	D	A	35	C	16	B	WB	18	97	21	99	12	98
		SB	47	14	5	D	B	A	13	B			SB	2	37	20	179		11
		EB	41	31	8	D	C	A	20	B			EB	16	100	18	102	7	93
Signalized	CSAH 81 & Abbott Avenue	NB	45	2		D	A		5	A			NB	5	56	5	56		
		WB									9	A	WB						
		SB		3	7		A	A	4	A			SB			6	157	6	157
		EB	40		43	D		D	40	D			EB	40	129			31	131
Unsignalized	Halifax Avenue & 34th Avenue	NB	0	0	4	A	A	A	4	A			NB						
		WB	0	0	0	A	A	A	0	A	2	A	WB						
		SB	0	0	4	A	A	A	4	A			SB		6		6		6
		EB	0	0	0	A	A	A	0	A			EB						
Unsignalized	Grimes Avenue & 34th Avenue	NB	0	0	4	A	A	A	4	A			NB		16		16		16
		WB	0	0	0	A	A	A	0	A	2	A	WB						
		SB	5	0	4	A	A	A	5	A			SB		6		6		6
		EB	0	0	0	A	A	A	0	A			EB						
Unsignalized	France Avenue & 34th Avenue	NB	0	9	7	A	A	A	9	A			NB	3	95	4	92	2	69
		WB	10	8	8	B	A	A	8	A	9	A	WB	9	114	12	124	12	118
		SB	10	11	9	B	B	A	10	B			SB	7	129	7	129	7	129
		EB	8	8	0	A	A	A	8	A			EB	1	34	1	34	1	30
Unsignalized	France Avenue & Terrace Mall Access	NB		1	1		A	A	1	A			NB						
		WB	10		6	B		A	7	A	1	A	WB		27				27
		SB	2	1		A	A		1	A			SB		50		50		
		EB											EB						
Unsignalized	France Avenue & 35th Avenue	NB	2	0	1	A	A	A	0	A			NB		6		6		6
		WB	10	10	6	B	B	A	7	A	2	A	WB	1	63	1	63	1	63
		SB	2	1	1	A	A	A	1	A			SB		37		37		37
		EB	9	16	5	A	C	A	9	A			EB		36		36		36
Signalized	CSAH 81 & New Terrace Mall Access	NB	43	2		D	A		10	B			NB	16	118	15	117		
		WB									9	A	WB						
		SB		6	3		A	A	5	A			SB			14	200	13	200
		EB	45		42	D		D	43	D			EB	26	127			26	127

* Average LRT travel time was calculated from a point just north of 36th Avenue to just south of Abbott Avenue. The distance following the LRT alignment was approximately 4,645 feet. The travel time includes deceleration, dwell, and acceleration time associated with the North Memorial Station.

Source: WSB & Associates

K:\01484-05\Traffic\[LOS Results.xls]2030AM_LRT(36th)

VISSIM Simulation Summary
Date: Monday, February 07, 2011
LRT: 36th Ave Alignment (PM Peak Hour)

*Average LRT Travel Time**
Northbound **153** *seconds*
Southbound **149** *seconds*

Control	Intersection Location	Appr	Total Delay by Movement (Sec/Veh) L	T	R	Level of Service by Movement L	T	R	LOS by Approach (Sec/Veh) Delay	LOS	LOS by Intersection (Sec/Veh) Delay	LOS	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Unsignalized	Halifax Avenue & 36th Avenue	NB											NB						
		WB		0	0		A	A	0	A	0	A	WB						
		SB	3		8	A		A	8	A			SB						
		EB	4	0		A	A		0	A			EB						
Unsignalized	Grimes Avenue & 36th Avenue	NB											NB						
		WB		0	0		A	A	0	A	1	A	WB						
		SB	12		6	B		A	9	A			SB		3				3
		EB	6	1		A	A		1	A			EB						
Signalized	France Avenue & 36th Avenue	NB	26	20	20	C	C	C	24	C			NB	67	342	68	343	68	343
		WB	23	4	4	C	A	A	6	A	14	B	WB	5	90	5	91	5	90
		SB	22	16	7	C	B	A	15	B			SB	8	88	7	86	7	87
		EB	9	9	7	A	A	A	8	A			EB	14	166	15	165	15	166
Unsignalized	W. Broadway Frontage Rd & 36th Avenue	NB											NB						
		WB		0	0		A	A	0	A	0	A	WB				32		32
		SB	8		5	A		A	6	A			SB						
		EB	2	0		A	A		0	A			EB						
Signalized	CSAH 81 & 36th Avenue	NB	38	11	5	D	B	A	14	B			NB	23	184	23	185		46
		WB	50	37	7	D	D	A	31	C	19	B	WB	13	65	16	67	9	65
		SB	49	21	5	D	C	A	22	C			SB	12	102	23	143		
		EB	34	33	7	C	C	A	26	C			EB	27	123	28	125	20	125
Signalized	CSAH 81 & Abbott Avenue	NB	54	4		D	A		5	A			NB	7	113	7	112		
		WB									12	B	WB						
		SB		2	5		A	A	2	A			SB			3	104	3	104
		EB	40		41	D		D	40	D			EB	66	204			64	206
Unsignalized	Halifax Avenue & 34th Avenue	NB	0	0	4	A	A	A	4	A			NB						
		WB	0	0	0	A	A	A	0	A	1	A	WB						
		SB	0	0	4	A	A	A	4	A			SB		9		9		9
		EB	0	0	0	A	A	A	0	A			EB						
Unsignalized	Grimes Avenue & 34th Avenue	NB	0	0	4	A	A	A	4	A			NB		16		16		16
		WB	0	0	1	A	A	A	0	A	1	A	WB						
		SB	6	0	4	A	A	A	5	A			SB		9		9		9
		EB	1	0	0	A	A	A	0	A			EB						
Unsignalized	France Avenue & 34th Avenue	NB	0	9	6	A	A	A	9	A			NB	3	91	5	89	2	66
		WB	12	15	11	B	C	B	11	B	11	B	WB	19	150	25	163	25	157
		SB	12	14	10	B	B	B	12	B			SB	12	185	12	185	12	185
		EB	9	6	5	A	A	A	8	A			EB	1	30	1	30		27
Unsignalized	France Avenue & Terrace Mall Access	NB		1	1		A	A	1	A			NB				17		17
		WB	11		7	B		A	7	A	2	A	WB		48				48
		SB	3	1		A	A		1	A			SB		56		56		
		EB											EB						
Unsignalized	France Avenue & 35th Avenue	NB	3	1	1	A	A	A	1	A			NB		20		20		20
		WB	13	9	8	B	A	A	11	B	3	A	WB	1	61	1	61	1	61
		SB	2	1	1	A	A	A	1	A			SB		43		43		43
		EB	13	12	7	B	B	A	11	B			EB	1	66	1	66	1	66
Signalized	CSAH 81 & New Terrace Mall Access	NB	44	6		D	A		10	A			NB	27	167	27	166		
		WB									14	B	WB						
		SB		9	4		A	A	8	A			SB			13	162	10	162
		EB	42		39	D		D	41	D			EB	59	186			60	187

* Average LRT travel time was calculated from a point just north of 36th Avenue to just south of Abbott Avenue. The distance following the LRT alignment was approximately 4,645 feet. The travel time includes deceleration, dwell, and acceleration time associated with the North Memorial Station.

Source: WSB & Associates

K:\01484-05\Traffic\[LOS Results.xls]2030PM_LRT(36th)

VISSIM Simulation Summary
Date: Tuesday, February 08, 2011
LRT: 34th Ave Alignment (AM Peak Hour)

*Average LRT Travel Time**
Northbound **174** *seconds*
Southbound **170** *seconds*

Intersection: Control	Intersection: Location	Appr	Total Delay by Movement (Sec/Veh): L	T	R	Level of Service by Movement: L	T	R	LOS by Approach (Sec/Veh): Delay	LOS	LOS by Intersection (Sec/Veh): Delay	LOS	Appr	Left Turn: Ave Queue	Left Turn: Max Queue	Through: Ave Queue	Through: Max Queue	Right Turn: Ave Queue	Right Turn: Max Queue
Unsignalized	Halifax Avenue & 36th Avenue	NB	9	0	8	A	A	A	9	A			NB						
		WB	5	0	1	A	A	A	0	A	1	A	WB						
		SB	7	10	6	A	B	A	7	A			SB						
		EB	3	0	1	A	A	A	0	A			EB						
Unsignalized	Grimes Avenue & 36th Avenue	NB	7	2	7	A	A	A	7	A			NB						
		WB	3	0	0	A	A	A	0	A	1	A	WB						
		SB	7	9	5	A	A	A	6	A			SB						
		EB	3	1	1	A	A	A	1	A			EB						
Signalized	France Avenue & 36th Avenue	NB	12	8	4	B	A	A	10	A			NB	6	95	6	95	6	95
		WB	10	6	4	B	A	A	6	A	7	A	WB	4	75	4	75	4	75
		SB	10	8	4	B	A	A	8	A			SB	3	59	3	60	3	59
		EB	7	7	5	A	A	A	6	A			EB	8	116	8	116	8	116
Unsignalized	W. Broadway Frontage Rd & 36th Avenue	NB	8	0	5	A	A	A	6	A			NB		3		3		3
		WB	2	0	0	A	A	A	1	A	1	A	WB		87		87		87
		SB	0	0	0	A	A	A	0	A			SB						
		EB	0	0	3	A	A	A	0	A			EB		6		6		6
Signalized	CSAH 81 & 36th Avenue	NB	30	17	3	C	B	A	19	B			NB	7	74	12	122		
		WB	32	22	5	C	C	A	20	C	17	B	WB	9	95	12	95	8	95
		SB	24	22	7	C	C	A	18	B			SB	1	38	36	241		4
		EB	24	15	6	C	B	A	12	B			EB	9	68	10	70	4	70
Signalized	CSAH 81 & Abbott Avenue	NB	35	2		D	A		8	A			NB	8	84	7	84		
		WB									9	A	WB						
		SB		6	5		A	A	6	A			SB			7	148	6	148
		EB	33		7	C		A	30	C			EB	14	85			10	85
Unsignalized	Halifax Avenue & 34th Avenue	NB	0	0	0	A	A	A	0	A			NB						
		WB	3	4	2	A	A	A	3	A	0	A	WB						
		SB	0	0	0	A	A	A	0	A			SB						
		EB	0	0	0	A	A	A	0	A			EB						
Signalized	France Avenue & 34th Avenue	NB	17		5	B		A	14	B			NB	4	70			2	76
		WB	13		11	B		B	11	B	11	B	WB	8	118			8	118
		SB	11		8	B		A	11	B			SB	10	172			10	171
		EB											EB						
Unsignalized	France Avenue & Terrace Mall Access	NB		0	0		A	A	0	A			NB						
		WB	7		5	A		A	5	A	0	A	WB		7				7
		SB	1	0		A	A		0	A			SB		5		5		
		EB											EB						
Unsignalized	France Avenue & 35th Avenue	NB	1	1	1	A	A	A	1	A			NB						
		WB	9	10	6	A	B	A	7	A	2	A	WB		50		50		50
		SB	1	0	1	A	A	A	0	A			SB		33		33		33
		EB	8	9	5	A	A	A	6	A			EB						

* Average LRT travel time was calculated from a point just north of 36th Avenue to just south of Abbott Avenue. The distance following the LRT alignment was approximately 5,475 feet. The travel time includes deceleration, dwell, and acceleration time associated with the North Memorial Station.
Source: WSB & Associates
K:\01484-05\Traffic\[LOS Results.xls]2030AM_LRT(34th)

VISSIM Simulation Summary
Date: Tuesday, February 08, 2011
LRT: 34th Ave Alignment (PM Peak Hour)

*Average LRT Travel Time**
Northbound **173** *seconds*
Southbound **172** *seconds*

Control	Location	Appr	Total Delay by Movement (Sec/Veh) L	T	R	Level of Service by Movement L	T	R	LOS by Approach (Sec/Veh) Delay	LOS	LOS by Intersection (Sec/Veh) Delay	LOS	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Unsignalized	Halifax Avenue & 36th Avenue	NB	11	0	7	B	A	A	10	B			NB						
		WB	7	0	1	A	A	A	0	A	1	A	WB						
		SB	8	0	6	A	A	A	6	A			SB						
		EB	5	1	1	A	A	A	1	A			EB						
Unsignalized	Grimes Avenue & 36th Avenue	NB	9	5	6	A	A	A	8	A			NB						
		WB	2	0	1	A	A	A	0	A	1	A	WB						
		SB	7	11	6	A	B	A	8	A			SB						
		EB	3	1	1	A	A	A	1	A			EB						
Signalized	France Avenue & 36th Avenue	NB	13	9	6	B	A	A	11	B			NB	13	190	13	190	13	190
		WB	13	8	5	B	A	A	8	A	9	A	WB	7	95	7	95	7	95
		SB	11	8	5	B	A	A	8	A			SB	3	59	3	59	3	59
		EB	10	8	6	B	A	A	8	A			EB	11	107	11	107	11	107
Unsignalized	W. Broadway Frontage Rd & 36th Avenue	NB	9	8	7	A	A	A	8	A			NB		33		33		33
		WB	2	0	0	A	A	A	1	A	3	A	WB		84		84		84
		SB	7	0	4	A	A	A	5	A			SB						
		EB	1	1	3	A	A	A	1	A			EB						
Signalized	CSAH 81 & 36th Avenue	NB	34	11	5	C	B	A	15	B			NB	24	204	19	194		17
		WB	51	37	9	D	D	A	29	C	21	C	WB	11	74	15	74	10	74
		SB	48	20	5	D	C	A	20	C			SB	13	101	24	126		
		EB	41	27	5	D	C	A	28	C			EB	41	249	42	251	31	251
Signalized	CSAH 81 & Abbott Avenue	NB	42	4		D	A		7	A			NB	12	103	12	104		
		WB									16	B	WB						
		SB		18	4		B	A	16	B			SB			21	177	20	176
		EB	39		8	D		A	34	C			EB	37	154			34	154
Unsignalized	Halifax Avenue & 34th Avenue	NB	0	0	0	A	A	A	0	A			NB						
		WB	5	0	1	A	A	A	5	A	1	A	WB						
		SB	0	0	0	A	A	A	0	A			SB						
		EB	6	7	3	A	A	A	6	A			EB						
Signalized	France Avenue & 34th Avenue	NB	18		8	B		A	17	B			NB	5	83			3	88
		WB	14		10	B		B	10	B	11	B	WB	13	188			13	188
		SB	10		10	B		B	10	B			SB	11	186			11	186
		EB											EB						
Unsignalized	France Avenue & Terrace Mall Access	NB		1	0		A	A	1	A			NB						
		WB	8		7	A		A	7	A	1	A	WB		28				28
		SB	2	0		A	A		0	A			SB		6		6		
		EB											EB						
Unsignalized	France Avenue & 35th Avenue	NB	2	1	1	A	A	A	1	A			NB		22		22		22
		WB	10	7	7	B	A	A	9	A	2	A	WB	1	60	1	60	1	60
		SB	2	0	0	A	A	A	0	A			SB		36		36		36
		EB	9	10	6	A	B	A	8	A			EB		44		44		44

* Average LRT travel time was calculated from a point just north of 36th Avenue to just south of Abbott Avenue. The distance following the LRT alignment was approximately 5,475 feet. The travel time includes deceleration, dwell, and acceleration time associated with the North Memorial Station.

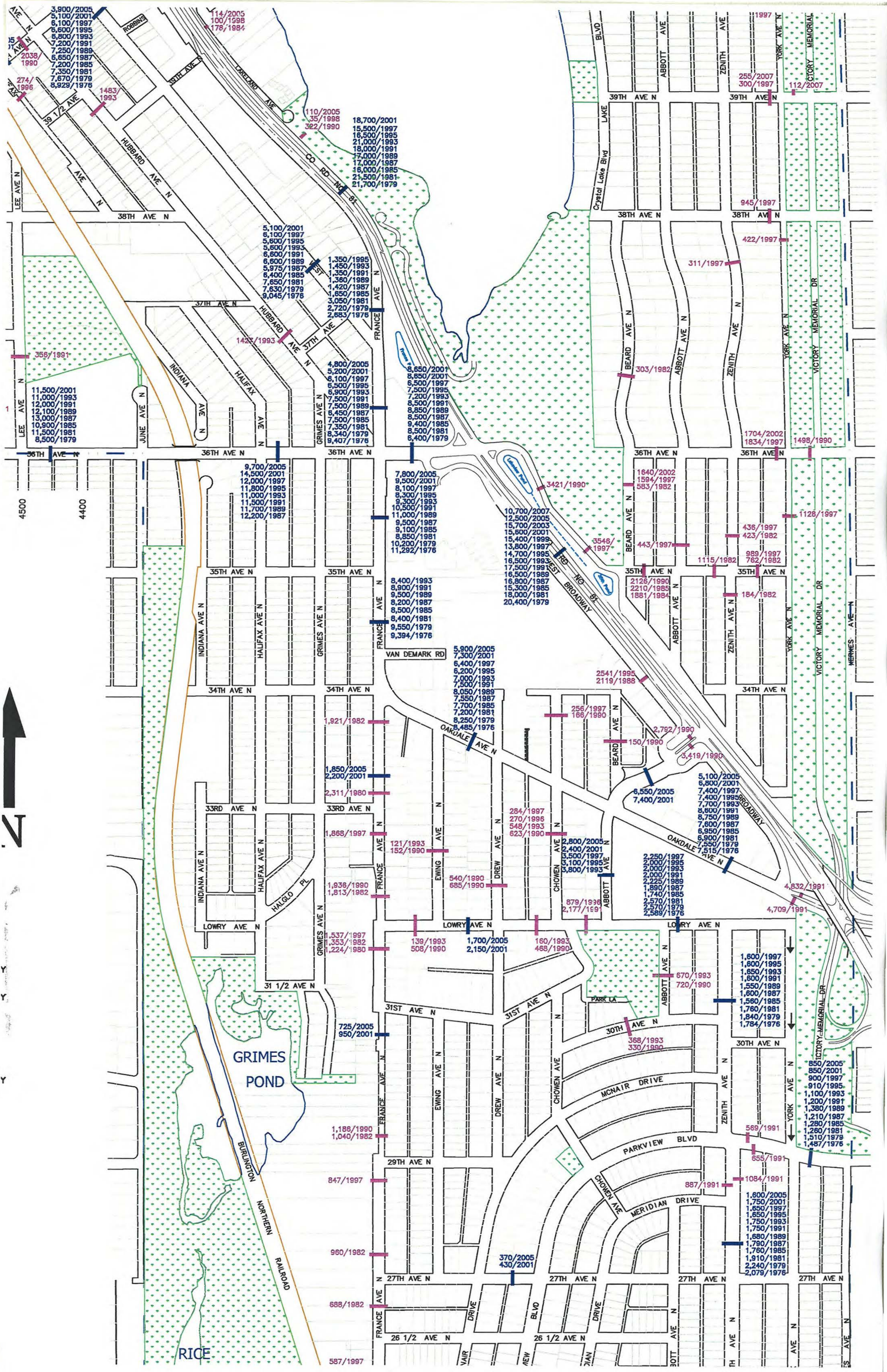
Source: WSB & Associates

K:\01484-05\Traffic\[LOS Results.xls]2030PM_LRT(34th)

Appendix F

Historical Traffic Counts

(Two-way tube counts provided by Hennepin County)



ROBBINS
39TH AVE N
39 1/2 AVE
LAKELAND AVE
HUBBARD AVE N
LEE AVE N
38TH AVE N
CO RD NO 81
WEST BROADWAY
37TH AVE N
37TH AVE
HUBBARD AVE N
FRANCE AVE
INDIANA AVE
HALIFAX AVE
GRIMES AVE N
JUNE AVE N
LEE AVE
36TH AVE N
35TH AVE N
34TH AVE N
VAN DEMARK RD
OAKDALE AVE N
33RD AVE N
HALGLO PL
LOWRY AVE N
31 1/2 AVE N
31ST AVE N
29TH AVE N
27TH AVE N
26 1/2 AVE N
EWING AVE N
DREW AVE
CHOWEN AVE
BEARD AVE
ABBOTT AVE
ZENITH AVE N
YORK AVE N
VICTORY MEMORIAL DR
XERXES AVE N
LAKE BLVD
Crystal Lake Blvd
PARK LA
30TH AVE N
MCNAIR DRIVE
PARKVIEW BLVD
MERIDIAN DRIVE
BURLINGTON NORTHERN RAILROAD
GRIMES POND
RICE
4500
4400
N
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5,100/2001
6,100/1997
6,600/1995
6,800/1993
7,200/1991
7,250/1989
6,650/1987
7,200/1985
7,350/1981
7,670/1979
8,929/1976
114/2005
100/1998
178/1984
2038/1990
274/1996
1483/1993
110/2005
35/1998
322/1990
18,700/2001
15,500/1997
16,500/1995
21,000/1993
18,000/1991
17,000/1989
17,000/1987
16,000/1985
21,500/1981
21,700/1979
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112/2007
945/1997
422/1997
311/1997
5,100/2001
6,100/1997
5,600/1995
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12,200/1987
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1126/1997
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15,400/1999
13,800/1997
14,700/1995
16,500/1993
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762/1982
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6,200/1995
7,000/1993
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8,485/1976
2541/1995
2119/1988
256/1997
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150/1990
3,419/1990
1,850/2005
2,200/2001
2,311/1980
6,550/2005
7,400/2001
5,100/2005
6,800/2001
7,400/1997
7,400/1995
7,700/1993
8,600/1991
8,750/1989
7,600/1987
6,950/1985
6,900/1981
7,550/1979
7,515/1976
284/1997
270/1995
548/1993
623/1990
1,868/1997
121/1993
152/1990
2,800/2005
2,400/2001
3,500/1997
3,100/1995
3,800/1993
2,250/1997
2,000/1995
2,000/1993
2,000/1991
2,225/1989
1,890/1987
1,740/1985
2,570/1981
2,570/1979
2,589/1976
540/1990
685/1990
1,936/1990
1,813/1982
879/1996
2,177/1991
4,832/1991
4,709/1991
1,537/1997
1,353/1982
1,224/1980
139/1993
508/1990
1,700/2005
2,150/2001
160/1993
468/1990
670/1993
720/1990
1,600/1997
1,600/1995
1,650/1993
1,600/1991
1,550/1989
1,600/1987
1,560/1985
1,760/1981
1,840/1979
1,784/1976
725/2005
950/2001
368/1993
330/1990
850/2005
850/2001
900/1997
910/1995
1,100/1993
1,200/1991
1,380/1989
1,210/1987
1,280/1985
1,280/1981
1,510/1979
1,437/1976
1,186/1990
1,040/1982
569/1991
655/1991
847/1997
887/1991
1084/1991
1,600/2005
1,750/2001
1,650/1997
1,650/1995
1,750/1993
1,750/1991
1,680/1989
1,790/1987
1,760/1985
1,910/1981
2,240/1979
2,079/1976
960/1982
370/2005
430/2001
688/1982
587/1997

Appendix G

Sensitivity Analysis Results

(Revised Forecasts: Annual growth rate of one percent)

VISSIM Simulation Summary
Date: Monday, February 07, 2011
LRT: 36th Ave Alignment (AM Peak Hour with 1% annual background growth)

*Average LRT Travel Time**		
Northbound	**156**	*seconds*
Southbound	**157**	*seconds*

Intersection			Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)			Average & Maximum Traffic Queuing (feet)					
Control	Location	Appr	L	T	R	L	T	R	Delay	LOS	Delay	LOS	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Unsignalized	Halifax Avenue & 36th Avenue	NB									1	A	NB						
		WB		0	0		A	A	0	A			WB						
		SB	11		8	B		A	10	A			SB						
		EB	4	1		A	A		1	A			EB						
Unsignalized	Grimes Avenue & 36th Avenue	NB									1	A	NB						
		WB		0	1		A	A	0	A			WB						
		SB	11		6	B		A	8	A			SB						
		EB	5	2		A	A		2	A			EB						
Signalized	France Avenue & 36th Avenue	NB	24	19	19	C	B	B	22	C	13	B	NB	54	244	54	245	54	245
		WB	31	6	5	C	A	A	10	B			WB	11	112	11	113	11	112
		SB	20	17	7	C	B	A	17	B			SB	10	97	9	94	10	96
		EB	9	8	9	A	A	A	9	A			EB	18	233	19	232	20	233
Unsignalized	W. Broadway Frontage Rd & 36th Avenue	NB									0	A	NB						
		WB		0	0		A	A	0	A			WB				80		80
		SB	9		0	A		A	9	A			SB						
		EB	1	0		A	A		0	A			EB						
Signalized	CSAH 81 & 36th Avenue	NB	54	8	4	D	A	A	14	B	19	B	NB	12	93	7	85		
		WB	42	33	7	D	C	A	33	C			WB	22	118	24	119	15	102
		SB	47	18	6	D	B	A	17	B			SB	4	64	30	239		
		EB	41	31	10	D	C	B	22	C			EB	20	100	22	103	12	103
Signalized	CSAH 81 & Abbott Avenue	NB	48	2		D	A		6	A	10	B	NB	7	65	7	65		
		WB											WB						
		SB		4	9		A	A	6	A			SB			11	176	10	176
		EB	38		46	D		D	38	D			EB	43	136			36	139
Unsignalized	Halifax Avenue & 34th Avenue	NB	0	0	4	A	A	A	4	A	1	A	NB						
		WB	0	0	0	A	A	A	0	A			WB						
		SB	0	0	4	A	A	A	4	A			SB		9		9		9
		EB	0	0	0	A	A	A	0	A			EB						
Unsignalized	Grimes Avenue & 34th Avenue	NB	0	0	4	A	A	A	4	A	2	A	NB		25		25		25
		WB	0	0	0	A	A	A	0	A			WB						
		SB	6	0	5	A	A	A	6	A			SB		9		9		9
		EB	0	0	0	A	A	A	0	A			EB						
Unsignalized	France Avenue & 34th Avenue	NB	0	10	7	A	B	A	10	A	11	B	NB	5	102	6	100	3	76
		WB	13	13	10	B	B	B	10	B			WB	13	145	18	154	18	148
		SB	13	14	12	B	B	B	13	B			SB	15	173	15	173	14	173
		EB	9	9	0	A	A	A	9	A			EB	2	46	2	46	1	43
Unsignalized	France Avenue & Terrace Mall Access	NB		1	0		A	A	1	A	1	A	NB						
		WB	12		6	B		A	7	A			WB		35				35
		SB	3	1		A	A		1	A			SB		81		81		
		EB											EB						
Unsignalized	France Avenue & 35th Avenue	NB	2	1	1	A	A	A	1	A	3	A	NB		19		19		19
		WB	15	11	8	C	B	A	10	B			WB	2	75	2	75	2	75
		SB	3	1	1	A	A	A	1	A			SB	1	84	1	84	1	84
		EB	12	13	8	B	B	A	11	B			EB	1	46	1	46	1	46
Signalized	CSAH 81 & New Terrace Mall Access	NB	42	2		D	A		10	A	9	A	NB	18	103	18	102		
		WB											WB						
		SB		6	3		A	A	5	A			SB			18	227	16	227
		EB	39		42	D		D	41	D			EB	30	136			30	137

* Average LRT travel time was calculated from a point just north of 36th Avenue to just south of Abbott Avenue. The distance following the LRT alignment was approximately 4,545 feet. The travel time includes deceleration, dwell, and acceleration time associated with the North Memorial Station.

Source: WSB & Associates

K:\01484-05\Traffic\[LOS Results.xls]2030AM_LRT(36th)_GROWTH

VISSIM Simulation Summary
Date: Monday, February 07, 2011
LRT: 36th Ave Alignment (PM Peak Hour with 1% annual background growth)

*Average LRT Travel Time**
Northbound **153** *seconds*
Southbound **149** *seconds*

Control	Location	Appr	Total Delay by Movement (Sec/Veh) L	T	R	Level of Service by Movement L	T	R	LOS by Approach (Sec/Veh) Delay	LOS	LOS by Intersection (Sec/Veh) Delay	LOS	Appr	Average & Maximum Traffic Queuing (feet) Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Unsignalized	Halifax Avenue & 36th Avenue	NB									1	A	NB						
		WB		0	1		A	A	0	A			WB						
		SB	12		10	B		B	10	B			SB						
		EB	7	1		A	A		1	A			EB						
Unsignalized	Grimes Avenue & 36th Avenue	NB									1	A	NB						
		WB		0	0		A	A	0	A			WB						
		SB	14		6	B		A	10	B			SB		3				3
		EB	6	2		A	A		2	A			EB						
Signalized	France Avenue & 36th Avenue	NB	34	26	26	C	C	C	31	C	17	B	NB	109	415	109	415	109	415
		WB	27	4	5	C	A	A	7	A			WB	8	111	9	112	8	111
		SB	21	16	9	C	B	A	15	B			SB	10	115	9	113	10	114
		EB	14	12	9	B	B	A	11	B			EB	27	313	27	312	28	313
Unsignalized	W. Broadway Frontage Rd & 36th Avenue	NB									0	A	NB						
		WB		0	0		A	A	0	A			WB				80		80
		SB	7		5	A		A	6	A			SB						
		EB	1	0		A	A		0	A			EB						
Signalized	CSAH 81 & 36th Avenue	NB	43	16	6	D	B	A	19	B	23	C	NB	36	249	42	254	1	90
		WB	47	38	10	D	D	B	31	C			WB	17	89	20	90	14	87
		SB	47	24	5	D	C	A	24	C			SB	14	136	32	205		
		EB	36	34	8	D	C	A	28	C			EB	34	144	35	146	28	147
Signalized	CSAH 81 & Abbott Avenue	NB	45	4		D	A		5	A	13	B	NB	10	117	10	116		
		WB											WB						
		SB		3	7		A	A	4	A			SB			5	128	5	128
		EB	41		37	D		D	41	D			EB	78	240			76	242
Unsignalized	Halifax Avenue & 34th Avenue	NB	0	0	4	A	A	A	4	A	2	A	NB						
		WB	0	0	0	A	A	A	0	A			WB						
		SB	5	0	4	A	A	A	4	A			SB		16		16		16
		EB	0	0	0	A	A	A	0	A			EB						
Unsignalized	Grimes Avenue & 34th Avenue	NB	0	0	4	A	A	A	4	A	1	A	NB		16		16		16
		WB	0	0	1	A	A	A	0	A			WB						
		SB	5	0	4	A	A	A	5	A			SB		9		9		9
		EB	1	0	1	A	A	A	0	A			EB						
Unsignalized	France Avenue & 34th Avenue	NB	14	11	7	B	B	A	11	B	16	C	NB	5	110	7	109	3	85
		WB	16	21	15	C	C	C	15	C			WB	36	256	43	267	42	261
		SB	19	19	17	C	C	C	19	C			SB	31	245	31	245	31	244
		EB	9	9	6	A	A	A	9	A			EB	1	37	1	37	1	34
Unsignalized	France Avenue & Terrace Mall Access	NB		4	2		A	A	4	A	4	A	NB			9	208	9	208
		WB	17		10	C		B	10	B			WB	2	77			2	77
		SB	6	2		A	A		2	A			SB	2	129	2	129		
		EB											EB						
Unsignalized	France Avenue & 35th Avenue	NB	5	2	2	A	A	A	2	A	5	A	NB	2	114	2	114	2	114
		WB	20	21	13	C	C	B	18	C			WB	6	104	6	104	6	104
		SB	3	1	1	A	A	A	1	A			SB		60		60		60
		EB	20	20	12	C	C	B	17	C			EB	6	111	6	111	6	111
Signalized	CSAH 81 & New Terrace Mall Access	NB	41	8		D	A		11	B	15	B	NB	32	227	32	226		
		WB											WB						
		SB		8	4		A	A	7	A			SB			17	194	14	194
		EB	44		43	D		D	44	D			EB	72	237			73	238

* Average LRT travel time was calculated from a point just north of 36th Avenue to just south of Abbott Avenue. The distance following the LRT alignment was approximately 4,545 feet. The travel time includes deceleration, dwell, and acceleration time associated with the North Memorial Station.

Source: WSB & Associates

K:\01484-05\Traffic\[LOS Results.xls]2030PM_LRT(36th)_GROWTH

VISSIM Simulation Summary
Date: Tuesday, February 08, 2011
LRT: 34th Ave Alignment (AM Peak Hour with 1% annual background growth)

*Average LRT Travel Time**
Northbound **174** *seconds*
Southbound **170** *seconds*

Intersection			Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)			Average & Maximum Traffic Queuing (feet)					
Control	Location	Appr											Appr	Left Turn		Through		Right Turn	
			L	T	R	L	T	R	Delay	LOS	Delay	LOS		Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Unsignalized	**Halifax Avenue &**	NB	12	0	10	B	A	B	12	B			NB		33		33		33
	36th Avenue	WB	8	0	0	A	A	A	0	A	1	A	WB						
		SB	9	12	7	A	B	A	8	A			SB						
		EB	5	1	1	A	A	A	1	A			EB						
Unsignalized	**Grimes Avenue &**	NB	10	10	6	B	B	A	8	A			NB						
	36th Avenue	WB	3	0	1	A	A	A	0	A	1	A	WB						
		SB	7	10	6	A	B	A	7	A			SB						
		EB	3	1	0	A	A	A	1	A			EB						
Signalized	**France Avenue &**	NB	13	9	5	B	A	A	11	B			NB	8	93	9	93	9	93
	36th Avenue	WB	14	7	5	B	A	A	8	A	8	A	WB	5	76	6	76	5	76
		SB	12	9	5	B	A	A	9	A			SB	4	64	4	64	4	64
		EB	9	8	6	A	A	A	7	A			EB	11	115	11	115	11	115
Unsignalized	**W. Broadway Frontage Rd &**	NB	8	0	5	A	A	A	6	A			NB						
	36th Avenue	WB	3	1	0	A	A	A	2	A	2	A	WB		102		102		102
		SB	6	0	0	A	A	A	6	A			SB						
		EB	1	0	3	A	A	A	1	A			EB		18		18		18
Signalized	**CSAH 81 &**	NB	31	21	4	C	C	A	22	C			NB	8	84	20	191		
	36th Avenue	WB	31	23	6	C	C	A	21	C	18	B	WB	11	87	14	86	11	87
		SB	19	22	7	B	C	A	18	B			SB	1	68	43	278		
		EB	26	15	7	C	B	A	13	B			EB	13	86	14	88	6	89
Signalized	**CSAH 81 &**	NB	34	2		C	A		8	A			NB	10	80	9	81		
	Abbott Avenue	WB									10	B	WB						
		SB		8	6		A	A	7	A			SB			10	189	9	188
		EB	32		7	C		A	29	C			EB	17	101			13	102
Unsignalized	**Halifax Avenue &**	NB	0	0	0	A	A	A	0	A			NB						
	34th Avenue	WB	6	7	5	A	A	A	6	A	1	A	WB						
		SB	0	0	0	A	A	A	0	A			SB						
		EB	6	0	0	A	A	A	6	A			EB						
Signalized	**France Avenue &**	NB	29		12	C		B	24	C			NB	11	108			2	76
	34th Avenue	WB	21		14	C		B	14	B	15	B	WB	14	180			14	180
		SB	11		14	B		B	11	B			SB	15	217			15	217
		EB											EB						
Unsignalized	**France Avenue &**	NB		1	1		A	A	1	A			NB						
	Terrace Mall Access	WB	8		6	A		A	7	A	1	A	WB		18				18
		SB	1	0		A	A		0	A			SB						
		EB											EB						
Unsignalized	**France Avenue &**	NB	1	1	1	A	A	A	1	A			NB		32		32		32
	35th Avenue	WB	11	12	7	B	B	A	8	A	2	A	WB	1	66	1	66	1	66
		SB	2	1	1	A	A	A	1	A			SB		54		54		54
		EB	9	9	6	A	A	A	7	A			EB		14		14		14

* Average LRT travel time was calculated from a point just north of 36th Avenue to just south of Abbott Avenue. The distance following the LRT alignment was approximately 5,475 feet. The travel time includes deceleration, dwell, and acceleration time associated with the North Memorial Station.
Source: WSB & Associates
K:\01484-05\Traffic\[LOS Results.xls]2030AM_LRT(34th)_GROWTH

VISSIM Simulation Summary
Date: Tuesday, February 08, 2011
LRT: 34th Ave Alignment (PM Peak Hour with 1% annual background growth)

*Average LRT Travel Time**

Northbound	**173**	*seconds*
Southbound	**172**	*seconds*

Control	Location	Appr	Total Delay by Movement (Sec/Veh) L	T	R	Level of Service by Movement L	T	R	LOS by Approach (Sec/Veh) Delay	LOS	LOS by Intersection (Sec/Veh) Delay	LOS	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Unsignalized	Halifax Avenue & 36th Avenue	NB	14	0	10	B	A	B	13	B	1	A	NB		13		13		13
		WB	7	0	1	A	A	A	0	A			WB						
		SB	14	0	8	B	A	A	9	A			SB						
		EB	7	1	1	A	A	A	1	A			EB						
Unsignalized	Grimes Avenue & 36th Avenue	NB	9	8	7	A	A	A	8	A	1	A	NB						
		WB	3	0	1	A	A	A	0	A			WB		7		7		7
		SB	8	12	6	A	B	A	8	A			SB						
		EB	4	1	1	A	A	A	1	A			EB						
Signalized	France Avenue & 36th Avenue	NB	16	11	8	B	B	A	14	B	10	B	NB	20	285	20	285	20	285
		WB	16	9	5	B	A	A	9	A			WB	10	104	11	104	10	104
		SB	12	9	6	B	A	A	9	A			SB	4	78	4	78	4	78
		EB	12	9	7	B	A	A	9	A			EB	14	115	14	115	14	115
Unsignalized	W. Broadway Frontage Rd & 36th Avenue	NB	10	12	8	B	B	A	9	A	3	A	NB		38		38		38
		WB	3	1	1	A	A	A	2	A			WB		90		90		90
		SB	8	0	4	A	A	A	6	A			SB						
		EB	2	1	4	A	A	A	1	A			EB		19		19		19
Signalized	CSAH 81 & 36th Avenue	NB	37	13	6	D	B	A	17	B	22	C	NB	33	232	27	228		30
		WB	52	36	10	D	D	B	29	C			WB	15	105	18	104	14	105
		SB	45	23	6	D	C	A	22	C			SB	14	122	33	172		
		EB	44	27	6	D	C	A	29	C			EB	53	250	54	252	44	253
Signalized	CSAH 81 & Abbott Avenue	NB	40	5		D	A		8	A	18	B	NB	18	121	18	122		
		WB											WB						
		SB		21	5		C	A	19	B			SB			30	216	29	216
		EB	38		9	D		A	34	C			EB	45	205			42	205
Unsignalized	Halifax Avenue & 34th Avenue	NB	0	0	0	A	A	A	0	A	1	A	NB						
		WB	6	0	5	A	A	A	6	A			WB						
		SB	0	0	0	A	A	A	0	A			SB						
		EB	6	7	5	A	A	A	6	A			EB						
Signalized	France Avenue & 34th Avenue	NB	28		11	C		B	26	C	15	B	NB	11	102			2	70
		WB	20		15	C		B	15	B			WB	28	290			28	290
		SB	10		11	B		B	10	B			SB	15	216			15	216
		EB											EB						
Unsignalized	France Avenue & Terrace Mall Access	NB		1	1		A	A	1	A	1	A	NB				8		8
		WB	9		7	A		A	7	A			WB		42				42
		SB	3	0		A	A		0	A			SB		36		36		
		EB											EB						
Unsignalized	France Avenue & 35th Avenue	NB	2	1	1	A	A	A	1	A	3	A	NB		32		32		32
		WB	11	9	8	B	A	A	10	A			WB	1	65	1	65	1	65
		SB	3	1	1	A	A	A	1	A			SB		53		53		53
		EB	11	12	6	B	B	A	9	A			EB	1	42	1	42	1	42

* Average LRT travel time was calculated from a point just north of 36th Avenue to just south of Abbott Avenue. The distance following the LRT alignment was approximately 5,475 feet. The travel time includes deceleration, dwell, and acceleration time associated with the North Memorial Station.
Source: WSB & Associates
K:\01484-05\Traffic\[LOS Results.xls]2030PM_LRT(34th)_GROWTH

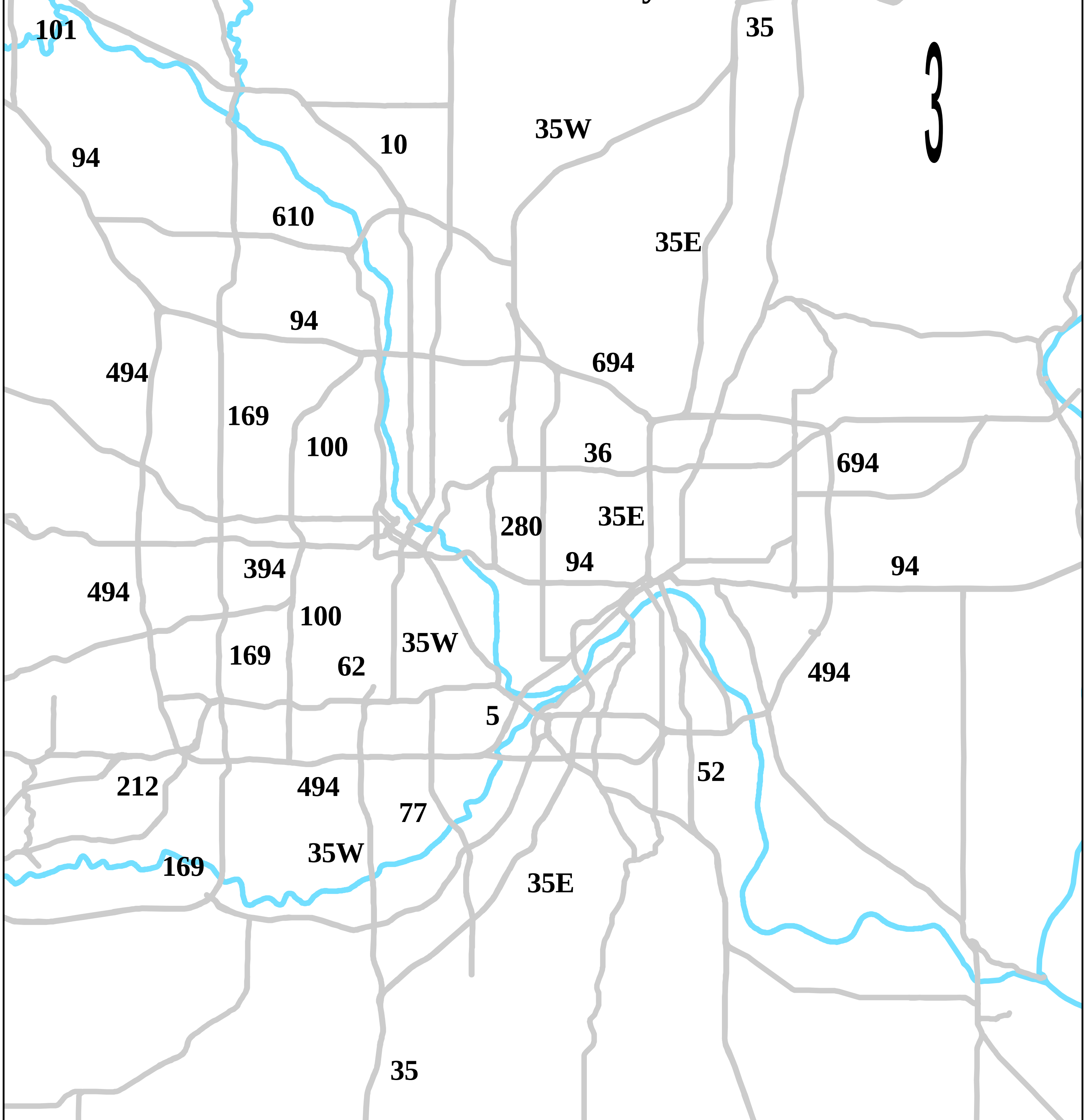
Appendix H

Weekend Traffic Analysis

(Supporting Information)

All Detector Report

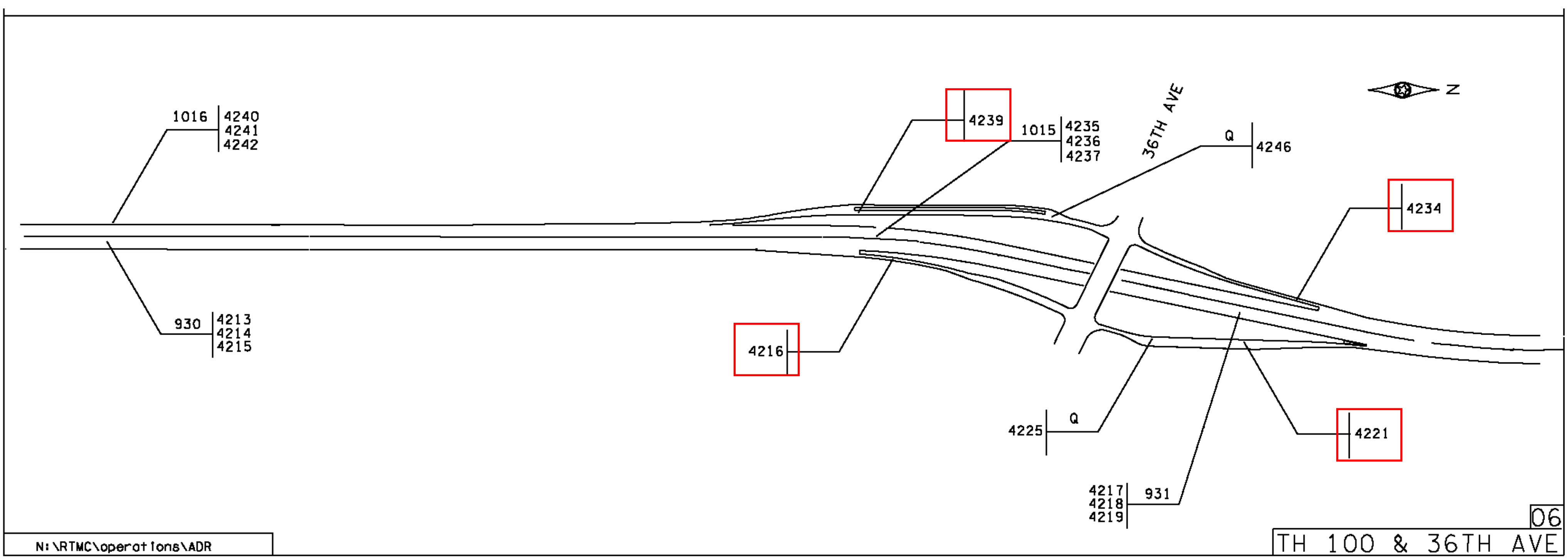
Mn/DOT Twin Cities Freeway Detectors



Use bookmarks or click on freeway labels to navigate this file.

ADR Updated March 2011

Detector Numbers and Locations



ATR locations on the TH 100 & 36th Ave Ramps
All ramp volumes combined

		MAX Hourly Volume	**2102**	
4:30 PM	TO	5:30 PM	Weekday	

		MAX Hourly Volume	**1644**		
3:30 PM	TO	4:30 PM	Sat		
			78%	of weekday	

		MAX Hourly Volume	**1607**		
Noon	TO	1:00 PM	Sun		
			76%	of weekday	

Weekdays:	Saturdays:	Sundays:
4/19/2011	4/23/2011	4/24/2011
4/20/2011	4/30/2011	5/1/2011
4/21/2011	5/7/2011	5/8/2011
4/26/2011	5/14/2011	5/15/2011
4/27/2011		
4/28/2011		
5/3/2011		
5/4/2011		
5/5/2011		
5/10/2011		
5/11/2011		
5/12/2011		

Bottineau - Robbinsdale
Weekend Traffic Ratio to be used for Rainbow (Terrace Mall) Modeling
Approximately 80% of the weekday PM peak hour traffic is present during the highest hourly volume on both Saturday and Sunday
5/18/2011

			Totals (Hourly volumes)		
			ALL RAMPS Weekday	ALL RAMPS Sat	ALL RAMPS Sun
12:00 AM	TO	1:00 AM	196	343	395
12:15 AM	TO	1:15 AM	161	307	354
12:30 AM	TO	1:30 AM	139	278	313
12:45 AM	TO	1:45 AM	126	256	269
1:00 AM	TO	2:00 AM	119	235	247
1:15 AM	TO	2:15 AM	116	213	229
1:30 AM	TO	2:30 AM	111	199	223
1:45 AM	TO	2:45 AM	103	194	214
2:00 AM	TO	3:00 AM	98	182	201
2:15 AM	TO	3:15 AM	89	170	181
2:30 AM	TO	3:30 AM	79	156	152
2:45 AM	TO	3:45 AM	76	133	132
3:00 AM	TO	4:00 AM	75	122	118
3:15 AM	TO	4:15 AM	84	119	107
3:30 AM	TO	4:30 AM	100	114	100
3:45 AM	TO	4:45 AM	129	114	90
4:00 AM	TO	5:00 AM	163	112	85
4:15 AM	TO	5:15 AM	194	117	86
4:30 AM	TO	5:30 AM	261	128	88
4:45 AM	TO	5:45 AM	374	155	109
5:00 AM	TO	6:00 AM	498	195	137
5:15 AM	TO	6:15 AM	627	223	160
5:30 AM	TO	6:30 AM	793	270	207
5:45 AM	TO	6:45 AM	1017	330	255
6:00 AM	TO	7:00 AM	1236	387	298
6:15 AM	TO	7:15 AM	1434	436	333
6:30 AM	TO	7:30 AM	1592	479	349
6:45 AM	TO	7:45 AM	1651	531	377
7:00 AM	TO	8:00 AM	1737	591	401
7:15 AM	TO	8:15 AM	1774	633	443
7:30 AM	TO	8:30 AM	1762	705	501
7:45 AM	TO	8:45 AM	1696	784	550
8:00 AM	TO	9:00 AM	1572	855	631
8:15 AM	TO	9:15 AM	1471	951	730
8:30 AM	TO	9:30 AM	1383	1033	832
8:45 AM	TO	9:45 AM	1313	1085	944
9:00 AM	TO	10:00 AM	1249	1183	1035
9:15 AM	TO	10:15 AM	1200	1248	1089
9:30 AM	TO	10:30 AM	1156	1321	1139
9:45 AM	TO	10:45 AM	1138	1372	1169
10:00 AM	TO	11:00 AM	1140	1373	1212
10:15 AM	TO	11:15 AM	1158	1409	1249
10:30 AM	TO	11:30 AM	1184	1446	1264
10:45 AM	TO	11:45 AM	1213	1489	1297
11:00 AM	TO	Noon	1238	1518	1324

			Totals (Hourly volumes)		
			ALL RAMPS Weekday	ALL RAMPS Sat	ALL RAMPS Sun
11:15 AM	TO	12:15 PM	1258	1581	1399
11:30 AM	TO	12:30 PM	1278	1594	1511
11:45 AM	TO	12:45 PM	1295	1596	1580
Noon	TO	1:00 PM	1299	1574	1607
12:15 PM	TO	1:15 PM	1317	1557	1597
12:30 PM	TO	1:30 PM	1314	1549	1549
12:45 PM	TO	1:45 PM	1333	1550	1503
1:00 PM	TO	2:00 PM	1360	1600	1478
1:15 PM	TO	2:15 PM	1403	1591	1470
1:30 PM	TO	2:30 PM	1485	1597	1434
1:45 PM	TO	2:45 PM	1596	1609	1422
2:00 PM	TO	3:00 PM	1711	1623	1419
2:15 PM	TO	3:15 PM	1823	1625	1411
2:30 PM	TO	3:30 PM	1901	1620	1420
2:45 PM	TO	3:45 PM	1909	1634	1427
3:00 PM	TO	4:00 PM	1932	1628	1408
3:15 PM	TO	4:15 PM	1924	1643	1414
3:30 PM	TO	4:30 PM	1931	1644	1432
3:45 PM	TO	4:45 PM	2000	1618	1438
4:00 PM	TO	5:00 PM	2033	1596	1457
4:15 PM	TO	5:15 PM	2091	1585	1432
4:30 PM	TO	5:30 PM	2102	1544	1413
4:45 PM	TO	5:45 PM	2068	1512	1423
5:00 PM	TO	6:00 PM	2042	1485	1415
5:15 PM	TO	6:15 PM	1983	1444	1388
5:30 PM	TO	6:30 PM	1954	1446	1339
5:45 PM	TO	6:45 PM	1887	1413	1253
6:00 PM	TO	7:00 PM	1797	1345	1178
6:15 PM	TO	7:15 PM	1669	1278	1135
6:30 PM	TO	7:30 PM	1516	1208	1112
6:45 PM	TO	7:45 PM	1372	1161	1086
7:00 PM	TO	8:00 PM	1248	1118	1047
7:15 PM	TO	8:15 PM	1186	1090	1045
7:30 PM	TO	8:30 PM	1144	1030	1035
7:45 PM	TO	8:45 PM	1130	973	1001
8:00 PM	TO	9:00 PM	1110	944	978
8:15 PM	TO	9:15 PM	1088	900	899
8:30 PM	TO	9:30 PM	1055	901	796
8:45 PM	TO	9:45 PM	994	886	728
9:00 PM	TO	10:00 PM	923	872	661
9:15 PM	TO	10:15 PM	852	867	612
9:30 PM	TO	10:30 PM	781	833	590
9:45 PM	TO	10:45 PM	732	833	569
10:00 PM	TO	11:00 PM	682	781	542
10:15 PM	TO	11:15 PM	626	730	495
10:30 PM	TO	11:30 PM	559	689	431
10:45 PM	TO	11:45 PM	486	612	368
11:00 PM	TO	Midnight	417	579	304

TRIP GENERATION

An ITE Informational Report

8th Edition • Volume 3 of 3

Supermarket
(850)

Average Vehicle Trip Ends vs:	**1000 Sq. Feet Gross Floor Area**
On a:	**Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.**

Number of Studies:	40
Average 1000 Sq. Feet GFA:	59
Directional Distribution:	51% entering, 49% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
10.50	5.15 - 20.29	4.97

Average Vehicle Trip Ends vs:	**1000 Sq. Feet Gross Floor Area**
On a:	**Saturday, Peak Hour of Generator**

Number of Studies:	32
Average 1000 Sq. Feet GFA:	67
Directional Distribution:	51% entering, 49% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
10.85	5.78 - 22.60	4.93

ite
Institute of Transportation Engineers

To:	Joe Gladke, PE	**Copy:**	N/A
From:	Tony Heppelmann, PE Chad Ellos, PE Dean Chamberlain, EIT		
Date:	June 2011	**File:**	WSB No. 01484-05
Subject:	Operations Analysis of LRT and BRT at the 42nd Avenue Crossing Bottineau Transitway – Robbinsdale		

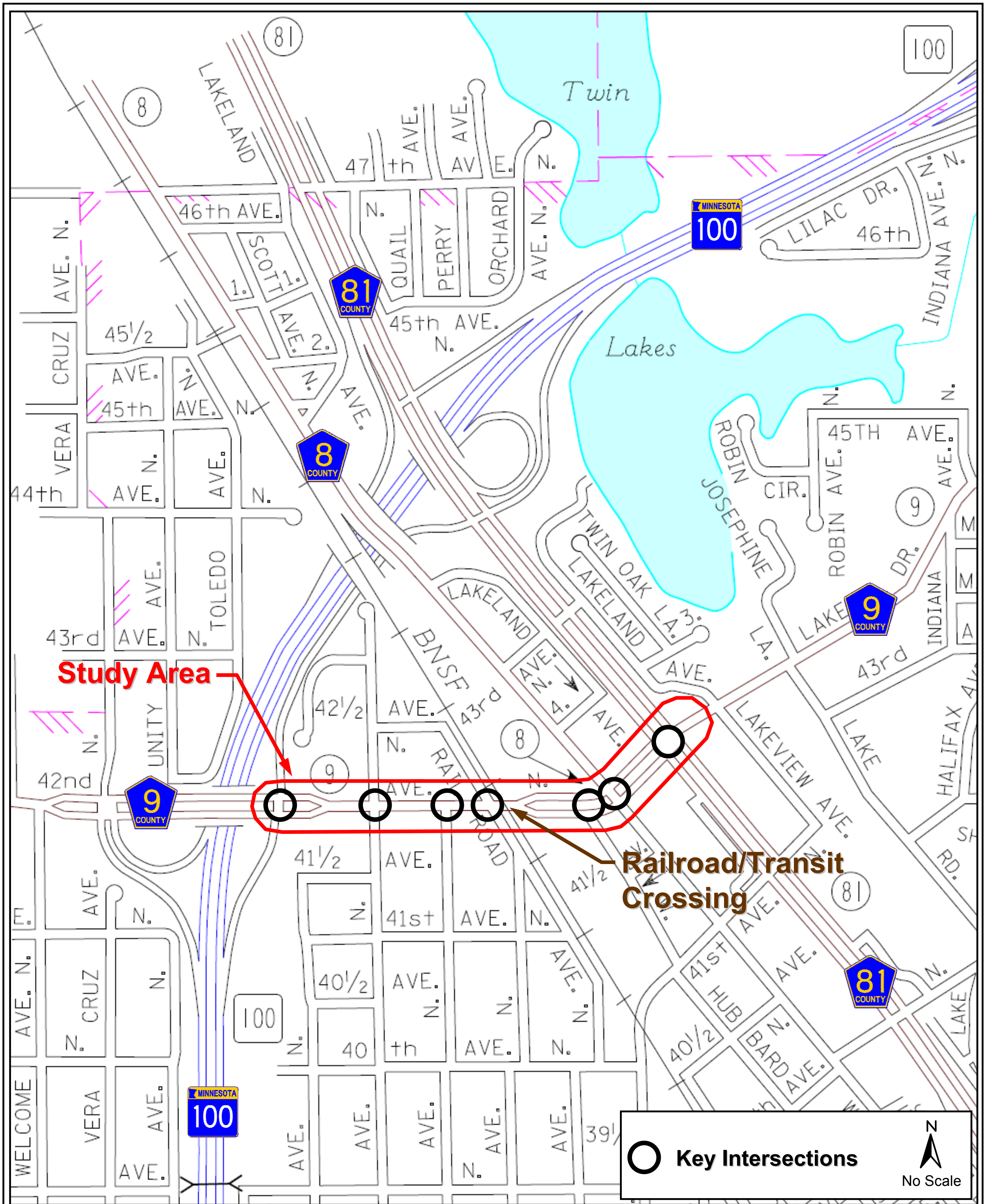
Introduction

The purpose of this study is to document traffic and transit (light-rail transit [LRT] and bus rapid transit [BRT]) operations at the 42nd Avenue (CSAH 9) railroad crossing in the City of Robbinsdale. It is assumed that either LRT or BRT will operate within the railroad right-of-way and include a Park & Ride facility south of 42nd Avenue. At the crossing, a flashing signal system and gate arms will provide transit preemption according to the assumptions in Technical Memorandum 1.

Within the study area are seven key intersections on 42nd Avenue that were analyzed, which include:

- TH 100 Northbound Ramps
- Regent Avenue
- Quail Avenue
- Railroad Avenue
- Hubbard Avenue
- West Broadway Avenue (CSAH 8)
- Bottineau Boulevard (CSAH 81)

The study area, key intersections, and transit/railroad crossing location being analyzed are shown on **Figure 1**.



Hennepin County
Bottineau Transitway
Robbinsdale, MN

Figure 1
Study Area Map

It was assumed that freight trains would use the crossing during non-peak times and therefore, freight trains were excluded from this analysis. Three scenarios were analyzed as part of this study. All the scenarios assume the existing (2010) roadway network. These scenarios include:

- Existing (2010 traffic volumes)
- LRT – (2030 forecast traffic volumes)
- BRT – (2030 forecast traffic volumes)

For the LRT and BRT scenarios, the crossing would consist of a two-way transitway and separate freight line as displayed in **Appendix A**.

Existing Conditions

Roadway System

The major roadways within the study area are 42nd Avenue, West Broadway Avenue, and CSAH 81. The functional classification of all the roadways being analyzed is provided in **Table 1**.

Table 1: Roadway Functional Classification

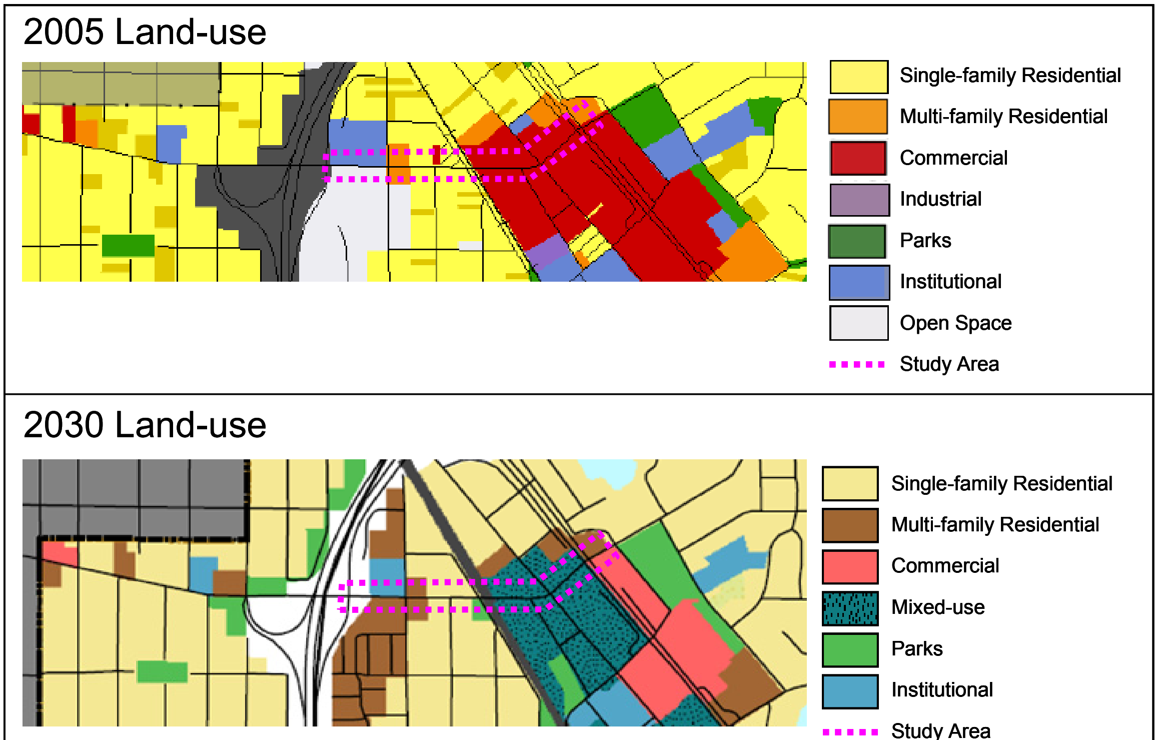
Roadway	Functional Classification
42nd Avenue	A Minor Augmentor
CSAH 81	A Minor Augmentor
CSAH 8 (West Broadway Avenue)	Major Collector
Regent Avenue	Local
Quail Avenue	Local
Railroad Avenue	Local
Hubbard Avenue	Local

SOURCE: Metropolitan Council

K:\01484-05\Admin\Docs\[Tables.xls]Fun - Juris Class Tables

Adjacent to 42nd Avenue, single-family and multi-family residential land uses are mainly prevalent west of the railroad/transit crossing. East of the crossing has mainly commercial land uses. **Figure 2** displays the 2005 land-use and the proposed 2030 land-use based on the City of Robbinsdale 2030 Comprehensive Plan.

Figure 2: 2005 and Proposed 2030 Land-use



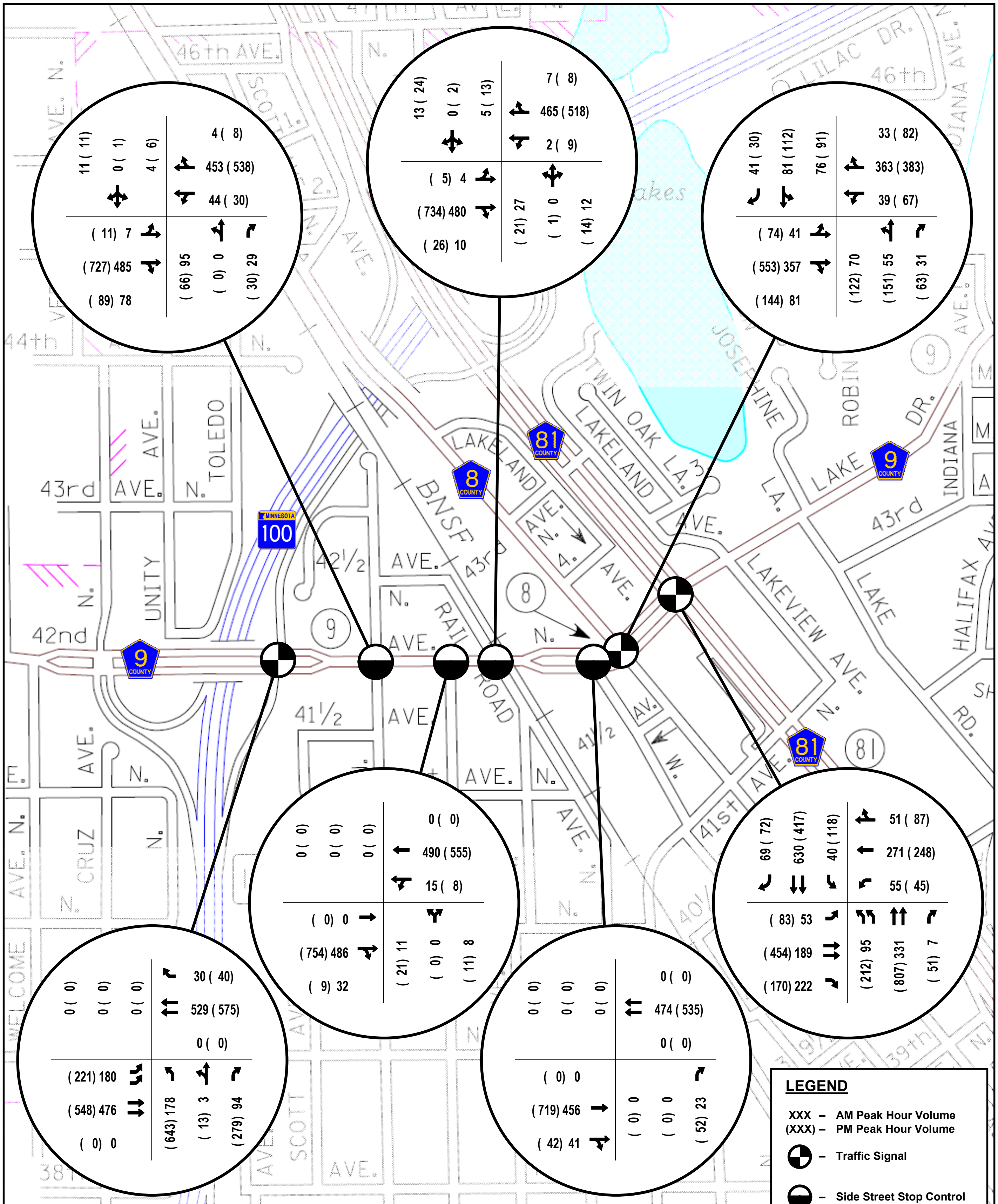
Source: City of Robbinsdale 2030 Comprehensive Plan

Existing Traffic

Average daily traffic counts in 2009 revealed that 42nd Avenue carries 11,600 vehicles per day (vpd) from TH 100 to West Broadway Avenue and 10,900 vpd from West Broadway Avenue to CSAH 81. CSAH 81 carries 15,700 vpd north of 42nd Avenue and 16,600 vpd south of 42nd Avenue1.

Turning movement data used to determine peak hour conditions was collected in early November of 2010. For reference, these counts are provided in **Appendix B**. This data was then analyzed to determine the AM and PM peak hours. **Figure 3** shows the existing (2010) AM and PM peak hour turning movements and lane configurations at the key intersections.

[1] Daily traffic volumes obtained from 2009 Mn/DOT traffic flow maps



AM and PM peak hour turning volumes derived from WSB counts in November 2010.

Hennepin County
Bottineau Transitway
Robbinsdale, MN

N
No Scale

Figure 3
Existing Conditions

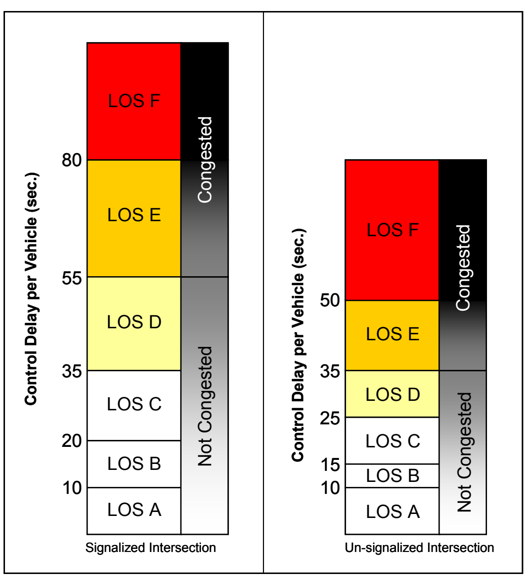
Modeling Methodology

VISSIM computer software was used to model the Existing, LRT, and BRT scenarios. VISSIM is a microscopic, time step and behavior based simulation model developed to model urban traffic and public transit operations. It is approved by Mn/DOT as a method to analyze complex transportation systems involving traffic and transit operations under constraints such as lane configuration, traffic composition, traffic signals, transit stops, etc., thus making it a useful tool for the evaluation of various alternatives based on transportation engineering and planning measures of effectiveness.

Level of Service Definition

The traffic operations analysis results are presented in the form of a letter grade from A to F, called level of service (LOS). The letter grade provides a qualitative assessment of the intersection operations based on the amount of delay per vehicle. The LOS system is set up similar to a report card with "A" representing high quality operations and "F" representing poor operations. At LOS A, motorists experience very little delay or interference. On a roadway or intersection with LOS F conditions, motorists would experience severe congestion and extreme delay, i.e., gridlock. The LOS analysis criteria for signalized and unsignalized intersections are shown in **Figure 4**. Although LOS A conditions represents the best possible level of traffic flow, the cost to construct intersections to such a high standard exceeds the benefit to the user. Within an urbanized area, it is generally regarded that LOS D or better provides for acceptable operations.

Figure 4: Delay Based LOS Thresholds



SOURCE: Level of Service thresholds from the Highway Capacity Manual, 2000.
K:\Traffic\Level of Service (LOS)\LOS Delay Graphic.ppt

Existing Operations

Existing bus data was collected and integrated into the traffic model. This included bus frequency, bus stops, and three seconds of stopped time before proceeding across the railroad tracks. Refer to **Appendix C** for bus data within the study area.

A summary of the existing level of service conditions is provided below. **Appendix D** provides more detail as to the individual movements at each intersection and the queue lengths recorded.

Table 2 summarizes the LOS conditions at the key intersections based on the existing lane geometry, Hennepin County signal timing, and 2010 traffic volumes as shown in *Figure 3*. All intersections are currently operating at LOS C or better during the am and pm peak hours. A few movements were operating at LOS D, refer to *Appendix D*. Adequate storage for queuing vehicles was provided at all approaches.

Table 2: Intersection LOS – Existing (No Build)

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)
TH 100 NB Off-Ramp & 42nd Ave	B	14	C	21
Regent Ave & 42nd Ave	A	1	A	1
Quail Ave & 42nd Ave	A	1	A	1
Railroad Ave & 42nd Ave	A	1	A	1
Hubbard Ave & 42nd Ave	A	1	A	3
CSAH 8 & 42nd Ave	B	11	C	24
CSAH 81 & 42nd Ave	C	24	C	30

K:\01484-05\Admin\Docs\Memos_Reports - 42nd\[LOS Summary Tables.xls]No Build
Source: WSB & Associates

Traffic Forecasts

The project is located in a historically built-up area in the City of Robbinsdale, which is an inner suburb of Minneapolis. Based the City's comprehensive plan and other known development plans, no increase in traffic within the study area over the next 20 years was assumed. Historical traffic volumes for the study area, provided in **Appendix E**, generally supports this assumption by showing that traffic volumes have decreased or remained relatively unchanged.

Year 2030 traffic forecasts for the LRT and BRT scenarios do include increased traffic due to the proposed Park & Ride station within the study area. The trip generation and distribution methodology used to route this additional traffic is described below.

Park & Ride Distribution

For the LRT scenario, a 250 vehicle Park & Ride lot was assumed. The BRT Park & Ride lot was assumed to hold 200 vehicles. Both scenarios assumed the lot would be filled during the AM peak hour and emptied during the PM peak hour. According to Metro Transit, the market area related to this Park & Ride is approximately 7.5 square miles as shown by the dashed red line on **Figure 5**. This figure also shows the assumed distribution percentages (by roadway) of vehicles traveling to and from the Park & Ride lot.

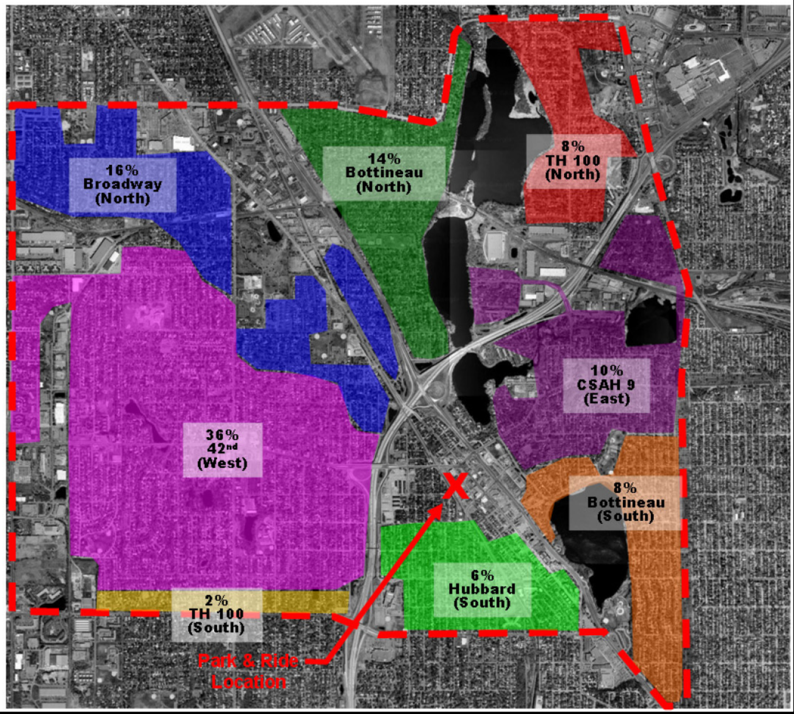
Figure 5: Park & Ride Distribution

LRT = 250 Vehicle P & R

Total	250	
36%	90	42nd Avenue (West)
16%	40	CSAH 8 (North)
14%	35	CSAH 81 (North)
8%	20	TH 100 (North)
10%	25	CSAH 9 (East)
8%	20	CSAH 81 (South)
6%	15	Hubbard Ave (South)
2%	5	TH 100 (South)

BRT = 200 Vehicle P & R

Total	200	
36%	72	42nd Avenue (West)
16%	32	CSAH 8 (North)
14%	28	CSAH 81 (North)
8%	16	TH 100 (North)
10%	20	CSAH 9 (East)
8%	16	CSAH 81 (South)
6%	12	Hubbard Ave (South)
2%	4	TH 100 (South)



Operations Analysis

General LRT Operating Assumptions

The LRT is assumed to operate at a frequency of 7.5 minutes, in each direction, during the peak hours with a station dwell time of approximately twenty seconds. Random arrival times at the Robbinsdale Transit Center Station are based on a mean value of 450 seconds (7.5 minutes) with a standard deviation of 90 seconds (representing ± 20%). Since a station is present within the study area, LRT speeds will vary. The desired LRT speed north and south of the station is 55 mph. Each LRT train consists of three 94 foot cars with an acceleration rate of 3.0 mph per second and a deceleration rate of 1.5 mph per second. LRT is given preemption at the crossing.

General BRT Operating Assumptions

The BRT is assumed to operate at a frequency of 3.75 minutes, in each direction, during the peak hours with a station dwell time of approximately twenty-five seconds. Random arrival times at the Robbinsdale Transit Center Station are based on a mean value of 225 seconds (3.75

minutes) with a standard deviation of 45 seconds (representing ± 20%). Since a station is present within the study area, BRT speeds will vary. The desired BRT speed north and south of the station is 55 mph. Each BRT vehicle consists of a 60-foot bus with an acceleration rate of 1.5 mph per second and a deceleration rate of 1.5 mph per second. BRT is given preemption at the crossing.

Crossing Signal Assumptions

Currently, an overhead flashing signal system alerts drivers that a train is approaching the crossing. For the proposed LRT and BRT scenarios, gate arms would be added to this system. The amount of time assumed from when the signal starts flashing to when the gates are back up is approximately 25 seconds plus the transit vehicle crossing time, as itemized below[2].

- Flashing warning prior to gates descending: 3 to 5 seconds
- Gates descending: 10 to 12 seconds
- Time after gates are down and before transit vehicle arrives at crossing: 5 seconds
- Transit vehicle crossing the roadway[3]
    - LRT = 3-6 seconds
    - BRT: 2-3 seconds
- Gates ascending: 5 seconds

This delay (27 to 31 seconds) will be experienced by drivers each time a transit vehicle crosses 42nd Avenue.

Traffic LOS Conditions

Analysis data from the models was collected for both the traffic and transit (LRT or BRT) traveling through the study area. A summary of the levels of service conditions and queue lengths for each scenario is provided below. *Appendix D* provides more detail as to the individual movements at each intersection and the queue lengths recorded through the study area.

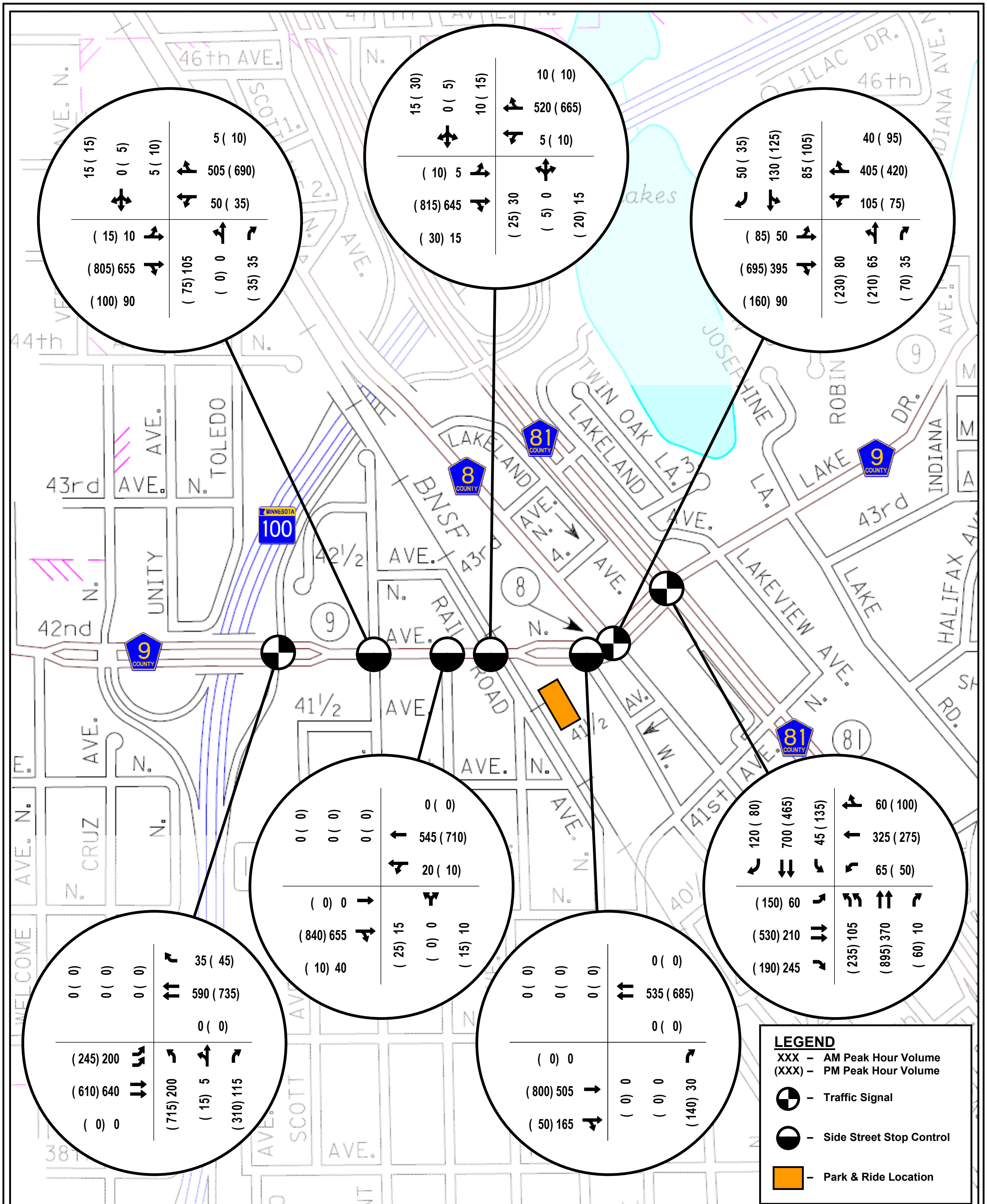
<u>LRT Scenario</u>

Table 3 summarizes the LOS conditions for the forecasted traffic volumes as shown in **Figure 6**. All intersections operate at LOS C or better during the AM and PM peak hours. These conditions were similar to the Existing conditions. A few movements in the peak hours are operating at LOS D and E as shown in *Appendix D*. The westbound left-turn movement at the West Broadway Avenue (CSAH 8) intersection and the southbound left-turn movement at the CSAH 81 intersection were operating just into LOS E during the PM peak hour.

---

[2] Assumptions from: Central Corridor Light Rail Transit, Section 34 42 60 – Signals Highway Crossings (July 2010)

[3] Range in times is due to the proximity of a station near the crossing. Transit vehicles are either accelerating or decelerating through the crossing.



Hennepin County
Bottineau Transitway
Robbinsdale, MN

N
No Scale

Figure 6
Forecasted Peak Hour Traffic
(LRT Scenario)

Eastbound queue lengths at West Broadway Avenue intersection and Hubbard Avenue intersection were also reviewed to determine if vehicles were backing up onto the railroad tracks. The distance between Hubbard Avenue and the railroad tracks is approximately 350 feet. The maximum queue recorded at Hubbard Avenue during the peak hours was 208 feet (PM peak hour).

Table 3: Intersection LOS – LRT Scenario

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)
TH 100 NB Off-Ramp & 42nd Ave	B	15	C	24
Regent Ave & 42nd Ave	A	2	A	2
Quail Ave & 42nd Ave	A	1	A	1
Railroad Ave & 42nd Ave	A	2	A	2
Hubbard Ave & 42nd Ave	A	2	A	6
CSAH 8 & 42nd Ave	B	14	C	25
CSAH 81 & 42nd Ave	C	25	C	30

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Source: WSB & Associates

BRT Scenario

Table 4 summarizes the LOS conditions for the forecasted traffic volumes as shown in **Figure 7**. All intersections operate at LOS C or better during the AM and PM peak hours. These conditions were similar to the Existing conditions. A few movements in the peak hours are operating at LOS D and E as shown in *Appendix D*. As with the LRT scenario, the westbound left-turn movement at the West Broadway Avenue (CSAH 8) intersection and the southbound left-turn movement at the CSAH 81 intersection were operating at LOS E during the PM peak hour. The maximum queue recorded at Hubbard Avenue during the peak hours was 215 feet (PM peak hour).

Table 4: Intersection LOS – BRT Scenario

Intersection	AM Peak Hour		PM Peak Hour	
	LOS	Control Delay (sec/veh)	LOS	Control Delay (sec/veh)
TH 100 NB Off-Ramp & 42nd Ave	B	15	C	24
Regent Ave & 42nd Ave	A	2	A	2
Quail Ave & 42nd Ave	A	1	A	1
Railroad Ave & 42nd Ave	A	1	A	2
Hubbard Ave & 42nd Ave	A	1	A	6
CSAH 8 & 42nd Ave	B	13	C	25
CSAH 81 & 42nd Ave	C	25	C	30

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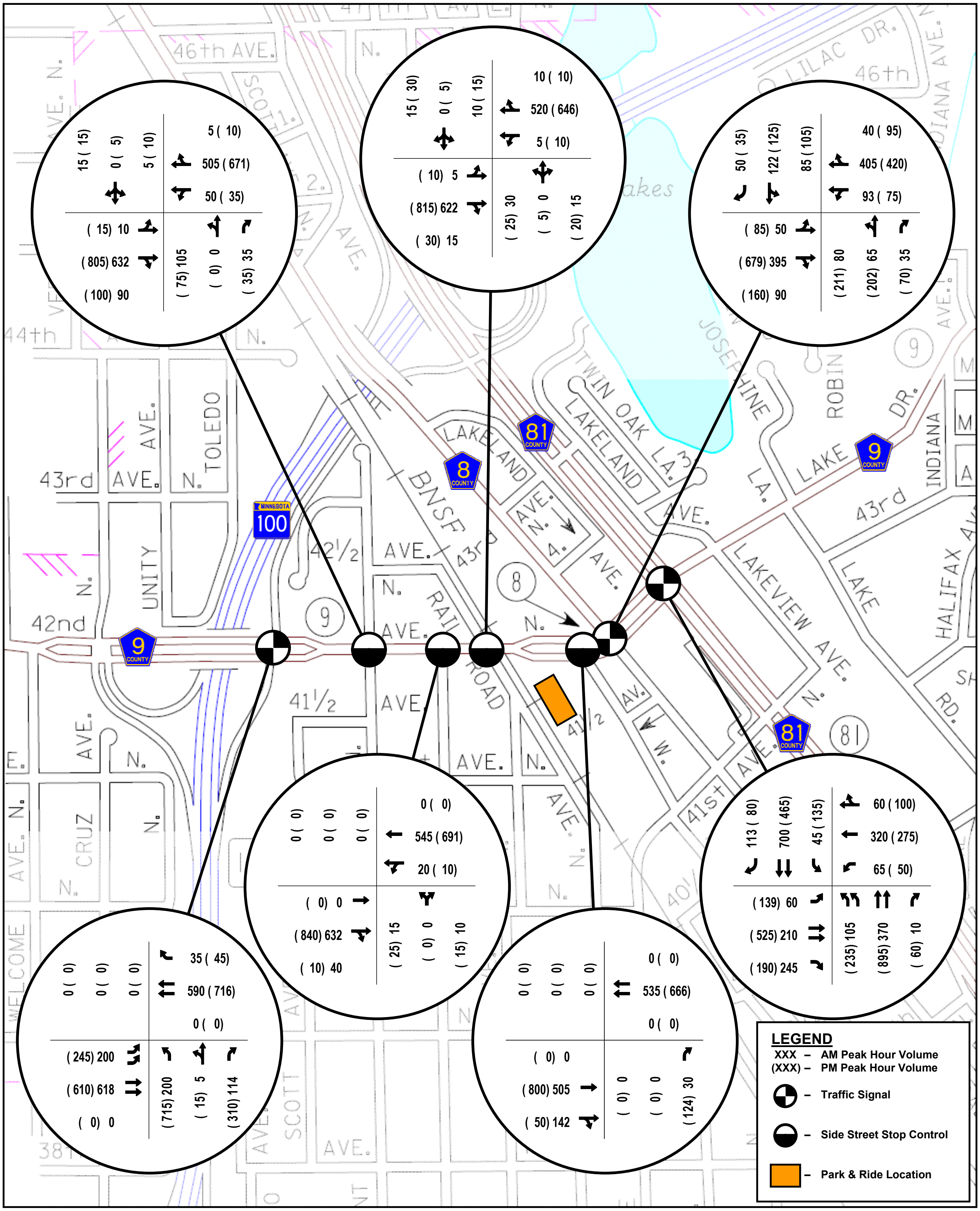
Source: WSB & Associates



WSB & Associates, Inc. Hennepin

Hennepin County
Bottineau Transitway
Robbinsdale, MN

N
No Scale

Figure 7
Forecasted Peak Hour Traffic
(BRT Scenario)

Additional Analyses

Sensitivity Analysis

Since the traffic forecasts were the same as the existing counts, a sensitivity analysis was also performed to determine if an increase in forecasted traffic would result in acceptable conditions. Even though traffic volumes in the study area are not anticipated to increase in the future, traffic on TH 100 is forecasted to increase. Congestion on TH 100 could lead to an increase in vehicles using CSAH 81 and 42nd Avenue during peak traffic hours. Revised 2030 forecasts for this analysis were developed assuming an annual increase of one percent per year.

For the sensitivity analysis, signal timing at the West Broadway Avenue intersection was revised. The existing 45 second cycle length was revised to 90 seconds. The CSAH 81 intersection also has a cycle length of 90 seconds thus preserving signal coordination.

The results of the sensitivity analysis were similar to the original analysis, producing acceptable LOS conditions for both the LRT and BRT scenarios. With the increase in traffic, eastbound queues at the West Broadway Avenue and Hubbard Avenue intersections also increased.

During the PM peak hour, the LRT maximum queue increased to 328 feet while the BRT maximum queue increased to 348 feet. With this growth scenario, the BRT maximum queue could extend back to the tracks causing vehicles to be in harms way if a transit vehicle was approaching. Tables of these results are provided in **Appendix F**.

Conclusions

- Future traffic levels on 42nd Avenue are not expected to increase unless a Park & Ride is built in the study area. A Park & Ride will generate additional peak hour trips and only slightly increase traffic. Background traffic along 42nd Avenue is not expected to increase based on historical counts.
- Both the LRT and BRT scenarios produce acceptable LOS conditions and queue lengths at all the area intersections. This assumes no traffic growth in the corridor.
- The sensitivity analysis, which included revising the 2030 forecasts to include an annual traffic increase of one percent, produced acceptable LOS conditions but increased the maximum queue lengths causing the BRT scenario to possibly strand vehicles on the tracks during the PM peak hour. The LRT scenario maximum queue length was only slightly less that of the BRT scenario.
- Interconnecting the railroad signal with the traffic signal at West Broadway Avenue may be needed if traffic volumes along CSAH 42 increase. By interconnecting the signals, a clearance phase could be introduced to allow eastbound vehicles to clear the tracks prior to a transit vehicle crossing 42nd Avenue.

Appendix A

Crossing Detail Figure

Bottineau Transitway
Alternatives Analysis Study

Hennepin

CONSULTANTS:

SRF Consulting Group, Inc.

Kimley-Horn and Associates, Inc.
2550 UNIVERSITY AVE. WEST, SUITE 345N
ST. PAUL, MINNESOTA 55114
TEL. NO. (651) 645-4197
FAX. NO. (651) 645-5116

LTK Engineering Services

DRAWING NAME
LRTCP08

DESIGNED BY:	MR
DRAWN BY:	LJ
CHECKED BY:	KM
DATE:	09-04-09
PROJECT NO.	C3802

FINAL
NOT FOR CONSTRUCTION

SCALE
0 100' 200'

BOTTINEAU TRANSITWAY
ALTERNATIVES ANALYSIS
CONCEPTUAL DESIGN

LRT SEGMENT C
SHEET 8 OF 17

ALIGNMENT PLAN
STA 3189+50 - 3217+50

P:\Projects\C3802 – Bottineau AA\LD\dwg\LRTCP08.dwg November 11, 2009 – 10:41pm

Appendix B

Turning Movement Counts

(Taken by WSB or supplied by Hennepin County)

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

42nd Ave & NB TH 100 Ramp
7:00-8:30 and 4:15-5:45
Robbinsdale, MN
sunny

File Name : 42nd ave & nb 100 ramp
Site Code : 00014841
Start Date : 11/3/2010

Groups Printed- Unshifted

	NB TH 100 Ramp From North					42nd Ave From East					NB TH 100 Ramp From South					42nd Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	0	0	1	1	5	110	0	0	115	16	0	34	4	54	2	68	28	0	98	268
07:15 AM	0	0	0	1	1	3	135	0	0	138	15	1	41	0	57	2	102	38	0	142	338
07:30 AM	0	0	0	1	1	11	135	0	0	146	20	0	37	0	57	0	118	47	0	165	369
07:45 AM	0	0	0	1	1	9	145	0	0	154	28	1	56	0	85	0	134	38	0	172	412
Total	0	0	0	4	4	28	525	0	0	553	79	2	168	4	253	4	422	151	0	577	1387
08:00 AM	0	0	0	1	1	7	105	0	0	112	31	1	44	0	76	0	109	57	0	166	355
08:15 AM	0	0	0	1	1	9	123	0	0	132	29	1	45	1	76	0	88	55	0	143	352
*** BREAK ***																					
Total	0	0	0	2	2	16	228	0	0	244	60	2	89	1	152	0	197	112	0	309	707
*** BREAK ***																					
04:15 PM	0	0	0	1	1	6	143	0	0	149	82	5	155	2	244	0	131	54	0	185	579
04:30 PM	0	0	0	3	3	11	144	0	0	155	55	2	161	0	218	0	126	44	0	170	546
04:45 PM	0	0	0	4	4	6	143	0	0	149	71	3	149	12	235	0	153	70	0	223	611
Total	0	0	0	8	8	23	430	0	0	453	208	10	465	14	697	0	410	168	0	578	1736
05:00 PM	0	0	0	1	1	11	152	0	0	163	84	3	163	2	252	0	152	59	0	211	627
05:15 PM	0	0	0	4	4	12	136	0	0	148	94	5	170	3	272	0	147	48	0	195	619
05:30 PM	0	0	0	2	2	8	131	0	0	139	59	1	133	2	195	0	142	79	0	221	557
Grand Total	0	0	0	21	21	98	1602	0	0	1700	584	23	1188	26	1821	4	1470	617	0	2091	5633
Apprch %	0	0	0	100		5.8	94.2	0	0		32.1	1.3	65.2	1.4		0.2	70.3	29.5	0		
Total %	0	0	0	0.4	0.4	1.7	28.4	0	0	30.2	10.4	0.4	21.1	0.5	32.3	0.1	26.1	11	0	37.1	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

42nd Ave N & Regent Ave
7:00-8:30 4:15-5:45
Robbinsdale, MN
cloudy, 30's

File Name : 42nd ave & regent ave
Site Code : 00000002
Start Date : 10/27/2010
Page No : 1

Groups Printed- Unshifted

	Regent Ave N From North					42nd Ave N From East					Regent Ave N From South					42nd Ave N From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	1	0	0	0	1	0	89	11	0	100	3	0	21	0	24	12	68	1	0	81	206
07:15 AM	4	0	0	0	4	1	128	5	0	134	4	0	21	0	25	9	117	1	0	127	290
07:30 AM	4	0	1	0	5	2	118	12	0	132	10	0	19	0	29	18	107	3	0	128	294
07:45 AM	1	0	1	0	2	1	159	19	0	179	8	0	22	0	30	36	134	3	0	173	384
Total	10	0	2	0	12	4	494	47	0	545	25	0	83	0	108	75	426	8	0	509	1174
08:00 AM	2	0	2	0	4	0	120	8	0	128	7	0	33	0	40	15	127	0	0	142	314
08:15 AM	3	2	1	0	6	1	111	2	0	114	3	1	24	0	28	4	115	2	0	121	269
*** BREAK ***																					
Total	5	2	3	0	10	1	231	10	0	242	10	1	57	0	68	19	242	2	0	263	583
*** BREAK ***																					
04:15 PM	2	1	0	0	3	6	115	5	0	126	6	0	17	0	23	23	175	2	0	200	352
04:30 PM	4	0	1	0	5	2	144	7	0	153	8	0	25	0	33	26	168	2	0	196	387
04:45 PM	2	1	2	0	5	3	129	7	0	139	6	0	12	0	18	29	199	3	0	231	393
Total	8	2	3	0	13	11	388	19	0	418	20	0	54	0	74	78	542	7	0	627	1132
05:00 PM	4	0	0	0	4	0	144	3	0	147	6	0	16	0	22	12	197	4	0	213	386
05:15 PM	1	0	3	0	4	3	134	13	0	150	10	0	13	0	23	22	173	2	0	197	374
05:30 PM	1	0	0	0	1	0	132	7	0	139	4	0	12	0	16	28	177	1	0	206	362
Grand Total	29	4	11	0	44	19	1523	99	0	1641	75	1	235	0	311	234	1757	24	0	2015	4011
Apprch %	65.9	9.1	25	0		1.2	92.8	6	0		24.1	0.3	75.6	0		11.6	87.2	1.2	0		
Total %	0.7	0.1	0.3	0	1.1	0.5	38	2.5	0	40.9	1.9	0	5.9	0	7.8	5.8	43.8	0.6	0	50.2	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

42nd Ave N & Quail Ave N
7:00-8:30 AM Turning Movement
Robbinsdale, MN
cloudy, 30's

File Name : 42nd ave & quail ave
Site Code : 00000003
Start Date : 10/28/2010
Page No : 1

Groups Printed- Unshifted

	From North					42nd Ave N From East					Quail Ave From South					42nd Ave N From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	0	0	0	0	0	110	1	0	111	1	0	5	0	6	1	80	0	0	81	198
07:15 AM	0	0	0	0	0	0	108	4	0	112	1	0	1	0	2	2	113	0	0	115	229
07:30 AM	0	0	0	0	0	0	134	3	0	137	0	0	5	0	5	1	112	0	0	113	255
07:45 AM	0	0	0	0	0	0	155	6	0	161	3	0	5	0	8	0	126	0	0	126	295
Total	0	0	0	0	0	0	507	14	0	521	5	0	16	0	21	4	431	0	0	435	977
08:00 AM	0	0	0	0	0	0	93	2	0	95	4	0	0	0	4	0	132	0	0	132	231
08:15 AM	0	0	0	0	0	0	105	2	0	107	0	0	2	0	2	0	109	0	0	109	218
*** BREAK ***																					
Total	0	0	0	0	0	0	198	4	0	202	4	0	2	0	6	0	241	0	0	241	449
*** BREAK ***																					
04:15 PM	0	0	0	0	0	0	128	5	0	133	3	0	3	0	6	3	165	0	0	168	307
04:30 PM	0	0	0	0	0	0	132	1	0	133	2	0	4	0	6	2	191	0	0	193	332
04:45 PM	0	0	0	0	0	0	136	2	0	138	2	0	3	0	5	4	196	0	0	200	343
Total	0	0	0	0	0	0	396	8	0	404	7	0	10	0	17	9	552	0	0	561	982
05:00 PM	0	0	0	0	0	0	131	3	0	134	5	0	3	0	8	2	195	0	0	197	339
05:15 PM	0	0	0	0	0	0	156	2	0	158	2	0	4	0	6	1	210	0	0	211	375
05:30 PM	0	0	0	0	0	0	137	3	0	140	3	0	2	0	5	2	210	0	0	212	357
Grand Total	0	0	0	0	0	0	1525	34	0	1559	26	0	37	0	63	18	1839	0	0	1857	3479
Apprch %	0	0	0	0		0	97.8	2.2	0		41.3	0	58.7	0		1	99	0	0		
Total %	0	0	0	0	0	0	43.8	1	0	44.8	0.7	0	1.1	0	1.8	0.5	52.9	0	0	53.4	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

42nd Ave & Railroad Ave
7:00-8:30 and 4:15-5:45
Robbinsdale, MN
sunny

File Name : 42nd ave & railroad ave
Site Code : 00000004
Start Date : 11/4/2010
Page No : 1

Groups Printed- Unshifted

	Railroad Ave From North					42nd Ave From East					Railroad Ave From South					42nd Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	3	0	0	0	3	1	111	1	0	113	2	0	1	0	3	0	82	1	0	83	202
07:15 AM	0	0	2	0	2	1	123	0	0	124	4	0	4	0	8	2	120	0	0	122	256
07:30 AM	1	0	2	0	3	3	131	0	0	134	4	0	3	0	7	0	120	0	0	120	264
07:45 AM	0	0	1	0	1	3	142	2	0	147	3	0	2	0	5	5	125	3	0	133	286
Total	4	0	5	0	9	8	507	3	0	518	13	0	10	0	23	7	447	4	0	458	1008
08:00 AM	1	0	0	0	1	0	79	0	0	79	1	0	1	0	2	3	119	1	0	123	205
08:15 AM	2	0	0	0	2	0	83	1	0	84	0	0	2	0	2	3	114	2	0	119	207
*** BREAK ***																					
Total	3	0	0	0	3	0	162	1	0	163	1	0	3	0	4	6	233	3	0	242	412
*** BREAK ***																					
04:15 PM	0	0	4	0	4	4	146	2	0	152	2	1	3	0	6	9	179	3	0	191	353
04:30 PM	1	0	4	0	5	2	152	0	0	154	5	0	1	0	6	6	178	1	0	185	350
04:45 PM	3	0	3	0	6	2	109	3	0	114	4	1	1	0	6	8	184	1	0	193	319
Total	4	0	11	0	15	8	407	5	0	420	11	2	5	0	18	23	541	5	0	569	1022
05:00 PM	0	2	3	0	5	3	135	5	0	143	1	0	3	0	4	5	159	2	0	166	318
05:15 PM	2	0	3	0	5	1	133	1	0	135	4	0	3	0	7	7	172	1	0	180	327
05:30 PM	2	0	2	0	4	1	125	2	0	128	1	0	1	0	2	12	166	2	0	180	314
Grand Total	15	2	24	0	41	21	1469	17	0	1507	31	2	25	0	58	60	1718	17	0	1795	3401
Apprch %	36.6	4.9	58.5	0		1.4	97.5	1.1	0		53.4	3.4	43.1	0		3.3	95.7	0.9	0		
Total %	0.4	0.1	0.7	0	1.2	0.6	43.2	0.5	0	44.3	0.9	0.1	0.7	0	1.7	1.8	50.5	0.5	0	52.8	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

42nd Ave & Hubbard Ave/driveway
7:00-8:30 AM Turning Movement
Robbinsdale, MN
sunny

File Name : 42nd ave & hubbard ave
Site Code : 00000007
Start Date : 11/4/2010
Page No : 1

Groups Printed- Unshifted

	driveway From North					42nd Ave From East					Hubbard Ave From South					42nd Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	0	0	0	0	0	1	111	1	0	113	3	0	3	0	6	10	73	0	0	83	202
07:15 AM	1	0	0	0	1	0	121	0	0	121	4	0	0	0	4	9	115	0	0	124	250
07:30 AM	2	0	0	0	2	1	133	1	0	135	6	0	2	0	8	10	113	0	0	123	268
07:45 AM	2	0	0	0	2	1	140	1	0	142	8	0	0	0	8	12	116	1	0	129	281
Total	5	0	0	0	5	3	505	3	0	511	21	0	5	0	26	41	417	1	0	459	1001
08:00 AM	2	0	0	0	2	6	69	1	0	76	5	0	2	0	7	9	112	0	0	121	206
08:15 AM	3	0	0	0	3	1	81	1	0	83	9	0	1	0	10	7	103	1	0	111	207
*** BREAK ***																					
Total	5	0	0	0	5	7	150	2	0	159	14	0	3	0	17	16	215	1	0	232	413
*** BREAK ***																					
04:15 PM	2	0	0	0	2	0	137	1	0	138	11	0	0	0	11	20	165	0	0	185	336
04:30 PM	6	0	0	0	6	0	143	1	0	144	11	0	2	0	13	7	176	0	0	183	346
04:45 PM	1	0	0	0	1	2	109	1	0	112	19	1	4	0	24	9	184	0	0	193	330
Total	9	0	0	0	9	2	389	3	0	394	41	1	6	0	48	36	525	0	0	561	1012
05:00 PM	2	0	0	0	2	2	143	0	0	145	11	0	1	1	13	15	146	0	0	161	321
05:15 PM	6	0	0	0	6	3	131	0	0	134	11	0	0	0	11	10	163	1	0	174	325
05:30 PM	4	0	0	0	4	1	125	1	0	127	15	0	1	0	16	14	163	2	0	179	326
Grand Total	31	0	0	0	31	18	1443	9	0	1470	113	1	16	1	131	132	1629	5	0	1766	3398
Apprch %	100	0	0	0		1.2	98.2	0.6	0		86.3	0.8	12.2	0.8		7.5	92.2	0.3	0		
Total %	0.9	0	0	0	0.9	0.5	42.5	0.3	0	43.3	3.3	0	0.5	0	3.9	3.9	47.9	0.1	0	52	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

42nd Ave & Co Rd 8/Broadway Ave
7:00-8:30 and 4:15-5:45
Robbinsdale, MN
sunny 50's

File Name : 42nd ave & co rd 8
Site Code : 00014845
Start Date : 11/4/2010
Page No : 1

Groups Printed- Unshifted

	Co Rd 8/Broadway From North					42nd Ave From East					Co Rd 8/Broadway From South					42nd Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	9	15	15	0	39	8	85	9	0	102	0	16	14	0	30	18	51	4	1	74	245
07:15 AM	8	20	19	1	48	5	84	13	0	102	10	13	26	2	51	24	88	3	1	116	317
07:30 AM	15	22	21	1	59	9	103	8	0	120	10	18	19	0	47	22	82	15	2	121	347
07:45 AM	11	22	19	1	53	7	112	9	1	129	3	18	18	1	40	20	93	13	0	126	348
Total	43	79	74	3	199	29	384	39	1	453	23	65	77	3	168	84	314	35	4	437	1257
08:00 AM	7	17	17	0	41	12	64	9	2	87	8	6	10	1	25	15	84	10	0	109	262
08:15 AM	9	17	10	1	37	11	48	7	0	66	4	6	20	1	31	23	92	7	1	123	257
*** BREAK ***																					
Total	16	34	27	1	78	23	112	16	2	153	12	12	30	2	56	38	176	17	1	232	519
*** BREAK ***																					
04:15 PM	11	52	25	1	89	37	89	22	4	152	13	41	33	1	88	28	130	17	1	176	505
04:30 PM	6	27	28	1	62	18	105	18	1	142	14	43	28	0	85	46	112	22	2	182	471
04:45 PM	7	28	17	0	52	12	75	15	2	104	17	28	25	2	72	37	154	17	1	209	437
Total	24	107	70	2	203	67	269	55	7	398	44	112	86	3	245	111	396	56	4	567	1413
05:00 PM	8	30	21	0	59	25	99	15	2	141	15	39	35	0	89	29	109	20	2	160	449
05:15 PM	9	27	25	2	63	27	87	19	2	135	17	41	34	4	96	32	138	15	1	186	480
05:30 PM	9	36	24	1	70	14	87	11	1	113	14	32	25	1	72	24	120	15	0	159	414
Grand Total	109	313	241	9	672	185	1038	155	15	1393	125	301	287	13	726	318	1253	158	12	1741	4532
Apprch %	16.2	46.6	35.9	1.3		13.3	74.5	11.1	1.1		17.2	41.5	39.5	1.8		18.3	72	9.1	0.7		
Total %	2.4	6.9	5.3	0.2	14.8	4.1	22.9	3.4	0.3	30.7	2.8	6.6	6.3	0.3	16	7	27.6	3.5	0.3	38.4	

WSB & Associates

701 Xenia Ave S
Minneapolis, MN

42nd Ave & Co Rd 81/Bottaneau Blvd
7:00-8::30 and 4:15-5:45
Robbinsdale, MN
sunny

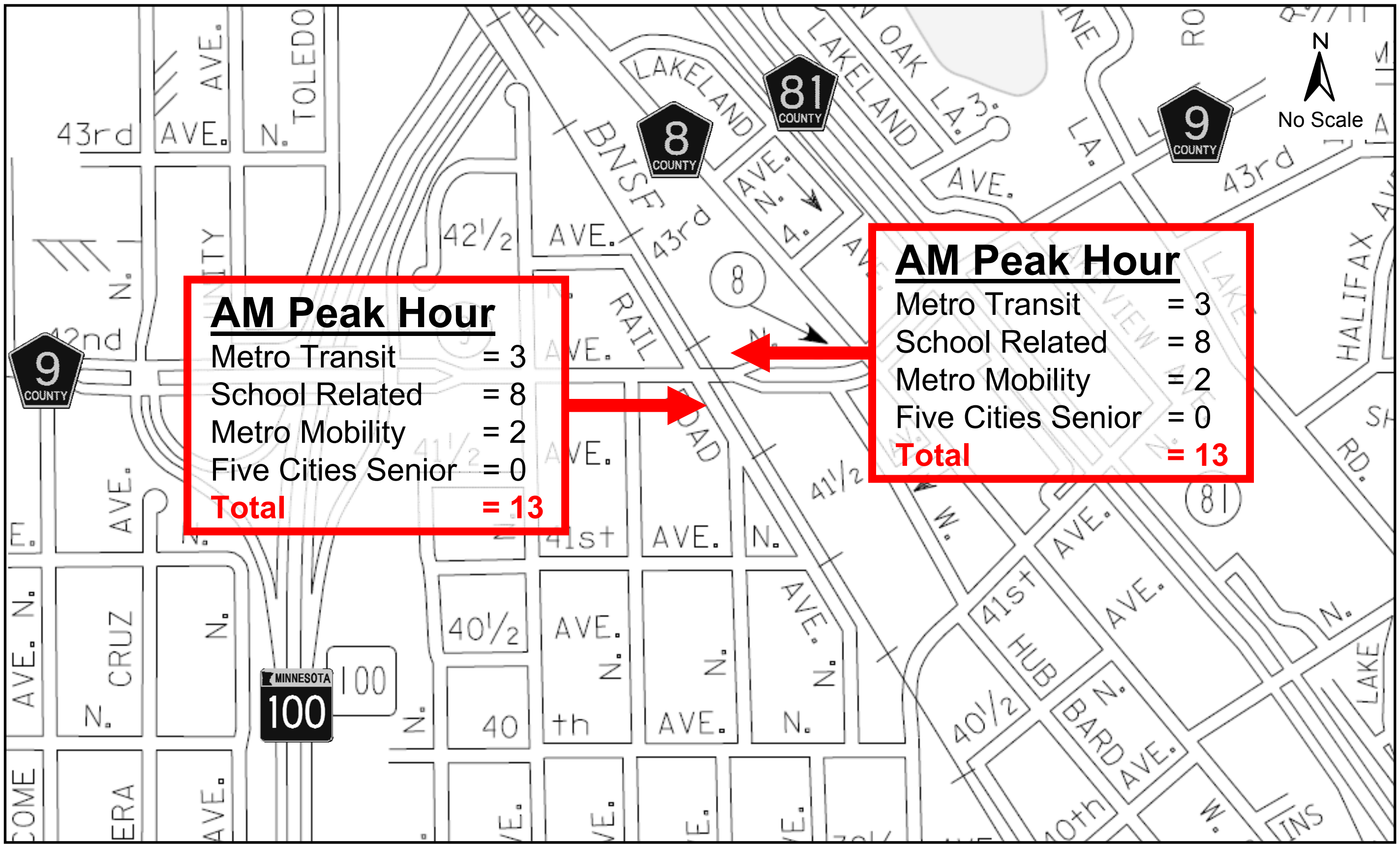
File Name : 42nd ave & co rd 81
Site Code : 00000006
Start Date : 11/3/2010
Page No : 1

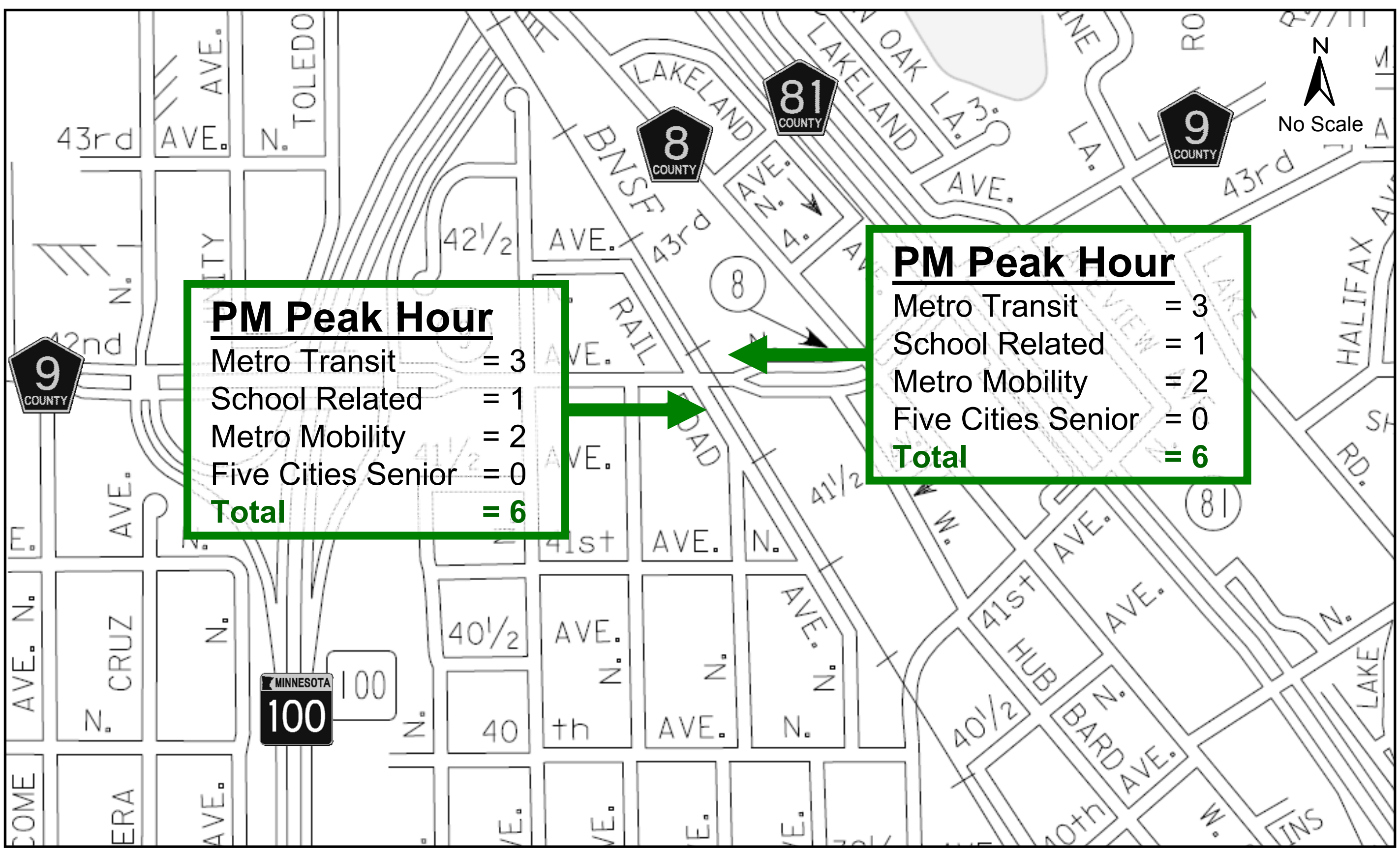
Groups Printed- Unshifted

	Co Rd 81/Bottaneau From North					42nd Ave From East					Co Rd 81/Bottaneau From South					42nd Ave From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	9	136	10	0	155	8	61	13	0	82	5	57	15	0	77	32	28	11	0	71	385
07:15 AM	16	144	6	0	166	12	61	12	0	85	1	67	26	0	94	55	56	21	0	132	477
07:30 AM	23	169	6	0	198	19	104	14	0	137	0	111	22	0	133	70	48	11	0	129	597
07:45 AM	19	168	12	0	199	9	80	17	0	106	1	84	22	0	107	55	45	6	0	106	518
Total	67	617	34	0	718	48	306	56	0	410	7	319	85	0	411	212	177	49	0	438	1977
08:00 AM	11	149	16	0	176	11	41	12	0	64	5	69	25	0	99	54	52	15	0	121	460
08:15 AM	8	139	3	0	150	16	73	8	0	97	5	54	35	0	94	36	53	10	0	99	440
*** BREAK ***																					
Total	19	288	19	0	326	27	114	20	0	161	10	123	60	0	193	90	105	25	0	220	900
*** BREAK ***																					
04:15 PM	20	113	22	0	155	17	66	5	0	88	15	172	54	0	241	35	110	21	0	166	650
04:30 PM	18	107	35	0	160	17	70	11	0	98	8	194	58	0	260	40	108	31	0	179	697
04:45 PM	19	84	22	0	125	21	60	7	0	88	12	199	54	0	265	34	118	19	0	171	649
Total	57	304	79	0	440	55	196	23	0	274	35	565	166	0	766	109	336	71	0	516	1996
05:00 PM	22	119	29	0	170	23	61	10	0	94	21	211	57	0	289	56	142	17	0	215	768
05:15 PM	13	107	32	0	152	26	75	17	0	118	10	203	62	0	275	57	107	21	0	185	730
05:30 PM	14	109	20	0	143	17	74	13	0	104	6	138	48	0	192	29	120	20	0	169	608
Grand Total	192	1544	213	0	1949	196	826	139	0	1161	89	1559	478	0	2126	553	987	203	0	1743	6979
Apprch %	9.9	79.2	10.9	0		16.9	71.1	12	0		4.2	73.3	22.5	0		31.7	56.6	11.6	0		
Total %	2.8	22.1	3.1	0	27.9	2.8	11.8	2	0	16.6	1.3	22.3	6.8	0	30.5	7.9	14.1	2.9	0	25	

Appendix C

Existing Bus Data


AM Peak Hour
Metro Transit = 3
School Related = 8
Metro Mobility = 2
Five Cities Senior = 0
Total = 13
AM Peak Hour
Metro Transit = 3
School Related = 8
Metro Mobility = 2
Five Cities Senior = 0
Total = 13
N
No Scale


PM Peak Hour
Metro Transit = 3
School Related = 1
Metro Mobility = 2
Five Cities Senior = 0
Total = 6
PM Peak Hour
Metro Transit = 3
School Related = 1
Metro Mobility = 2
Five Cities Senior = 0
Total = 6
N
No Scale

Appendix D

Detailed LOS Conditions and Queue Lengths

VISSIM Simulation Summary Results
Date: Tuesday, January 04, 2011
Measures of Effectiveness

2010 AM

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Control	Intersection Location	Appr	Forecast Volumes L	Forecast Volumes T	Forecast Volumes R	Forecast Volumes Total	Modeled Volumes L	Modeled Volumes T	Modeled Volumes R	Modeled Volumes Total	Error Volumes L	Error Volumes T	Error Volumes R	Volume Error by Approach Total	Volume Error by Approach %	Appr	Total Delay by Movement (Sec/Veh) L	Total Delay by Movement (Sec/Veh) T	Total Delay by Movement (Sec/Veh) R	Level of Service by Movement L	Level of Service by Movement T	Level of Service by Movement R	LOS by Approach (Sec/Veh) Delay	LOS by Approach (Sec/Veh) LOS	LOS by Intersection (Sec/Veh) Delay	LOS by Intersection (Sec/Veh) LOS	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Signalized	NB TH 100 Ramps &	NB	178	3	94	275	177	2	95	274	-1	-1	1	-1	0%	NB	31	33	10	C	C	B	24	C	14	B	NB	21	99	16	99	16	99
	42nd Avenue	WB	0	529	30	559	0	520	27	547	0	-9	-3	-12	-2%	WB	0	11	5	A	B	A	11	B			WB			16	157	15	158
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	180	476	0	656	173	483	0	656	-7	7	0	0	0%	EB	38	5	0	D	A	A	14	B			EB	22	107	18	107		
Unsignalized	Regent Avenue &	NB	95	0	29	124	95	0	29	124	0	0	0	0	0%	NB	12	0	9	B	A	A	11	B	1	A	NB	5	85	5	85	5	85
	42nd Avenue	WB	44	453	4	501	42	442	4	488	-2	-11	0	-13	-3%	WB	3	0	1	A	A	A	0	A			WB		38		38		38
		SB	4	0	11	15	4	0	10	14	0	0	-1	-1	-7%	SB	7	0	5	A	A	A	6	A			SB		27		27		27
		EB	7	485	78	570	5	496	77	578	-2	11	-1	8	1%	EB	2	0	1	A	A	A	0	A			EB		54		54		54
Unsignalized	Quail Avenue &	NB	11	0	8	19	11	0	7	18	0	0	-1	-1	-5%	NB	9	0	5	A	A	A	7	A	0	A	NB		33				33
	42nd Avenue	WB	15	490	0	505	17	477	0	494	2	-13	0	-11	-2%	WB	2	0	0	A	A	A	0	A			WB						
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	486	32	518	0	498	31	529	0	12	-1	11	2%	EB	0	0	1	A	A	A	0	A			EB				18		18
Unsignalized	Railroad Avenue &	NB	27	0	12	39	26	0	12	38	-1	0	0	-1	-3%	NB	9	0	5	A	A	A	8	A	0	A	NB	1	46	1	46	1	46
	42nd Avenue	WB	2	465	7	474	2	456	7	465	0	-9	0	-9	-2%	WB	1	0	1	A	A	A	0	A			WB						
		SB	5	0	13	18	5	0	13	18	0	0	0	0	0%	SB	11	0	5	B	A	A	7	A			SB	1	30	1	30	1	30
		EB	4	480	10	494	5	492	9	506	1	12	-1	12	2%	EB	2	0	1	A	A	A	0	A			EB		21		21		21
Unsignalized	Hubbard Avenue &	NB	0	0	23	23	0	0	22	22	0	0	-1	-1	-4%	NB	0	0	5	A	A	A	5	A	1	A	NB						32
	42nd Avenue	WB	0	474	0	474	0	465	0	465	0	-9	0	-9	-2%	WB	0	0	0	A	A	A	0	A			WB						
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	456	41	497	0	470	38	508	0	14	-3	11	2%	EB	0	1	1	A	A	A	1	A			EB				24		24
Signalized	CSAH 8 &	NB	70	55	31	156	68	59	27	154	-2	4	-4	-2	-1%	NB	15	13	7	B	B	A	13	B	11	B	NB	8	111	8	111	8	111
	42nd Avenue	WB	39	363	33	435	41	357	33	431	2	-6	0	-4	-1%	WB	17	11	7	B	B	A	11	B			WB	13	138	13	138	13	138
		SB	76	81	41	198	76	81	40	197	0	0	-1	-1	-1%	SB	14	14	8	B	B	A	13	B			SB	10	120	10	120	10	120
		EB	41	357	81	479	46	368	81	495	5	11	0	16	3%	EB	16	9	6	B	A	A	9	A			EB	14	142	14	142	14	142
Signalized	CSAH 81 &	NB	95	331	7	433	88	334	9	431	-7	3	2	-2	0%	NB	47	16	5	D	B	A	22	C	24	C	NB	29	133	30	133	27	133
	42nd Avenue	WB	55	271	51	377	58	270	50	378	3	-1	-1	1	0%	WB	52	33	23	D	C	C	35	C			WB	37	166	37	166	36	166
		SB	40	630	69	739	41	636	69	746	1	6	0	7	1%	SB	51	19	9	D	B	A	20	B			SB	44	259	44	259	43	259
		EB	53	189	222	464	50	194	228	472	-3	5	6	8	2%	EB	49	32	11	D	C	B	24	C			EB	26	151	28	151	25	151

VISSIM Simulation Summary Results
Date: Tuesday, January 04, 2011
Measures of Effectiveness

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2010 PM

Intersection																												Average & Maximum Traffic Queueing (feet)					
Control	Location	Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Appr	Left Turn		Through		Right Turn	
			L	T	R	Total	L	T	R	Total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS		Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signalized	NB TH 100 Ramps &	NB	643	13	279	935	641	13	275	929	-2	0	-4	-6	-1%	NB	30	34	16	C	C	B	26	C			NB	50	219	48	220	47	220
	42nd Avenue	WB	0	575	40	615	0	568	41	609	0	-7	1	-6	-1%	WB	0	19	7	A	B	A	18	B	21	C	WB			31	210	29	210
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	221	548	0	769	218	549	0	767	-3	1	0	-2	0%	EB	37	10	0	D	B	A	18	B			EB	29	133	26	133		
Unsignalized	Regent Avenue &	NB	66	0	30	96	66	0	30	96	0	0	0	0	0%	NB	14	0	9	B	A	A	12	B			NB	5	94	5	94	5	94
	42nd Avenue	WB	30	538	8	576	31	537	8	576	1	-1	0	0	0%	WB	4	0	1	A	A	A	0	A	1	A	WB		38		38		38
		SB	6	1	11	18	5	1	12	18	-1	0	1	0	0%	SB	9	12	7	A	B	A	8	A			SB	1	35	1	35	1	35
		EB	11	727	89	827	12	726	87	825	1	-1	-2	-2	0%	EB	2	0	2	A	A	A	0	A			EB		84		84		84
Unsignalized	Quail Avenue &	NB	21	0	11	32	18	0	11	29	-3	0	0	-3	-9%	NB	10	0	5	B	A	A	8	A			NB	1	41			1	41
	42nd Avenue	WB	8	555	0	563	9	561	0	570	1	6	0	7	1%	WB	3	0	0	A	A	A	0	A	0	A	WB						
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	754	9	763	0	752	8	760	0	-2	-1	-3	0%	EB	0	0	1	A	A	A	0	A			EB				13		13
Unsignalized	Railroad Avenue &	NB	21	1	14	36	20	0	16	36	-1	-1	2	0	0%	NB	12	2	6	B	A	A	9	A			NB	1	52	1	52	1	52
	42nd Avenue	WB	9	518	8	535	11	525	7	543	2	7	-1	8	1%	WB	3	0	1	A	A	A	0	A	1	A	WB		25		25		25
		SB	13	2	24	39	12	1	25	38	-1	-1	1	-1	-3%	SB	11	12	5	B	B	A	7	A			SB	1	36	1	36	1	36
		EB	5	734	26	765	4	734	26	764	-1	0	0	-1	0%	EB	1	0	2	A	A	A	0	A			EB		18		18		18
Unsignalized	Hubbard Avenue &	NB	0	0	52	52	0	0	49	49	0	0	-3	-3	-6%	NB	0	0	9	A	A	A	9	A			NB					1	52
	42nd Avenue	WB	0	535	0	535	0	543	0	543	0	8	0	8	1%	WB	0	0	0	A	A	A	0	A	3	A	WB						
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	719	42	761	0	723	41	764	0	4	-1	3	0%	EB	0	4	2	A	A	A	4	A			EB			2	105	2	105
Signalized	CSAH 8 &	NB	122	151	63	336	127	146	62	335	5	-5	-1	-1	0%	NB	41	37	25	D	D	C	36	D			NB	65	328	65	328	64	328
	42nd Avenue	WB	67	383	82	532	58	385	84	527	-9	2	2	-5	-1%	WB	41	26	21	D	C	C	27	C	24	C	WB	44	277	44	277	44	277
		SB	91	112	30	233	86	114	30	230	-5	2	0	-3	-1%	SB	36	35	22	D	D	C	34	C			SB	40	251	40	251	40	251
		EB	74	553	144	771	76	551	146	773	2	-2	2	2	0%	EB	26	14	9	C	B	A	14	B			EB	40	160	40	160	40	160
Signalized	CSAH 81 &	NB	212	807	51	1070	209	817	48	1074	-3	10	-3	4	0%	NB	49	24	14	D	C	B	28	C			NB	68	335	68	335	61	335
	42nd Avenue	WB	45	248	87	380	44	242	85	371	-1	-6	-2	-9	-2%	WB	53	38	25	D	D	C	37	D	30	C	WB	40	163	41	163	40	163
		SB	118	417	72	607	122	417	71	610	4	0	-1	3	0%	SB	49	21	7	D	C	A	25	C			SB	46	183	47	183	45	183
		EB	83	454	170	707	81	444	160	685	-2	-10	-10	-22	-3%	EB	47	37	11	D	D	B	32	C			EB	58	253	58	253	55	253

VISSIM Simulation Summary Results
Date: Friday, May 27, 2011
Measures of Effectiveness

K:\01484-05\Traffic\VISSIM_42nd\2030_AM_LRT\[2030AMLRT_MOEs.xls]MOE

2030 AM LRT

Control	Intersection Location	Appr	Forecast Volumes L	Forecast Volumes T	Forecast Volumes R	Forecast Volumes Total	Modeled Volumes L	Modeled Volumes T	Modeled Volumes R	Modeled Volumes Total	Error Volumes L	Error Volumes T	Error Volumes R	Volume Error by Approach Total	Volume Error by Approach %
Signalized	NB TH 100 Ramps & 42nd Avenue	NB	200	5	115	320	201	5	115	321	1	0	0	1	0%
		WB	0	590	35	625	0	588	33	621	0	-2	-2	-4	-1%
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%
		EB	200	640	0	840	194	658	0	852	-6	18	0	12	1%
Unsignalized	Regent Avenue & 42nd Avenue	NB	105	0	35	140	105	0	36	141	0	0	1	1	1%
		WB	50	505	5	560	45	500	4	549	-5	-5	-1	-11	-2%
		SB	5	0	15	20	4	0	15	19	-1	0	0	-1	-5%
		EB	10	655	90	755	9	679	85	773	-1	24	-5	18	2%
Unsignalized	Quail Avenue & 42nd Avenue	NB	15	0	10	25	14	0	10	24	-1	0	0	-1	-4%
		WB	20	545	0	565	22	534	0	556	2	-11	0	-9	-2%
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%
		EB	0	655	40	695	0	683	37	720	0	28	-3	25	4%
Unsignalized	Railroad Avenue & 42nd Avenue	NB	30	0	15	45	28	0	15	43	-2	0	0	-2	-4%
		WB	5	520	10	535	6	514	9	529	1	-6	-1	-6	-1%
		SB	10	0	15	25	9	0	14	23	-1	0	-1	-2	-8%
		EB	5	645	15	665	6	672	15	693	1	27	0	28	4%
Unsignalized	Hubbard Avenue & 42nd Avenue	NB	0	0	30	30	0	0	29	29	0	0	-1	-1	-3%
		WB	0	535	0	535	0	527	0	527	0	-8	0	-8	-1%
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%
		EB	0	505	165	670	0	520	176	696	0	15	11	26	4%
Signalized	CSAH 8 & 42nd Avenue	NB	80	65	35	180	75	67	34	176	-5	2	-1	-4	-2%
		WB	105	405	40	550	102	405	41	548	-3	0	1	-2	0%
		SB	85	130	50	265	86	128	48	262	1	-2	-2	-3	-1%
		EB	50	395	90	535	54	407	89	550	4	12	-1	15	3%
Signalized	CSAH 81 & 42nd Avenue	NB	105	370	10	485	96	377	11	484	-9	7	1	-1	0%
		WB	65	325	60	450	64	336	59	459	-1	11	-1	9	2%
		SB	45	700	120	865	45	701	117	863	0	1	-3	-2	0%
		EB	60	210	245	515	56	221	251	528	-4	11	6	13	3%
Signalized	RR Xing 42nd Avenue	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%
		WB	0	535	0	535	0	529	0	529	0	-6	0	-6	-1%
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%
		EB	0	670	0	670	0	696	0	696	0	26	0	26	4%

Intersection Location	Appr	Total Delay by Movement (Sec/Veh) L	Total Delay by Movement (Sec/Veh) T	Total Delay by Movement (Sec/Veh) R	Level of Service by Movement L	Level of Service by Movement T	Level of Service by Movement R	LOS by Approach (Sec/Veh) Delay	LOS by Approach (Sec/Veh) LOS	LOS by Intersection (Sec/Veh) Delay	LOS by Intersection (Sec/Veh) LOS
NB TH 100 Ramps & 42nd Avenue	NB	31	43	12	C	D	B	24	C		
	WB	0	13	6	A	B	A	13	B	15	B
	SB	0	0	0	A	A	A	0	A		
	EB	36	6	0	D	A	A	13	B		
Regent Avenue & 42nd Avenue	NB	15	0	11	C	A	B	14	B		
	WB	4	1	2	A	A	A	1	A	2	A
	SB	9	0	6	A	A	A	7	A		
	EB	2	1	2	A	A	A	1	A		
Quail Avenue & 42nd Avenue	NB	10	0	6	B	A	A	8	A		
	WB	2	0	0	A	A	A	0	A	0	A
	SB	0	0	0	A	A	A	0	A		
	EB	0	0	1	A	A	A	0	A		
Railroad Avenue & 42nd Avenue	NB	11	0	5	B	A	A	9	A		
	WB	0	0	0	A	A	A	0	A	2	A
	SB	14	0	6	B	A	A	9	A		
	EB	2	2	2	A	A	A	2	A		
Hubbard Avenue & 42nd Avenue	NB	0	0	6	A	A	A	6	A		
	WB	0	0	0	A	A	A	0	A	2	A
	SB	0	0	0	A	A	A	0	A		
	EB	0	3	2	A	A	A	3	A		
CSAH 8 & 42nd Avenue	NB	15	13	6	B	B	A	13	B		
	WB	26	16	13	C	B	B	18	B	14	B
	SB	14	13	8	B	B	A	12	B		
	EB	21	11	7	C	B	A	11	B		
CSAH 81 & 42nd Avenue	NB	46	19	6	D	B	A	24	C		
	WB	50	32	23	D	C	C	33	C	25	C
	SB	52	22	11	D	C	B	22	C		
	EB	49	30	12	D	C	B	23	C		
RR Xing 42nd Avenue	NB	0	0	0	A	A	A	0	A		
	WB	0	3	0	A	A	A	3	A	2	A
	SB	0	0	0	A	A	A	0	A		
	EB	0	1	0	A	A	A	1	A		

Intersection Location	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
NB TH 100 Ramps & 42nd Avenue	NB	23	108	19	108	19	108
	WB			21	205	20	205
	SB						
	EB	25	131	21	131		
Regent Avenue & 42nd Avenue	NB	8	108	8	108	8	108
	WB	1	91	1	91	1	91
	SB		33		33		33
	EB	1	102	1	102	1	102
Quail Avenue & 42nd Avenue	NB		36				36
	WB		16		16		
	SB						
	EB				22		22
Railroad Avenue & 42nd Avenue	NB	1	55	1	55	1	55
	WB		8		8		8
	SB		30		30		30
	EB	1	82	1	82	1	82
Hubbard Avenue & 42nd Avenue	NB					1	49
	WB				31		
	SB						
	EB			1	112	1	112
CSAH 8 & 42nd Avenue	NB	8	87	8	87	8	87
	WB	29	224	29	224	29	224
	SB	11	116	11	116	11	116
	EB	22	161	22	161	22	161
CSAH 81 & 42nd Avenue	NB	34	152	34	152	32	152
	WB	42	192	43	192	41	192
	SB	54	278	55	278	53	278
	EB	30	161	31	161	29	161
RR Xing 42nd Avenue	NB						
	WB			4	98		
	SB						
	EB			7	98		

VISSIM Simulation Summary Results
Date: Friday, May 27, 2011
Measures of Effectiveness

K:\01484-05\Traffic\VISSIM_42nd\2030_PM_LRT\[2030PMLRT_MOEs.xls]MOE

2030 PM LRT

Control	Intersection Location	Appr	Forecast Volumes L	Forecast Volumes T	Forecast Volumes R	Forecast Volumes Total	Modeled Volumes L	Modeled Volumes T	Modeled Volumes R	Modeled Volumes Total	Error Volumes L	Error Volumes T	Error Volumes R	Volume Error by Approach Total	Volume Error by Approach %	Appr	Total Delay by Movement (Sec/Veh) L	Total Delay by Movement (Sec/Veh) T	Total Delay by Movement (Sec/Veh) R	Level of Service by Movement L	Level of Service by Movement T	Level of Service by Movement R	LOS by Approach (Sec/Veh) Delay	LOS by Approach (Sec/Veh) LOS	LOS by Intersection (Sec/Veh) Delay	LOS by Intersection (Sec/Veh) LOS	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Signalized	NB TH 100 Ramps &	NB	715	15	310	1040	715	15	304	1034	0	0	-6	-6	-1%	NB	41	44	20	D	D	C	35	C			NB	73	281	72	281	70	281
	42nd Avenue	WB	0	735	45	780	0	730	41	771	0	-5	-4	-9	-1%	WB	0	17	7	A	B	A	16	B	24	C	WB			36	231	35	231
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	245	610	0	855	241	614	0	855	-4	4	0	0	0%	EB	37	8	0	D	A	A	16	B			EB	30	141	26	141		
Unsignalized	Regent Avenue &	NB	75	0	35	110	73	0	36	109	-2	0	1	-1	-1%	NB	15	0	11	C	A	B	14	B			NB	7	85	7	85	7	85
	42nd Avenue	WB	35	690	10	735	32	684	10	726	-3	-6	0	-9	-1%	WB	5	1	2	A	A	A	1	A	2	A	WB		49		49		49
		SB	10	5	15	30	10	5	13	28	0	0	-2	-2	-7%	SB	10	16	7	B	C	A	10	A			SB	1	44	1	44	1	44
		EB	15	805	100	920	14	809	95	918	-1	4	-5	-2	0%	EB	3	1	2	A	A	A	1	A			EB	1	79	1	79	1	79
Unsignalized	Quail Avenue &	NB	25	0	15	40	25	0	14	39	0	0	-1	-1	-3%	NB	10	0	5	B	A	A	8	A			NB	1	42			1	42
	42nd Avenue	WB	10	710	0	720	11	700	0	711	1	-10	0	-9	-1%	WB	3	0	0	A	A	A	0	A	0	A	WB		7		7		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	840	10	850	0	848	8	856	0	8	-2	6	1%	EB	0	0	2	A	A	A	0	A			EB				19		19
Unsignalized	Railroad Avenue &	NB	25	5	20	50	22	5	22	49	-3	0	2	-1	-2%	NB	10	12	6	B	B	A	8	A			NB		45		45		45
	42nd Avenue	WB	10	665	10	685	8	658	9	675	-2	-7	-1	-10	-1%	WB	1	0	0	A	A	A	0	A	2	A	WB		26		26		26
		SB	15	5	30	50	14	4	30	48	-1	-1	0	-2	-4%	SB	14	16	6	B	C	A	9	A			SB	1	49	1	49	1	49
		EB	10	815	30	855	9	824	30	863	-1	9	0	8	1%	EB	4	2	2	A	A	A	2	A			EB	1	75	1	75	1	75
Unsignalized	Hubbard Avenue &	NB	0	0	140	140	0	0	139	139	0	0	-1	-1	-1%	NB	0	0	15	A	A	C	15	C			NB					9	112
	42nd Avenue	WB	0	685	0	685	0	672	0	672	0	-13	0	-13	-2%	WB	0	0	0	A	A	A	0	A	6	A	WB				8		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	800	50	850	0	804	55	859	0	4	5	9	1%	EB	0	9	6	A	A	A	9	A			EB			14	208	14	208
Signalized	CSAH 8 &	NB	230	210	70	510	226	212	67	505	-4	2	-3	-5	-1%	NB	35	33	25	D	C	C	33	C			NB	73	452	73	452	73	452
	42nd Avenue	WB	75	420	95	590	72	412	98	582	-3	-8	3	-8	-1%	WB	61	33	25	E	C	C	35	D	25	C	WB	66	237	66	237	66	237
		SB	105	125	35	265	109	119	35	263	4	-6	0	-2	-1%	SB	30	25	14	C	C	B	26	C			SB	26	184	26	184	26	184
		EB	85	695	160	940	85	703	156	944	0	8	-4	4	0%	EB	24	15	12	C	B	B	15	B			EB	57	171	57	171	57	171
Signalized	CSAH 81 &	NB	235	895	60	1190	231	901	57	1189	-4	6	-3	-1	0%	NB	54	28	16	D	C	B	32	C			NB	100	357	100	357	99	357
	42nd Avenue	WB	50	275	100	425	51	275	99	425	1	0	-1	0	0%	WB	50	35	25	D	D	C	34	C	30	C	WB	42	202	43	202	42	202
		SB	135	465	80	680	134	469	77	680	-1	4	-3	0	0%	SB	57	22	8	E	C	A	27	C			SB	61	197	61	197	59	197
		EB	150	530	190	870	151	541	185	877	1	11	-5	7	1%	EB	46	29	11	D	C	B	28	C			EB	65	308	65	308	59	308
Signalized	RR Xing	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A			NB						
	42nd Avenue	WB	0	685	0	685	0	675	0	675	0	-10	0	-10	-1%	WB	0	2	0	A	A	A	2	A	1	A	WB			4	128		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	850	0	850	0	859	0	859	0	9	0	9	1%	EB	0	1	0	A	A	A	1	A			EB			8	102		

VISSIM Simulation Summary Results
Date: Friday, May 27, 2011
Measures of Effectiveness

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2030 AM BRT

Intersection		Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Appr	Average & Maximum Traffic Queueing (feet)					
Control	Location																											Left Turn		Through		Right Turn	
			L	T	R	Total	L	T	R	Total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS		Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signalized	NB TH 100 Ramps &	NB	200	5	114	319	199	6	113	318	-1	1	-1	-1	0%	NB	31	35	11	C	D	B	24	C	15	B	NB	23	114	19	115	19	114
	42nd Avenue	WB	0	590	35	625	0	588	33	621	0	-2	-2	-4	-1%	WB	0	13	6	A	B	A	13	B			WB			21	173	19	173
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	200	618	0	818	193	635	0	828	-7	17	0	10	1%	EB	38	6	0	D	A	A	13	B			EB	25	135	21	135		
Unsignalized	Regent Avenue &	NB	105	0	35	140	104	0	36	140	-1	0	1	0	0%	NB	15	0	11	C	A	B	14	B	2	A	NB	8	125	8	125	8	125
	42nd Avenue	WB	50	505	5	560	44	501	5	550	-6	-4	0	-10	-2%	WB	4	1	1	A	A	A	1	A			WB		103		103		103
		SB	5	0	15	20	4	0	15	19	-1	0	0	-1	-5%	SB	9	0	6	A	A	A	7	A			SB		34		34		34
		EB	10	632	90	732	9	653	86	748	-1	21	-4	16	2%	EB	3	1	1	A	A	A	1	A			EB		78		78		78
Unsignalized	Quail Avenue &	NB	15	0	10	25	13	0	10	23	-2	0	0	-2	-8%	NB	10	0	5	B	A	A	8	A	0	A	NB		36				36
	42nd Avenue	WB	20	545	0	565	21	536	0	557	1	-9	0	-8	-1%	WB	3	0	0	A	A	A	0	A			WB		54		54		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	632	40	672	0	656	37	693	0	24	-3	21	3%	EB	0	0	1	A	A	A	0	A			EB				21		21
Unsignalized	Railroad Avenue &	NB	30	0	15	45	28	0	15	43	-2	0	0	-2	-4%	NB	9	0	6	A	A	A	8	A	1	A	NB		49		49		49
	42nd Avenue	WB	5	520	10	535	6	516	9	531	1	-4	-1	-4	-1%	WB	0	0	0	A	A	A	0	A			WB		4		4		4
		SB	10	0	15	25	9	0	14	23	-1	0	-1	-2	-8%	SB	16	0	6	C	A	A	10	A			SB		34		34		34
		EB	5	622	15	642	6	645	15	666	1	23	0	24	4%	EB	3	2	1	A	A	A	2	A			EB		57		57		57
Unsignalized	Hubbard Avenue &	NB	0	0	30	30	0	0	29	29	0	0	-1	-1	-3%	NB	0	0	6	A	A	A	6	A	1	A	NB					1	51
	42nd Avenue	WB	0	535	0	535	0	528	0	528	0	-7	0	-7	-1%	WB	0	0	0	A	A	A	0	A			WB				8		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	505	142	647	0	520	150	670	0	15	8	23	4%	EB	0	2	2	A	A	A	2	A			EB			1	108	1	108
Signalized	CSAH 8 &	NB	80	65	35	180	75	67	34	176	-5	2	-1	-4	-2%	NB	15	13	6	B	B	A	13	B	13	B	NB	8	87	8	87	8	87
	42nd Avenue	WB	93	405	40	538	90	407	41	538	-3	2	1	0	0%	WB	27	15	11	C	B	B	17	B			WB	26	225	26	225	26	225
		SB	85	122	50	257	87	120	47	254	2	-2	-3	-3	-1%	SB	14	13	8	B	B	A	12	B			SB	11	146	11	146	11	146
		EB	50	395	90	535	54	407	90	551	4	12	0	16	3%	EB	18	10	7	B	B	A	10	B			EB	20	167	20	167	20	167
Signalized	CSAH 81 &	NB	105	370	10	485	96	376	11	483	-9	6	1	-2	0%	NB	45	18	6	D	B	A	23	C	25	C	NB	34	159	34	159	32	159
	42nd Avenue	WB	65	320	60	445	66	331	59	456	1	11	-1	11	2%	WB	51	32	22	D	C	C	33	C			WB	42	194	42	194	40	194
		SB	45	700	113	858	45	702	111	858	0	2	-2	0	0%	SB	53	21	11	D	C	B	21	C			SB	54	299	55	299	53	299
		EB	60	210	245	515	56	223	249	528	-4	13	4	13	3%	EB	51	32	12	D	C	B	25	C			EB	31	153	32	153	30	153
Signalized	RR Xing	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A	3	A	NB						
	42nd Avenue	WB	0	535	0	535	0	530	0	530	0	-5	0	-5	-1%	WB	0	4	0	A	A	A	4	A			WB			5	112		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	647	0	647	0	669	0	669	0	22	0	22	3%	EB	0	2	0	A	A	A	2	A			EB			9	97		

VISSIM Simulation Summary Results
Date: Friday, May 27, 2011
Measures of Effectiveness

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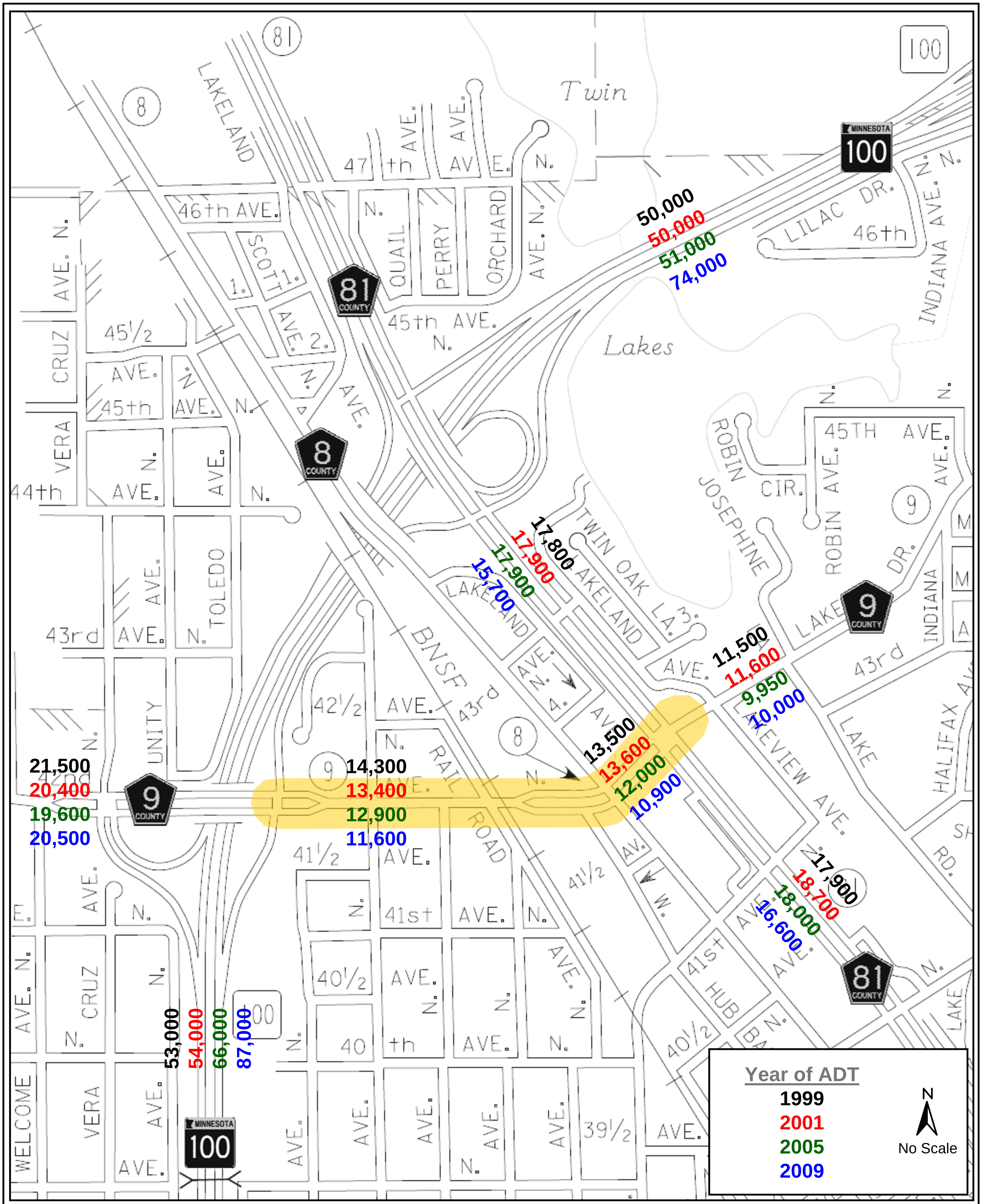
2030 PM BRT

Intersection		Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Appr	Average & Maximum Traffic Queueing (feet)					
Control	Location		L	T	R	Total	L	T	R	Total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS		Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Signalized	NB TH 100 Ramps &	NB	715	15	310	1040	707	18	307	1032	-8	3	-3	-8	-1%	NB	41	43	21	D	D	C	35	D	24	C	NB	72	272	70	272	69	272
	42nd Avenue	WB	0	716	45	761	0	706	40	746	0	-10	-5	-15	-2%	WB	0	17	8	A	B	A	17	B			WB			35	232	34	232
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	245	610	0	855	239	619	0	858	-6	9	0	3	0%	EB	38	8	0	D	A	A	16	B			EB	30	153	26	153		
Unsignalized	Regent Avenue &	NB	75	0	35	110	73	0	37	110	-2	0	2	0	0%	NB	15	0	10	C	A	B	13	B	2	A	NB	6	89	6	89	6	89
	42nd Avenue	WB	35	671	10	716	32	658	10	700	-3	-13	0	-16	-2%	WB	6	1	1	A	A	A	1	A			WB		105		105		105
		SB	10	5	15	30	8	5	14	27	-2	0	-1	-3	-10%	SB	12	14	8	B	B	A	10	B			SB	1	48	1	48	1	48
		EB	15	805	100	920	13	818	94	925	-2	13	-6	5	1%	EB	3	1	2	A	A	A	1	A			EB		99		99		99
Unsignalized	Quail Avenue &	NB	25	0	15	40	24	0	15	39	-1	0	0	-1	-3%	NB	10	0	6	B	A	A	8	A	1	A	NB	1	45			1	45
	42nd Avenue	WB	10	691	0	701	11	675	0	686	1	-16	0	-15	-2%	WB	3	0	0	A	A	A	0	A			WB		31		31		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	840	10	850	0	855	8	863	0	15	-2	13	2%	EB	0	1	1	A	A	A	1	A			EB				6		6
Unsignalized	Railroad Avenue &	NB	25	5	20	50	22	5	21	48	-3	0	1	-2	-4%	NB	10	11	7	B	B	A	9	A	2	A	NB		42		42		42
	42nd Avenue	WB	10	646	10	666	10	632	9	651	0	-14	-1	-15	-2%	WB	1	0	1	A	A	A	0	A			WB		8		8		8
		SB	15	5	30	50	14	4	30	48	-1	-1	0	-2	-4%	SB	15	17	6	C	C	A	10	A			SB	1	50	1	50	1	50
		EB	10	815	30	855	10	834	26	870	0	19	-4	15	2%	EB	2	3	2	A	A	A	3	A			EB	1	117	1	117	1	117
Unsignalized	Hubbard Avenue &	NB	0	0	124	124	0	0	124	124	0	0	0	0	0%	NB	0	0	14	A	A	B	14	B	6	A	NB					8	101
	42nd Avenue	WB	0	666	0	666	0	647	0	647	0	-19	0	-19	-3%	WB	0	0	0	A	A	A	0	A			WB				8		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	800	50	850	0	813	56	869	0	13	6	19	2%	EB	0	10	6	A	B	A	10	A			EB			16	215	16	215
Signalized	CSAH 8 &	NB	211	202	70	483	206	207	65	478	-5	5	-5	-5	-1%	NB	34	30	24	C	C	C	31	C	25	C	NB	64	430	64	430	64	430
	42nd Avenue	WB	75	420	95	590	76	408	95	579	1	-12	0	-11	-2%	WB	71	34	26	E	C	C	38	D			WB	72	282	72	282	72	282
		SB	105	125	35	265	106	122	34	262	1	-3	-1	-3	-1%	SB	32	24	14	C	C	B	26	C			SB	27	182	27	182	27	182
		EB	85	679	160	924	88	687	160	935	3	8	0	11	1%	EB	25	14	12	C	B	B	15	B			EB	57	171	57	171	57	171
Signalized	CSAH 81 &	NB	235	895	60	1190	233	890	59	1182	-2	-5	-1	-8	-1%	NB	54	27	16	D	C	B	32	C	30	C	NB	98	327	98	327	97	327
	42nd Avenue	WB	50	275	100	425	51	276	101	428	1	1	1	3	1%	WB	53	35	26	D	D	C	35	D			WB	43	184	44	184	43	184
		SB	135	465	80	680	135	459	79	673	0	-6	-1	-7	-1%	SB	55	22	8	E	C	A	27	C			SB	60	205	61	205	59	205
		EB	139	525	190	854	139	536	185	860	0	11	-5	6	1%	EB	44	27	10	D	C	B	26	C			EB	59	305	59	305	54	305
Signalized	RR Xing	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A	3	A	NB						
	42nd Avenue	WB	0	666	0	666	0	650	0	650	0	-16	0	-16	-2%	WB	0	4	0	A	A	A	4	A			WB			6	121		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	850	0	850	0	868	0	868	0	18	0	18	2%	EB	0	2	0	A	A	A	2	A			EB			11	103		

Appendix E

Historical Traffic Counts



Hennepin County
Bottineau Transitway
Robbinsdale, MN

Appendix E
Historical ADTs
(Mn/DOT Flow Maps)

Appendix F

Sensitivity Analysis Results

(Revised Forecasts: Annual growth rate of one percent)

GROWTH SCENARIO
2030 AM LRT

VISSIM Simulation Summary Results
Date: Friday, May 27, 2011
Measures of Effectiveness

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Intersection			Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach			Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)			Average & Maximum Traffic Queueing (feet)					
Control	Location	Appr	L	T	R	Total	L	T	R	Total	L	T	R	Total	%	Appr	L	T	R	L	T	R	Delay	LOS	Delay	LOS	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Signalized	NB TH 100 Ramps & 42nd Avenue	NB	220	5	125	350	218	6	125	349	-2	1	0	-1	0%	NB	31	39	12	C	D	B	24	C	15	B	NB	24	113	21	113	20	113
		WB	0	650	40	690	0	652	36	688	0	2	-4	-2	0%	WB	0	14	7	A	B	A	14	B			WB			25	204	24	204
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	220	700	0	920	213	717	0	930	-7	17	0	10	1%	EB	37	6	0	D	A	A	13	B			EB	27	144	22	144		
Unsignalized	Regent Avenue & 42nd Avenue	NB	120	0	40	160	121	0	40	161	1	0	0	1	1%	NB	18	0	14	C	A	B	17	C	3	A	NB	13	127	13	127	13	127
		WB	55	555	5	615	49	551	5	605	-6	-4	0	-10	-2%	WB	5	1	1	A	A	A	1	A			WB		62		62		62
		SB	5	0	15	20	4	0	15	19	-1	0	0	-1	-5%	SB	16	0	6	C	A	A	8	A			SB	1	34	1	34	1	34
		EB	10	715	100	825	9	738	96	843	-1	23	-4	18	2%	EB	2	1	2	A	A	A	1	A			EB		88		88		88
Unsignalized	Quail Avenue & 42nd Avenue	NB	15	0	10	25	14	0	10	24	-1	0	0	-1	-4%	NB	10	0	6	B	A	A	8	A	1	A	NB		36				36
		WB	20	600	0	620	23	591	0	614	3	-9	0	-6	-1%	WB	3	0	0	A	A	A	0	A			WB		35		35		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	720	40	760	0	744	38	782	0	24	-2	22	3%	EB	0	1	1	A	A	A	1	A			EB				29		29
Unsignalized	Railroad Avenue & 42nd Avenue	NB	35	0	15	50	34	0	14	48	-1	0	-1	-2	-4%	NB	11	0	6	B	A	A	10	A	2	A	NB	1	51	1	51	1	51
		WB	5	565	10	580	6	562	9	577	1	-3	-1	-3	-1%	WB	1	0	1	A	A	A	0	A			WB		9		9		9
		SB	10	0	20	30	9	0	18	27	-1	0	-2	-3	-10%	SB	17	0	5	C	A	A	9	A			SB		31		31		31
		EB	5	710	15	730	6	734	13	753	1	24	-2	23	3%	EB	2	2	2	A	A	A	2	A			EB	1	77	1	77	1	77
Unsignalized	Hubbard Avenue & 42nd Avenue	NB	0	0	30	30	0	0	29	29	0	0	-1	-1	-3%	NB	0	0	6	A	A	A	6	A	2	A	NB					1	49
		WB	0	580	0	580	0	574	0	574	0	-6	0	-6	-1%	WB	0	0	0	A	A	A	0	A			WB				34		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	565	170	735	0	579	180	759	0	14	10	24	3%	EB	0	3	2	A	A	A	3	A			EB			2	120	2	120
Signalized	CSAH 8 & 42nd Avenue	NB	90	70	40	200	85	73	39	197	-5	3	-1	-3	-2%	NB	16	12	6	B	B	A	13	B	15	B	NB	9	89	9	89	9	89
		WB	110	435	45	590	109	438	45	592	-1	3	0	2	0%	WB	32	17	16	C	B	B	20	B			WB	36	194	36	194	36	194
		SB	95	140	55	290	96	140	53	289	1	0	-2	-1	0%	SB	14	14	9	B	B	A	13	B			SB	13	143	13	143	13	143
		EB	55	440	100	595	59	453	99	611	4	13	-1	16	3%	EB	22	11	8	C	B	A	12	B			EB	26	169	26	169	26	169
Signalized	CSAH 81 & 42nd Avenue	NB	115	405	10	530	108	411	11	530	-7	6	1	0	0%	NB	46	20	6	D	C	A	25	C	26	C	NB	38	162	39	162	36	162
		WB	70	355	65	490	68	368	64	500	-2	13	-1	10	2%	WB	54	30	25	D	C	C	33	C			WB	46	194	47	194	45	194
		SB	50	770	120	940	52	769	119	940	2	-1	-1	0	0%	SB	49	25	13	D	C	B	25	C			SB	67	322	67	322	65	322
		EB	65	235	275	575	62	248	279	589	-3	13	4	14	2%	EB	46	28	13	D	C	B	23	C			EB	30	183	32	183	29	183
Signalized	RR Xing 42nd Avenue	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A	1	A	NB						
		WB	0	580	0	580	0	577	0	577	0	-3	0	-3	-1%	WB	0	2	0	A	A	A	2	A			WB			4	94		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	735	0	735	0	759	0	759	0	24	0	24	3%	EB	0	1	0	A	A	A	1	A			EB			8	98		

GROWTH SCENARIO
2030 PM LRT

VISSIM Simulation Summary Results
Date: Friday, May 27, 2011
Measures of Effectiveness

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Control	Intersection Location	Appr	Forecast Volumes L	Forecast Volumes T	Forecast Volumes R	Forecast Volumes Total	Modeled Volumes L	Modeled Volumes T	Modeled Volumes R	Modeled Volumes Total	Error Volumes L	Error Volumes T	Error Volumes R	Volume Error by Approach Total	Volume Error by Approach %
Signalized	NB TH 100 Ramps &	NB	785	20	345	1150	785	17	343	1145	0	-3	-2	-5	0%
	42nd Avenue	WB	0	805	50	855	0	804	45	849	0	-1	-5	-6	-1%
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%
		EB	270	670	0	940	261	677	0	938	-9	7	0	-2	0%
Unsignalized	Regent Avenue &	NB	85	0	40	125	84	0	41	125	-1	0	1	0	0%
	42nd Avenue	WB	40	755	10	805	38	752	11	801	-2	-3	1	-4	0%
		SB	10	5	15	30	11	4	13	28	1	-1	-2	-2	-7%
		EB	15	890	110	1015	12	896	111	1019	-3	6	1	4	0%
Unsignalized	Quail Avenue &	NB	30	0	15	45	29	0	15	44	-1	0	0	-1	-2%
	42nd Avenue	WB	10	775	0	785	10	773	0	783	0	-2	0	-2	0%
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%
		EB	0	925	15	940	0	934	13	947	0	9	-2	7	1%
Unsignalized	Railroad Avenue &	NB	30	5	20	55	27	5	21	53	-3	0	1	-2	-4%
	42nd Avenue	WB	15	725	10	750	11	726	9	746	-4	1	-1	-4	-1%
		SB	20	5	30	55	18	6	30	54	-2	1	0	-1	-2%
		EB	10	895	35	940	10	902	38	950	0	7	3	10	1%
Unsignalized	Hubbard Avenue &	NB	0	0	145	145	0	0	143	143	0	0	-2	-2	-1%
	42nd Avenue	WB	0	750	0	750	0	741	0	741	0	-9	0	-9	-1%
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%
		EB	0	880	55	935	0	875	61	936	0	-5	6	1	0%
Signalized	CSAH 8 &	NB	245	225	80	550	249	217	78	544	4	-8	-2	-6	-1%
	42nd Avenue	WB	85	465	105	655	78	456	107	641	-7	-9	2	-14	-2%
		SB	115	140	40	295	116	139	38	293	1	-1	-2	-2	-1%
		EB	90	755	180	1025	92	744	181	1017	2	-11	1	-8	-1%
Signalized	CSAH 81 &	NB	260	985	65	1310	246	985	63	1294	-14	0	-2	-16	-1%
	42nd Avenue	WB	55	305	110	470	53	307	109	469	-2	2	-1	-1	0%
		SB	145	510	90	745	139	517	91	747	-6	7	1	2	0%
		EB	160	580	210	950	155	576	208	939	-5	-4	-2	-11	-1%
Signalized	RR Xing	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%
	42nd Avenue	WB	0	750	0	750	0	746	0	746	0	-4	0	-4	-1%
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%
		EB	0	935	0	935	0	941	0	941	0	6	0	6	1%

Intersection Location	Appr	Total Delay by Movement (Sec/Veh) L	T	R	Level of Service by Movement L	T	R	LOS by Approach (Sec/Veh) Delay	LOS	LOS by Intersection (Sec/Veh) Delay	LOS
NB TH 100 Ramps &	NB	47	48	26	D	D	C	41	D		
42nd Avenue	WB	0	18	8	A	B	A	17	B	26	C
	SB	0	0	0	A	A	A	0	A		
	EB	38	9	0	D	A	A	17	B		
Regent Avenue &	NB	19	0	12	C	A	B	17	C		
42nd Avenue	WB	7	1	2	A	A	A	1	A	2	A
	SB	15	19	8	C	C	A	12	B		
	EB	4	1	2	A	A	A	1	A		
Quail Avenue &	NB	13	0	5	B	A	A	10	B		
42nd Avenue	WB	5	0	0	A	A	A	0	A	1	A
	SB	0	0	0	A	A	A	0	A		
	EB	0	1	2	A	A	A	1	A		
Railroad Avenue &	NB	12	14	6	B	B	A	10	A		
42nd Avenue	WB	1	0	0	A	A	A	0	A	2	A
	SB	16	20	6	C	C	A	11	B		
	EB	3	2	3	A	A	A	2	A		
Hubbard Avenue &	NB	0	0	23	A	A	C	23	C		
42nd Avenue	WB	0	0	0	A	A	A	0	A	10	B
	SB	0	0	0	A	A	A	0	A		
	EB	0	17	11	A	C	B	17	C		
CSAH 8 &	NB	42	37	31	D	D	C	38	D		
42nd Avenue	WB	73	42	31	E	D	C	44	D	30	C
	SB	37	25	16	D	C	B	29	C		
	EB	30	16	13	C	B	B	17	B		
CSAH 81 &	NB	68	37	25	E	D	C	42	D		
42nd Avenue	WB	51	33	25	D	C	C	33	C	34	C
	SB	60	24	10	E	C	B	29	C		
	EB	48	27	11	D	C	B	27	C		
RR Xing	NB	0	0	0	A	A	A	0	A		
42nd Avenue	WB	0	2	0	A	A	A	2	A	2	A
	SB	0	0	0	A	A	A	0	A		
	EB	0	2	0	A	A	A	2	A		

Intersection Location	Appr	Average & Maximum Traffic Queueing (feet): Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
NB TH 100 Ramps &	NB	84	295	83	296	81	296
42nd Avenue	WB			41	257	40	257
	SB						
	EB	33	135	29	136		
Regent Avenue &	NB	9	92	9	92	9	92
42nd Avenue	WB	1	94	1	94	1	94
	SB	1	43	1	43	1	43
	EB	1	126	1	126	1	126
Quail Avenue &	NB	1	47			1	47
42nd Avenue	WB		26		26		
	SB						
	EB				37		37
Railroad Avenue &	NB	1	48	1	48	1	48
42nd Avenue	WB		24		24		24
	SB	1	52	1	52	1	52
	EB	2	97	2	97	2	97
Hubbard Avenue &	NB					16	136
42nd Avenue	WB				15		
	SB						
	EB			41	328	41	328
CSAH 8 &	NB	98	497	98	497	98	497
42nd Avenue	WB	94	328	94	328	94	328
	SB	34	211	34	211	34	211
	EB	73	170	73	170	73	170
CSAH 81 &	NB	157	719	157	719	156	719
42nd Avenue	WB	45	187	46	187	45	187
	SB	68	215	68	215	66	215
	EB	67	364	67	364	61	364
RR Xing	NB						
42nd Avenue	WB			4	134		
	SB						
	EB			10	107		

GROWTH SCENARIO
2030 AM BRT

VISSIM Simulation Summary Results
Date: Friday, May 27, 2011
Measures of Effectiveness

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Intersection Control	Intersection Location	Appr	Forecast Volumes L	Forecast Volumes T	Forecast Volumes R	Forecast Volumes Total	Modeled Volumes L	Modeled Volumes T	Modeled Volumes R	Modeled Volumes Total	Error Volumes L	Error Volumes T	Error Volumes R	Volume Error by Approach Total	Volume Error by Approach %	Appr	Total Delay by Movement (Sec/Veh) L	Total Delay by Movement (Sec/Veh) T	Total Delay by Movement (Sec/Veh) R	Level of Service by Movement L	Level of Service by Movement T	Level of Service by Movement R	LOS by Approach (Sec/Veh) Delay	LOS by Approach (Sec/Veh) LOS	LOS by Intersection (Sec/Veh) Delay	LOS by Intersection (Sec/Veh) LOS	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Signalized	**NB TH 100 Ramps &**	NB	220	5	119	344	220	5	119	344	0	0	0	0	0%	NB	30	37	11	C	D	B	24	C			NB	23	124	20	125	19	125
	42nd Avenue	WB	0	650	40	690	0	653	36	689	0	3	-4	-1	0%	WB	0	14	7	A	B	A	14	B	15	B	WB			25	195	24	195
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	220	683	0	903	214	700	0	914	-6	17	0	11	1%	EB	38	6	0	D	A	A	13	B			EB	28	141	24	142		
Unsignalized	**Regent Avenue &**	NB	120	0	40	160	121	0	40	161	1	0	0	1	1%	NB	18	0	14	C	A	B	17	C			NB	12	137	12	137	12	137
	42nd Avenue	WB	55	555	5	615	49	554	5	608	-6	-1	0	-7	-1%	WB	6	1	1	A	A	A	1	A	3	A	WB	1	109	1	109	1	109
		SB	5	0	15	20	4	0	15	19	-1	0	0	-1	-5%	SB	12	0	7	B	A	A	8	A			SB	1	38	1	38	1	38
		EB	10	692	100	802	9	715	95	819	-1	23	-5	17	2%	EB	2	1	2	A	A	A	1	A			EB	1	131	1	131	1	131
Unsignalized	**Quail Avenue &**	NB	15	0	10	25	13	0	10	23	-2	0	0	-2	-8%	NB	10	0	6	B	A	A	8	A			NB		39				39
	42nd Avenue	WB	20	600	0	620	23	594	0	617	3	-6	0	-3	0%	WB	3	0	0	A	A	A	0	A	1	A	WB		29		29		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	697	40	737	0	723	37	760	0	26	-3	23	3%	EB	0	1	1	A	A	A	1	A			EB				28		28
Unsignalized	**Railroad Avenue &**	NB	35	0	15	50	34	0	14	48	-1	0	-1	-2	-4%	NB	10	0	6	B	A	A	9	A			NB		46		46		46
	42nd Avenue	WB	5	565	10	580	6	564	9	579	1	-1	-1	-1	0%	WB	0	0	0	A	A	A	0	A	2	A	WB		10		10		10
		SB	10	0	20	30	9	0	18	27	-1	0	-2	-3	-10%	SB	12	0	5	B	A	A	7	A			SB		38		38		38
		EB	5	687	15	707	6	712	14	732	1	25	-1	25	4%	EB	4	2	3	A	A	A	2	A			EB	1	54	1	54	1	54
Unsignalized	**Hubbard Avenue &**	NB	0	0	30	30	0	0	29	29	0	0	-1	-1	-3%	NB	0	0	6	A	A	A	6	A			NB					1	48
	42nd Avenue	WB	0	580	0	580	0	576	0	576	0	-4	0	-4	-1%	WB	0	0	0	A	A	A	0	A	2	A	WB						
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	565	147	712	0	580	158	738	0	15	11	26	4%	EB	0	3	2	A	A	A	3	A			EB			1	95	1	95
Signalized	**CSAH 8 &**	NB	90	70	40	200	85	73	39	197	-5	3	-1	-3	-2%	NB	16	12	6	B	B	A	13	B			NB	9	90	9	90	9	90
	42nd Avenue	WB	98	435	45	578	96	441	45	582	-2	6	0	4	1%	WB	31	17	14	C	B	B	19	B	14	B	WB	34	233	34	233	34	233
		SB	95	132	55	282	97	131	52	280	2	-1	-3	-2	-1%	SB	14	14	9	B	B	A	13	B			SB	13	134	13	134	13	134
		EB	55	440	100	595	59	452	98	609	4	12	-2	14	2%	EB	21	11	7	C	B	A	11	B			EB	23	159	23	159	23	159
Signalized	**CSAH 81 &**	NB	115	405	10	530	107	410	11	528	-8	5	1	-2	0%	NB	46	19	6	D	B	A	24	C			NB	37	155	38	155	36	155
	42nd Avenue	WB	70	350	65	485	68	365	64	497	-2	15	-1	12	2%	WB	51	30	24	D	C	C	32	C	27	C	WB	45	198	46	198	44	198
		SB	50	770	113	933	52	768	113	933	2	-2	0	0	0%	SB	52	26	14	D	C	B	26	C			SB	71	429	72	429	70	429
		EB	65	235	275	575	63	250	278	591	-2	15	3	16	3%	EB	50	31	14	D	C	B	25	C			EB	35	210	36	210	34	210
Signalized	**RR Xing**	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A			NB						
	42nd Avenue	WB	0	580	0	580	0	578	0	578	0	-2	0	-2	0%	WB	0	4	0	A	A	A	4	A	3	A	WB			6	111		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	712	0	712	0	737	0	737	0	25	0	25	4%	EB	0	2	0	A	A	A	2	A			EB			9	96		

GROWTH SCENARIO
2030 PM BRT

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Intersection		Appr	Forecast Volumes				Modeled Volumes				Error Volumes			Volume Error by Approach		Appr	Total Delay by Movement (Sec/Veh)			Level of Service by Movement			LOS by Approach (Sec/Veh)		LOS by Intersection (Sec/Veh)		Appr	Average & Maximum Traffic Queueing (feet)					
Control	Location																											Left Turn		Through		Right Turn	
			L	T	R	Total	L	T	R	Total	L	T	R	Total	%		L	T	R	L	T	R	Delay	LOS	Delay	LOS		Ave Queue	Max Queue	Ave Queue	Max Queue	Ave Queue	Max Queue
Signalized	NB TH 100 Ramps &	NB	785	20	345	1150	788	19	338	1145	3	-1	-7	-5	0%	NB	47	49	26	D	D	C	41	D	26	C	NB	83	275	82	275	81	275
	42nd Avenue	WB	0	786	50	836	0	792	46	838	0	6	-4	2	0%	WB	0	18	8	A	B	A	17	B			WB			41	273	40	273
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	270	670	0	940	266	673	0	939	-4	3	0	-1	0%	EB	37	9	0	D	A	A	17	B			EB	32	127	28	127		
Unsignalized	Regent Avenue &	NB	85	0	40	125	85	0	40	125	0	0	0	0	0%	NB	19	0	14	C	A	B	17	C	2	A	NB	10	104	10	104	10	104
	42nd Avenue	WB	40	736	10	786	38	737	11	786	-2	1	1	0	0%	WB	6	1	2	A	A	A	1	A			WB	1	120	1	120	1	120
		SB	10	5	15	30	10	6	13	29	0	1	-2	-1	-3%	SB	13	19	8	B	C	A	12	B			SB	1	39	1	39	1	39
		EB	15	890	110	1015	13	894	104	1011	-2	4	-6	-4	0%	EB	4	1	2	A	A	A	1	A			EB	1	99	1	99	1	99
Unsignalized	Quail Avenue &	NB	30	0	15	45	31	0	13	44	1	0	-2	-1	-2%	NB	13	0	5	B	A	A	11	B	1	A	NB	1	45			1	45
	42nd Avenue	WB	10	756	0	766	11	755	0	766	1	-1	0	0	0%	WB	3	0	0	A	A	A	0	A			WB		13		13		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	925	15	940	0	930	13	943	0	5	-2	3	0%	EB	0	1	1	A	A	A	1	A			EB				30		30
Unsignalized	Railroad Avenue &	NB	30	5	20	55	28	5	21	54	-2	0	1	-1	-2%	NB	11	11	6	B	B	A	9	A	2	A	NB		47		47		47
	42nd Avenue	WB	15	706	10	731	11	707	8	726	-4	1	-2	-5	-1%	WB	2	0	0	A	A	A	0	A			WB		30		30		30
		SB	20	5	30	55	16	5	32	53	-4	0	2	-2	-4%	SB	21	29	8	C	D	A	14	B			SB	2	64	2	64	2	64
		EB	10	895	35	940	9	897	35	941	-1	2	0	1	0%	EB	5	3	3	A	A	A	3	A			EB	2	101	2	101	2	101
Unsignalized	Hubbard Avenue &	NB	0	0	129	129	0	0	128	128	0	0	-1	-1	-1%	NB	0	0	21	A	A	C	21	C	11	B	NB					13	110
	42nd Avenue	WB	0	731	0	731	0	723	0	723	0	-8	0	-8	-1%	WB	0	0	0	A	A	A	0	A			WB				8		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	880	55	935	0	865	58	923	0	-15	3	-12	-1%	EB	0	19	14	A	C	B	19	C			EB			52	348	52	348
Signalized	CSAH 8 &	NB	226	217	80	523	224	214	76	514	-2	-3	-4	-9	-2%	NB	41	35	29	D	D	C	37	D	29	C	NB	88	482	88	482	88	482
	42nd Avenue	WB	85	465	105	655	79	459	108	646	-6	-6	3	-9	-1%	WB	74	42	31	E	D	C	44	D			WB	95	331	95	331	95	331
		SB	115	140	40	295	116	137	41	294	1	-3	1	-1	0%	SB	34	25	16	C	C	B	27	C			SB	32	202	32	202	32	202
		EB	90	739	180	1009	93	727	173	993	3	-12	-7	-16	-2%	EB	30	16	12	C	B	B	17	B			EB	72	171	72	171	72	171
Signalized	CSAH 81 &	NB	260	985	65	1310	256	982	64	1302	-4	-3	-1	-8	-1%	NB	66	33	21	E	C	C	39	D	33	C	NB	130	538	130	538	129	538
	42nd Avenue	WB	55	305	110	470	52	307	108	467	-3	2	-2	-3	-1%	WB	51	32	24	D	C	C	32	C			WB	43	184	44	184	43	184
		SB	145	510	90	745	141	515	90	746	-4	5	0	1	0%	SB	58	25	10	E	C	B	29	C			SB	68	237	68	237	66	237
		EB	149	575	210	934	142	576	202	920	-7	1	-8	-14	-1%	EB	46	27	11	D	C	B	26	C			EB	66	304	66	304	61	304
Signalized	RR Xing	NB	0	0	0	0	0	0	0	0	0	0	0	0	0%	NB	0	0	0	A	A	A	0	A	3	A	NB						
	42nd Avenue	WB	0	731	0	731	0	726	0	726	0	-5	0	-5	-1%	WB	0	4	0	A	A	A	4	A			WB			7	150		
		SB	0	0	0	0	0	0	0	0	0	0	0	0	0%	SB	0	0	0	A	A	A	0	A			SB						
		EB	0	935	0	935	0	932	0	932	0	-3	0	-3	0%	EB	0	3	0	A	A	A	3	A			EB			14	102		

Memorandum

To: Ed Hunter, Project Manager
Interchange Project office

From: JoNette Kuhnau, P.E., PTOE

Thru: Debra Brisk, P.E.

Date: August 22, 2011

Subject: **The Interchange**
2030 Build Analysis Update - Traffic Technical Memorandum #3

The purpose of this memorandum is to update the traffic analysis completed for the 2030 Build scenario of The Interchange project. This memorandum documents the Phase 1 build-out for The Interchange site as documented in the Environmental Assessment, and is an update to Traffic Technical Memorandum #2 dated March 7, 2011.

Traffic Forecasts

The same assumptions relative to background traffic, opening and design years, pedestrian volumes, and transit operations, as previously documented in Traffic Technical Memorandum #1 and #2, have been retained in this analysis. The previous 2030 analysis evaluated scenarios with either Southwest LRT or Bottineau LRT grade separated, or both grade separated. This analysis assumes the same geometrics as Option 1-BT, with Bottineau LRT operating at-grade through the TH 55/7th Street/6th Avenue intersection, Southwest LRT grade separated at the TH 55/7th Street/6th Avenue intersection, and both LRT lines grade separated at the HERC driveway.

The only differences between the updated 2030 Build analysis and the previous 2030 Option 1-BT analysis are as follows:

- The maximum number of structured parking spaces on The Interchange site is assumed to be 425 (increased from 350).
- The lower level of the parking ramp (up to 244 spaces) is restricted to only enter/exit at the 5th Street N/5th Avenue N intersection.
- The upper level of the parking ramp (up to 108 spaces) is restricted to only enter/exit onto 6th Avenue N.

- Parking is assumed to be open for public use. Previously all parking was assumed to be leased to known tenants near The Interchange site. While it has not been determined at this time how the parking will be used, public parking is a possibility that is being considered, therefore this analysis documents the expected worst case of traffic impacts if the public parking is allowed.

The modified assumptions regarding the parking on The Interchange site result in changes to the forecast volumes entering and exiting the site during peak hours, as summarized in **Table 1** below. The trips produced by the 425 parking spaces on The Interchange site were estimated assuming that the all spaces are fully occupied and the percentage of spaces entering/exiting the site during peak hours was based on Chapter 18 of the Institute of Transportation Engineers (ITE) *Transportation Planning Handbook 3rd Edition.* The public parking and increased number of spaces results in greater trip generation during the peak hours, in both directions (entering and exiting).

Table 1. 2030 Traffic Analysis – Parking Assumptions

		3/2011 Analysis	8/2011 Analysis
Parking Spaces		350	425
Use		Office (No Public Parking)	Open to Public Use
Access		Internal Ramp Circulation - vehicles arrive and depart from either access	Upper Level - access 5th St only Lower Level - access 6th Ave only
AM Traffic	In	140	180
	Out	20	70
PM Traffic	In	20	60
	Out	120	190

Infrastructure and Operations

The access points to the parking on The Interchange site are still proposed to be located at the south leg of the 5th Street N/5th Avenue N intersection and at a new driveway located on 6th Avenue N between the HERC entrance and 5th Street N. The parking spaces by themselves do not generate new trips (i.e., land uses generate trips, not parking), but will redistribute existing vehicle and pedestrian trips into The Interchange modeling area. The same assumptions regarding the reconfiguration of the 5th Street N/6th Avenue N intersection were also used.

The level of service analysis included all ten intersections from the previous 2030 Build analysis of Option 1-BT, although the only significant changes in volume were at the 6th Avenue N/HERC driveway, 6th Avenue N/Interchange driveway, 6th Avenue N/5th Street N, and 5th Street N/5th Avenue N intersections.

Modeling Results

The VISSIM modeling results reported in this memorandum are based on the average of five one-hour runs for each peak hour in each scenario. Within the peak hour, the 15-minute forecast flows were input into the model to accurately reflect the variations in traffic during the overall peak hour. Based on the counts, 7:30-8:30 AM was modeled as the AM peak hour and 4:45-5:45 PM was modeled as the PM peak hour.

2030 Build – Option 1-BT + Parking

In this option, Southwest LRT was assumed to cross 7th Street N above grade, and Bottineau LRT was assumed to be at-grade along TH 55 through the TH 55/7th Street N/6th Avenue N intersection. Within the TH 55/7th Street N intersection, Bottineau LRT was assumed to transition from a center running alignment to a side-running alignment (south side of 6th Avenue N). The TH 55/7th Street N and TH 55/Border Avenue/Oak Lake Avenue N signals are assumed to utilize TSP operation (no gates or pre-emption).

The AM and PM peak hour results for this option are shown in **Table 2** and **Table 3**, respectively, on the following pages. The peak hour queuing results for the primary intersections around The Interchange site are shown in **Table 4** and **Table5**.

The LOS operations shown for the parking exit and 5th Avenue N approach at the 5th Street N intersection in the AM and PM peak hours is primarily due to the low volumes on those approaches. The signal is assumed to operate with a 110-second cycle, therefore most vehicles on the minor approaches will arrive during the red phase and the average delay will be greater than 55 seconds. However, the relatively short 95th percentile queues on both the parking access and 5th Avenue N approaches show that the LOS E operations do not represent an operational deficiency.

Table 2. 2030 Build Option 1-BT + Parking: AM Peak Hour Level of Service Results

Intersection	Control	Approach	Operations by Movement						Overall Intersection	
			Left		Through		Right			
			Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
TH 55/ 7th Street N/ 6th Avenue N	Signal	NB	63.5	E	68.2	E	73.5	E	56.1	E
		EB	0.0	A	38.5	D	16.0	B		
		SB	92.5	F	89.1	F	94.9	F		
		WB	372.2	F	24.0	C	8.1	A		
6th Avenue N/ Bradford Avenue/ HERC Entrance	Signal	NB	75.1	E	0.0	A	64.7	E	9.7	A
		EB	8.2	A	4.2	A	9.7	A		
		SB	65.7	E	0.0	A	68.3	E		
		WB	44.4	D	15.5	B	6.8	A		
6th Avenue N/ 5th Street N	Signal	NB	46.3	D	42.8	D	46.0	D	15.2	B
		EB	5.7	A	5.7	A	1.2	A		
		SB	47.0	D	49.6	D	54.5	D		
		WB	8.6	A	10.8	B	9.6	A		
5th Street N/ 5th Avenue N	Signal	NB	8.0	A	6.8	A	5.7	A	11.6	B
		EB	65.6	E	0.0	A	62.6	E		
		SB	4.6	A	3.6	A	3.1	A		
		WB	64.6	E	0.0	A	61.9	E		
6th Avenue N/ Interchange Driveway	Driveway Stop Control	NB	3.4	A	0.0	A	0.7	A	0.8	A
		EB	0.0	A	1.6	A	1.4	A		
		SB	0.0	A	0.0	A	0.0	A		
		WB	1.5	A	2.5	A	0.0	A		
TH 55/ Border Avenue/ Oak Lake Avenue	Signal	NB	57.5	E	53.5	D	18.2	B	25.4	C
		EB	70.1	E	19.1	B	14.8	B		
		SB	84.4	F	71.5	E	38.5	D		
		WB	76.6	E	5.4	A	0.8	A		
5th Street N/ 3rd Avenue N	Signal	NB	51.1	D	17.5	B	0.0	A	22.3	C
		EB	0.0	A	0.0	A	0.0	A		
		SB	0.0	A	28.4	C	28.1	C		
		WB	27.1	C	25.3	C	9.3	A		
7th Street N/ 5th Avenue N	Signal	NB	22.7	C	9.9	A	0.0	A	8.6	A
		EB	51.8	D	0.0	A	29.9	C		
		SB	0.0	A	4.5	A	8.7	A		
		WB	0.0	A	0.0	A	0.0	A		
Royalston Ave N/ 5th Avenue N	Signal	NB	0.0	A	36.9	D	16.2	B	27.6	C
		EB	0.0	A	0.0	A	0.0	A		
		SB	36.0	D	34.1	C	0.0	0		
		WB	27.7	C	0.0	A	14.4	B		
7th Street N/ Oak Lake Avenue N	Signal	NB	49.3	D	47.2	D	0.0	A	12.5	B
		EB	63.8	E	67.4	E	17.7	B		
		SB	58.3	E	28.2	C	25.6	C		
		WB	0.0	A	11.9	B	10.9	B		

Table 3. 2030 Build Option 1-BT+ Parking: PM Peak Hour Level of Service Results

Intersection	Control	Approach	Operations by Movement						Overall Intersection	
			Left		Through		Right			
			Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
TH 55/ 7th Street N/ 6th Avenue N	Signal	NB	46.3	D	49.3	D	54.2	D	46.0	D
		EB	0.0	A	41.9	D	10.9	B		
		SB	56.2	E	56.5	E	52.9	D		
		WB	166.8	F	42.5	D	20.2	C		
6th Avenue N/ Bradford Avenue/ HERC Entrance	Signal	NB	49.4	D	0.0	A	50.3	D	8.5	A
		EB	7.5	A	6.4	A	8.0	A		
		SB	53.9	D	0.0	A	12.4	B		
		WB	9.3	A	7.4	A	6.8	A		
6th Avenue N/ 5th Street N	Signal	NB	50.8	D	48.6	D	51.6	D	28.7	C
		EB	25.9	C	23.3	C	3.0	A		
		SB	48.0	D	44.1	D	51.8	D		
		WB	17.7	B	19.3	B	15.5	B		
5th Street N/ 5th Avenue N	Signal	NB	15.8	B	17.1	B	12.7	B	24.7	C
		EB	60.2	E	0.0	A	55.2	E		
		SB	13.1	B	10.9	B	6.6	A		
		WB	49.6	D	0.0	A	50.6	D		
6th Avenue N/ Interchange Driveway	Driveway Stop Control	NB	3.1	A	0.0	A	1.9	A	0.4	A
		EB	0.0	A	2.9	A	1.1	A		
		SB	0.0	A	0.0	A	0.0	A		
		WB	1.2	A	0.3	A	0.0	A		
TH 55/ Border Avenue/ Oak Lake Avenue	Signal	NB	49.3	D	44.2	D	23.2	C	19.6	B
		EB	64.8	E	8.1	A	3.2	A		
		SB	54.3	D	58.2	E	35.6	D		
		WB	58.9	E	11.9	B	4.3	A		
5th Street N/ 3rd Avenue N	Signal	NB	65.2	E	20.0	B	0.0	A	28.0	C
		EB	0.0	A	0.0	A	0.0	A		
		SB	0.0	A	30.7	C	26.4	C		
		WB	41.9	D	37.4	D	19.1	B		
7th Street N/ 5th Avenue N	Signal	NB	19.7	B	13.6	B	0.0	A	16.3	B
		EB	39.0	D	0.0	A	25.5	C		
		SB	0.0	A	13.0	B	14.4	B		
		WB	0.0	A	0.0	A	0.0	A		
Royalston Ave N/ 5th Avenue N	Signal	NB	0.0	A	45.4	D	32.7	C	37.2	D
		EB	0.0	A	0.0	A	0.0	A		
		SB	41.4	D	39.9	D	0.0	A		
		WB	30.1	C	0.0	A	13.4	B		
7th Street N/ Oak Lake Avenue N	Signal	NB	72.0	E	57.0	E	0.0	A	21.7	C
		EB	12.1	B	6.8	A	2.5	A		
		SB	43.4	D	40.4	D	44.0	D		
		WB	0.0	A	10.4	B	11.6	B		

Table 4. 2030 Build Option 1-BT+ Parking: AM Peak Hour 95th Percentile Queue Results

Intersection	Control	Approach	95th Percentile Queue	
			95th % Queue	Available Storage
6th Avenue N/ Bradford Avenue/ HERC Entrance	Signal	NB	59	280
		EB	83	310
		SB	179	390
		WB	58	240
6th Avenue N/ 5th Street N	Signal	NB	83	150
		EB	106	550
		SB	65	350
		WB	202	330
5th Street N/ 5th Avenue N	Signal	NB	12	740
		EB	5	50
		SB	25	330
		WB	8	410
6th Avenue N/ Interchange Driveway	Driveway Stop Control	NB	55	60
		EB	45	240
		SB	-	-
		WB	34	150

Table 5. 2030 Build Option 1-BT+ Parking: PM Peak Hour 95th Percentile Queue Results

Intersection	Control	Approach	95th Percentile Queue	
			95th % Queue	Available Storage
6th Avenue N/ Bradford Avenue/ HERC Entrance	Signal	NB	79	280
		EB	68	310
		SB	42	390
		WB	106	240
6th Avenue N/ 5th Street N	Signal	NB	210	150
		EB	123	550
		SB	185	350
		WB	339	330
5th Street N/ 5th Avenue N	Signal	NB	25	740
		EB	16	50
		SB	51	330
		WB	27	410
6th Avenue N/ Interchange Driveway	Driveway Stop Control	NB	86	60
		EB	46	240
		SB	-	-
		WB	11	150

In the AM peak hour, none of the 95th percentile queues are expected to exceed the available storage. In the PM peak hour, the 95th percentile queue on the northbound approach of the 6th Avenue N/5th Street

N is expected to exceed the distance between the signal and The Interchange driveway by approximately 3 vehicles (60 feet). The 95th percentile queue represents the longest queue that would ever be expected to occur and in the PM peak hour simulation, the northbound queue was not observed to impact or delay vehicles exiting or entering The Interchange site. This is confirmed by the expected LOS A operations for all movements at the driveway. The 95th percentile queue reported for The Interchange exit onto 6th Avenue was 86 feet, or approximately four vehicles. If the northbound queue at the 6th Avenue N/5th Street N intersection became an operational of safety issue during the PM peak period, The Interchange access could be limited to right-in/right-out using signed restrictions for peak periods only or the driveway could be modified to prevent left-turn movements.

Summary and Conclusions

The 2030 peak hour operations of The Interchange, including updated parking assumptions, were modeled in VISSIM to determine the expected traffic impact. For this analysis, only the scenario with Bottineau LRT at-grade at 7th Street N, Southwest LRT grade separated at 7th Street N, and both LRT lines grade separated at the HERC driveway was analyzed. Based on the 2030 peak hour traffic and LRT modeling results of Options 1-BT+Parking, the following conclusions are made:

- The intersections adjacent to The Interchange are expected to have acceptable operations with up to 425 parking spaces created on the site, whether the parking is leased or open to the public, which is the worst case scenario in terms of traffic.
- Queuing at the intersections adjacent to The Interchange during peak hours is not expected to impact access in and out of The Interchange site. If the northbound queue on 6th Avenue N at the 5th Street N intersection becomes an issue at The Interchange access during the PM peak hour, the driveway could be limited to right-in/right-out using signed restrictions for the PM peak period or the driveway could be modified to restrict left-turn movements.

Memorandum

To: Brent Rusco, P.E.
Hennepin County Engineering and Transit Planning

From: JoNette Kuhnau, P.E., PTOE
Sarah Ott, EIT
Kimley-Horn and Associates, Inc.

Date: September 19, 2011

Subject: Bottineau Segment D2
Traffic Analysis Memorandum

This memorandum presents the results of the scoping level traffic operations analysis for the D2 alignment of the Bottineau Transitway within the City of Minneapolis. This document is intended for review and consideration by the technical staff of the Minneapolis Focused Issue Group (FIG), and is one of a series of technical memoranda that address various traffic operations issues along the transitway corridor.

The following sections focus on the traffic operational aspects of the D2 alignment, including a summary of the existing conditions, the alternative D2 alignments, forecast 2030 traffic volumes, and the 2030 operational modeling results for light rail (LRT) transit. Additional considerations including noise analysis, parking impacts, pedestrian/bicycle circulation, property access, roadway network impacts, and emergency vehicle access, are important issues to be considered for the D2 alignment, but are not part of the analysis documented in this memorandum.

EXISTING CONDITIONS

The D2 segment for this analysis extends from Trunk Highway (TH) 55 to Lowry Avenue in Minneapolis along Penn Avenue (County State Aid Highway (CSAH) 2)/ Oliver Avenue and W Broadway Avenue (CSAH 81). **Figure 1** shows the existing daily and PM peak hour traffic volumes for these arterials. The focus of the operations analysis was the PM peak hour because it has the highest volumes and would therefore represent a worst case condition. The existing daily and peak hour volumes were collected by the City of Minneapolis in 2009.

The D2 LRT alignment may impact traffic operations at signalized intersections because of the potential for additional delay. Traffic signals are currently operating at the following intersections:

- W Broadway Avenue (CSAH 81) at 29th Avenue
- W Broadway Avenue (CSAH 81) at 26th Avenue
- W Broadway Avenue (CSAH 81) at Penn Avenue (CSAH 2)/ McNair Avenue
- Penn Avenue (CSAH 2) at Golden Valley Road
- Penn Avenue (CSAH 2) at 16th Avenue
- Penn Avenue (CSAH 2) at 14th Avenue
- Penn Avenue (CSAH 2) at Plymouth Avenue
- Penn Avenue (CSAH 2) at 12th Avenue
- Penn Avenue (CSAH 2) at Oak Park Avenue
- TH 55 at Penn Avenue (CSAH 2)

Existing peak hour parking restrictions are located on W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2). W Broadway Avenue (CSAH 81) is signed as NO PARKING 7 AM-9 AM MON-FRI on the west side of the roadway and NO PARKING 4 PM-6 PM MON-FRI on the east side of the roadway for the length of the study corridor. Penn Avenue (CSAH 2) is signed NO PARKING 4 PM-6 PM MON-FRI on both sides of the street north of W Broadway Avenue (CSAH 81) and the east side of the street south of W Broadway Avenue (CSAH 81). Parking is also currently restricted on Penn Avenue (CSAH 2) at bus stops, which are generally located at the near side of intersections.

Existing Traffic Volumes

The existing (2009-2010) daily and peak hour traffic volumes on Broadway Avenue (CSAH 81), Penn Avenue (CSAH 2), and Oliver Avenue are shown in Table 1. In general, the daily directional volumes are approximately equal on W Broadway Avenue (CSAH 81), but the daily volumes on Penn Avenue (CSAH 2) and TH 55 are heavier in the northbound and eastbound directions. These are also the dominant traffic flows during the PM peak hour. On W Broadway Avenue (CSAH 81), the primary traffic flow is westbound.

Table 1. Existing Daily and Peak Hour Traffic Volumes

Roadway Segment	Time Period	Broadway Avenue (CSAH 81)			Penn Avenue (CSAH 2)			Oliver Avenue			TH 55		
		Total	EB	WB	Total	SB	NB	Total	SB	NB	Total	EB	WB
Lowry Avenue (CSAH 153) to Penn Avenue (CSAH 2)	Daily	13,100	6,400	6,700									
	PM Peak Hour	1,171	470	701									
Penn Avenue (CSAH 2) to Fremont Avenue	Daily	15,300	7,900	7,400									
	PM Peak Hour	1,161	522	639									
W Broadway Ave (CSAH 81) to Golden Valley Rd	Daily				11,300	5,300	6,000	340	150	190			
	PM Peak Hour				936	403	533	33	15	19			
Golden Valley Rd to Plymouth Ave	Daily				12,500	5,900	6,600	360	360	0			
	PM Peak Hour				1,069	419	650	27	27	0			
Plymouth Ave to TH 55	Daily				10,700	4,900	5,800	280	280	0			
	PM Peak Hour				888	385	503	29	29	0			
West City Limits to Penn Avenue (CSAH 2)	Daily										22,700	14,100	8,600
	PM Peak Hour										2,725	1,534	1,191
Penn Avenue (CSAH 2) to Bryant Avenue	Daily										25,700	15,100	10,600
	PM Peak Hour										3,036	1,658	1,378

Operations Analysis

All operational analysis for the D2 segment was completed in Synchro/SimTraffic because it provides the ability to efficiently analyze a number of different geometric and operational parameters. In addition, transit is assumed to operate in a priority scheme under all the future operations scenarios, therefore Synchro/SimTraffic can be used to analyze these type of operations because the LRT will not preempt the traffic signals and will generally operate concurrently with the through vehicle phases or as its own signal phase that will be called only when a transit vehicle is detected. In a priority scheme, it is important to note that the early green or green extension time is typically considered to be about 10 percent of the cycle, and therefore the transit vehicle still may have to stop at the signal.

The existing/proposed signals at Penn Avenue (CSAH 2)/16th Avenue and Penn Avenue (CSAH 2)/Oak Park Avenue and the existing signals at Penn Avenue (CSAH 2)/14th Avenue and Penn Avenue (CSAH 2)/12th Avenue were excluded from the existing and future operations analysis. These cross streets generally have very low traffic volumes (less than 60 approach vehicles per direction in the peak hour, except westbound 14th Avenue, which had 90 vehicles in the peak hour) and therefore are not expected to be significantly impacted by the D2 alternatives.

Existing Operations

The existing conditions PM peak hour analysis shows that W Broadway Avenue (CSAH 81) has adequate capacity to accommodate peak hour volumes and intersection levels of service (LOS) are all LOS C or better at the 29th Avenue, 26th Avenue, and Penn Avenue (CSAH 2) intersections. **Table 2** shows the results from the existing conditions analysis.

Table 2. Existing Delay and LOS Results

Intersection	Intersection Delay (s/veh)	Intersection LOS	Comments
W Broadway Ave (CSAH 81) & 29th Ave	4.0	A	All movements operate at LOS B or better
W Broadway Ave (CSAH 81) & 26th Ave	9.3	A	All movements operate at LOS C or better
W Broadway Ave (CSAH 81) & Penn Ave (CSAH 2) – McNair Avenue approach assumed closed	19.6	B	All movements operate at LOS C or better
Penn Ave (CSAH 2) & Golden Valley Rd	17.3	B	All movements operate at LOS C or better
Penn Ave (CSAH 2) & Plymouth Ave	22.1	C	All movements operate at LOS D or better
TH 55 & Penn Ave (CSAH 2) – with N/S split phasing	80.2	F	All movements operate at LOS E or F except eastbound through
TH 55 & Penn Ave (CSAH 2) – without N/S split phasing	34.4	C	Southbound left-turns operate at LOS F, northbound and eastbound left-turns operate at LOS E

The intersection of W Broadway Avenue (CSAH 81) at Penn Avenue (CSAH 2)/McNair Avenue was modeled without McNair Avenue because the traffic volumes on McNair Avenue are very low, and the approach requires an additional signal phase that would increase delay for the other movements. The McNair Avenue approach is closed at the W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2) intersection for alternatives D2-A and D2-C, and could be closed for D2-B; therefore, disregarding McNair Avenue in the existing model allows for a fair comparison between the existing and 2030 D2 alternative models.

On Penn Avenue (CSAH 2) at Golden Valley Road, Plymouth Avenue, and TH 55, a short 50-foot left-turn lane was incorporated into the model to represent the ability for through vehicles to bypass a waiting left-turn vehicle. Although there are no designated left-turn lanes, based on field observations this geometry more accurately represents actual operations.

The signal at TH 55/ Penn Avenue (CSAH 2) currently operates with split phasing because of the wide median and geometrics that cause the paths of the northbound and southbound left-turn movements to overlap. The split phasing could be eliminated if geometric changes were made to allow the left-turn movements to operate concurrently. Split phasing reduces the available green time for the Penn Avenue (CSAH 2) movements, and therefore increases the delay significantly. Field observations indicated that the existing PM peak hour queues on Penn Avenue (CSAH 2) frequently extend more than one block and vehicles wait more than one signal cycle to clear the intersection. The intersection was modeled with and without the split phasing for the existing conditions to provide a more accurate comparison with the 2030 D2 alternative operational results.

Oliver Avenue is a local street and is stop-controlled at major intersections. There are currently no direct vehicle connections from Oliver Avenue to Broadway Avenue (CSAH 81) or to TH 55. In addition, Oliver Avenue has the following unique operational and traffic flow characteristics:

- One-way southbound traffic flow from Golden Valley Road to Plymouth Avenue
- Roadway is discontinuous between Plymouth Avenue and 12½ Avenue (i.e., no through traffic in this block)
- One-way southbound traffic flow from 12½ Avenue to TH 55 North Frontage Road

As a result of the roadway being severed and also the one-way traffic flow, existing traffic volumes on Oliver Avenue are very low (<400 vehicles per day). Therefore, Oliver Avenue was not analyzed in the existing conditions.

FUTURE CONDITIONS

Along the W Broadway Avenue (CSAH 81) segment of the D2 alignment, access to several cross streets will be modified at the following unsignalized intersections:

- 30th Avenue (right-in/right-out access on east side only)
- 27th Avenue (right-in/right-out on west side only; eliminate connection on east side)
- Queen Avenue (dead end on east side only)
- 24th Avenue (dead end on west side only)

The D2 segment alternative includes three alignment sub-options along Penn Avenue (CSAH 2) and Oliver Avenue: D2-A, D2-B, and D2-C. All three alternatives operate in the median of TH 55, turn north on either Penn Avenue (CSAH 2) or Oliver Avenue, and then turn northwest to operate in a center median on W Broadway Avenue (CSAH 81). Each of the alternatives is described in greater detail in the following:

- Alternative D2-A

On Alternative D2-A, the transitway operates on the east side of Penn Avenue (CSAH 2) and then crosses diagonally through the W Broadway Avenue (CSAH 81)/Penn Avenue (CSAH 2) intersection. Due to the limited right-of-way, all southbound vehicular traffic continues to operate on Penn Avenue (CSAH 2), but all northbound vehicular traffic is moved to Oliver Avenue. In this alternative, northbound traffic rejoins Penn Avenue (CSAH 2) at 23rd Avenue, just south of W Broadway Avenue (CSAH 81). All existing on-street parking on Penn Avenue (CSAH 2) would be eliminated in this alternative. One side parking was assumed to remain on Oliver Avenue based on a roadway width of 28 to 29 feet, which is wide enough for one driving lane and one parking lane.

Under alignment D2-A, traffic signals are assumed to be added at the following intersections:

- TH 55 and Oliver Avenue
- Oliver Avenue and Oak Park Avenue
- Oliver Avenue and Plymouth Avenue
- Oliver Avenue and 16th Avenue
- Oliver Avenue and Golden Valley Road

On Penn Avenue (CSAH 2), the existing signals at 12th Avenue and 14th Avenue are assumed to be removed. All other existing signals were assumed to continue to operate under this alternative.

The D2-A alternative creates a one-way pair between Penn Avenue (CSAH 2) and Oliver Avenue and would likely necessitate changes in jurisdiction and functional class. Oliver Avenue would need to be reopened between Plymouth Avenue and 12½ Avenue. Several cross streets would be severed at the east side of Penn Avenue (CSAH 2) due to the need to prevent crossings of the LRT alignment at the following unsignalized intersections:

- 21st Avenue
- 17th Avenue
- 15th Avenue
- 14th Avenue
- 12th Avenue
- 8th Avenue

At the dead end sections, additional parking is proposed to be provided to replace the loss of the on-street parking.

- Alternative D2-B

Alternative D2-B turns north on Oliver Avenue from TH 55 to W Broadway Avenue (CSAH 81), where it crosses the W Broadway Avenue (CSAH 81)/Oliver Avenue intersection diagonally at a new signalized intersection. The D2-B alternative removes all vehicular traffic from Oliver Avenue to accommodate the transitway, and the vehicular traffic was assumed to relocate to Penn Avenue (CSAH 2). The existing volumes on Oliver Avenue are extremely low (less than 500 vehicles per day), therefore this does not result in significant changes in traffic patterns. Penn Avenue (CSAH 2) would remain open to two-way traffic, with signals at the existing locations except for 12th Avenue and 14th Avenue, which were assumed to be removed. All existing on-street parking on Oliver Avenue would be eliminated in this alternative.

Due to the need to control crossings of the transitway, traffic signals were assumed to be added at the following intersections:

- TH 55 and Oliver Avenue
- Oliver Avenue and Oak Park Avenue
- Oliver Avenue and Plymouth Avenue
- Oliver Avenue and 16th Avenue
- Oliver Avenue and Golden Valley Road
- W Broadway Avenue (CSAH 81) and Oliver Avenue

The signalized intersection at W Broadway (CSAH 81)/Oliver Avenue would include a diagonal crossing of the transitway through the intersection, which would require its own signal phase.

Several cross streets would be severed on both sides of Oliver Avenue due to the need to prevent crossings of the LRT alignment at the following unsignalized intersections:

- 23rd Avenue (cul-de-sac at west side only)
- 21st Avenue
- 18th Avenue (east side only)
- 17th Avenue
- 15th Avenue
- 14th Avenue
- 12th Avenue
- 8th Avenue

At the dead end sections, additional parking is proposed to be provided to replace the loss of the on-street parking.

- Alternative D2-C

Alternative D2-C assumes the transitway is center-running along Penn Avenue (CSAH 2), similar to alternative D2-A, except that two-way traffic is maintained on Penn Avenue (CSAH 2). This would require that all properties on one side of Penn Avenue (CSAH 2) would need to be acquired in order to provide adequate right-of-way. All existing on-street parking on Penn Avenue (CSAH 2) would be eliminated in this alternative.

Similar to alternative D2-A, the existing signals at 14th Avenue and 12th Avenue are assumed to be removed. However, no additional traffic signals would be needed on Oliver Avenue.

Several cross streets would become right-in/right-out on both sides of Penn Avenue (CSAH 2) due to the need to prevent crossings of the LRT alignment at the following unsignalized intersections:

- McNair Avenue (west side only)
- 23rd Avenue
- 21st Avenue

- o 17th Avenue
- o 15th Avenue (east side only)
- o 14th Avenue
- o 12th Avenue
- o 8th Avenue

2030 Forecast Traffic Volumes

The existing and daily peak hour turning movement counts were used to forecast 2030 traffic volumes for the study area. The McNair Avenue approach was removed from the W Broadway Avenue (CSAH 81)/Penn Avenue (CSAH 2) intersection for all D2 alternatives because the additional phase would cause more delay to the intersection, which already experiences capacity and level of service (LOS) challenges. Left-turn movements were also assumed to be banned when an exclusive left-turn lane could not be provided along the transitway alignment (see the *Future Operations* section of this memorandum). Left-turn movements along the alignment were assumed to be prohibited at the following intersections:

- W Broadway Avenue (CSAH 81) and 29th Avenue (less than 50 total vehicles in the peak hour)
- W Broadway Avenue (CSAH 81) and 26th Avenue (less than 75 total vehicles in the peak hour)
- W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2)
  - Eastbound left-turn movements for all D2 alternatives (less than 25 vehicles in the peak hour)
  - Westbound left-turn movements for alternative D2-B only (less than 100 vehicles in the peak hour)

Left-turn movements at signalized intersections on Penn Avenue are not assumed to be restricted at any locations under any of the alternatives, based on the provision of left-turn lanes.

The forecast 2030 volumes assume a one percent per year background growth rate, consistent with the Bottineau Transitway Alternatives Analysis “Traffic Operations Analysis Report” dated January 2010. These 2030 volumes were then reduced based on assumed traffic diversion due to the capacity constrictions on W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2), as well as the left-turn restrictions. The Metropolitan Council travel demand model was used to determine the magnitude of the expected diversion in 2030, which is forecast to be approximately 20 percent of through traffic along W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2). The travel demand model shows that approximately 500 to1,000 vehicles per day would be expected to divert from W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2) to sections of TH 100, I-94, Lowry Avenue, and Penn Avenue (CSAH 2) north of W Broadway

Avenue (CSAH 81). **Figure 2** shows the reassignment of traffic volumes due to the Bottineau Transitway.

Table 3 shows the 2030 daily and PM peak hour traffic volumes for the Penn Avenue (CSAH 2) and Oliver Avenue corridors under each D2 alternative. The 2030 forecast volumes and lane geometry for alternatives D2-A, -B, and -C are shown in **Figure 3, Figure 4, and Figure 5**, respectively.

Table 3. 2030 Daily and PM Peak Hour Traffic Volumes

Roadway Segment	Time Period	Alternative D2-A						Alternative D2-B						Alternative D2-C					
		Penn Ave (CSAH 2)			Oliver Ave			Penn Ave (CSAH 2)			Oliver Ave			Penn Ave (CSAH 2)			Oliver Ave		
		Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB
W Broadway Ave (CSAH 81) to Golden Valley Rd	Daily	5,410	5,410	0	6,090	0	6,090	11,500	5,410	6,090	0	0	0	11,160	5,260	5,900	430	190	240
	PM Peak	410	410	0	540	0	540	950	410	540	0	0	0	930	400	530	40	20	20
Golden Valley Rd to Plymouth Ave	Daily	6,140	6,140	0	6,500	0	6,500	12640	6,140	6,500	0	0	0	12,280	5,780	6,500	450	450	0
	PM Peak	440	440	0	640	0	640	1080	440	640	0	0	0	1050	410	640	30	30	0
Plymouth Ave to TH 55	Daily	5,150	5,150	0	5,670	0	5,670	10820	5,150	5,670	0	0	0	10,540	4,870	5,670	350	350	0
	PM Peak	410	410	0	500	0	500	910	410	500	0	0	0	880	380	500	40	40	0

Future Operations

The D2 alternatives were modeled with LRT, which is assumed to operate under a transit priority scheme in these corridors, based on the operating speeds of the transit and the adjacent roadway. For this analysis, LRT was assumed to operate three-car trains at 7.5 minute headways.

The transitway was modeled in Synchro either as a concurrent phase with the through movements or as an exclusive phase with overlaps, depending on the alignment of the transitway through the intersection. The following intersections are assumed to operate as a concurrent phase with the through movements:

- W Broadway Avenue (CSAH 81) and 29th Avenue
- W Broadway Avenue (CSAH 81) and 26th Avenue
- W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2) (D2-B only)
- Penn Avenue (CSAH 2) and Golden Valley Road (D2-A and D2-C)
- Penn Avenue (CSAH 2) and 16th Avenue (D2-A and D2-C) – not modeled
- Penn Avenue (CSAH 2) and Plymouth Avenue (D2-A and D2-C)
- Penn Avenue (CSAH 2) and Oak Park Avenue (D2-A and D2-C) – not modeled

The following intersections have transit modeled as an exclusive phase, with overlaps as appropriate:

- W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2) (D2-A and D2-C)
- W Broadway Avenue (CSAH 81) and Oliver Avenue (D2-B only)
- Oliver Avenue and Golden Valley Road (D2-B only)
- Oliver Avenue and 16th Avenue (D2-B only) – not modeled
- Oliver Avenue and Plymouth Avenue (D2-B only)
- Oliver Avenue and Oak Park Avenue (D2-B only) – not modeled
- TH 55 and Penn Avenue (CSAH 2) (D2-A and D2-C)
- TH 55 and Oliver Avenue (D2-B only)

Protected only phasing is needed to control left-turn movements for vehicles traveling parallel to the guideway that then turn left across the guideway. The through movement is generally compatible with the transit movement, but the left-turn vehicles must be protected so as not to turn across the path of an approaching transit vehicle. This is particularly a risk for a transit vehicle approaching from the rear of the passenger vehicle. Left-turn movements from a cross street across the guideway can be either protected or permissive, as the through movements are not compatible with the transit phase.

Left-turn movements in the D2 alignment are assumed to operate with protected-only phasing for all movements that cross the tracks with a concurrent or an overlap phase. Left-turns on the arterial (W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2)) are therefore assumed to be prohibited where an exclusive left-turn lane is not provided due to the severe operational impacts of operating opposing travel directions with split phasing (e.g., NB and SB Penn Avenue (CSAH 2) operating as separate phases). These assumptions are consistent with current operations on the Hiawatha LRT line in downtown Minneapolis and the proposed operations on the Central Corridor LRT line.

The northbound and southbound approaches at TH 55 and Penn Avenue (CSAH 2) currently operate with split phasing (i.e., northbound and southbound movements do not operate concurrently); however this causes a number of capacity and LOS issues that are observed in the existing conditions. Therefore, the signal phasing for all the D2 alternatives was assumed to consist of permissive left-turning phasing and concurrent through movement phasing for the northbound and southbound approaches.

In the alternative D2-A modeling, parking restrictions were assumed to be implemented on Oliver Avenue near the signalized intersections to allow for through vehicles to maneuver around turning vehicles. Alternative D2-A was modeled with two different signal phasing options (D2-A1 and D2-A2) at the intersections of TH 55/Penn Avenue (CSAH 2) and TH 55/Oliver Avenue. D2-A1 assumes that one controller would be used to operate both intersections and D2-A2 assumes two separate controllers would be used, which allows independent operations/phasing at each intersection, although coordination was still assumed. Due to the high volume of northbound vehicles on Penn Avenue that are diverted to northbound Oliver Avenue, with two controllers this movement must weave across three lanes of eastbound TH 55 traffic to turn left at Oliver Avenue. The interaction of accelerating northbound vehicles with high-speed eastbound TH 55 vehicles could cause safety concerns. With one controller in option D2-A1, the northbound traffic will not interact with eastbound TH 55 traffic, which eliminates the weaving issue. However, one controller operation limits the available green time for eastbound/westbound through vehicles on TH 55.

In alternative D2-B, the intersections of Penn Avenue (CSAH 2) at Golden Valley Road and Penn Avenue (CSAH 2) at Plymouth Avenue will not be affected by the transit route; therefore, the geometries modeled were the same as existing.

The operational results for the D2-A, D2-B, and D2-C alignments under 7.5-minute (LRT) headways are shown in **Table 4, Table 5, and Table 6**, respectively.

Table 4. Intersection Delay and LOS Results: Alignment D2-A (LRT – 7.5-Minute Headways)

Intersection	D2-A1: Single Controller at TH 55/Penn Avenue (CSAH 2)/Oliver Avenue			D2-A2: Two Signal Controllers at TH 55/Penn Avenue (CSAH 2) and TH 55/Oliver Avenue		
	Delay (sec/veh)	LOS	Comments	Delay (sec/veh)	LOS	Comments
W Broadway Ave (CSAH 81) & 29th Ave [1]	7.4	A	All movements operate at LOS B or better	-	-	Same as D2-A1
W Broadway Ave (CSAH 81) & 26th Ave [2]	19.2	B	All movements operate at LOS D or better	-	-	Same as D2-A1
W Broadway Ave (CSAH 81) & Penn Ave (CSAH 2) [3]	112.1	F	Northbound approach and westbound left-turn operate at LOS F	-	-	Same as D2-A1
Penn Ave (CSAH 2) & Golden Valley Rd	12.3	B	All movements operate at LOS B or better	-	-	Same as D2-A1
Oliver Ave & Golden Valley Rd	17.9	B	All movements operate at LOS C or better	-	-	Same as D2-A1
Penn Ave (CSAH 2) & Plymouth Ave	21.1	C	All movements operate at LOS C or better	-	-	Same as D2-A1
Oliver Ave & Plymouth Ave	26.1	C	All movements operate at LOS D or better	-	-	Same as D2-A1
TH 55 & Penn Ave (CSAH 2)	62.9	E	Eastbound and southbound approaches operate at LOS F	72.6	E	Eastbound through and southbound approach operates at LOS F
TH 55 & Oliver Ave	32.0	C	All movements operate at LOS D or better	20.2	C	All movements operate at LOS D or better

[1] *Assumes left-turn movements on Broadway Avenue (CSAH 81) are banned, impacting approximately 60 vehicles in the PM peak hour and more than 500 vehicles daily.*

[2] *Assumes left-turn movements on Broadway Avenue (CSAH 81) are banned, impacting approximately 80 vehicles in the PM peak hour and more than 800 vehicles daily.*

[3] *Assumes eastbound left-turn movements on Broadway Avenue (CSAH 81) are banned, impacting approximately 30 vehicles in the PM peak hour and more than 250 vehicles daily.*

Table 5. Intersection Delay and LOS Results: Alignment D2-B

Intersection	7.5-Minute Headways (LRT)		
	Delay (sec/veh)	LOS	Comments
W Broadway Ave (CSAH 81) & 29th Ave [1]	6.9	A	All movements operate at LOS B or better
W Broadway Ave (CSAH 81) & 26th Ave [2]	17.8	B	All movements operate at LOS D or better
W Broadway Ave (CSAH 81) & Penn Ave (CSAH 2) [3]	36.8	D	Northbound left-turn and through and southbound left-turn movements operate at LOS E
Penn Ave (CSAH 2) and Golden Valley Rd	23.1	C	All movements operate at LOS C or better
Penn Ave (CSAH 2) and Plymouth Ave	38.5	D	Eastbound left-turn and through movements and southbound left-turn movement operate at LOS E
TH 55 & Penn Ave (CSAH 2)	59.8	E	Southbound approach operates at LOS F; eastbound left-turn and northbound left-turn and through operate at LOS E
TH 55 & Oliver Ave	7.0	A	All movements operate at LOS A

[1] *Assumes left-turn movements on Broadway Avenue (CSAH 81) are banned, impacting approximately 60 vehicles in the PM peak hour and more than 500 vehicles daily.*

[2] *Assumes left-turn movements on Broadway Avenue (CSAH 81) are banned, impacting approximately 80 vehicles in the PM peak hour and more than 800 vehicles daily.*

[3] *Assumes left-turn movements on Broadway Avenue (CSAH 81) are banned, impacting approximately 150 vehicles in the PM peak hour and more than 1,100 vehicles daily.*

Table 6. Intersection Delay and LOS Results: Alignment D2-C

Intersection	7.5-Minute Headways (LRT)		
	Delay (s/veh)	LOS	Comments
W Broadway Ave (CSAH 81) & 29th Ave [1]	7.2	A	All movements operate at LOS B or better
W Broadway Ave (CSAH 81) & 26th Ave [2]	18.7	B	All movements operate at LOS D or better
W Broadway Ave (CSAH 81) & Penn Ave (CSAH 2) [3]	56.4	E	Westbound left-turns operate at LOS F; northbound approach and southbound left-turns operate at LOS E
Penn Ave (CSAH 2) & Golden Valley Rd	32.3	C	All movements operate at LOS D or better except northbound left-turns which operate at LOS E
Penn Ave (CSAH 2) & Plymouth Ave	49.2	D	All left-turn movements operate at LOS E or LOS F; southbound through and right-turn operate at LOS E
TH 55 & Penn Ave (CSAH 2)	79.1	E	Southbound approach and eastbound left-turns operate at LOS F; all other movements operate at LOS D or LOS E

[1] *Assumes left-turn movements on Broadway Avenue (CSAH 81) are banned, impacting approximately 60 vehicles in the PM peak hour and more than 500 vehicles daily.*

[2] *Assumes left-turn movements on Broadway Avenue (CSAH 81) are banned, impacting approximately 80 vehicles in the PM peak hour and more than 800 vehicles daily.*

[3] *Assumes eastbound left-turn movements on Broadway Avenue (CSAH 81) are banned, impacting approximately 30 vehicles in the PM peak hour and more than 250 vehicles daily.*

In alternative D2-A, the through movements along the W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2) corridors operate concurrently with the transit phase and generally operate at LOS D or better. However, the high-volume intersections of W Broadway Avenue (CSAH 81)/Penn Avenue (CSAH 2) and TH 55/Penn Avenue (CSAH 2) are expected to operate near capacity, with several movements at LOS F. Options D2-A1 and D2-A2 had similar intersection delays for the two different signal operations at the intersections of TH 55 at Penn Avenue (CSAH 2) and Oliver Avenue. Option D2-A1 with one controller had slightly lower delays, which appeared to be due to less delay for the northbound movements from Penn Avenue (CSAH 2) to Oliver Avenue and also because vehicles on TH 55 only have to stop at one intersection, instead of two.

Alternative D2-A as currently proposed is expected to result in the W Broadway Avenue (CSAH 81)/ Penn Avenue (CSAH 2) and TH 55/Penn Avenue (CSAH 2) intersections operating at LOS E or LOS F in the 2030 PM peak hour. This is due to limited capacity at the intersection due to the LRT guideway requiring the removal of through lanes and/or taking a portion of the signal cycle for the LRT movement diagonally through the intersection. At W Broadway Avenue (CSAH 81)/Penn Avenue (CSAH 2), the mitigation measures would require either banning the northbound left-turn movement or providing a 200-foot northbound left-turn lane to improve from LOS F to LOS D/E (the assumed threshold for acceptable peak hour operations). Restricting the northbound left-turn movements would be expected to result in diversion to other intersections, such as Oliver Avenue/Golden Valley Road, Theodore Wirth Parkway/Golden Valley Road and/or Penn Avenue (CSAH 2)/Lowry Avenue. Additional northbound left-turn storage prevents the left-turn traffic from spilling into the through lane and also provides additional capacity to allow better use of the northbound green time at the signal, however it appears that additional right-of-way would be required to extend the northbound left-turn lane. There is sufficient storage for the westbound left-turn, therefore restricting this movement is not recommended. The westbound left-turn movement was modeled with protected only phasing, due to the crossing of the LRT guideway, which contributes to the high delay for that movement.

At TH 55 and Penn Avenue (CSAH 2), providing a 200 foot southbound left-turn lane improves the capacity of the intersection by removing the left-turning vehicles from the through lane. Left-turn storage is available through parking restrictions and lane reassignment by removing the exclusive southbound right-turn lane and creating a shared through/right-turn lane. This mitigation is in addition to geometric improvements to allow the northbound/southbound left-turn movements to operate concurrently. Providing southbound left-turn storage is expected to improve the intersection to LOS D operations during the PM peak. **Table 7** shows the intersection delay and LOS for Alternative D2-A with mitigation measures implemented.

Table 7. Intersection Delay and LOS Results: Alignment D2-A Mitigation

Intersection	Mitigation Measure	7.5-Minute Headways (LRT)		
		Delay (s/veh)	LOS	Comments
W Broadway Ave (CSAH 81) & Penn Ave (CSAH 2)[1]	200 foot northbound left-turn storage	54.8	D	Northbound and westbound left-turns operate at LOS F
W Broadway Ave (CSAH 81) & Penn Ave (CSAH 2)[1]	Banned northbound left-turns	60.7	E	Westbound left-turns operate at LOS F
TH 55 & Penn Ave (CSAH 2)	One controller, 200 foot southbound left-turn storage	49.6	D	Southbound left-turns operate at LOS F

[1]Assumes eastbound left-turn movements on Broadway Avenue (CSAH 81) are banned, impacting approximately 30 vehicles in the PM peak hour and more than 250 vehicles daily.

Alternative D2-B operates similar to D2-A with acceptable operations for W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2), with the critical intersections at W Broadway Avenue (CSAH 81)/Penn Avenue (CSAH 2) and TH 55/Penn Avenue (CSAH 2). The impact of the guideway through the W Broadway Avenue (CSAH 81)/Penn Avenue (CSAH 2) intersection has significant capacity impacts, which are somewhat mitigated by eliminating the left-turn movements. However, this traffic would get pushed elsewhere in the network – either to neighborhood streets or onto other arterials such as Emerson Avenue/Fremont Avenue (one-way pair) and Lowry Avenue.

Alternative D2-B is expected to result in LOS E operations at the TH 55/Penn Avenue (CSAH 2) intersection in the 2030 PM peak hour. Similar to Alternative D2-A, a 200-foot southbound left-turn lane with protected/permissive southbound left-turn phasing would be expected to improve the overall intersection from LOS E to LOS D. The left-turn storage provides additional capacity to the intersection and allows the southbound through movement to take better advantage of the green time. Similar to D2-A mitigation at the intersection, parking restrictions and lane reassignment would be needed to provide the exclusive left-turn lane with a shared through/right-turn lane. **Table 8** shows the intersection delay and LOS for Alternative D2-B with mitigation measures implemented.

Table 8. Intersection Delay and LOS Results: Alignment D2-B Mitigation

Intersection	Mitigation Measure	7.5-Minute Headways (LRT)		
		Delay (s/veh)	LOS	Comments
TH 55 & Penn Ave (CSAH 2)	One controller, 200 foot southbound left-turn storage	49.7	D	Northbound left-turn and through operate at LOS F; Eastbound left-turn operates at LOS F

Alternative D2-C provides the most capacity on Penn Avenue (CSAH 2) because of the additional right-of-way that provides northbound left-turn storage on Penn Avenue (CSAH 2) at W Broadway Avenue (CSAH 81). In addition, because the transitway does not operate on W Broadway Avenue (CSAH 81) between Oliver Avenue and Penn Avenue (CSAH 2), westbound left-turn storage can be provided on W Broadway Avenue (CSAH 81) at Penn Avenue (CSAH 2).

Alternative D2-C is expected to result in LOS E operations at the W Broadway Avenue (CSAH 81)/Penn Avenue (CSAH 2) in the 2030 PM peak hour. Similar to Alternative D2-A, a recommended mitigation measure would be to provide a 200-foot northbound left-turn lane, which would be expected to improve the overall intersection operations from LOS E to LOS D. The left-turn storage provides additional capacity to the intersection and allows the northbound through movement to take better advantage of the green time. The additional northbound left-turn storage would likely require additional right-of-way acquisition. Restricting the northbound left-turn movements would also address the LOS issue, but would be expected to result in diversion to other intersections, such as Oliver Avenue/Golden Valley Road, Theodore Wirth Parkway/Golden Valley Road and/or Penn Avenue (CSAH 2)/Lowry Avenue. There is sufficient storage for the westbound left-turn, therefore restricting this movement is not recommended. The westbound left-turn movement was modeled with protected only phasing, due to the crossing of the LRT guideway, which contributes to the high delay for that movement. At TH 55 and Penn Avenue (CSAH 2), providing a 200 foot southbound left-turn lane improves the capacity of the intersection, but is not enough to improve the overall intersection to LOS D due to the limited capacity and signal green time available for the left-turn movements. Table 9 shows the intersection delay and LOS for Alternative D2-C with mitigation measures implemented.

Table 9. Intersection Delay and LOS Results: Alignment D2-C Mitigation

Intersection	Mitigation Measure	7.5-Minute Headways (LRT)		
		Delay (s/veh)	LOS	Comments
W Broadway Ave (CSAH 81) & Penn Ave (CSAH 2)[1]	200 foot northbound left-turn storage	53.0	D	Westbound left-turns operate at LOS F
W Broadway Ave (CSAH 81) & Penn Ave (CSAH 2)[1]	Banned northbound left-turns	38.1	D	Westbound left-turns operate at LOS F
TH 55 & Penn Ave (CSAH 2)	200-foot southbound left-turn storage	60.3	E	All left-turns operate at LOS E or LOS F

Pedestrian Crossings

Table 10 shows the current pedestrian crossing volumes of W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2) at signalized intersections in the study area. The table also shows the distance between each signalized intersection under the existing and proposed conditions. Therefore, the furthest distance a pedestrian would have to walk to cross the guideway, assuming no unsignalized crossings of the guideway, is one-half the distance between signalized intersections. Unsignalized crossings of the guideway require additional space in the median to accommodate a refuge space between the road crossing and the guideway crossing and have been assumed to be infeasible on these corridors due to right-of-way constraints. In general, the pedestrian crossing volumes are very low and would not meet the pedestrian warrant for a traffic signal. Increases in pedestrian volumes due to the introduction of LRT would be expected mainly near the station areas (i.e., Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2)).

Table 10. Pedestrian Volumes Across Transitway and Crossing Distances

Intersection	Pedestrian Volumes in Peak Hour			Existing Distance between Signalized Crossings (miles)	Proposed Distance between Signalized Crossings (miles)
	AM	MID	PM		
W Broadway Ave (CSAH 81) & 29th Ave	0	0	16		
W Broadway Ave (CSAH 81) & 26th Ave	8	4	20	0.29	0.29
W Broadway Ave (CSAH 81) & Penn Ave (CSAH 2)	10	23	20	0.20	0.20
Penn Ave (CSAH 2) & Golden Valley Rd	20	26	41	0.33	0.33
Penn Ave (CSAH 2) & 16th Ave	2	10	8	0.23	0.23
Penn Ave (CSAH 2) & 14th Ave	16	17	13	0.12	-
Penn Ave (CSAH 2) & Plymouth Ave	43	9	14	0.12	0.24
Penn Ave (CSAH 2) & 12th Ave	4	1	6	0.12	-
Penn Ave (CSAH 2) & Oak Park Ave	10	7	11	0.12	0.24
TH 55 & Penn Ave (CSAH 2)	4	2	8	0.22	0.11

SUMMARY

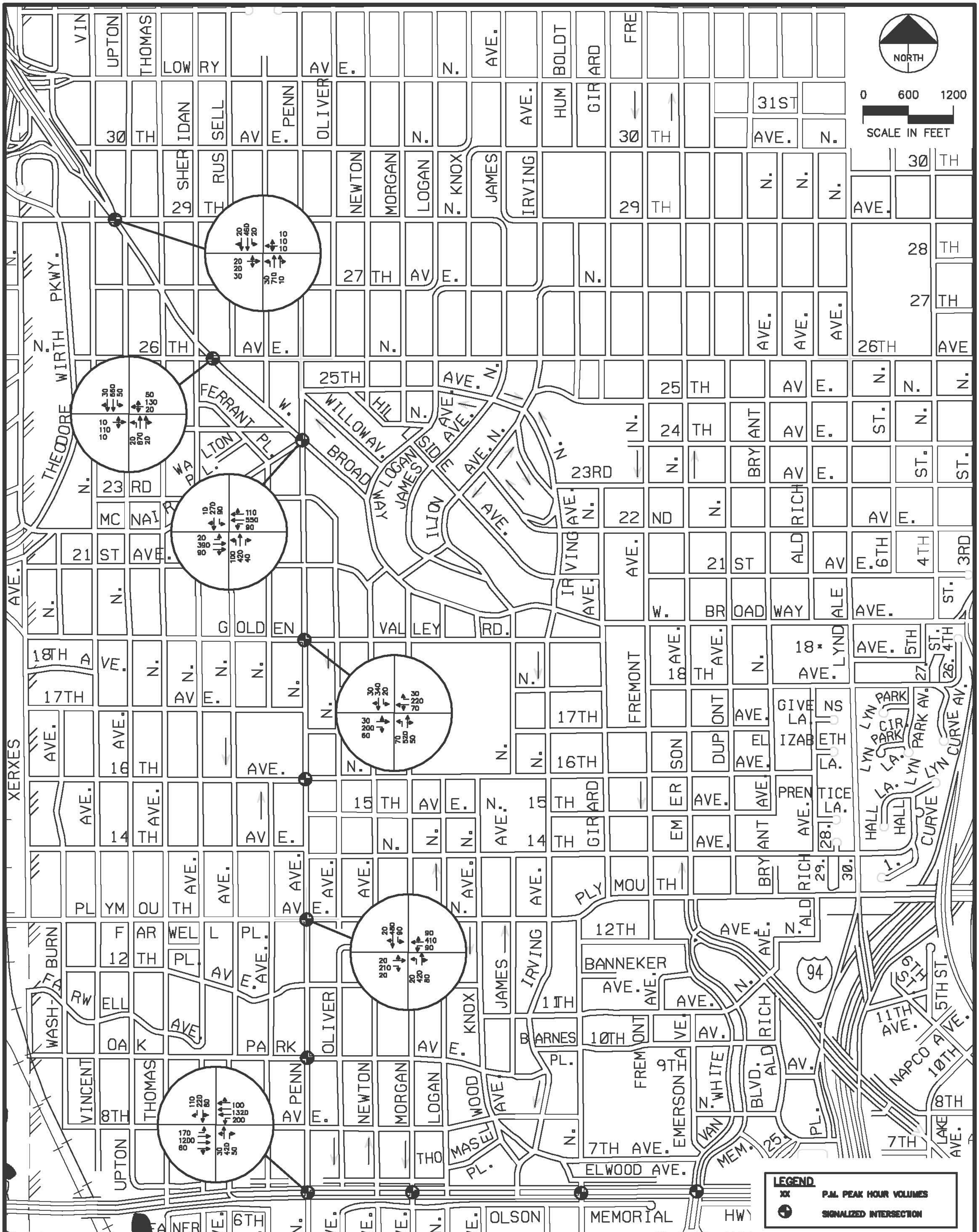
The existing PM peak hour modeling showed acceptable operations for all signalized intersections in the study area on W Broadway Avenue (CSAH 81) and Penn Avenue (CSAH 2). Due to the capacity constraints caused by the introduction of a transitway along the corridors, 20 percent of through traffic volumes were assumed to divert to other corridors in 2030. In addition, left-turn movements were assumed to be restricted at all locations along the alignment where left-turn lanes could not be provided. The McNair Avenue approach was also assumed to be removed from the W Broadway Avenue (CSAH 81)/Penn Avenue (CSAH 2) intersection because of the limited capacity available at the signal and the inefficient operation resulting from the inclusion of a fifth leg at the intersection.

In general, the modeling showed that Alternative D2-A resulted in LOS F operations at W Broadway Avenue (CSAH 81)/Penn Avenue (CSAH 2) due to the restricted capacity. The different control options, D2-A1 and D2-A2, showed similar intersection delay results for TH-55 at Penn Avenue (CSAH 2) and Oliver Avenue; however, the single controller for the two intersections operated with slightly less delay for northbound Penn Avenue (CSAH 2) and eliminates the weaving issue between intersections. Alternative D2-C showed the least vehicle delay, but comes at significant right-of-way acquisition costs. The potential mitigation measures to address the operational and delay issues at the W Broadway Avenue (CSAH 81)/Penn Avenue (CSAH 2) include:

- Construct a 200-foot northbound left-turn lane. This would require additional right-of-way.
- Restrict all northbound left-turn movements at the intersection. This would result in additional traffic on other roadways such as Golden Valley Road, Theodore Wirth Parkway, or Lowry Avenue.
- While the westbound left-turn movement is expected to operate at LOS F, this is primarily due to the protected only phasing to cross the guideway and limited available green time for this phase. There is adequate storage space for the left-turn movement, therefore restricting the westbound left-turn is not recommended.

The TH 55 and Penn Avenue (CSAH 2) intersection is a second capacity constraint in all alternatives. The introduction of the transit phase does cause some additional delay, primarily to the Penn Avenue (CSAH 2) approaches and the westbound TH 55 approach due to the need for a transit phase (which can also run concurrently with eastbound TH 55). The recommended mitigations to address the 2030 operational issues at the TH 55/Penn Avenue (CSAH 2) intersection include:

- Geometric improvements to allow the northbound/southbound left-turn movements to operate concurrently (eliminate existing split phasing)
- Reassign traffic lanes to create a 200-foot southbound left-turn lane and a shared through/right-turn lane. This improvement could be done through parking restrictions and does not require additional right-of-way acquisition.



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BOTTINEAU TRANSITWAY

EXISTING LANE GEOMETRY AND PM PEAK HOUR TRAFFIC VOLUMES

FIGURE 1

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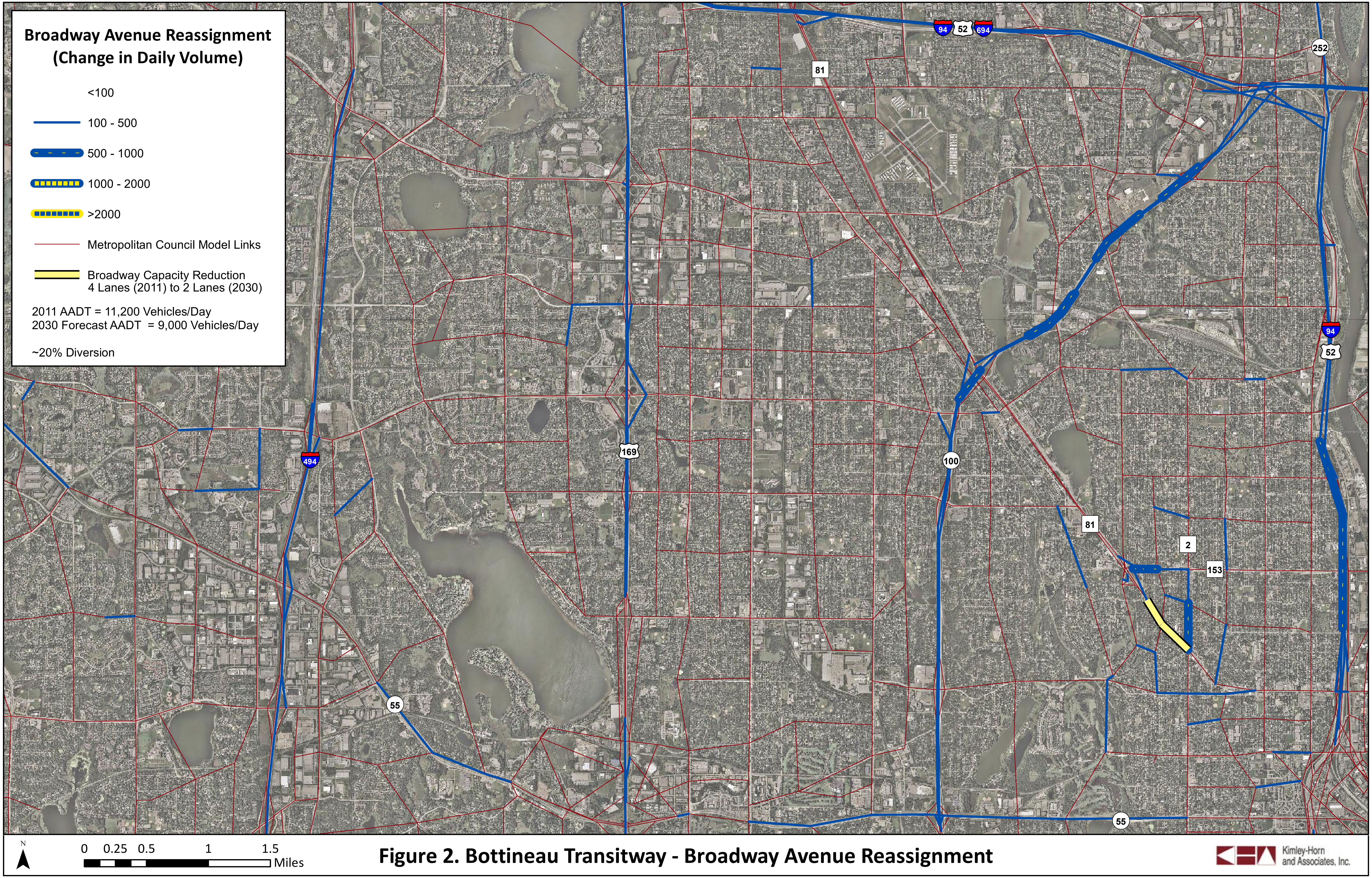
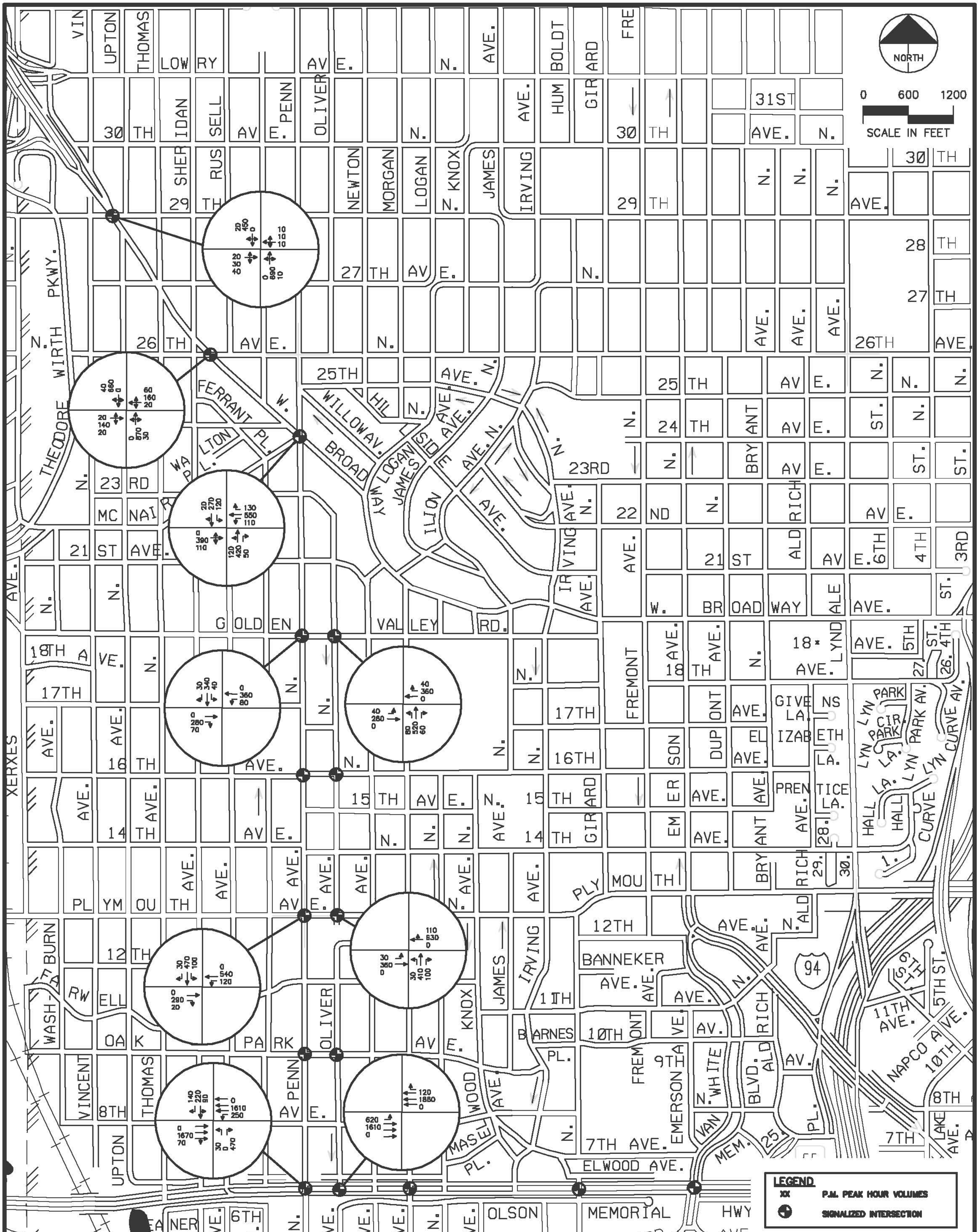


Figure 2. Bottineau Transitway - Broadway Avenue Reassignment



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Kimley-Horn and Associates, Inc.
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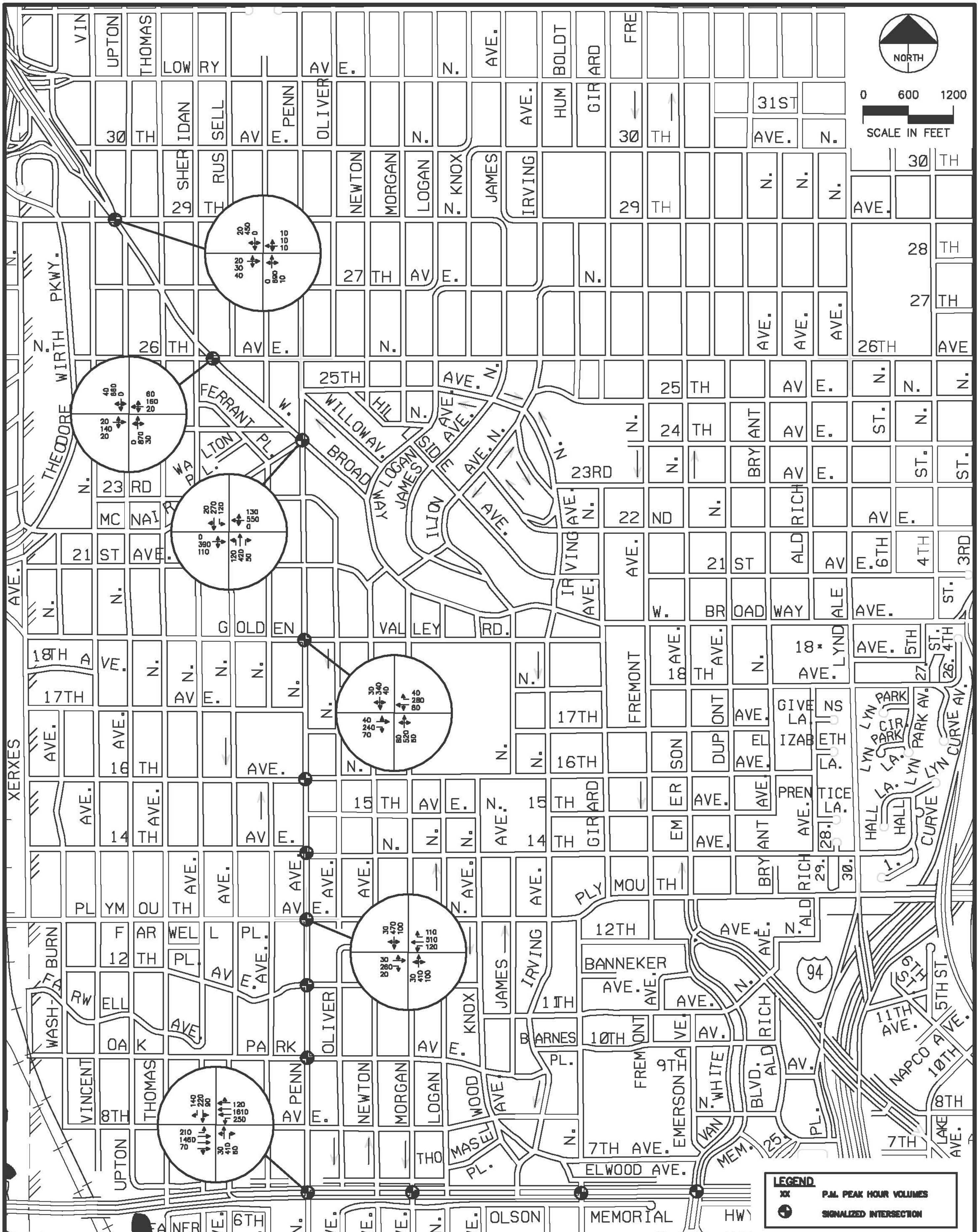
BOTTINEAU TRANSITWAY - D2-A ALIGNMENT
2030 LANE GEOMETRY AND PM PEAK HOUR TRAFFIC VOLUMES
FIGURE 3



BOTTINEAU TRANSITWAY - D2-B ALIGNMENT
2030 LANE GEOMETRY AND PM PEAK HOUR TRAFFIC VOLUMES
FIGURE 4

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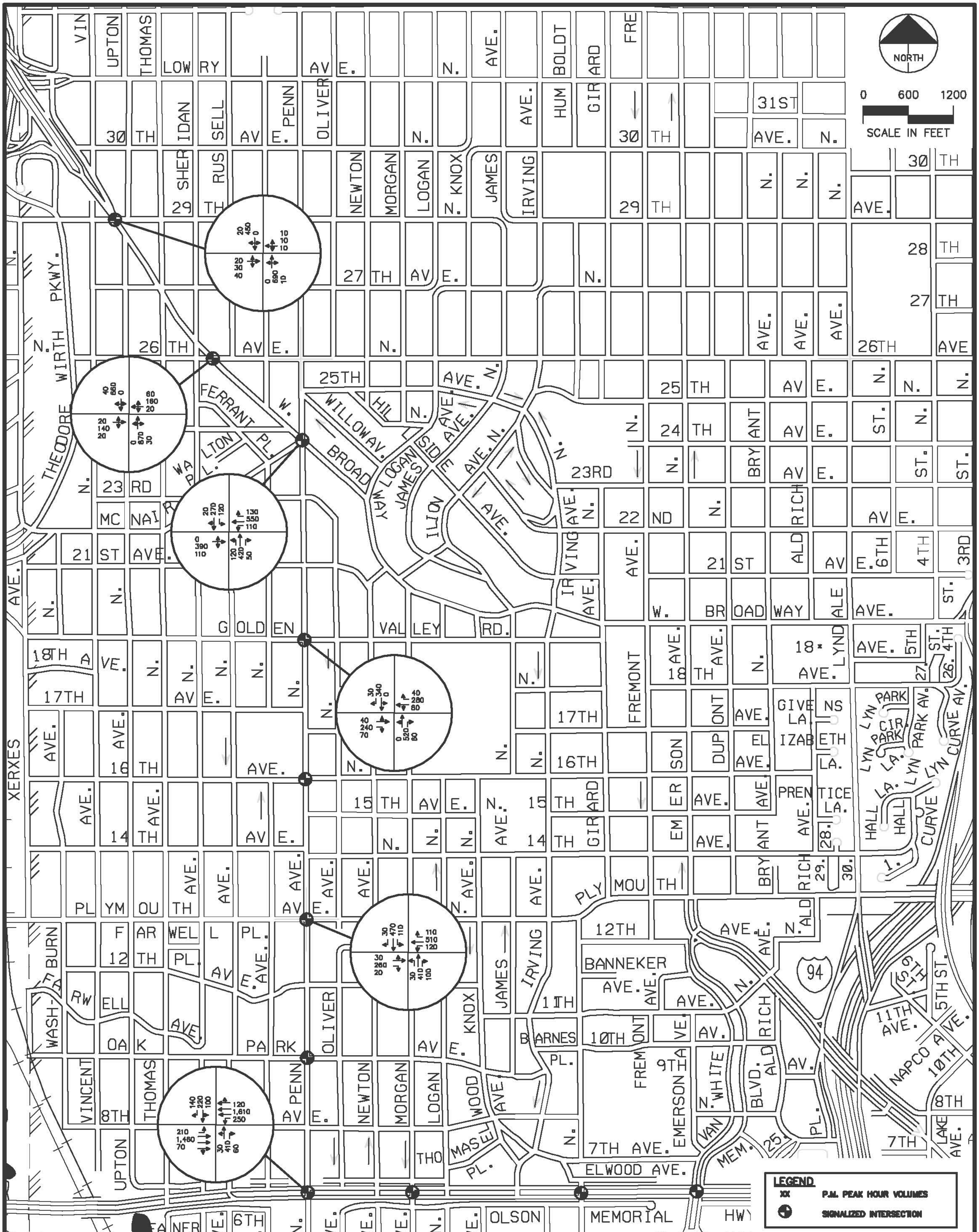

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BOTTINEAU TRANSITWAY - D2-C ALIGNMENT
2030 LANE GEOMETRY AND PM PEAK HOUR TRAFFIC VOLUMES
FIGURE 5

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Memorandum

Date: December 6, 2011

To: Brent Rusco, P.E., Joe Gladke, P.E.
Hennepin County Regional Railroad Authority

From: JoNette Kuhnau, P.E., PTOE
Kimley-Horn and Associates, Inc.

Subject: Bottineau Transitway Draft Environmental Impact Statement
Transit/Traffic Signal Operating Schemes Technical Memorandum

This memorandum presents a discussion of transit signal priority (TSP) and transit preemption operating scenarios at the signalized intersections along the Bottineau Transitway. The document is one of a series of technical memoranda that address various traffic operations issues along the transitway corridor. It is intended for review and consideration by technical staff of Hennepin County, agency staff that operate traffic signals along the transitway alignment, and Metro Transit staff.

The following sections focus on the traffic operations, transit operations, and cost implications of TSP and preemption operating scenarios along the corridor generally, and also identifies potential impacts and implications of the operating scenario in specific segments of the corridor. Additional considerations including transit travel time, transit ridership, and specific right-of-way impacts are discussed in this memorandum, but have not been analyzed for this memorandum.

DEFINITIONS AND STANDARDS

This section defines the terms and operating scenarios to be discussed in this memorandum, based on the standards and definitions contained in the 2005 Minnesota Manual on Uniform Traffic Control Devices (MnMUTCD).

In terms of traffic signal control, priority and preemption operating schemes are defined as follows:

- Priority Control – The modification of normal operation of a traffic control signal that alters the sequences of phases or changes the timing in response to an external event without leaving the normal mode of operation. This scheme will be referred to as transit signal priority (TSP) or priority in this document, but is also sometimes called “partial priority” in the traffic engineering industry.

  For the context of this memorandum, priority operations are assumed to consist of the displaying of early or extended green signal indications at an intersection to assist public transit vehicles in remaining on schedule.

- Preemption Control – The transfer of normal operation of a traffic control signal to a special control mode of operation in response to an external event. This scheme will be referred to as preemption in this document, but is also sometimes called “full priority” in the traffic engineering industry in reference to transit operations (as opposed to emergency vehicle preemption, which is always referred to as a preemption operation).

Preemption control can have several types of operation, even at the same intersection, depending on the type of vehicle making the preemption call:

- o The prompt displaying of green signal indications at signalized locations ahead of fire vehicles, law enforcement vehicles, ambulances, and other official emergency vehicles.
- o A special sequence of signal phases and timing to provide additional clearance time for vehicles to clear the tracks prior to the arrival of a train (heavy rail or light rail).
- o A special sequence of signal phases to display a red indication to prohibit turning movements towards the tracks during the approach or passage of a train (heavy rail or light rail).

The MnMUTCD defines priority at traffic signals that are designed to respond under both preemption and/or priority control to more than one type or class of vehicle:

1. Railroad preemption, including trains and semiexclusive alignment light rail crossings where the light rail transit movement is not controlled by a traffic control signal or a light rail transit signal.
2. Emergency vehicle preemption, including fire and law enforcement vehicles, ambulances, and other official emergency vehicles.
3. Transit priority, including buses and semiexclusive or mixed-use alignment light rail crossings where the light rail transit movement is controlled by a traffic control signal or a light rail transit signal.

Relative to the transitway alignment, the types of alignments are defined based on the transit vehicle interaction with other traffic as follows:

- Exclusive – A transit right-of-way that is grade-separated or protected by a fence or traffic barrier. Motor vehicles, pedestrians, and bicycles are prohibited within the right-of-way. Subways and aerial structures are included within this group. This type of alignment does not have at-grade grade crossings.
- Semiexclusive: A transit alignment that is in a separate right-of-way or along a street or railroad right-of-way where motor vehicles, pedestrians, and bicycles have limited access and cross at designated locations only.
- Mixed-Use: An alignment where light rail transit operates in mixed traffic with all types of road users. This includes streets, transit malls, and pedestrian malls where the right-of-way is shared.

The Bottineau Transitway would be considered to be a semiexclusive alignment for its entire length, both in the side-running and center-running segments. This means that by MnMUTCD standards, either priority or preemption control can be used at traffic signals.

In combination with traffic signal control, the MnMUTCD also provides for the use of four-quadrant gate systems, automatic gates, flashing-light signals, actuated blank-out and variable message signs, and other active traffic control devices for at-grade transitway crossings. The use of these devices can be based on engineering judgment, but the MnMUTCD provides the following guidance:

- When light rail transit speed is cited in this Part (Section 10D), it refers to the maximum speed at which light rail transit vehicles are permitted to traverse a particular grade crossing. (Section 10D.1)
- Highway-light rail transit grade crossings in semiexclusive alignments should be equipped with automatic gates and flashing-light signals where light rail transit speeds exceed 35 miles per hour (mph).(Section 10D.3)
- Traffic control signals may be used instead of automatic gates at highway-light rail transit grade crossings within highway-highway intersections where light rail transit speeds do not exceed 35 mph. (Section 10D.3)

When automatic gates are used, the following clearance standards apply:

- Minimum Track Clearance Distance – for standard two-quadrant railroad warning devices, the minimum track clearance distance is the length along a highway at one or more railroad tracks, measured either from the highway stop line, warning device, or 12 ft perpendicular to the track centerline, to 6 ft beyond the track(s) measured perpendicular to the far rail, along the centerline or edge line of the highway, as appropriate, to obtain the longer distance. (Section 8A.1)

OPERATING SCENARIO CONSIDERATIONS

The decision about whether to operate a traffic signal with priority or preemption control is based not only on standards and requirements, but also balancing the needs and priorities of each of the traffic flows (automobile and transit). The following sections discuss the considerations that should influence the decision about whether to operate a signalized intersection under a priority or preemption scenario and the implication of these decisions as applicable to the Bottineau Corridor. This discussion is applicable only to the light rail transit mode, as the MnMUTCD does not discuss dedicated bus rapid transit (BRT) facilities and has no signal operations requirements (automatic gates or preemption) for BRT.

Signal Preemption

The purpose of traffic signal preemption near railroad or light rail grade crossings is to increase safety at these intersections by clearing vehicles from the path of approaching trains, particularly those traveling at high speeds. The main advantages of signal preemption for transit vehicle operations are more efficient and reliable travel times. Automatic gates are assumed to be used at speeds greater than 35 mph. There are a number of distinct time segments involved in a preemption scenario:

- Preemption call is received through detection in the guideway.
- The signal phase running when the preemption call is received is terminated.
- One or more clearance phases are run to clear any vehicles from the track crossing. The sequence of clearance phases can be as short as 20 seconds or longer than 60 seconds depending on the configuration of the crossing and the preferences of the agency operating the signal.
- The signal runs the phase(s) compatible with the transit crossing. This phase is typically held until the transit vehicle clears the “check out” loop at the far side of the intersection.

- The signal runs the "recovery" phase. There are several ways a signal can recover from a preemption, which can be based on traffic operations and the preferences of the agency operating the traffic signal. The following are typical recovery options for a signal with a side-running guideway (e.g., Bottineau Transitway along Bottineau Boulevard (CSAH 81) in Brooklyn Park):
  - Recover to the phase that the signal would have been in had there not been a preemption call. This mode attempts to recover corridor coordination as soon as possible, but usually has the biggest impact on side street delays and mainline left-turn movements since they are most likely to be skipped either during or recovering from the preemption.
  - Recover to the side street through and/or left-turn phases (i.e., phases that are not compatible with transit and therefore may be skipped during a preemption call).
  - Recover to mainline left-turn phases (i.e., phases that are not compatible with transit and therefore may be skipped during a preemption call).

Several important factors must be considered when assessing preemption operations and how signals will recover from a preemption call into normal signal operations:

- Delays to mainline automobile traffic (e.g., minimize mainline through delay at individual intersection)
- Coordination for mainline automobile traffic (e.g., minimize mainline through delay and maximize corridor progression)
- Delays for left-turn and cross-street traffic (e.g., minimize delays for non-compatible phases)
- Consequences of multiple back-to-back preemption calls (e.g., the same phase being omitted in multiple consecutive cycles, which can lead to drivers violating the traffic signal or the automatic gates)
- Capabilities of the traffic signal controller and software at the intersection. There are several type of controllers and software available, but in general Econolite ASC2 and ASC3 controllers (currently used by Hennepin County) have been shown to have greater capabilities to handle both priority and preemption calls compared to Siemens Eagle controllers (currently used by City of Minneapolis).

The diagram in **Figure 1** shows an illustration of a "normal" signal cycle and the same cycle with a transit preemption occurring during the mainline through movement phase, with the signal attempting to recover into coordination. Depending on the signal spacing, the frequency of preemption calls, and the length of preemption calls, coordination may or may not be able to be maintained in a corridor. Attempting to maintain coordination, as shown in the example cycle in **Figure 1**, will result in higher delays on the cross street because the mainline through movements receive additional green time (since they are compatible with the through movement) and because the signal is forced back to the mainline phases according to the coordination plan.

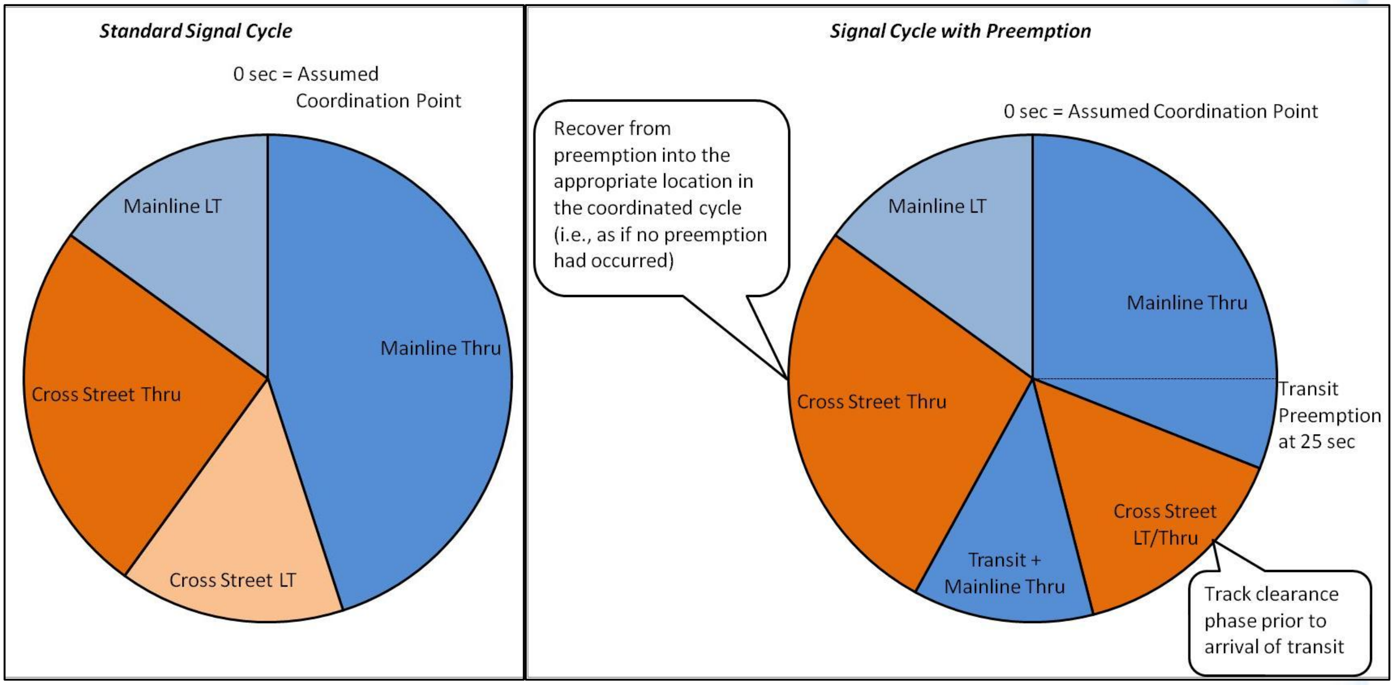


Figure 1. Premption Signal Cycle Example

The traffic volumes on the cross street should also play a role in determining whether it is more important to maintain mainline coordination or minimize overall intersection delay. Figure 2 shows an alternate operations strategy that recovers into the next phase to be sequenced. This type of recovery typically reduces the delays for the cross street and left-turn movements, but also means the signal will need several cycles to attempt to get back into coordination. Depending on the frequency of preemption calls and the spacing of the signals in the corridor, it may not be possible to maintain coordination at all.

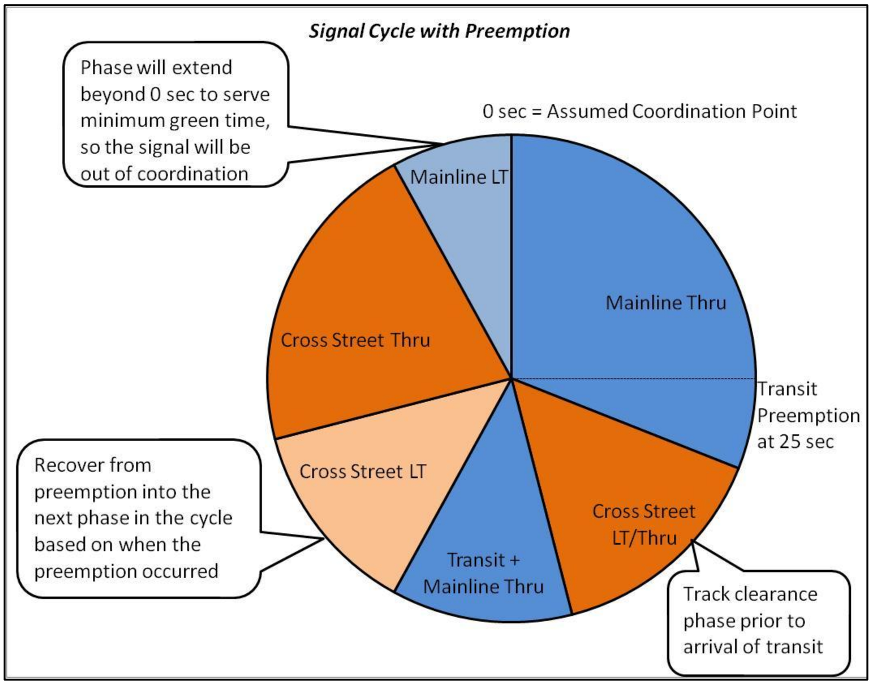


Figure 2. Alternate Preemption Signal Cycle Example

In addition to traffic signal operations, a preemption operating scenario also typically necessitates the use of automatic gates at the intersection to prevent vehicles from crossing the guideway. For a side-running transit alignment, the gate configuration typically involves a center median on the cross street and one automatic gate for each approaching travel direction (e.g., west of the guideway for eastbound traffic and east of the guideway for westbound traffic). Automatic gates are also typically used for the parallel right-turn movement across the guideway. This is the standard gate installation used for the Hiawatha LRT line where it is side-running along TH 55 in Minneapolis. Automatic gates do have significant cost implications, typically costing approximately $250,000-$300,000 per intersection for the gate arms, controllers, blank-out signs, detection, and other necessary equipment.

The installation of automatic gates for a center-running guideway is much more unusual and challenging due to the space needed for the gate foundations and arms, as well as placement of the gate to best protect automobile traffic from conflicts with transit vehicles, as well as other automobile traffic. One known center-running LRT system with gates is located on 36th Street NE in Calgary, Alberta, Canada. On this system, four-quadrant gates are installed parallel to the guideway to prevent vehicles from crossing the guideway. Gates are also installed in some locations for the parallel left-turn movements across the guideway, where four-quad gates are not used. This configuration is shown in the photo in Figure 3 and is the safest configuration in terms of preventing conflicts between automobile traffic and the transit vehicles. However, an automobile on the cross street that enters the intersection during a preemption, when the automatic gates are being lowered, could potentially be trapped in the intersection and have conflicts with other vehicle traffic.

Figure 3. Center-Running Gated LRT Guideway
36th Street NE/39th Avenue NE intersection. Source: Google Streetview

Another potential option would be to install automatic gates on the cross street approaches (at the stop bars) and across the parallel (mainline) left-turn lanes. The advantage of this approach is that it avoids any cross street traffic from being trapped in the intersection. However, if vehicles violate the traffic signal or drive around the gates, they are not physically prevented from entering the guideway while a transit vehicle is approaching, which is a potential safety concern. In either gate configuration, approximately 10 to 15 feet of additional space is required for the gate installations, either in the guideway or for the mainline left-turn medians. For the Bottineau Transitway, this would potentially have right-of-way or construction implications for CSAH 103 (W Broadway Ave). The other segments with posted roadway speeds greater than 35 mph have assumed transitway operating speeds of 35 mph or less, therefore not triggering the need automatic gates.

For transitway operating speeds greater than 35 mph, a priority scheme may be feasible from a purely technical standpoint, but is not known to be operating on any transit system in the United States. A priority scheme is not recommended for transit operations in any segment with speeds greater than 35 mph for the following reasons:

- Priority operations do not include the track clearance phases that would be triggered by a preemption call. Therefore there may be greater risk that vehicles are queued across the guideway when the train arrives, particularly on a side-running alignment.
- Priority operations ultimately mean that the transit vehicle may be required to stop at signalized intersections. This would in turn require bar signal and transit detection infrastructure located not only at the intersection but also several hundred feet upstream to

allow the transit vehicle adequate time and distance to come to a complete stop prior to the intersection.

- In addition to the delay times transit vehicles would experience at the signalized intersections, which could be 30 seconds or more at any individual intersection, transitway running times will be further impacted by the need to accelerate and decelerate from a minimum speed of 0 mph (stopped condition) to a maximum of 45-55 mph (maximum operating speed).
- Past studies have shown the priority operations compared to preemption operations may have slightly better operations for automobile traffic, but have significantly worse operations for transit traffic. This result is dependent on many factors, including automobile traffic volumes, traffic signal controller, and preemption clearance and recovery phasing. However, it is still important to consider whether the benefit gained by the automobile traffic in a priority scheme is sufficient to justify the impact on transit travel times and delays.

Measures that can mitigate the potential impacts of preemption operations include software/controller selection and programming, location of transit vehicle detection (i.e., timing of preemption call), preemption clearance phasing and timing, preemption recovery phasing, and vehicle detection.

Transit Signal Priority

Priority signal operation is generally used in urban and some suburban environments where transit vehicles travel at lower speeds and are controlled at intersections by traffic signals and bar signals. The nature of priority operation is that a transit vehicle may have to slow or stop before proceeding through the intersection. In a signalized corridor, TSP has the benefit of maintaining traffic progression and coordination on the main roadway by providing more green time for the transit vehicle to proceed through an intersection when possible. The agency that operates the signals has the flexibility to designate by corridor or by intersection how much of the total signal cycle time is available to provide the transit advantage. The amount of available time is based on several factors and assumptions:

- Minimum pedestrian crossing times – pedestrian crossing times will never be shortened in a TSP scenario.
- Minimum green and clearance times for the cross street – minimum green times (typically 7 to 20 seconds) and clearance times (yellow + all-red – typically 6 to 10 seconds) will never be shortened in a TSP scenario.
- Assume all signal phases are served – TSP scenarios do not typically involve skipping any phases.

The diagram in **Figure 4** shows an illustration of a “normal” signal cycle and the same cycle with a transit vehicle serviced using TSP, assuming that the transit phase is compatible with the mainline through movements, 7-second minimum green times for the left-turn movements, 15-second minimum green times for the through movements, and 6-second clearance times for all phases. The sequence of signal phases following a TSP call are the same as if there is no TSP call – the only differences are in the lengths of time for each phase.

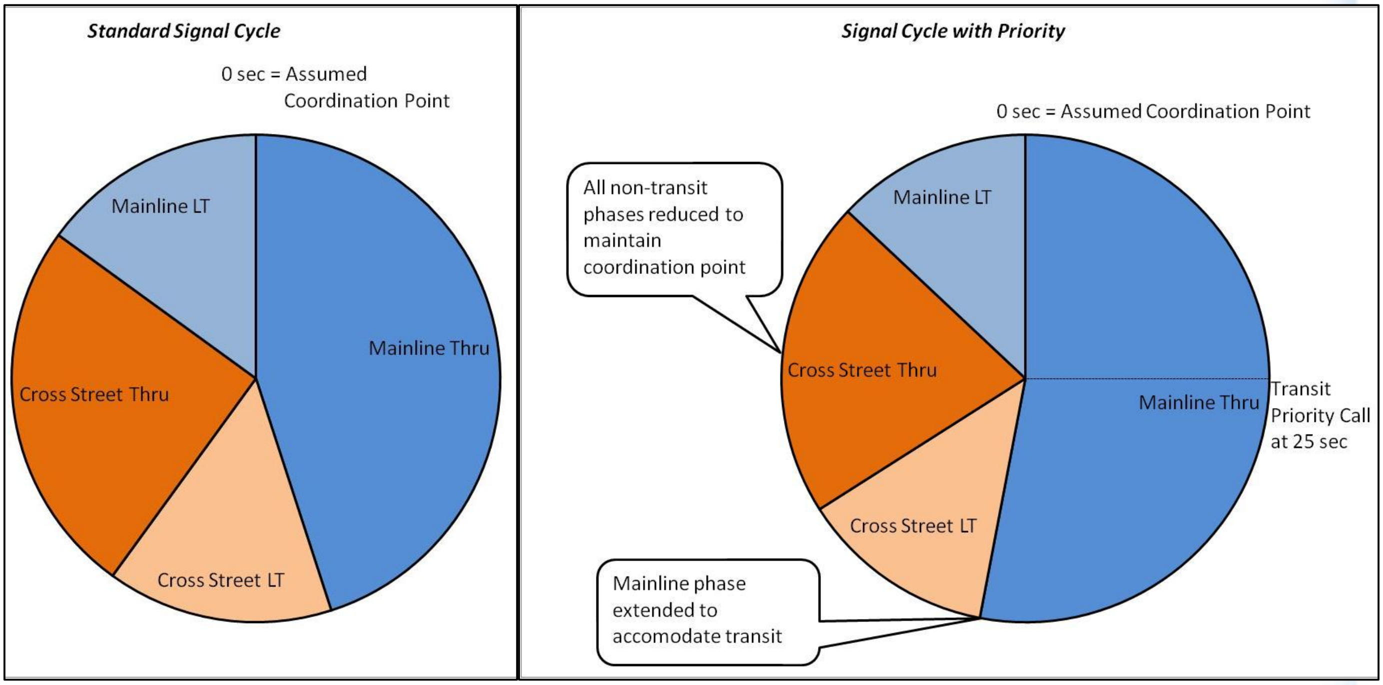


Figure 4. Priority Signal Cycle Examples

The main advantage of TSP is that it provides improved on-time reliability and faster travel times for transit vehicles, while minimizing impacts on automobile traffic. This means that transit vehicles are given additional green time at the signal when possible, but if the additional green time is not sufficient to accommodate the transit vehicle's arrival, the transit vehicle would have to stop and wait for the signal to cycle back to its phase. For both LRT and BRT, the infrastructure necessary to accommodate TSP and the potential need to stop include the following:

1. Advance transit detection, located based on speed and calculated maximum stopping distance of the transit vehicle.
2. Nearside and farside bar signals at each signalized intersection. Advance bar signals may also be needed based on line of sight and necessary stopping distance.
3. Communications infrastructure (e.g., fiber optic line) between traffic signal and transit system.
4. Software and hardware to process the transit detection call input and provide the bar signal output.

Items 1 and 3 are needed for either a priority or preemption operating scenario. However, items 2 and 4 can have costs implications of $25,000-$40,000 per intersection.

The primary disadvantage of a priority operating scenario occurs in corridors with high travel speeds for both transit and automobile traffic. A TSP operating scenario means that the transit vehicle may have to stop at signalized intersections, especially where the "extra" green time available for transit is small (due to high traffic volumes and/or limited intersection capacity). Stopping the transit vehicle is most problematic when the transit mode is LRT and the guideway travel speeds are greater than 35 mph. Under these conditions, the time and distance needed for the light rail vehicle to decelerate and accelerate are significant and have negative impacts on the travel time between stations, but also on the rider experience. Further, operating automatic gates in a priority scenario becomes significantly complicated since sometimes the track clearance and gate sequence would need to be triggered immediately upon detection (if a green signal indication was going to be given) or could be delayed by 60 seconds or more (if the transit vehicle cannot be given a green indication and will have to stop at the intersection). This is a very unusual operating scenario and would require significant communications hardware, software, and programmed logic for the equipment to respond differently under the various potential scenarios. There are no known LRT systems operating in a semi-exclusive alignment at high speeds under a priority scenario.

BOTTINEAU TRANSITWAY OPERATIONS

A number of operating assumptions have been made as part of the Bottineau Transitway Draft Environmental Impact Statement (DEIS) analysis relative to operating speeds in various segments of the corridor and signal operations at the signalized intersections. The DEIS assumptions and recommended signal operations based on those assumptions are documented in **Table 1**.

For segments B and C, where the proposed transitway operating speeds are greater than 35 mph, operating under a priority scheme, rather than preemption, would change the operations at up to 14 signalized intersections. Considering only intersection delay (i.e., ignoring delay to acceleration/deceleration), priority operations in these segments would have the potential to increase the running times by several minutes, which in turn has a negative impact on ridership

Table 1. Bottineau Transitway Operating Assumptions

Segment	Proposed Transitway Operating Speed, mph	Posted Roadway Speed Limit, mph	Proposed Guideway Configuration	Signalized Intersections	Recommended Signal Operation
A	35	35	Center Median Running	Arbor Lakes Pkwy/ Zachary Ln	Priority
A	35	40	Center Median Running	Brooklyn Blvd/ Northland Dr Brooklyn Blvd/ Boone Ave	Priority
B	45	50 [1]	Center Median Running	W Broadway Ave (CSAH 103)/ 94th Ave W Broadway Ave (CSAH 103)/ 93rd Ave W Broadway Ave (CSAH 103)/ Setzler Pkwy W Broadway Ave (CSAH 103)/ Maplebrook Pkwy	Preemption
A/B	55	55	Side Running (West)	Bottineau Blvd (CSAH 81)/ 73rd Ave Bottineau Blvd (CSAH 81)/ 71st Ave	Preemption
B	45	45 [1]	Center Median Running	W Broadway Ave (CSAH 103)/ 85th Ave W Broadway Ave (CSAH 103)/ College Park Dr W Broadway Ave (CSAH 103)/ Candlewood Dr W Broadway Ave (CSAH 103)/ Brooklyn Blvd W Broadway Ave (CSAH 103)/ 76th Ave W Broadway Ave (CSAH 103)/ 75th Ave	Preemption
C	55	45	Side Running (West)	Bottineau Blvd (CSAH 81)/ 63rd Ave Bottineau Blvd (CSAH 81)/ Bass Lake Rd	Preemption

[1] Existing speed limits on CSAH 103 (W Broadway Ave) are 45 mph south of 85th Avenue and 50 mph north of 85th Avenue. Future speed limits will be determined as part of the highway reconstruction project, independent of the Bottineau Transitway DEIS.

Table 1 Continued. Bottineau Transitway Operating Assumptions

Segment	Proposed Transitway Operating Speed, mph	Posted Roadway Speed Limit, mph	Proposed Guideway Configuration	Signalized Intersections	Recommended Signal Operation
D1	35	40	Center Median Running	TH 55/ Thomas Ave	Priority
D2 Sub-Alt 2	35	30	N/A	France Ave/ Oakdale Ave	Priority
D2 – Alt 3	≤35 [2]	40	Center Median Running	Bottineau Blvd (CSAH 81)/ 35th Ave	Priority
D2 D2 Sub-Alt 1 D2 Sub-Alt 2 D2 Sub-Alt 3	≤35 [2]	40	D2 and Sub-Alt 1 = Side Running (West) Sub-Alt 2 and Sub-Alt 3 = Center Median Running	Bottineau Blvd (CSAH 81)/ Abbott Ave	Priority
D2	30	35	Center Median Running	W Broadway Ave (CSAH 81)/ 29th Ave	Priority
				W Broadway Ave (CSAH 81)/ 26th Ave	
D2 D2 – ALTa D2 - ALTb D2 - ALTc	30	30	D2 and ALTa = Side Running (East) ALTb = N/A ALTc = Center Median Running	W Broadway Ave (CSAH 81)/ Penn Ave (CSAH 2)	Priority
				Penn Ave (CSAH 2) and Oliver Ave/ Golden Valley Rd	
				Penn Ave (CSAH 2) and Oliver Ave/ 16th Ave	
				Penn Ave (CSAH 2) and Oliver Avenue/ Plymouth Ave	
				Penn Ave (CSAH 2) and Oliver Ave/ Oak Park Ave	
D1 D2 – ALTb	35	D1 = 40 D2 ALTb = 30	D1 = Center Median Running D2 ALTb = Turn	TH 55/ Penn Ave (CSAH 2) and Oliver Ave	Priority
D	35	40	Center Median Running	TH 55/ Morgan Ave	Priority
				TH 55/ Humboldt Ave	
				TH 55/ Van White Memorial Blvd	
D	30	40	Center Median Running	TH 55/Bryant Ave	Priority
				TH 55/ W Lyndale Ave	
				TH 55/ E Lyndale Ave	
D	30	30	Center Median Running	TH 55/ Border Ave	Priority
				TH 55/ 7th St/ 6th Ave	

[2] Operating speeds for the D2 Sub-Alternatives have not been defined in the current operating plan. Based on the adjacent segments and locations of curves, the operating speed is assumed to be at or less than 35 mph.

SUMMARY AND RECOMMENDATIONS

This document outlines the standards, advantages, and disadvantages related to preemption and priority scenarios for transit operations. Priority operations provide a transit advantage at signalized intersections, with fewer impacts on automobile traffic. Preemption operations provide the safest operations where transit vehicles are traveling at high speeds, but can also have the greatest impacts on automobile traffic flow. However, these impacts can be reduced by the transit vehicle detection and preemption call timing, traffic signal hardware/ software, preemption phasing, and automobile detection.

Based on safety and operational considerations, preemption operations are recommended on Bottineau Transitway for all signalized intersections in Segments B and C where operating speeds exceed 35 mph. For all other segments, priority operations are recommended.

OTHER RESOURCES

The following list of resources provides more in-depth technical discussion of priority and preemption operations.

1. Venglar, Jacobson, Sunkari, Engelbrecht, and Urbanik. *Guide for Traffic Signal Preemption Near Railroad Grade Crossing*. Report FHWA/TX-01/1439-9, September 2000.
2. Bauer and Fuller. *An Evaluation of Light Rail Transit Signal Control Options.* Completed for City of Phoenix, 2001. Document available at: http://www.ptvamerica.com/fileadmin/files_ptvamerica.com/library/2002%20ITE%20LRT%20Signal%20Control.pdf
3. Urbanik. *Hiawatha LRT Preemption Evaluation*. Completed for City of Minneapolis, October 2010.
4. Institute of Transportation Engineers, *Preemption of Traffic Signals At or Near Railroad Grade Crossings with Active Control Devices.* Committee TENC-99-06, 2003.
5. Korve Engineering, *Light Rail Service: Pedestrian and Vehicular Safety*. Transportation Research Board Transit Cooperative Research Program Report 69, 2001.

Memorandum

Date: February 16, 2012

To: Brent Rusco, P.E., Joe Gladke, P.E.
Hennepin County Regional Railroad Authority

From: JoNette Kuhnau, P.E., PTOE
Kimley-Horn and Associates, Inc.

Subject: Bottineau Transitway Draft Environmental Impact Statement
TH 55/7th Street/6th Avenue Intersection – Traffic Analysis

This memorandum presents the results of the traffic operations analysis for the Trunk Highway (TH) 55/7th Street/6th Avenue intersection analysis, which is part of the Bottineau Transitway within the City of Minneapolis. This memorandum includes a brief review of the previous modeling work completed at this intersection and the 2030 modeling results with geometric changes at the TH 55/7th Street/6th Avenue intersection.

This document is intended for review and consideration by the technical staff of the Minneapolis Focused Issue Group (FIG), and is one of a series of technical memoranda that address various traffic operations issues along the transitway corridor.

Previous 2030 Operations Modeling

Previous modeling work for the TH 55/7th Street/6th Avenue intersection is described in detail in the following documents:

- *Bottineau Transitway Traffic Study Report, Trunk Highway 55 (Olson Memorial Highway) Corridor*, WSB and Associates, November 10, 2009
- *The Interchange, Existing and 2030 No Build Analysis Traffic Technical Memorandum #1*, Kimley-Horn and Associates, January 25, 2011
- *The Interchange, 2030 Build Analysis Traffic Technical Memorandum #2*, Kimley-Horn and Associates, March 7, 2011
- *The Interchange, 2030 Build Analysis Update Traffic Technical Memorandum #3*, Kimley-Horn and Associates, August 22, 2011

The previous analysis included a number of intersections along the proposed Bottineau Transitway alignment on TH 55 and around the site of The Interchange, which is approximately located in the southeast quadrant of the TH 55/7th Street/6th Avenue intersection. As part of the modeling analysis for The Interchange project, TH 55/7th Street/6th Avenue was identified as a critical intersection because it has high traffic volumes, serves as a critical entry point into downtown, and was previously shown to have potential significant traffic operations impacts due to an at-grade LRT alignment.

The operations analysis completed for The Interchange project identified the following key findings:

- Operating both Bottineau LRT and Southwest LRT with at-grade crossings of TH 55/7th Street/6th Avenue would be expected to result in LOS E/F operations during both peak hours in 2030. Even with significant capacity improvements, it is unlikely that the intersection would operate at LOS D or better.
- Operating either Bottineau LRT or Southwest LRT with an at-grade crossing of TH 55/7th Street/6th Avenue would be expected to result in LOS E operations in one or both peak hours. Some capacity improvements would likely be needed to improve the overall intersection to LOS D or better.

Based on the previous analysis, the major operational concerns that were identified were:

- Northbound/southbound split phasing necessitated by the northbound shared left/through lane. A single northbound left-turn lane would not provide adequate capacity, and geometric changes would be needed to provide two exclusive northbound left-turn lanes. The northbound left-turn is a critical movement in the PM peak.
- Reduction in capacity for the eastbound right-turn movement, compared to existing conditions. This movement currently has two exclusive turn lanes, whereas in the 2030 Build conditions with Bottineau Transitway assumed to be center running on TH 55, the eastbound approach would be limited to through, shared through/right, and right-turn lanes.

These issues are the basis for the analysis of mitigation at the TH 55/7th Street/6th Avenue.

2030 MITIGATION SCENARIO ANALYSIS

The purpose of the current analysis is to determine what geometric or other mitigations would be necessary to provide LOS D or better operations at the TH 55/7th Street/6th Avenue intersection. The 2030 forecasts and operations modeling for the current modeling effort are based on the following assumptions:

- Background growth rates were previously developed for the study area by WSB and Associates as part of the 2009 *Bottineau Transitway Traffic Study Report*. The growth rates were based on the Metropolitan Council travel demand model and the anticipated population and employment growth in downtown Minneapolis. The growth rates developed by WSB in the previous study were applied to the 2010 peak hour counts conducted for The Interchange project to produce 2030 peak hour forecasts.
- Development of The Interchange site, including up to 425 on-site parking spaces and grade separation of all LRT at the Hennepin Energy Recovery Center (HERC) entrance.
- Hiawatha LRT operating three-car trains at 7.5-minute headways in each direction, with an end-of-line station at The Interchange.
- Central Corridor LRT operating three-car trains at 7.5-mintue headways in each direction.
- Southwest LRT operating three-car trains at 7.5-minute headways in each direction. Central Corridor LRT would be interlined with Southwest LRT, meaning that Southwest LRT trains would continue onto the Central Corridor line and vise versa (i.e., Southwest and Central

Corridor trains do not reverse direction when they reach the The Interchange). Southwest LRT is assumed to have a grade-separated crossing of 7th Street.

- Bottineau Transitway operating three-car trains at 7.5-minute headways. Assumed to operate on a center running alignment on TH 55, with a diagonal at-grade crossing at the TH 55/7th Street/6th Avenue intersection. Previous modeling included both at-grade and grade-separated operations at TH 55/7th Street/6th Avenue.
- All modeling was completed in VISSIM to simulate the impacts of transit and pedestrians on the study intersections.
- Transit priority operating scheme at the TH 55/7th Street/6th Avenue based on the anticipated transit vehicle operating speeds and the negative traffic operations impacts previously identified under a preemption scheme.

The geometrics that were previously analyzed, including Bottineau Transitway crossing the intersection at-grade, and the 2030 peak hour forecast volumes are shown in **Figure 1**. As shown in the figure, the TH 55/ 7th Street/ 6th Avenue intersection is skewed, but for the purposes of this discussion the TH 55/6th Avenue approaches will be considered to be east/west and the 7th Street approaches will be considered to be north/south. The skewed intersection geometrics are also relevant to the analysis because they increase pedestrian crossing distances (and therefore required signal phase times), increase the vehicle clearance times for the signal, require a longer phase to clear the train from the intersection, and also result in slower turning speeds for some movements, especially larger vehicles. The existing right-turn channelization island in the southeast quadrant of the intersection allows for large vehicles to make the northbound to eastbound right-turn movement. However, the island is a concern for the Bottineau Transitway project because the free right-turn movement is not compatible with a rail crossing at this location. The detailed design of the rail alignment through this area, and the control of the vehicle and pedestrian conflicts at the rail crossing, will be further explored as part of the more advanced design work yet to be completed for the Draft Environmental Impact Statement. As part of the current modeling effort at the intersection, the northbound right-turn movement was assumed to operate as a signalized movement, with no right turn allowed during the red signal phase.

In addition to providing acceptable operations for the overall intersection in 2030, it is desired that the individual movements also have generally have acceptable delays and queues that do not impact upstream intersections. A concept geometric layout was developed to provide two exclusive northbound left-turn lanes, as shown in **Figure 2**. For this analysis, Southwest LRT was assumed to operate grade-separated at 7th Street and Bottineau LRT was assumed to operate at-grade.

In addition to the need for a second northbound left-turn lane for capacity reasons, a southbound left-turn lane was added to provide better lane alignment for the through movements and to take advantage of the left-turn phasing. The City of Minneapolis striped bike lanes on 7th Street in late 2011, which are also represented on the layout. To avoid right-of-way impacts, minimum lane widths of 11 feet for through lanes, 10 feet for turn lanes, and 6 feet for bike lanes was used. The existing roadway width on 7th Street is 63 feet north of TH 55/6th Avenue and 71 feet south of TH 55/6th Avenue. Therefore the roadway section would need to widen by approximately three feet for the length of the southbound left-turn lane, with the north curb line assumed to be held constant, and by about five feet for the length of the second northbound turn lane, with the south curb line assumed to be held constant. Potential right-of-way acquisition for the segment south of TH 55/6th Avenue will be explored further during the DEIS process, but would not be expected to impact any adjacent buildings or other private infrastructure.

The intersection operations and approach delays would also be expected to be improved by adding a second eastbound right-turn only lane on TH 55 at 7th Street. However, this improvement would be dependent on the removal of the segment of Royalston Avenue parallel to TH 55, which is not part of the Bottineau Transitway project. Since acceptable intersection operations are not dependent on this improvement and it would be an independent project as part of the North Loop Small Area Plan, the addition of the second right-turn lane has not been assumed for this analysis.

The LOS results of the modeling with the improved geometrics and signal operations are shown in Table 2 and the expected queuing is shown in Table 3.

Table 2. 2030 LOS Results – Improved Geometry/Signal Operations

Peak Hour	Approach	Operations By Movement						Overall Intersection	
		Left		Through		Right			
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
AM	NB	58.2	E	50.2	D	54.6	D	42.9	D
	EB	0.0	A	28.2	C	11.3	B		
	SB	65.6	E	78.2	E	70.3	E		
	WB	166.1	F	10.9	B	4.1	A		
PM	NB	60.3	E	51.3	D	51.8	D	38.3	D
	EB	0.0	A	29.1	C	6.9	A		
	SB	24.2	C	43.2	D	50.9	D		
	WB	111.4	F	24.3	C	10.9	B		

Table 3. 2030 Queuing Results – Improved Geometry/Signal Operations

Peak Hour	Approach	Movement Queuing					
		Left		Through		Right	
		95th % Queue (feet)	Available Storage (feet)	95th % Queue (feet)	Available Storage (feet)	95th % Queue (feet)	Available Storage (feet)
AM	NB	149	420	149	640	-	-
	EB	-	-	275	330	153	337
	SB	121	175	573	490	-	-
	WB	234	100	38	650	39	100
PM	NB	302	420	302	640	-	-
	EB	-	-	126	330	28	337
	SB	42	175	135	490	-	-
	WB	195	100	262	650	24	100

The results show that with the proposed geometric changes, the TH 55/7th Street/6th Avenue intersection would be expected to operate at LOS D or better during peak hours. However, some movements may still be expected to operate at LOS E or LOS F. Movements such as the southbound approach in the AM peak that is projected to operate at LOS E can likely be further improved through the signal timing and phasing. As part of the current analysis, only a cursory evaluation of signal timing splits, sequencing, and offsets was conducted, and operations could likely be improved by further refining the signal timing parameters. These improvements to the signal operations should be explored further during the preliminary and advanced preliminary design phases.

The westbound left-turn movement would likely continue to operate at LOS F during both peak hours due to very low approach volumes, the long cycle length, and the protected-only phasing. For low-volume movements, there are typically only one or two vehicles making the movement per signal cycle. This means that most vehicles making this movement will likely arrive on a red signal phase and because of the protected phasing cannot take advantage of the green signal phase for the through movements. With cycle lengths of 120-150 seconds, a vehicle could wait 60-120 seconds for the left-turn phase to come up in the next cycle. Given the relatively high delays expected, there are two possible options:

- Provide for the westbound left-turn movement at the intersection due to the lack of readily available alternative routes for a westbound vehicle that is forced to go through at the intersection instead of turning left. Vehicles could use Border Avenue or Oak Lake Avenue-7th Street to travel towards downtown, but these are relatively circuitous routes and the resulting increase in travel time may actually be greater than the delay that would have been experienced at the TH 55/7th Street/6th Avenue N intersection. The advantage of continuing to allow the left-turn movement is that it provides drivers the option to divert prior to this intersection if there is a convenient alternative route (particularly for commuters or drivers familiar with downtown) or to make the left-turn movement at TH 55/7th Street/6th Avenue if there is not another convenient route from their origin to downtown or for drivers unfamiliar with downtown that may not be aware of alternative routes.
- Ban the westbound left-turn movement and either sign an alternative route east of the intersection or use signing prior to the intersection to try to capture drivers destined for downtown. Due to the number of potential origins for the westbound left-turn movement, it likely would not be possible to capture every driver prior to arriving at the intersection, which would result in circuitous rerouting to direct them back towards downtown. However, the primary advantage of this option is that it would eliminate a signal phase at the intersection and therefore improve the overall intersection delay and operations.

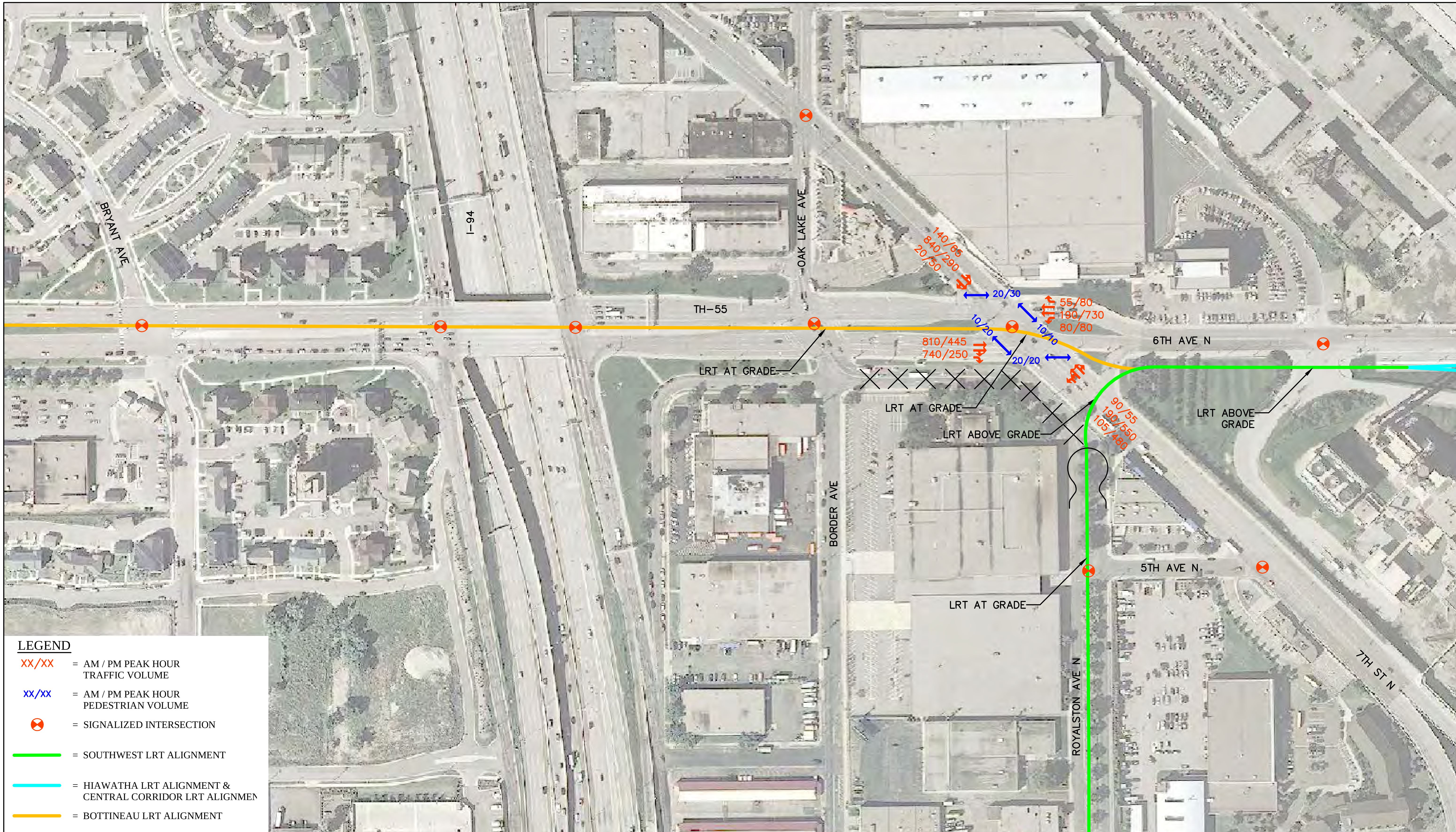
SUMMARY

The following geometric changes are recommended for the TH 55/7th Street/6th Avenue intersection in order to provide LOS D or better intersection operations with Bottineau LRT assumed to operate at-grade:

- Provide a second northbound left-turn lane, as well as an opposing southbound left-turn lane.
- Operate the northbound and southbound approaches with concurrent (rather than split) phasing.

The addition of the northbound and southbound left-turn lanes will require roadway widening for the length of the turn lanes. Right-of-way impacts due to the widening will need to be explored further in the DEIS process. In addition, the design of the LRT alignment through the right-turn channelization island at the TH 55/7th Street/6th Avenue intersection needs to be analyzed further due to potential vehicle and pedestrian conflicts at the LRT crossing.

If the segment of Royalston Avenue parallel to TH 55 is removed, consistent with the North Loop Small Area Plan, the addition of a second eastbound right-turn lane would be expected to further improve intersection operations. However, achieving LOS D or better operations at the TH 55/7th Street/6th Avenue intersection is not expected to be dependent on this improvement.



Bottineau Transitway
DRAFT ENVIRONMENTAL IMPACT STATEMENT

FIGURE 1
TH 55 / 7TH STREET / 6TH AVENUE
2030 PEAK HOUR TURNING MOVEMENT VOLUMES

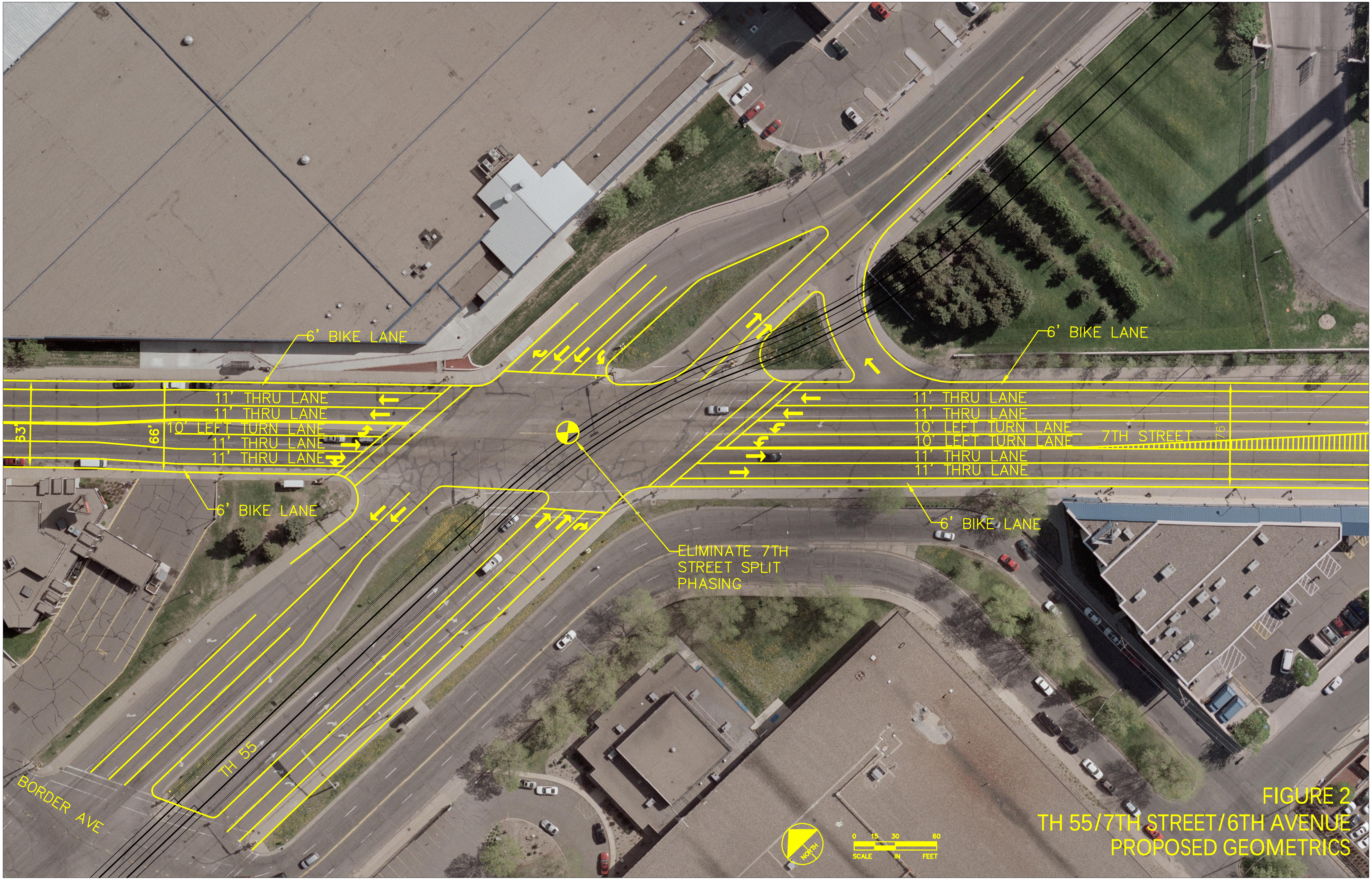


FIGURE 2
TH 55/7TH STREET/6TH AVENUE
PROPOSED GEOMETRICS

BottineauTransitway
DRAFT ENVIRONMENTAL IMPACT STATEMENT

This technical memorandum contains forecasts for both two-lane and four-lane scenarios on CSAH 103 (Broadway Avenue), which were analyzed as part of the CSAH 103 reconstruction project led by Hennepin County Transportation. Independent from the Bottineau Transitway Project, Hennepin County Transportation has determined that a four-lane section will be constructed on CSAH 103. Therefore only the four-lane forecasts have been used for the modeling of the Bottineau Transitway Project.

Memorandum

Date: April 11, 2012

To: Brent Rusco, P.E., Joe Gladke, P.E.
Hennepin County Regional Railroad Authority

From: Steve Wilson, SRF Consulting Group
Joshua Maus, P.E., SRF Consulting Group
Alex Fox, P.E., SRF Consulting Group

Subject: Bottineau Transitway – CSAH 103 (Broadway Avenue) Traffic Study Travel Demand Forecasts: Four-Lane and Two-Lane Alternatives

Introduction

The purpose of this study is to develop 2030 peak hour turning movements for key intersections along CSAH 103 (Broadway Avenue) from 76th Avenue to TH 610 for a four-lane and two-lane roadway alternative. In addition, a comparison of forecast traffic volumes between the two alternatives was conducted for CSAH 103 (Broadway Avenue) and other roadways within the project area.

Currently, CSAH 103 (Broadway Avenue) is a four-lane facility from CSAH 152 (Brooklyn Boulevard) to CSAH 109 (85th Avenue), a two-lane facility between CSAH 109 (85th Avenue) and CSAH 30 (93rd Avenue), and a four-lane facility between CSAH 30 (93rd Avenue) and TH 610. Under the four-lane alternative, the existing two-lane section would be widened to a four-lane facility. Under the two-lane alternative, the four-lane section between Candlewood Drive and CSAH 109 (85th Avenue) would be converted to a two-lane facility and the current two-lane section between CSAH 109 (85th Avenue) and CSAH 30 (93rd Avenue) would remain a two-lane roadway.

Due to the recent conversion of the signalized intersections at TH 169/CSAH 81 (Bottineau Boulevard) and TH 169/CSAH 109 (85th Avenue) into grade-separated interchanges, new traffic data was collected by WSB and Associates, Inc. in September 2011.

Forecasts developed as described in this memorandum were subsequently used in operations analysis and simulation of alternatives.

Existing Volumes

Existing traffic volumes provided by WSB and Associates, Inc. (September 2011) were utilized to develop future year forecasts. A comparison of this recent data to previously collected data (2005 and 2009) indicates the following:

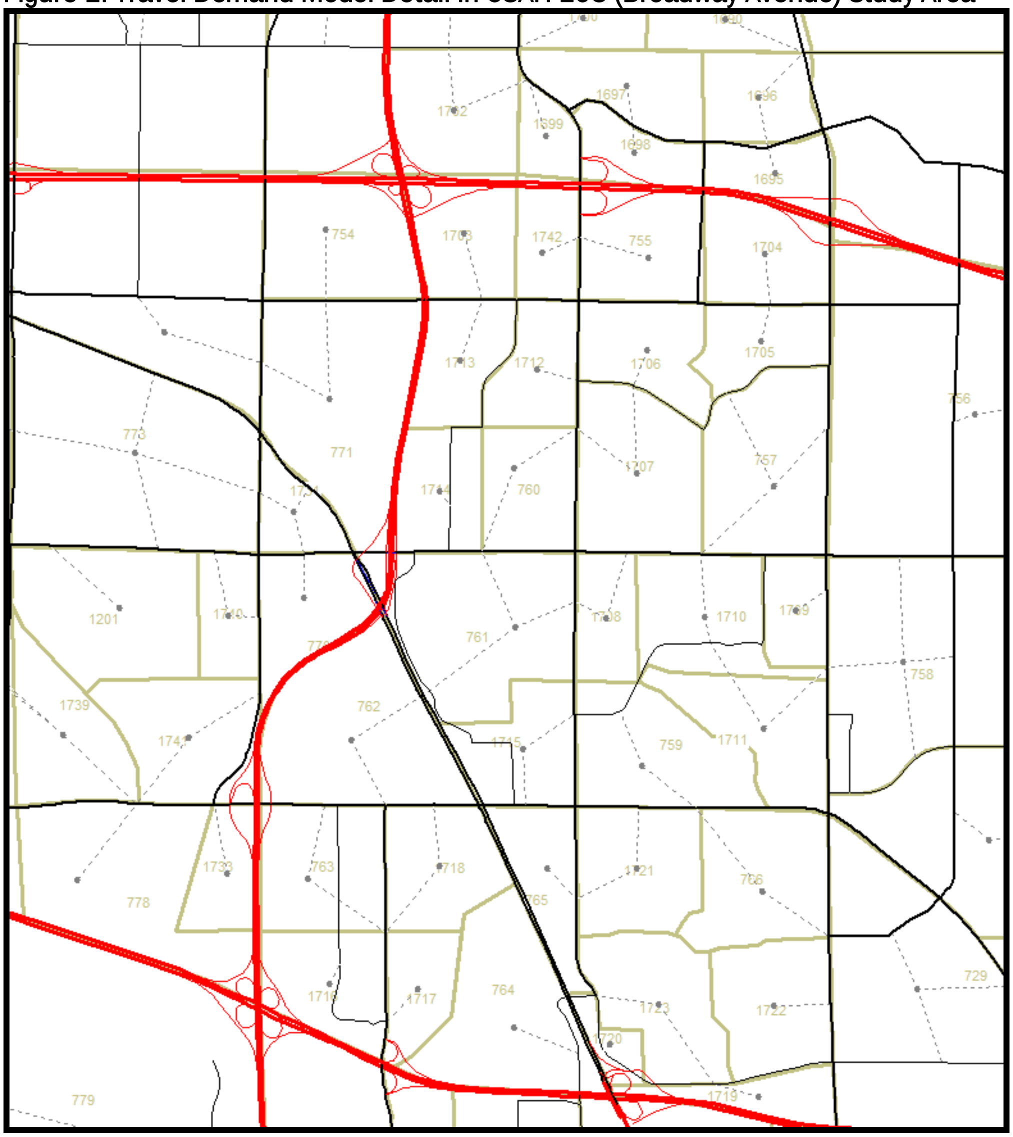
- Current (2011) daily traffic volumes along the corridor are similar to 2005 data identified in the Brooklyn Park Transportation Plan and the Hennepin County Special Project Analysis Report (SPAR) for CSAH 103 (Broadway Avenue) prepared in May, 2007. However, the recent data does show an increase of approximately 5,000 vehicles on CSAH 103 (Broadway Avenue) north of CSAH 30 (93rd Avenue) when compared to the 2005 data.
- During the a.m. and p.m. peak hours in the peak direction of travel, the current traffic along the corridor is approximately 200-300 vehicles less than counts from 2005 and 2009. However, the current (2011) peak hour volume in the off-peak direction is similar to counts from 2005 and 2009. In addition, the current (2011) daily traffic volumes along the corridor are similar to 2005 data and 2009 data south of CSAH 30. Therefore, it is assumed that the peak hour, peak

direction reduction can be accounted for by traffic diversion to TH 169 as a result of the conversion of the signalized intersections at TH 169/CSAH 81 (Bottineau Boulevard) and TH 169/CSAH 109 (85th Avenue) into grade-separated interchanges.

Forecast Method and Validation

Travel demand forecasts for the year 2030 were developed for the two-lane and four-lane alternatives using the Twin Cities Regional Travel Demand model as modified for use in the Bottineau Transitway Draft EIS (DEIS). A horizon year of 2030 is consistent with the adopted comprehensive plans as well as the horizon year of the DEIS. The regional model was modified for the DEIS to incorporate additional zone and network detail in the project area to provide better fidelity for transit and roadway analyses. Consequently, it was suitable for use in the CSAH 103 (Broadway Avenue) analysis. A portion of the network showing modeled zones and roadways is shown in Figure 1.

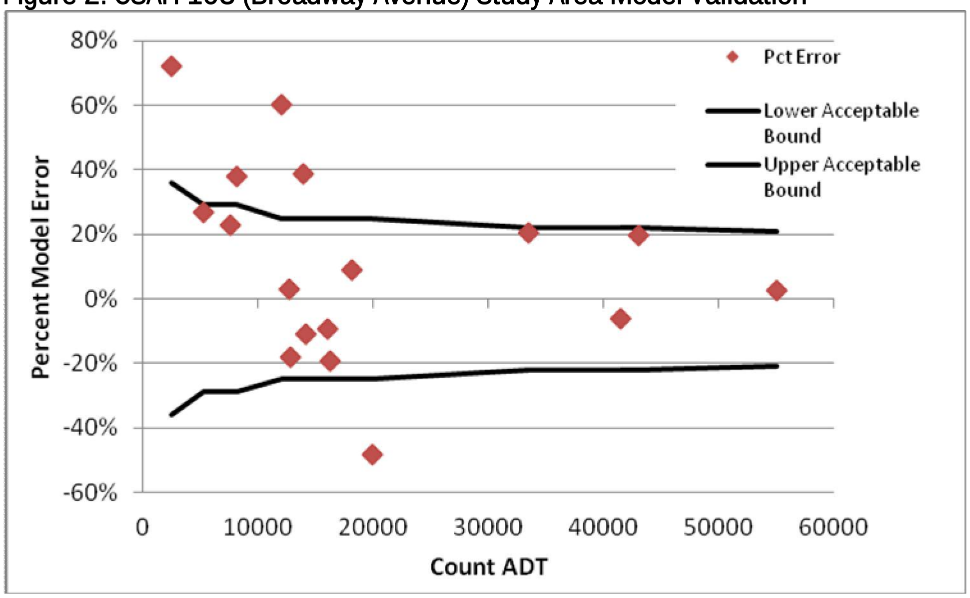
Figure 1: Travel Demand Model Detail in CSAH 103 (Broadway Avenue) Study Area



The travel demand model is an advanced version of a "four-step" model (trip generation, trip distribution, mode choice and route assignment) in its treatment of peak and offpeak travel characteristics, estimation of high-occupancy (HOV) and MnPASS use and equilibrium assignment algorithms. The activity-generator is socioeconomic data (population, household and employment along with selected special generators) as opposed to straight land use-based vehicle trip rates.

The travel demand model was validated to existing conditions by comparing published traffic flow volumes from Hennepin County and the Minnesota Department of Transportation to daily traffic volumes estimated from the model. Figure 2 shows a comparison of the percent error of modeled volumes compared to counts. Twelve of 17 links in the study area with traffic counts (71 percent) were found to fall within acceptable error limits specified by the FHWA Model Validation and Reasonableness Checking Manual. The study area is relatively small, therefore broader statistical measures of modeling fit would not provide meaningful results due to small sample sizes.

Figure 2: CSAH 103 (Broadway Avenue) Study Area Model Validation



The model validation was used to identify manual adjustments to be applied to the model results where necessary. The procedures used for the adjustments and factoring of peak and turn volumes are consistent with *NCHRP-255 Highway Traffic Data for Urbanized Area Project Planning and Design*.

Traffic Forecasts

Traffic forecasts (2030 four-lane and two-lane) were developed using the Met Council's Regional Travel Demand Model along with existing traffic volumes provided by WSB and Associates, Inc.

Land use assumptions for the City of Brooklyn Park are consistent with those identified under 'Alternative B' in the City of Brooklyn Park Transportation Plan which is being assumed in the Bottineau Transitway Draft EIS ridership forecasts and is the comprehensive plan alternative accepted by the Metropolitan Council. In the vicinity of the study area along CSAH 30 (93rd Avenue North) area between TH 169 and CSAH 14 (Zane Avenue) the City of Brooklyn Park has approved two development proposals (Astra and Gateway) at higher intensities than assumed in the regionally-accepted comprehensive plan. These proposals, if developed at maximum allowed intensities, would likely generate significantly more traffic than assumed in the City's Comprehensive Plan and in the DEIS forecasts. However, the City's land use plan is a guide and other areas may develop at lower intensities than anticipated. Based on discussions with the City of Brooklyn Park, the land use in the travel demand model was not modified due to these two developments.

Within the travel demand model, the future roadway network (2030) assumes the following within the study area:

- Candlewood Drive is extended west of CSAH 103 (Broadway Avenue) to 79th Avenue (Planned Roadway Improvement, City of Brooklyn Park Comprehensive Plan)
- Completion of TH 610 from CSAH 81 (Bottineau Boulevard) to I-94 (Commitment, MnDOT HIP)
- Full access intersection at TH 169 and 101st Avenue North
- Existing full access intersection at TH 169 and CSAH 30 (93rd Avenue)

The TH 169/93rd Avenue intersection was modeled according to the Metropolitan Council's default 2030 highway network and TIP, which is a full access at-grade intersection. However, the CSAH 30 (93rd Avenue) interchange has been recently programmed as a partial access interchange with ramps to/from the south. The loss of access to and from north TH 169 would be expected to increase the 2030 forecast volumes on CSAH 103 (Broadway Avenue) between TH 610 and CSAH 30 (93rd Avenue) with traffic oriented between TH 169 to the north and CSAH 30 (93rd Avenue) to the east diverted to TH 610 and CSAH 103 (Broadway Avenue) north of CSAH 30 (93rd Avenue).

The TH 169/101st Avenue intersection was modeled according to the Metropolitan Council's default 2030 highway network, which assumed a full access intersection consistent with the intersection configuration in 2010. However, while it is currently a right-in/right-out intersection, an applicattion has been made to construct an interchange, which would restore full access. If the current right-in/right-out intersection configuration was assumed for 2030, an increase in traffic on Broadway Avenue at TH 610 would be expected compared to the reported forecast volumes that assumed a full access interchange at TH 169/101st Avenue.

For the purpose of this analysis a "No Build" transit system was assumed since ridership forecasts had not yet been developed for the transit alternatives. Subsequent sensitivity tests showed that the expected reduction in vehicle traffic on CSAH 103 (Broadway Avenue) due to Bottineau Transitway was no greater than 500 vehicles per day.

The 2030 traffic forecasts were compared to the current volumes and peaking characteristics of CSAH 103 (Broadway Avenue). The results indicate that the percentage of traffic carried in the peak hour will decrease by year 2030, and the peak directionality of the corridor will also decrease by year 2030. This is typical of arterial traffic patterns as volumes increase.

Four-Lane Alternative Forecast Analysis

The four-lane alternative assumes roadway capacities on CSAH 103 of 1,500 to 1,700 vehicles per hour per direction, with the lower values assumed between CSAH 30 (93rd Avenue North) and Candlewood Drive due to access and right-of-way patterns. The results of the four-lane analysis indicate the following:

Projected (2030) daily traffic volumes between CSAH 152 and CSAH 30 are similar to previously published volumes in the City of Brooklyn Park Transportation Plan and the SPAR for CSAH 103 (Broadway Avenue). However, the forecast of 28,000 ADT vehicles per day north of CSAH 30 is 4,000 to 8,000 vehicles per day larger than the previously published volumes (24,000 vehicles per day).

The increase in the forecast is is consistent with the change in existing volumes between 2005 and 2011.

Peak hour traffic volumes are expected to increase by the following annual traffic growth rates:

- CSAH 103 (Broadway Avenue)
  - South of CSAH 152 (Brooklyn Boulevard): 1.25 – 1.50%
  - Between CSAH 109 (85th Avenue) and CSAH 30 (93rd Avenue): 1.50 – 2.00%
  - North of CSAH 30 (93rd Avenue): 2.50 – 3.50%
- CSAH 152 (Brooklyn Boulevard) and CSAH 109 (85th Avenue): 0.75 – 1.25%
- CSAH 30 (93rd Avenue): 2.50 – 3.50%

These annual growth rate values are generally consistent with those recommended in the SPAR for CSAH 103 (Broadway Avenue).

Two-Lane Alternative Forecast Analysis

The two-lane alternative assumes roadway capacities on CSAH 103 of 750 to 850 vehicles per hour per direction, with the lower values assumed between CSAH 30 (93rd Avenue North) and Candlewood Drive. Results of the two-lane analysis indicate the following:

- Future (2030) traffic demand for the CSAH 103 (Broadway Avenue) corridor will exceed the daily planning-level capacity of a two lane facility by 30 percent.
- To avoid congestion and reduced speeds along the CSAH 103 (Broadway Avenue) corridor that would be expected to result from the two-lane alternative, approximately 3,000 daily vehicles between CSAH 152 (Brooklyn Boulevard) and CSAH 30 (93rd Avenue) will divert from CSAH 103 (Broadway Avenue) to other roadway facilities.
- During the a.m. and p.m. peak hours approximately 400-500 vehicles between CSAH 152 (Brooklyn Boulevard) and CSAH 30 (93rd Avenue) will divert to other roadway facilities to avoid congestion. Most of the diverted vehicles are traveling in the peak direction and are traveling through the corridor, not having a local origin or destination.
- A majority of the diverted traffic will use TH 169 (45%). The current 2030 forecast volume of 65,000 on TH 169 is consistent with current regional modeling and would result in available capacity. The 2030 forecast for TH 169 as shown in he Brooklyn Park Transportation Plan is 80,000 vehicles per day, which would not provide sufficient reserve capacity to accommodate additional traffic.
- The remaining traffic will use CSAH 14 (Zane Avenue) (15%), CSAH 81 (Bottineau Boulevard) (10%), Wyoming Avenue (10%), and Noble Avenue (10%). The remaining 10% will use other local roadways in the area.

Figure 3 graphically depicts the estimated year 2030 traffic diversions resulting from the two-lane alternative, which are detailed in Table 1.

A future year (2030) planning-level capacity analysis was completed for the roadways identified above that are expected to carry diverted traffic from CSAH 103 (Broadway Avenue) under the two-lane alternative. This is a high-level analysis of available daily traffic volumes from the Brooklyn Park Transportation Plan. Additional data collection and analysis would be needed to determine if operational issues will develop during peak hour conditions.

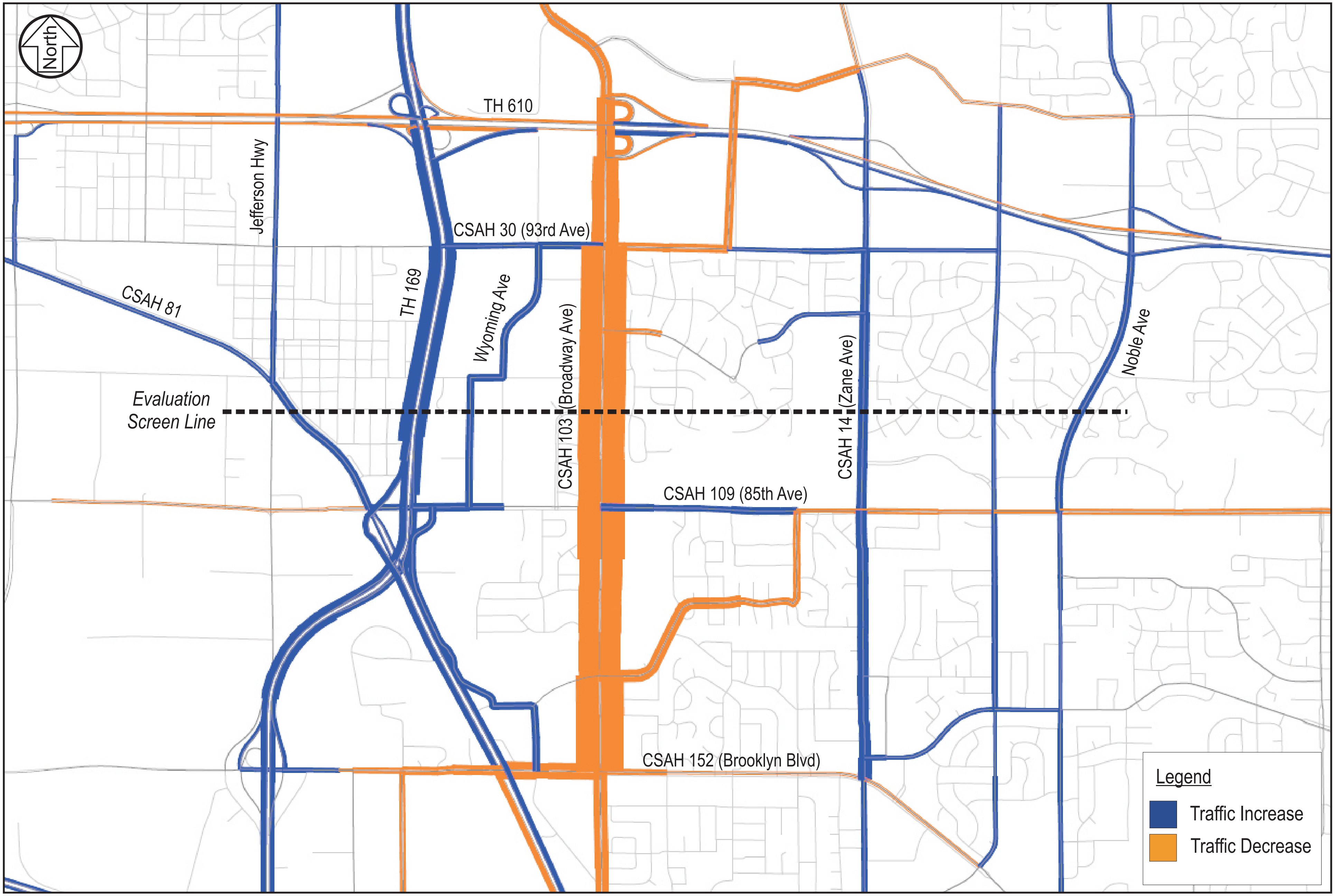
Table 1
CSAH 103 (Broadway Avenue) Two-Lane Alternative Daily Traffic Diversions
Between CSAH 109 (85th Avenue) and CSAH 30 (93rd Avenue) – Screen Line Analysis

Roadway	Existing (2005) *	Forecast 2030 *	Forecast Diversion	Forecast 2030 with Diversion	Planning Level Capacity **
TH 169	56,000	65,000	1,350	66,350	80,000
CSAH 14 (Zane Ave.)	12,700	15,000	450	15,450	28,000
CSAH 81	23,900	39,000	300	39,300	42,000
Wyoming Ave.	4,850	5,300	300	5,600	10,000
Noble Ave.	13,700	19,500	300	19,800	28,000
Other Local Roadways	N/A	N/A	300	N/A	N/A

* Traffic volumes are from the Brooklyn Park Transportation Plan (2008)
** Planning level capacities are consistent with those identified in the Brooklyn Park Transportation Plan

The projected (2030) peak hour turning movements (four-lane and two-lane) were developed based on the daily forecasts from the Met Council Travel Demand Model, but were adjusted to reflect access modifications assumed in the Bottineau LRT alignment plan and consistent with NCHRP 255 as described above. This mainly consists of rerouting movements that will be restricted to right-in/right-out access in the future. Turning movements for existing (2011), 2030 four-lane and 2030 two-lane conditions are shown in the attached tables.

Tables showing the projected turn movements under each alternative are shown in the attachments to this memorandum.



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SRF Consulting Group, Inc.

0117497
November2011

CSAH 103 (Broadway Ave) - Two-Lane vs. Four-Lane Traffic Comparison

Figure 3

Bottineau Transitway Draft EIS
Hennepin County

Bottineau Transitway - CSAH 103 (Broadway Avenue) Traffic Study
Existing (2011) Turning Movement Counts
AM Peak Hour

Intersection	Int. #	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CSAH 103 and 76th Avenue	1	25	219	16	24	577	95	15	4	9	14	30	29
CSAH 103 and CSAH 152	2	34	196	33	59	604	399	143	360	13	79	454	84
CSAH 103 and Retail Access	3	19	398	6	8	1042	35	19	4	9	11	1	2
CSAH 103 Candlewood Drive	5		397	22	11	1012					73		32
CSAH 103 and College Park Drive	7	14	415			963	6	1		60			
CSAH 103 and 84th Avenue	9	3	339	74	131	933	6	5	1	6	30	0	13
CSAH 103 and CSAH 109	10	73	187	97	70	667	173	81	352	155	248	467	24
CSAH 103 and Maplebrook Parkway	11	4	273	15	3	847	7	15	0	15	48	4	16
CSAH 103 and Setzler Parkway	13	18	268	18	15	767	23	2	0	2	88	0	27
CSAH 103 and 92nd Avenue	14	14	274	9	8	789	80	5	0	2	14	0	25
CSAH 103 and CSAH 30	15	25	255	24	6	729	410	70	95	44	104	136	22
CSAH 103 and 94th Avenue	16												
CSAH 103 and TH 610 S Ramp	17		131	216	201	1025					120		109
CSAH 103 and TH 610 N Ramp	18		194	46	27	545					681		72

Bottineau Transitway - CSAH 103 (Broadway Avenue) Traffic Study
Existing (2011) Turning Movement Counts
PM Peak Hour

Intersection	Int. #	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CSAH 103 and 76th Avenue	1	65	473	50	101	259	174	150	47	51	37	62	79
CSAH 103 and CSAH 152	2	60	454	188	135	357	212	393	648	59	118	587	200
CSAH 103 and Retail Access	3	94	889	64	24	591	86	154	25	68	45	21	67
CSAH 103 Candlewood Drive	5		1002	108	16	643					58		30
CSAH 103 and College Park Drive	7	50	982			620	14	8		39			
CSAH 103 and 84th Avenue	9	3	931	56	96	543	3	6	0	0	91	2	80
CSAH 103 and CSAH 109	10	127	575	315	68	350	67	325	757	85	207	485	46
CSAH 103 and Maplebrook Parkway	11	20	859	67	9	444	25	15	3	12	29	2	13
CSAH 103 and Setzler Parkway	13	16	767	104	28	394	10	20	0	42	42	1	11
CSAH 103 and 92nd Avenue	14	11	780	7	5	409	5	34	1	20	3	2	6
CSAH 103 and CSAH 30	15	32	738	50	19	334	74	321	176	50	35	80	47
CSAH 103 and 94th Avenue	16												
CSAH 103 and TH 610 S Ramp	17		445	661	107	386					41		45
CSAH 103 and TH 610 N Ramp	18		357	133	108	258					235		151

Bottineau Transitway - CSAH 103 (Broadway Avenue) Traffic Study
2030 4-Lane Alternative - Turning Movement Projections
AM Peak Hour

Intersection	Int. #	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CSAH 103 and 76th Avenue	1	30	275	25	35	690	110	20	10	15	20	35	40
CSAH 103 and CSAH 152	2	65	230	40	115	710	445	190	435	15	110	530	115
CSAH 103 and Retail Access (1)	3		525	10		1255	45			15			15
CSAH 103 Candlewood Drive (2)	5	10	510	20	20	1240	100	50	20	10	50	35	45
CSAH 103 and College Park Drive (1)	7	30	535	40	155	1255	15	25	5	70	35	5	10
CSAH 103 and 84th Avenue (1)	9		525	45		1415	15			10			15
CSAH 103 and CSAH 109	10	90	340	110	110	980	200	150	405	175	275	520	40
CSAH 103 and Maplebrook Parkway (1)	11		510	20		1270	15			20			30
CSAH 103 and Setzler Parkway	13	25	490	25	40	1105	35	10	5	5	175	20	40
CSAH 103 and 92nd Avenue (1)	14		525	15		1170	90			10			35
CSAH 103 and CSAH 30	15	60	470	30	20	1025	560	195	165	80	155	195	35
CSAH 103 and 94th Avenue (3)	16	50	575	75	200	1530	175	75	10	50	25	10	50
CSAH 103 and TH 610 S Ramp	17		420	280	435	1560					345		500
CSAH 103 and TH 610 N Ramp	18		750	170	390	1160					835		310

Notes:

(1) Projected turning movement volumes reflect access modifications (right-in/right-out) assumed in the Bottineau LRT alignment plan. Some movements may be lower than existing counts.

(2) Projected volumes assume construction of Candlewood Drive west of CSAH 103 and associated travel pattern shifts. Some movements may be lower than existing counts.

(3) Projected volumes were developed using assumed land use projections.

Bottineau Transitway - CSAH 103 (Broadway Avenue) Traffic Study
2030 4-Lane Alternative - Turning Movement Projections
PM Peak Hour

Intersection	Int. #	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CSAH 103 and 76th Avenue	1	75	605	55	120	330	200	165	55	60	45	70	90
CSAH 103 and CSAH 152	2	145	505	210	180	400	270	525	750	65	185	725	245
CSAH 103 and Retail Access (1)	3		1200	75		775	105			75			75
CSAH 103 Candlewood Drive (2)	5	20	1175	80	30	830	75	110	40	10	40	25	35
CSAH 103 and College Park Drive (1)	7	60	1230	30	115	790	25	35	5	45	100	5	45
CSAH 103 and 84th Avenue (1)	9		1275	35		925	15			5			50
CSAH 103 and CSAH 109	10	165	810	350	90	605	90	420	840	95	240	545	75
CSAH 103 and Maplebrook Parkway (1)	11		1230	75		770	35			15			20
CSAH 103 and Setzler Parkway	13	20	1115	115	60	665	20	30	5	50	90	15	20
CSAH 103 and 92nd Avenue (1)	14		1155	10		720	15			25			15
CSAH 103 and CSAH 30	15	75	1025	70	40	575	170	515	280	100	60	155	60
CSAH 103 and 94th Avenue (3)	16	50	1525	25	75	660	200	175	10	50	75	10	250
CSAH 103 and TH 610 S Ramp	17		1135	815	340	795					140		410
CSAH 103 and TH 610 N Ramp	18		1165	380	475	840					295		390

Notes:

(1) Projected turning movement volumes reflect access modifications (right-in/right-out) assumed in the Bottineau LRT alignment plan. Some movements may be lower than existing counts.

(2) Projected volumes assume construction of Candlewood Drive west of CSAH 103 and associated travel pattern shifts. Some movements may be lower than existing counts.

(3) Projected volumes were developed using assumed land use projections.

Bottineau Transitway - CSAH 103 (Broadway Avenue) Traffic Study
2030 2-Lane Alternative - Turning Movement Projections
AM Peak Hour

Intersection	Int. #	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CSAH 103 and 76th Avenue	1	30	250	25	35	490	110	20	10	15	20	35	40
CSAH 103 and CSAH 152	2	65	205	40	65	510	270	165	435	15	110	530	115
CSAH 103 and Retail Access (1)	3		475	10		830	45			15			15
CSAH 103 Candlewood Drive (2)	5	10	460	20	20	815	75	50	20	10	50	35	45
CSAH 103 and College Park Drive (1)	7	30	485	40	155	805	15	25	5	70	35	5	10
CSAH 103 and 84th Avenue (1)	9		475	45		965	15			10			15
CSAH 103 and CSAH 109	10	90	290	110	110	605	175	150	405	150	225	520	40
CSAH 103 and Maplebrook Parkway (1)	11		460	20		870	15			20			30
CSAH 103 and Setzler Parkway	13	25	440	25	40	705	35	10	5	5	175	20	40
CSAH 103 and 92nd Avenue (1)	14		475	15		770	90			10			35
CSAH 103 and CSAH 30	15	60	420	30	20	700	585	195	165	55	105	195	35
CSAH 103 and 94th Avenue (3)	16	50	525	75	200	1230	175	75	10	50	25	10	50
CSAH 103 and TH 610 S Ramp	17		395	255	435	1310					295		500
CSAH 103 and TH 610 N Ramp	18		725	170	390	1010					735		310

Notes:

(1) Projected turning movement volumes reflect access modifications (right-in/right-out) assumed in the Bottineau LRT alignment plan. Some movements may be lower than existing counts.

(2) Projected volumes assume construction of Candlewood Drive west of CSAH 103 and associated travel pattern shifts. Some movements may be lower than existing counts.

(3) Projected volumes were developed using assumed land use projections.

Bottineau Transitway - CSAH 103 (Broadway Avenue) Traffic Study
2030 2-Lane Alternative - Turning Movement Projections
PM Peak Hour

Intersection	Int. #	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBL	WBT	WBR
CSAH 103 and 76th Avenue	1	75	405	55	120	305	200	165	55	60	45	70	90
CSAH 103 and CSAH 152	2	145	305	210	180	375	245	350	750	65	185	725	195
CSAH 103 and Retail Access (1)	3		775	75		725	105			75			75
CSAH 103 Candlewood Drive (2)	5	20	750	80	30	780	75	85	40	10	40	25	35
CSAH 103 and College Park Drive (1)	7	60	780	30	115	740	25	35	5	45	100	5	45
CSAH 103 and 84th Avenue (1)	9		825	35		875	15			5			50
CSAH 103 and CSAH 109	10	140	435	300	90	555	90	395	840	95	240	545	75
CSAH 103 and Maplebrook Parkway (1)	11		830	75		720	35			15			20
CSAH 103 and Setzler Parkway	13	20	715	115	60	615	20	30	5	50	90	15	20
CSAH 103 and 92nd Avenue (1)	14		755	10		670	15			25			15
CSAH 103 and CSAH 30	15	50	675	45	40	525	170	540	280	100	60	155	60
CSAH 103 and 94th Avenue (3)	16	50	1200	25	75	610	200	175	10	50	75	10	250
CSAH 103 and TH 610 S Ramp	17		935	690	340	745					140		410
CSAH 103 and TH 610 N Ramp	18		1015	330	475	815					270		390

Notes:

(1) Projected turning movement volumes reflect access modifications (right-in/right-out) assumed in the Bottineau LRT alignment plan. Some movements may be lower than existing counts.

(2) Projected volumes assume construction of Candlewood Drive west of CSAH 103 and associated travel pattern shifts. Some movements may be lower than existing counts.

(3) Projected volumes were developed using assumed land use projections.

Memorandum

Date: May 24, 2012

To: Brent Rusco, P.E., Joe Gladke, P.E.
Hennepin County Regional Railroad Authority

From: JoNette Kuhnau, P.E., PTOE
Kimley-Horn and Associates, Inc.

Subject: Bottineau Transitway Draft Environmental Impact Statement
CSAH 81 (Brooklyn Boulevard) Transit Headway Analysis

This memorandum presents the results of the traffic operations analysis of transit headways along CSAH 81 (Brooklyn Boulevard) within the City of Brooklyn Park. The memorandum includes a brief review of the purpose of the analysis, the modeling assumptions, and the 2030 analysis results.

This document is one of a series of technical memoranda that address various traffic operations issues along the transitway corridor.

BACKGROUND

Portions of Segment A and Segment C of the Bottineau Transitway consist of a shared freight rail/transit corridor that runs parallel to County State Aid Highway (CSAH) 81 (Bottineau Boulevard), with crossings at four signalized intersections. Based on the presence of freight rail and the proposed transit vehicle speeds, signal preemption is proposed for each of the signalized crossings[1]. Both light rail transit (LRT) and bus rapid transit (BRT) modes were considered for the Bottineau Transitway. While 7.5-minute peak hour headways in each direction were assumed for LRT, these headways would not be able to accommodate the forecast ridership based on the passenger capacity of the BRT vehicles and therefore more vehicles at shorter headways would be needed to meet the forecast demand. The purpose of this analysis was to evaluate the impact of decreased transit headways on the traffic operations along CSAH 81 and determine the shortest headways that would continue to provide acceptable traffic operations. A secondary objective was also to confirm that a diagonal crossing of the transitway at CSAH 81/73rd Avenue could remain at-grade, and would not be required to be grade separated based on traffic operations and delay.

MODELING ASSUMPTIONS

The focus of the modeling work was on BRT, due to the need for headways less than 7.5 minutes in each direction. The signalized intersections in the area of study are as follows:

- CSAH 81/73rd Avenue
- CSAH 81/71st Avenue/West Broadway Avenue (County Road 8)
- CSAH 81/63rd Avenue

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[1] *Bottineau Transitway Draft Environmental Impact Statement, Transit/Traffic Signal Operating Schemes Technical Memorandum*, Kimley-Horn and Associates, Inc., December 6, 2011.

- CSAH 81/Bass Lake Road (County Road 10)

Note that for the purposes of this discussion, CSAH 81 will be described as a north/south corridor.

All modeling was completed for 2030 based on the Bottineau Transitway forecasting. VISSIM was chosen as the analysis tool because it has the ability to model both traffic and transit operations relatively accurately in a preemption scenario, whereas Synchro/SimTraffic does not have the capabilities to explicitly model preemption operations. Other key assumptions used in the modeling were as follows:

- Only the PM peak hour was modeled, based on the higher traffic volumes and congestion under existing and forecast conditions.
- All signalized intersections were assumed to have gated freight/transit crossings and to operate with preemption. The length of each preemption, including flashers, gate lowering, transit vehicle crossing, and gate raising, ranges from 30-38 seconds based on allowable speeds through the intersection and the flasher and gate times specified in section 8C.4 of the Minnesota Manual on Uniform Traffic Control Devices (MnMUTCD).
- BRT vehicles were assumed to be 38 feet long.
- Transit headways between 3.75 and 7.5 minutes were assumed in each direction, with 5-10 percent variability.
- Current freight rail traffic in the corridor consists of only one train per day. While this train could be traveling through the corridor during the peak hour, for the sake of simplicity and easier comparisons between transit alternatives, freight traffic was not included in the model.
- CSAH 81 was assumed to have been reconstructed as a six-lane divided roadway, according to the preliminary plans prepared by Hennepin County.
- The CSAH 81/73rd Avenue and CSAH 81/Bass Lake Road intersections were chosen for the analysis to represent a low volume and high volume intersection, respectively.
- The CSAH 81/73rd Avenue intersection was modeled with a diagonal transitway crossing of the intersection, as shown in the Segment B alignment drawing, to represent the worst case traffic operations. With the geometrics of the diagonal crossing, only the northbound and southbound right-turn movements were allowed to operate concurrently with the transit phase.
- At the CSAH 81/Bass Lake Road intersection, the northbound and southbound through movements were allowed to operate concurrently with the transit phase.

The modeling was completed using proposed 2030 geometrics provided by Hennepin County. Geometric improvements included converting CSAH 81 from a four-lane section to a six-lane section and adding northbound and southbound dual left turn lanes at Bass Lake Road.

A total of six scenarios were modeled for each intersection in the 2030 PM peak hour, as shown in **Table 1**.

Table 1. Transit Headway Scenarios

Headway (minutes)	CSAH 81 Signal Operations	
3.75	Coordinated	Uncoordinated
5.0	Coordinated	Uncoordinated
7.5	Coordinated	Uncoordinated

The purpose of modeling both coordinated and uncoordinated operations on CSAH 81 was to analyze two different preemption recovery scenarios. For locations where the transitway is side running, when a preemption call is received the controller is assumed to end the phase it was running, provide green time for the eastbound approach (to clear any vehicles potentially queued on the freight rail/transitway), and then go to the phases compatible with the rail/transitway crossing (northbound/southbound through movements and southbound left-turn movement). This means that the movements the northbound left-turn movement and all westbound movements are most likely to experience additional delay due to a preemption event because they are not served as part of the preemption clearance and are not compatible with the crossing movement. At the diagonal crossing at CSAH 81/73rd Avenue, it is not necessary to run the clearance phases since there is little or no risk that vehicles on the cross street approaches could be stopped on the transitway.

Under the coordinated scenario, the signal controller attempts to return to coordination as quickly as possible after a preemption event by returning to the northbound/southbound through movements and then serving only minimum green times on all the non-coordinated phases. While this provides potentially improved traffic flow on CSAH 81, it also has the potential to have the greatest delays for the non-coordinated phases (mainline left-turn movements and all cross street movements). In general, maintaining corridor coordination is the preferred operation for Hennepin County roadways.

In the uncoordinated scenario, the signal controller does not immediately return to the coordinated phases, but is allowed to serve one of the non-coordinated phases in order to reduce overall intersection delays. In this case, the signal recovered from preemption into the northbound left-turn phase, which was most often skipped due to a preemption event.

2030 ANALYSIS

For the purposes of this analysis, LOS D is considered to be acceptable during the peak hour. The results of five one-hour simulations for the 2030 PM peak hour were used to produce average delay results for each scenario, which are shown in **Table 2** on the following page.

The results show that at the lower volume intersection (CSAH 81/73rd Avenue), the transit headway does not have a significant impact on the overall intersection level of service. This is primarily because of the lower volumes on the cross street, which do not require long green times and also do not influence the intersection level of service as much as the high volume mainline movements. Several of the left-turn movements with long delays are due to the low volumes on those movements, which results in vehicles almost always arriving on the red and having to wait for the signal to cycle around to the left-turn phase. This would be expected to occur even without the presence of the transitway crossing. The other significant finding at the CSAH 81/73rd Avenue intersection is that acceptable intersection operations can be maintained with an at-grade crossing of the transitway diagonally through the intersection. Based on this result, a grade separated crossing is not needed at CSAH 81/73rd Avenue as part of the Segment B alignment of the Bottineau Transitway project.

At the CSAH 81/Bass Lake Road intersection, the transit headways (frequency of preemptions) had a much more significant impact on the intersection operations. At 3.75-minute headways and maintaining coordination on CSAH 81, the intersection would be expected to have failing operations, with many northbound and westbound vehicles waiting more than one signal cycle to be serviced. In addition, the northbound left-turn queues would be expected to back up into the mainline northbound through lanes, which would be both an operations and a safety issue. At 5.0-minute headways, the intersection has overall acceptable operations and the northbound left-turn movement no longer queues into the northbound through lanes, although several movements are still expected to operate at LOS F with relatively long delays.

Table 2. 2030 Operations Results

Headway (minutes)		3.75	5.0	7.5
		Intersection Delay (sec/veh) and LOS	Intersection Delay (sec/veh) and LOS	Intersection Delay (sec/veh) and LOS
CSAH 81/ 73rd Avenue				
Coordinated	Intersection Delay (sec/veh) Level of Service	17 B	13 B	12 B
	Comments	NB LT, SB LT, EB TH, and WB TH operate at LOS F EB LT and WB LT operate at LOS E	NB LT, SB LT, EB TH and WB TH operate at LOS F EB LT and WB LT operate at LOS E	NB LT and WB TH operate at LOS F SB LT, EB LT, EB TH, and WB LT operate at LOS E
Uncoordinated	Intersection Delay (sec/veh) Level of Service	22 C	18 B	17 B
	Comments	All movements operate at LOS D or better	All movements operate at LOS D or better	All movements operate at LOS D or better
CSAH 81/ Bass Lake Road				
Coordinated	Intersection Delay (sec/veh) Level of Service	100+ F	52 D	29 C
	Comments	All NB and WB movements operate with delays of 100+ sec/veh	NB LT and WB TH operate with delays of 100+ sec/veh WB LT operates at LOS E	NB LT, WB LT, and WB TH operate at LOS F EB LT operates at LOS E
Uncoordinated	Intersection Delay (sec/veh) Level of Service	51 D	29 C	25 C
	Comments	All WB movements operate with delays of 100+ sec/veh	WB LT and WB TH operate with delays of 100+ sec/veh	WB LT and WB TH operate at LOS F EB LT and SB LT operate at LOS E

SUMMARY

The CSAH 81/73rd Avenue and CSAH 81/Bass Lake Road intersections were modeled with preemption for the transitway crossing, with transit headways of 3.75, 5.0, and 7.5 minute headways to determine the impact on overall traffic operations. Based on the results of the modeling, the following recommendations are made for the Bottineau Transitway project:

- An at-grade crossing of the transitway will result in acceptable intersection operations at the CSAH 81/73rd Avenue intersection, and a grade separation of the transitway and highway is not necessary for traffic operations.
- The minimum (shortest) headways recommended are 5.0 minutes in order to maintain coordination in the CSAH 81 corridor and provide acceptable traffic operations.

Memorandum

To: Brent Rusco, P.E.
Hennepin County Engineering and Transit Planning

From: Patrick Corkle, P.E., PTOE
SRF Consulting Group

Date: June 18, 2012

Subject: Bottineau Alignment A
Traffic Analysis Memorandum

This memorandum presents the results of the scoping level traffic operations analysis for alignment A of the Bottineau Transitway within the City of Maple Grove and Brooklyn Park. This document is one of a series of technical memoranda that address various traffic operations issues along the transitway corridor.

The following sections focus on the traffic operational aspects of alignment A, including a summary of the existing conditions, the characteristics of the A alignment, forecast 2030 traffic volumes, and the 2030 operational modeling results for light rail transit (LRT). Additional considerations including noise analysis, parking impacts, pedestrian/bicycle circulation, property access, roadway network impacts, and emergency vehicle access, are important issues to be considered for alignment A, but are not part of the analysis documented in this memorandum.

EXISTING CONDITIONS

The A segment for this analysis extends east-west north of County State Aid Highway (CSAH) 130 (Elm Creek Boulevard) in Maple Grove and Brooklyn Boulevard in Brooklyn Park from CSAH 61 (Hemlock Lane) to CSAH 81 (Bottineau Boulevard). At the CSAH 81 (Bottineau Boulevard)/CSAH 130 (Brooklyn Boulevard) intersection, the transitway corridor turns south on the west side of CSAH 81 (Bottineau Boulevard). The focus of the operations analysis was the PM peak hour because it has the highest volumes and would therefore represent a worst case condition.

Alignment A may impact traffic operations at signalized intersections because of the potential for additional delay. Traffic signals are currently operating at the following intersections:

- CSAH 130 (Brooklyn Boulevard)/Boone Avenue
- CSAH 81 (Bottineau Boulevard)/CSAH 103 (Brooklyn Boulevard)
- CSAH 81 (Bottineau Boulevard)/73rd Avenue
- CSAH 81 (Bottineau Boulevard)/CSAH 8 (71st Avenue)

The CSAH 130 (Brooklyn Boulevard)/Northland Drive intersection was not analyzed. This intersection was considered a lower volume roadway and therefore no significant operational impacts are expected.

Existing Traffic Volumes

The existing daily traffic volumes are shown in **Table 1**. The PM peak hour turning movement counts are shown in **Table 2**.

Table 1 Existing Daily Traffic Volumes

Roadway	Location	Year	Daily Volume
CSAH 130 (Elm Creek Blvd)	West of TH 169	2010	17,000
CSAH 130 (Brooklyn Blvd)	West of Boone Ave	2009	19,800
CSAH 130 (Brooklyn Blvd)	East of Boone Ave	2009	18,400
CSAH 81 (Bottineau Blvd)	South of CSAH 130 (Brooklyn Blvd)	2009	22,400

Table 2 Existing PM Peak Hour Traffic Volumes

Intersection	Count Year Agency	Northbound			Southbound			Eastbound			Westbound		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
CSAH 130 (Brooklyn Blvd) at Boone Ave	2007 Hennepin	271	78	499	8	6	7	43	1057	98	93	521	14
CSAH 81 (Bottineau Blvd) at CSAH 130 (Brooklyn Blvd)	2007 Hennepin	102	1354	212	159	578	40	232	832	61	205	446	141
CSAH 81 (Bottineau Blvd) at 73rd Ave	2011 SRF	18	1182	56	13	666	21	49	41	43	33	18	33
CSAH 81 (Bottineau Blvd) at CSAH 8 (71st Ave)	2003 Hennepin	27	1399	423	97	953	151	216	458	40	316	252	93

Operations Analysis

The initial operational analysis for alignment A was completed in Synchro/SimTraffic because it provides the ability to efficiently analyze a number of different geometric and operational parameters and more detailed analysis was completed in VISSIM where needed. Preemption can't be modeled directly in Synchro/SimTraffic but the signal timing and phasing can be modified to reasonably approximate the impacts on traffic. VISSIM modeling more accurately replicates the transit preemption sequence and recovery, as well as accounting for truncated and skipped signal phases.

Transit is assumed to operate in a priority scheme at the CSAH 130 (Brooklyn Boulevard)/Boone Avenue intersection, based on operating speeds of 35 miles per hour (mph) and below. In a priority scheme, LRT will generally operate concurrently with the through vehicle phases or as its own signal phase that will be called only when a transit vehicle is detected. In a priority scheme, it is important to note that the early green or green extension time is typically considered to be about 10 percent of the cycle, and therefore the transit vehicle still may have to stop at the signal.

Transit is assumed to operate in a preemption scheme for the intersections of CSAH 81 (Bottineau Boulevard) at 73rd Avenue and CSAH 8 (71st Avenue) under all the future operations scenarios. In a preemption scheme, when the transit vehicle approaches the intersection on the transitway, the traffic signal green phase is terminated and goes to the yellow and red phase. The approach being crossed has a green phase "clearance interval" to clear any queued vehicles from the transitway crossing. The roadway green indications rest in the non-conflicting movements, which would be the CSAH 81 (Bottineau Boulevard) through movements. The traffic movements at the 73rd Avenue intersection are fairly low, so a Synchro/Sim-traffic model was used to model the preemption operations. VISSIM was used to model the CSAH 8 (71st Avenue) intersection due to the higher traffic volumes and potential operational impacts of preemption.

The existing traffic signal at CSAH 130 (Brooklyn Boulevard)/Northland Drive was excluded from the existing and future operations analysis. This intersection was considered low-volume and therefore no significant operational impacts are expected.

Existing Operations

The existing conditions PM peak hour analysis shows that the CSAH 81 (Bottineau Boulevard) intersection at CSAH 130 (Brooklyn Blvd) operates at Level of Service (LOS) E and the CSAH 81 (Bottineau Boulevard) intersection at CSAH 8 (71st Avenue) operates at LOS D. Both of these intersections are nearing or at capacity. **Table 3** shows the results from the existing conditions analysis.

Table 3 Existing Delay and LOS Results

Intersection	Intersection Delay (s/veh)	Intersection LOS	Comments
CSAH 130 (Brooklyn Blvd) at Boone Ave	30.6	C	All movements operate at LOS D or better
CSAH 81 (Bottineau Blvd) at CSAH 130 (Brooklyn Blvd)	58.8	E	Many movements operate at LOS F, operating near or at capacity
CSAH 81 (Bottineau Blvd) at 73rd Ave	12.3	B	All movements operate at LOS E or better
CSAH 81 (Bottineau Blvd) at CSAH 8 (71st Ave)	50.8	D	Some movements operate at LOS F, operating near capacity

FUTURE CONDITIONS

Along alignment A, several modifications would be introduced in the future at the following locations:

- Alignment A through Maple Grove is under a mining operation. Therefore, none of these intersections exist (Zachary and Jefferson Highway (new alignment)) and they are expected to be planned with adequate geometrics to ensure no operational problems would occur.
- The transitway would be grade-separated with TH 169.
- The transitway would cross into a new median just west of the CSAH 130 (Brooklyn Boulevard)/Northland Drive intersection. This intersection was not analyzed because of the low cross-street volumes and because the transitway would not impact eastbound traffic.
- The transitway would cross the Boone Avenue intersection at-grade in the median. Left-turn lanes would be added on the CSAH 130 (Brooklyn Boulevard) approaches.
- CSAH 81 (Bottineau Boulevard) will be expanded to a six-lane section as part of a planned roadway reconstruction project that is separate from the transitway project. The roadway reconstruction project includes the intersections of CSAH 130 (Brooklyn Boulevard), 73rd Avenue, and CSAH 8 (71st Avenue).
- The transitway will not impact the CSAH 81 (Bottineau Boulevard)/CSAH 130 (Brooklyn Boulevard) intersection because the transitway crossing will be grade-separated.
- The transitway crosses CSAH 8 (73rd Avenue) at-grade on the west side of CSAH 81. This is currently a low volume approach. Alignment B would cross from CSAH 103 (Broadway Avenue) to CSAH 81 (Bottineau Boulevard), diagonally across the intersection. The analysis of alignment B crossing at this intersection was analyzed and documented as part of a separate traffic memo.

- The transitway crosses CSAH 8 (71st Avenue) at-grade on the west side of CSAH 81. The intersection includes additional cross-street improvements identified in the CSAH 81 (Bottineau Boulevard) reconstruction project, including dual left-turn lanes on each approach and right-turn lanes.

2030 Forecast Traffic Volumes

The forecast 2030 volumes were based on the "Bottineau Boulevard 2030 Highway and Bus Rapid Transit Ridership Forecast from March 7, 2006, by SRF Consulting Group". These are consistent with other previous work including the CSAH 81 (Bottineau Boulevard) reconstruction project and the Bottineau Transitway Alternatives Analysis "Traffic Operations Analysis Report" dated January 2010. Table 4 shows the year 2030 daily traffic volumes. Table 5 shows the 2030 PM peak hour traffic volumes.

Table 4 Year 2030 Daily Traffic Volumes

Roadway	Location	Year	Daily Volume
CSAH 130 (Elm Creek Blvd)	West of TH 169	2030	Not available
CSAH 130 (Brooklyn Blvd)	West of Boone Ave	2030	Not available
CSAH 130 (Brooklyn Blvd)	East of Boone Ave	2030	25,000
CSAH 81 (Bottineau Blvd)	South of CSAH 130 (Brooklyn Blvd)	2030	38,000

Table 5 Year 2030 PM Peak Hour Traffic Volumes

Intersection	Forecast Year	Northbound			Southbound			Eastbound			Westbound		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
(CSAH 130)/Brooklyn Blvd at Boone Ave	2030	350	80	500	10	10	10	50	1250	120	110	700	20
(CSAH81)/Bottineau Blvd at (CSAH 130)Brooklyn Blvd	2030	240	1580	270	270	1200	50	240	1295	155	210	680	370
(CSAH81)/Bottineau Blvd at 73rd Ave	2030	40	1940	180	60	1465	40	80	60	60	120	20	70
(CSAH81)/Bottineau Blvd at (CSAH 8)/71st Ave	2030	35	1725	580	130	1305	210	300	535	45	355	310	135

Future Operations

Alignment A was modeled with LRT, which is assumed to operate under a transit preemption scheme for the intersections of CSAH 81 (Bottineau Boulevard) at 73rd Avenue and CSAH 8 (71st Avenue), based on the transit operating speeds (45 to 55 MPH). For this analysis, LRT was assumed to operate three-car trains at 7.5 minute headways.

The transitway was modeled as operating with the through movement of the mainline. The transit preemption disrupts the phasing sequence and may result in short green times for movements conflicting with the transitway. It is possible to maintain coordination in the corridor in the future, but the frequency of preemptions would likely have operational impacts on the cross streets that would need to be weighed against the benefits to mainline traffic. The CSAH 81 (Bottineau Boulevard)/CSAH 130 (Brooklyn Boulevard) intersection would not be impacted by preemptions since the transitway will be grade-separated.

For the transit signal priority operations at CSAH 130 (Brooklyn Boulevard)/Boone Avenue, the transit movements were modeled in Synchro as a concurrent phase with the through movements.

Protected only phasing is needed to control left-turn movements for vehicles traveling parallel to the guideway that then turn left across the guideway. The through movement is generally compatible with the transit movement, but the left-turn vehicles must be protected so as not to turn across the path of an approaching transit vehicle. This is particularly a risk when a transit vehicle is approaching from the rear of the passenger vehicle. Left-turn movements from a cross street across the guideway can be either protected or permissive, as the through movements are not compatible with the transit phase. For the intersections where the transitway is side-running, right turn on red (RTOR) was banned for those rights turn movements across the transitway.

The operational results for alignment A under 7.5-minute LRT headways are shown in Table 6.

Table 6 Year 2030 Delay and LOS Results

Intersection	Intersection		Comments
	Delay (s/veh)	LOS	
CSAH 103 (Brooklyn Blvd) at Boone Ave	40.9	D	Most movements crossing the tracks operate at LOS E
CSAH 81 (Bottineau Blvd) at CSAH 130 (Brooklyn Blvd)	60.3	E	The transitway does not impact the intersection operations
CSAH 81 (Bottineau Blvd) at 73rd Ave	30.5	C	Cross-street movements operate at LOS E/F
CSAH 81 (Bottineau Blvd) at CSAH 8 (71st Ave)	50.4	D	Movements conflicting with the transitway are LOS E or F

The CSAH 81 (Bottineau Boulevard)/CSAH 130 (Brooklyn Boulevard) intersection was included in the analysis to show the intersection is near the LOS D/E threshold (acceptable/unacceptable) even though the transitway would be grade separated at this intersection. This was done to show the need for the grade separation, as the intersection is anticipated to be at or near unacceptable conditions even after significant improvements. The operation of this intersection is complicated even more by the freight rail movements.

SUMMARY

The following is a summary of the results of the analysis:

Under existing conditions, the intersections of CSAH 81 (Bottineau Boulevard) at CSAH 130 (Brooklyn Boulevard) and CSAH 8 (71st Avenue) are near the LOS D/E and capacity levels.

The alignment A northern terminus is in the gravel mining area of Maple Grove, it crosses over TH 169 into the median of CSAH 130 (Brooklyn Boulevard), and then heads south on CSAH 81 (Bottineau Boulevard). Below are the key intersections potentially impacted by the transitway:

- Zachary Lane: future roadway, assumed no impact
- Re-aligned Jefferson Highway: future roadway, assumed no impact
- TH 169: overpass, no impact
- Northland Drive: cross to median, lower volume roadway, assumed no impact
- Boone Avenue: median running transitway, analyzed
- CSAH 81 (Bottineau Boulevard): grade-separated crossing of CSAH 130 (Brooklyn Boulevard), no impact
- 73rd Avenue: side running transitway, analyzed
- CSAH 8 (71st Avenue): side running transitway, analyzed

Under year 2030 future conditions, the future CSAH 81 (Bottineau Boulevard) reconstruction project was assumed along with left-turn lane improvements at the CSAH 81 (Bottineau Boulevard) intersections at CSAH 130 (Brooklyn Boulevard) and CSAH 8 (71st Avenue).

The analyzed intersections are expected to operate with acceptable LOS given the above improvements, except CSAH 81 (Bottineau Boulevard)/CSAH 130 (Brooklyn Boulevard) will operate near unacceptable operations and near/at capacity. The transitway would have no operational impacts to the CSAH 81 (Bottineau Boulevard)/CSAH 130 (Brooklyn Boulevard) intersection, since it is proposed to be grade separated. The grade-separated crossing of CSAH 130 (Brooklyn Boulevard) at CSAH 81 (Bottineau Boulevard) is warranted because this intersection is expected to operate near unacceptable operation even with significant improvements provided in the future CSAH 81 (Bottineau Boulevard) reconstruction project.

BottineauTransitway
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Memorandum

To: Brent Rusco, P.E.
Hennepin County Engineering and Transit Planning

From: Patrick Corkle, P.E., PTOE
SRF Consulting Group

Date: June 18, 2012

Subject: Bottineau Alignment C
Traffic Analysis Memorandum

This memorandum presents the results of the scoping level traffic operations analysis for alignment C of the Bottineau Transitway within the Cities of Brooklyn Park, Crystal, and Robbinsdale. This document is one of a series of technical memoranda that address various traffic operations issues along the transitway corridor.

The following sections focus on the traffic operational aspects of alignment C, including a summary of the existing conditions, the characteristics of alignment C, forecast 2030 traffic volumes, and the 2030 operational modeling results for light rail transit (LRT). Additional considerations including noise analysis, parking impacts, pedestrian/bicycle circulation, property access, roadway network impacts, and emergency vehicle access, are important issues to be considered for alignment C, but are not part of the analysis documented in this memorandum.

EXISTING CONDITIONS

Alignment C for this analysis extends north-south along the west side of County State Aid Highway (CSAH) 81 (Bottineau Boulevard) from north of I-94 to Bass Lake Road (CSAH 10). At this point, the transitway alignment leaves CSAH 81 and follows the railroad alignment to 36th Avenue, where alignment D alternatives begin. The focus of the operations analysis was the PM peak hour because it has the highest volumes and would therefore represent a worst case condition.

The C alignment may impact traffic operations at signalized intersections because of the potential for additional delay. Traffic signals are currently operating at the following intersections:

- CSAH 81 (Bottineau Boulevard)/I-94 North Ramp (no impact; not modeled)
- CSAH 81 (Bottineau Boulevard)/I-94 South Ramp (no impact; not modeled)
- CSAH 81 (Bottineau Boulevard)/63rd Avenue

- CSAH 81 (Bottineau Boulevard)/CSAH 10 (Bass Lake Road) (analyzed separately)

The I-94 ramps were not analyzed, since the transitway crosses I-94 on the west side of the interchange. The I-94 interchange is a folded diamond to the east and therefore the transitway does not cross any of the ramps and would not impact the operation of the traffic signals. The CSAH 81 (Bottineau Boulevard)/CSAH 10 (Bass Lake Road) intersection is a critical intersection with high volumes. Therefore, it was analyzed in VISSIM to best understand how the transitway and traffic signal would operate. The assumptions and results of this analysis are documented in the *CSAH 81 (Brooklyn Boulevard) Transit Headway Analysis* technical memorandum by Kimley-Horn and Associates, dated May 24, 2012.

Other unsignalized intersections or crossings exist along this alignment are at the following locations:

- Corvalias Avenue Crossing: non-intersection with gated crossing, not modeled
- West Broadway Avenue Crossing: non-intersection with gated crossing, not modeled
- 45 ½ Avenue Crossing: low volume/non-intersection with gated crossing, not modeled
- TH 100: overpass, not modeled
- 42nd Avenue: non-intersection with gated crossing, analyzed separately
- 41st Avenue/Noble Avenue: non-intersection with gated crossing, not modeled
- 39 ½ Avenue Crossing: low volume/non-intersection with gated crossing, not modeled

None of the non-intersections were modeled as part of this analysis. They were reviewed in the previous Alternatives Analysis work and determined not to be significantly impacted by the transitway. This is mainly because the only time the roadway traffic would be stopped is during the transitway vehicle crossing and the remaining time the roadway would be free to cross. The 42nd Avenue crossing was previously analyzed, with the assumptions and results documented in the *Operations Analysis of LRT and BRT at the 42nd Avenue Crossing* technical memorandum by WSB and Associates, dated June 2011.

Existing Traffic Volumes

The existing daily traffic volumes are shown in **Table 1**. The PM peak hour turning movement counts are shown in **Table 2**.

Table 1 Existing Daily Traffic Volumes

Roadway	Location	Year	Daily Volume
CSAH 81 (Bottineau Blvd)	North of I-94	2010	30,000
CSAH 81 (Bottineau Blvd)	North of 63rd Ave	2010	25,000
CSAH 81 (Bottineau Blvd)	South of 63rd Ave	2010	24,200
63rd Ave	West of CSAH 81 (Bottineau Blvd)	2010	8,800
63rd Ave	East of CSAH 81 (Bottineau Blvd)	2010	13,300
Corvallis Ave	Transitway Crossing	2010	4,250
Broadway Ave	Transitway Crossing	2010	8,800
42nd Ave	Transitway Crossing	2010	11,600
41st Ave/Noble Ave	Transitway Crossing	2010	2,150

Table 2 Existing PM Peak Hour Traffic Volumes

Intersection	Count Year Agency	Northbound			Southbound			Eastbound			Westbound		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
CSAH 81 (Bottineau Blvd) at 63rd Ave	2002 Hennepin	158	1052	298	176	644	59	144	407	88	168	324	112

Operations Analysis

The initial operational analysis for alignment C was completed in Synchro/SimTraffic because it provides the ability to efficiently analyze a number of different geometric and operational parameters and more detailed analysis was completed in VISSIM where needed. Preemption can't be modeled directly in Synchro/SimTraffic but the signal timing and phasing can be modified to reasonably approximate the impacts on traffic. VISSIM modeling more accurately replicates the transit preemption sequence and recovery, as well as accounting for truncated and skipped signal phases.

Transit is assumed to operate in a preemption scheme for all the signalized intersections along alignment C. In a preemption scheme, when the transit vehicle approaches the intersection on the transitway, the traffic signal green phase is terminated and goes to the yellow and red phase. The approach being crossed has a green phase "clearance interval" to clear any queued vehicles from the transitway crossing. The roadway green indications rest in the non-conflicting movements, which would be the CSAH 81 (Bottineau Boulevard) through movements.

The existing traffic signal at CSAH 81 (Bottineau Boulevard)/CSAH 10 (Bass Lake Road) was excluded from alignment C existing and future operations analysis, because that work was completed under a separate technical memo. The unsignalized intersections were not analyzed, since the vehicle traffic is only stopped briefly during transitway crossings, and otherwise flows unimpeded.

Existing Operations

The existing conditions PM peak hour analysis shows that the CSAH 81 (Bottineau Boulevard)/63rd Ave intersection operates at Level of Service (LOS) D. **Table 3** shows the results from the existing conditions analysis.

Table 3 Existing Delay and LOS Results

Intersection	Intersection		Comments
	Delay (s/veh)	LOS	
CSAH 81 (Bottineau Blvd) at 63rd Ave	45.0	D	All movements operate at LOS E or better

FUTURE CONDITIONS

Along alignment C, several future modifications would be introduced at the following locations:

- The transitway alignment would have an overpass at TH 100.
- A future CSAH 81 (Bottineau Boulevard) reconstruction project will expand CSAH 81 (Bottineau Boulevard) to a six-lane roadway. The additional improvements at the 63rd Avenue intersection include dual

left-turn lanes on each approach, except northbound, and right-turn lanes on the 63rd Avenue approaches.

2030 Forecast Traffic Volumes

The forecast 2030 volumes were based on the "Bottineau Boulevard 2030 Highway and Bus Rapid Transit Ridership Forecast from March 7, 2006, by SRF Consulting Group". These are consistent with other previous work including the CSAH 81 (Bottineau Boulevard) reconstruction project and the Bottineau Transitway Alternatives Analysis "Traffic Operations Analysis Report" dated January 2010. **Table 4** shows the year 2030 daily traffic volumes. **Table 5** shows the 2030 PM peak hour traffic volumes.

Table 4 Year 2030 Daily Traffic Volumes

Roadway	Location	Year	Daily Volume
CSAH 81 (Bottineau Blvd)	North of I-94	2030	46,000
CSAH 81 (Bottineau Blvd)	North of 63rd Ave	2030	36,000
CSAH 81 (Bottineau Blvd)	South of 63rd Ave	2030	35,000
63rd Ave	West of CSAH 81 (Bottineau Blvd)	2030	12,400
63rd Ave	East of CSAH 81 (Bottineau Blvd)	2030	18,700
Corvallis Ave	Transitway Crossing	2030	Not available
Broadway Ave	Transitway Crossing	2030	Not available
42nd Ave	Transitway Crossing	2030	17,000
41st Ave/Noble Ave	Transitway Crossing	2030	Not available

Table 5 Year 2030 PM Peak Hour Traffic Volumes

\Intersection	Forecast Year	Northbound			Southbound			Eastbound			Westbound		
		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
CSAH 81 (Bottineau Blvd) at 63rd Ave	2030	170	1600	325	290	900	100	260	625	110	220	475	240

Future Operations

Alignment C was modeled with LRT, which is assumed to operate under a transit preemption scheme in these corridors, based on the operating speeds (45 to 55 MPH) of the transit and the adjacent roadway. For this analysis, LRT was assumed to operate three-car trains at 7.5 minute headways.

The transitway was modeled with the through movement of the mainline. The preemption disrupts the phasing sequence and may result in short green times for movements conflicting with the transitway. It is possible to maintain coordination in the corridor in the future, but the frequency of preemptions would likely have operational impacts on the cross streets that would need to be weighed agains the benefits to mainline traffic. Protected only phasing is needed to control left-turn movements for vehicles traveling parallel to the guideway that then turn left across the guideway. The through movement is generally compatible with the transit movement. Left-turn movements from a cross street across the guideway can be either protected or permissive, as the through movements are not compatible with the transit phase. For the intersections where the transitway is side-running, right turn on red (RTOR) was banned for those rights turn movements across the transitway.

The operational results for alignment C under 7.5-minute (LRT) headways are shown in **Table 6**. The results include future improvements to the CSAH 81 (Bottineau Boulevard) corridor.

Table 6 Year 2030 Delay and LOS Results

Intersection	Intersection		Comments
	Delay (s/veh)	LOS	
CSAH 81 (Bottineau Blvd) at 63rd Ave	52.7	D	Movements across the tracks operate at LOS E or F

SUMMARY

The following is a summary of the results of the analysis:

Under existing conditions, the CSAH 81 (Bottineau Blvd)/63rd Ave intersection operates at LOS D.

The alignment C northern terminus is just north of the I-94 interchange with a southern terminus around 36th Avenue. Below are the key intersections potentially impacted by the transitway:

- I-94 Interchange: no impact to the intersections as the transitway bypasses the interchange on the west side, no impact
- 63rd Avenue: side running transitway, analyzed

- Bass Lake Road: evaluated under separate analysis
- Corvalias Avenue Crossing, West Broadway Avenue Crossing, 45 ½ Avenue, 41st Avenue/Noble Avenue Crossing, and 39 ½ Avenue Crossing Crossing: non-intersection gated crossings, not analyzed
- TH 100 overpass: grade separated, no impact
- 42nd Avenue Crossing: non-intersection gated crossing, evaluated under separate analysis

Under year 2030 future conditions, the future CSAH 81 (Bottineau Boulevard) reconstruction to six-lanes was assumed along with left-turn lane and right-turn improvements at the CSAH 81 (Bottineau Blvd)/63rd Avenue.

The analyzed intersection at CSAH 81 (Bottineau Boulevard)/63rd Avenue is expected to operate at LOS D given the above improvements under year 2030 conditions.

Technical Memorandum

To:	Joe Gladke, PE	**Copy:**	n/a
From:	Chad Ellos, PE Tony Heppelmann, PE		
Date:	October, 2012 (Revised)	**File:**	WSB No. 01484-070
Subject:	Modeling Assumptions Bottineau LRT Transitway – Broadway Avenue		

The purpose of this memorandum is to list the assumptions to be used in the modeling analysis of LRT running along the Broadway Avenue alignment. Assumptions were arrived at through conversations with Hennepin County staff and by reviewing previous documents created for the Bottineau Transitway Draft Environmental Impact Statement. Most assumptions were taken from the two documents listed below.

- Proposed LRT and BRT Operating Plan Assumptions (8-23-2011)
- Transit/Traffic Signal Operating Schemes Technical Memorandum (12-6-2011)

1. PROJECT LIMITS

The extents of the project include Broadway Avenue from just north of TH 610 North Ramp intersection to just south of the 76th Avenue intersection.

2. LRT ALIGNMENT

The LRT alignment was assumed to be side-running along the west side of Broadway Avenue from the northern extents to 94th Avenue. At 94th Avenue, it was assumed that the LRT alignment would transition to center-running and remain in the Broadway Avenue median to the southern extents of the project.

3. STATIONS

Three stations are located in the study area. These include:

- 93rd Avenue P&R Station
- 85th Avenue Station
- Brooklyn Boulevard Station

Each station is located in the roadway median and consists of far-side platform locations on each side of the signalized intersection. Dwell time at stations was assumed to be 20 seconds.

4. LRT CHARACTERISTICS

- Maximum Speed = 45 mph
- Acceleration = 3.0 mphps
- Deceleration = 3.0 mphps
- Length = 188 feet (2 cars at 94 feet per car)
- Full Priority (Preemption) at signalized intersections
- Average LRV Headway = 7.5 minutes in each direction. An assumed random variance of plus or minus 20% around the scheduled time will be used to develop a random arrival schedule.

5. ADDITIONAL TRAFFIC AND GEOMETRIC CHARACTERISTICS

- Traffic Speeds on Broadway Avenue = 45 mph
- Forecast 2030 traffic volumes for a 4-Lane alternative were provided by Hennepin County and used in this analysis
- The roadway sections on CSAH 103 was assumed to be four lanes from south of 76th Avenue (south project limit) to north of the TH 610 North Ramp intersection (north project limit)
- Dual left-turn lanes for:
  - EB approach at Brooklyn Boulevard
  - EB and WB approaches at 85th Avenue
  - EB approach at 93rd Avenue
  - SB approach at the TH 610 North Ramp intersection
- Dedicated left-turn lanes have protected phasing on all approaches paralleling the tracks

6. GATE ARM OPERATIONS

Gate arms were assumed at all signalized intersections since the LRV speed was greater than 35 mph. During the preempt call, the mainline left turn phases were assumed to receive a track clearance phase prior to the gates descending. Cross-street traffic did not receive a track clearance phase. Permitted left-turning vehicles that may be waiting on the tracks were assumed to clear the intersection during the two seconds of all-red prior to the mainline left's track clearance phase. Generally, gate arm operations were assumed to follow the time tolerances listed below.

- Flashing warning prior to gates descending = 3 to 5 seconds
- Gates descending = 10 to 12 seconds
- Time after gates are down and before transit vehicle arrives at crossing = 5 seconds

- Transit vehicle crossing the roadway = varies
- Gates ascending = 5 seconds

TOTAL TIME = Approximately 25 seconds plus transit vehicle crossing time.

7. TRAFFIC SIGNAL – RECOVERY SEQUENCE

Once a preempt call was terminated, the traffic signal recovery sequence went first to the EBL and EBT phases, then to the next phase in the ring and barrier. The next phase was usually the WB through movement followed by the WB left-turn phase. Since the mainline left turning vehicles received a clearance phase prior to the LRV arriving at the intersection and the mainline through movements went with the LRV, the EB approach was the remaining critical movement that has the heaviest traffic volume (movement that had been delayed the longest). Recovering first to the EB approach allowed the intersection to best recover while minimizing vehicle queuing on all approaches.

2030 PM Peak Hour
4-Lane Alternative Traffic Volumes
LRT Preemption

VISSIM Simulation Summary Results
Date: Monday, October 01, 2012
Measures of Effectiveness

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Control	Location (Intersection)	Appr	Total Delay by Movement (Sec/Veh) L	T	R	Level of Service by Movement L	T	R	LOS by Approach (Sec/Veh) Delay	LOS	LOS by Intersection (Sec/Veh) Delay	LOS	Appr	Left Turn Ave Queue	Left Turn Max Queue	Through Ave Queue	Through Max Queue	Right Turn Ave Queue	Right Turn Max Queue
Signalized	1: 76th Ave at Broadway Ave	NB	48	28	21	D	C	C	30	C			NB	59	280	59	280		60
		SB	38	14	6	D	B	A	16	B	28	C	SB	33	168	33	168		56
		EB	58	59	5	E	E	A	47	D			EB	72	358	72	358	3	125
		WB	53	44	30	D	D	C	40	D			WB	43	269	43	269	3	120
Signalized	2: Brooklyn Blvd at Broadway Ave	NB	58	32	6	E	C	A	30	C			NB	71	276	71	276	3	176
		SB	49	37	5	D	D	A	30	C	53	D	SB	62	269	62	269		20
		EB	110	49	3	F	D	A	71	E			EB	211	681	211	681	5	178
		WB	111	67	14	F	E	B	63	E			WB	195	802	195	802	12	364
Unsignalized	3: Rainbow at Broadway Ave	NB	0	1	0	A	A	A	1	A			NB						
		SB	0	3	2	A	A	A	3	A	2	A	SB				123		123
		EB	0	0	10	A	A	B	10	B			EB						
		WB	0	0	10	A	A	B	10	B			WB						
Signalized	5: Candlewood Dr at Broadway Ave	NB	35	15	13	D	B	B	15	B			NB	3	50	59	482	3	160
		SB	37	13	12	D	B	B	14	B	17	B	SB	5	68	24	320	24	320
		EB	47	43	14	D	D	B	44	D			EB	27	174	9	94		
		WB	41	37	12	D	D	B	29	C			WB	11	81	11	81		
Signalized	7: College Park Dr at Broadway Ave	NB	42	21	15	D	C	B	22	C			NB	11	96	66	526	1	50
		SB	37	18	14	D	B	B	20	B	22	C	SB	15	124	45	363	2	135
		EB	58	42	17	E	D	B	37	D			EB	16	126	16	126		
		WB	38	51	9	D	D	A	29	C			WB	20	137	2	53		
Unsignalized	9: 84th Ave at Broadway Ave	NB	0	2	1	A	A	A	2	A			NB				68		68
		SB	0	2	1	A	A	A	2	A	2	A	SB						
		EB	0	0	11	A	A	B	11	B			EB						
		WB	0	0	12	A	A	B	12	B			WB						
Signalized	10: 85th Ave at Broadway Ave	NB	58	50	22	E	D	C	43	D			NB	136	712	136	712	4	282
		SB	51	43	16	D	D	B	41	D	47	D	SB	81	414	81	414		
		EB	57	49	5	E	D	A	49	D			EB	131	494	131	494		48
		WB	64	55	7	E	E	A	54	D			WB	99	371	99	371		
Unsignalized	11: Maplebrook Pkwy at Broadway Ave	NB	0	5	4	A	A	A	5	A			NB						
		SB	0	1	2	A	A	A	1	A	4	A	SB						
		EB	0	0	6	A	A	A	6	A			EB						
		WB	0	0	8	A	A	A	8	A			WB						
Signalized	13: Setzler Pkwy at Broadway Ave	NB	54	15	9	D	B	A	15	B			NB	37	446	37	446	1	53
		SB	38	12	4	D	B	A	14	B	17	B	SB	26	266	26	266		15
		EB	47	55	9	D	E	A	26	C			EB	10	90	10	90		
		WB	55	53	13	E	D	B	48	D			WB	29	177	29	177		
Unsignalized	14: 92nd Ave at Broadway Ave	NB	0	5	2	A	A	A	5	A			NB				11		11
		SB	0	1	0	A	A	A	1	A	3	A	SB						
		EB	0	0	6	A	A	A	6	A			EB						
		WB	0	0	8	A	A	A	8	A			WB						
Signalized	15: 93rd Ave at Broadway Ave	NB	59	29	9	E	C	A	30	C			NB	21	145	75	618	5	313
		SB	57	23	3	E	C	A	21	C	42	D	SB	41	298	41	298		36
		EB	81	56	6	F	E	A	65	E			EB	121	387	94	457		
		WB	82	92	12	F	F	B	74	E			WB	88	428	88	428	2	128
Signalized	16: 94th Ave at Broadway Ave	NB	52	24	11	D	C	B	25	C			NB	92	752	92	752	14	467
		SB	107	17	16	F	B	B	24	C	28	C	SB	60	245	60	245	60	245
		EB	85	72	5	F	E	A	66	E			EB	82	396	82	396	3	148
		WB	64	64	18	E	E	B	29	C			WB	25	168	9	200		
Signalized	17: TH 610 South Ramp at Broadway Ave	NB	0	22	31	A	C	C	26	C			NB			157	849	37	526
		SB	48	5	0	D	A	A	18	B	23	C	SB	56	215	56	215		
		EB	0	0	0	A	A	A	0	A			EB						
		WB	48	0	20	D	A	C	27	C			WB	53	314			1	69
Signalized	18: TH 610 North Ramp at Broadway Ave	NB	0	15	9	A	B	A	14	B			NB			40	328		62
		SB	47	7	0	D	A	A	21	C	20	C	SB	76	341	76	341		
		EB	0	0	0	A	A	A	0	A			EB						
		WB	49	0	18	D	A	B	31	C			WB	57	223				12

Average & Maximum Traffic Queueing (feet)