Appendix H: Environmental Screening

Environmental Screening
Belgrade Ave Corridor Study

SEE Topics	Considerations	Existing Conditions
Water Resources	Effects to water resources. Wetlands that may be impacted by partial or complete filling, excavation or drainage, or severance of water supply	Known Water Resources Locations (Figure 1) • The Minnesota River traverses to the east and south of the study area. • The Minnesota River is listed as an Impaired Stream. • No wetlands were located near the study area.
Floodplains	Development encroachments on the 100-year floodplain	Known Floodplains Locations (Figure 1) • Flood Hazard Areas are associated with the Minnesota River to the east and south of TH 169. • Study area protected from the 100-year flood by levee or other structure which may be subject to possible failure or overtopping during prolonged floods or high riverstages.
Surface Water Drainage/Water Quality	Effects of drainage modifications. Run-off effects to protected lakes and watercourses	Drainage infrastructure alterations and impervious surface additions may affect the bodies of water.
Wildlife, Threatened and Endangered Species	• Unique habitats • Widened section • Federal and state listed threatened and endangered species	There are no known wildlife, threatened and endangered species in the study area.
Fisheries	• Trout streams • Fish migrations • Spawning runs • Unique habitats	There are no designated trout streams within the study area.
Vegetation	• Native plant communities • Landscape vegetation • Functional vegetation • High value vegetation • Hazard trees	The study area is dominated by devleoped residential and commerical uses with altered vegetation.

Environmental Screening
Belgrade Ave Corridor Study

SEE Topics	Considerations	Existing Conditions
Contaminated Properties	Disturbance of contaminated properties may increase project cost	Known history of contamination in the study area (Figure 2). • 1 activity in southwest quadrant of Belgrade Ave. and Nicollet Ave. • 1 activity on north side of Belgrade Ave. at Nicollet Ave. intersection • 1 activity on the north side of Belgrade Ave. between Range St. and Nicollet Ave. mid-block • 2 activities in northeast quadrant of Belgrade Ave. and Range St. intersection • 1 activity in southwest quadrant of Belgrade Ave.and Cross St. intersection • 1 activity in northwest quadrant of Belgrade Ave. and Cross St. intersection • 1 activity on north side of Belgrade Ave. between Center St. and Cross St. mid-block • 1 activity in southeast quadrant of Belgrade Ave. and Center St. intersection • 2 activities in northwest quadrant of Belgrade Ave. and Center St. intersection • 1 activity on west side of Center St. between Belgrade Ave. and Wheeler Ave. mid-block • 1 activity on south side of Belgrade Ave. between Lake St. and South Lake St. mid-block • 1 activity at Belgrade Ave. and Lake St. intersection south side • 1 activity on south side of Belgrade Ave. and Nicollet Ave. intersection More detailed investigations may be recommended for properties with existing/past land uses that may have used hazardous/chemical waste.
Parks and Recreation Areas (Section 4f/6f Resources)	• Parks and recreation areas • Land and Water Conservation (LAWCON) funds • Wildlife & waterfowl refuges • Historic sites • Landscapes • Highways • Bridges • Buildings & districts • Wildlife management areas • School playgrounds • Fairgrounds • Public multiple-use land holdings • Public golf courses • Archaeological sites • Wild & scenic rivers	Known Parks and Recreational Areas (Figure 3) • Centennial Park at the northwest corner of Belgrade Ave. and Lake St. and meets the Section 4(f) criteria. • BellTower Apartments at 442 Belgrade Avenue is listed on the National Register of Historic Places and meets the Section 4(f) criteria. • No LAWCON parks identified in the study area. • No Schools identified in the study area.

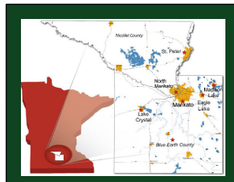
Environmental Screening
Belgrade Ave Corridor Study

SEE Topics	Considerations	Existing Conditions
Environmental Justice	Disproportionate effects to low-income or minority populations	Known current Zoning (Figure 4) • The study area predominately includes the CBD and R-1 (One Family Dwelling) housing. • Smaller concentrations of R-3 (Limited Multiple Dwelling) and R-4 (Multiple Dwelling) housing are in the vicinity of the study area. • Improvements to the study area are not expected to cause disproportionately high or adverse effects.
Social and Community	• Hospitals • Schools • Libraries • Churches • Government buildings • Post offices	Known Social and Community Locations (Figure 3) • U.S. Post Office located between Nicollet Ave. and Range St. on the south side mid-block • Belgrade Avenue United Methodist Church located in the southwest quadrant of the intersection of Belgrade Ave. and Sherman St. • City of North Mankato Water Plant No. 1 located between Lake St. and Nicollet Ave. on the south side mid-block • North Mankato Taylor Library located on the south corner of Belgrade Ave. and Nicollet St. • North Mankato Police Annex located in the sotheast quadrant of Belgrade Ave. and Lee Blvd. • North Mankato Municipal Building located in the sotheast quadrant of Belgrade Ave. and Lee Blvd.
Cultural Resources	Buildings that exceed 50 years in age, archaeological sites, and Traditional Cultural Properties.	Known Cultural Resources Locations (Figure 3) • BellTower Apartments; the former North Mankato Public School at 442 Belgrade Ave. • Additional buildings along Belgrade Ave. exceed 50 years of age and may be eligible for designation
Pedestrian & Bicycle Facilities	Bicycle and pedestrian safety	Known Pedestrian and Bicycle Facilities (Figure 3) • A Regional Trail exists along east side of TH 169 and crosses the Minnesota River on Veterans' Memorial Bridge into the City of Mankato. • On-Road Bicycle Routes exist on Nicollet Ave, Center St, Sherman St, Lake St & Robel St. to South Ave.
Transit & Intermodal Issues	All modes of transportation and existing facilities for alternatives.	Known Transit & Intermodal Issues • The eastern terminus of Belgrade Avenue is serviced by TH 169. • Greater Mankato Transit System Bus Routes 4 and 5 traverse through the study area.
Air Quality	• Impacts to air quality • Mobile source air toxins	The need for an air quality analysis, conformity determination, or Mobile Source Air Toxics analysis will be determined once individual improvement projects are identified.*
Traffic Noise	• Comply with federal noise criteria and Minnesota Noise Standards • Identify of sensitive noise receptors	The need for a noise analysis will be determined once individual improvement projects are identified.*

Environmental Screening
Belgrade Ave Corridor Study

SEE Topics	Considerations	Existing Conditions
Costruction Noise	• Comply with federal noise criteria and Minnesota Noise Standards • Identify of sensitive noise receptors	Construction noise will be further considered in a future environmental review.* City ordinances can regulate the daytime hours of construction activities in order to minimize potential impacts to adjacent areas.
Utilities	Impacts to utilities may incur additional project costs.	To be considered in future environmental review.*
Farmland and Soils	• Minimization of effects to agricultural land • Properties of soils • Suitability for roadway construction	There are no designated farmland and soils in the project area.
Erosion	• Erosional effects • Water pollution	To be considered in a future environmental review.*
Right of Way and Relocation	Effects of right of way acquisition	Additional right-of-way may need to be acquired for future improvement projects. Temporary easements and changes to local roadway and property access points are also likely. Any impacts resulting from right-of-way acquisition, relocation or access changes will be identified in a future environmental review.
Visual Quality	• Scenic intrusion • Grading, Trails • Vegetation modifications • Bridges • Walls • Lighting • Fencing • Railings	The proposed project is not anticipated to result in adverse visual impacts.

*Additional study considerations will be pursued when improvements are identified.



Belgrade Avenue Corridor Study

Mankato/North Mankato Area Planning Organization

Figure 1: Water Resources & Floodplains

July, 2016

BOLTON & MENK Engineers & Surveyors

Lake View Ave
Bennett St
Garfield Ave
Notingham Dr
Sherwood Dr
Lake St
Grant Ave
Wall St
Lyndale St
Wanda St
169
Page Ave
Page Ave
Page Ave
Cedar St
Lee Blvd
Park Ave
Belltower Apartments
Wheeler Ave
Wheeler Ave
Belvista Dr
Belgrade Ave
Lake St
Cornelia St
Belgrade Avenue United Methodist Church
Sherman St
Center St
Top Shop/ PJ's Liquors
Cross St
Spinner's Bar
Range St
Nicollet Ave
Christensen St
Robel St
North Mankato City Hall
South Ave
Lookout Dr
169

Legend

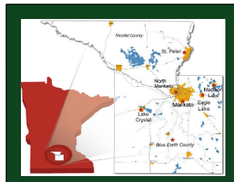
- Study Corridor
- Impaired Streams
- Wetlands
- Flood Hazard Area

0 0.1 Miles

Description

Study area protected from the 100-year flood by levee or other structure which may be subject to possible failure or overtopping during prolonged floods or high riverstages.

Map Document: \\Arcserver1\gis\MAPO_MUIT4211862\ESRI\Maps\Belgrade - Water & Floodplains.mxd
Date Saved: 7/18/2016 11:03:19 AM



Belgrade Avenue Corridor Study

Mankato/North Mankato Area Planning Organization

Figure 2: Contaminated Properties

July, 2016

BOLTON & MENK Engineers & Surveyors

Lee Blvd
Belvista Dr
Lake St
Grant Ave
Page Ave
Park Ave
Belltower Apartments
Wheeler Ave
Belgrade Ave
Cornelia St
Belgrade Avenue United Methodist Church
Sherman St
Center St
Top Shop/ PJ's Liquors
Cross St
Spinner's Bar
Range St
Nicollet Ave
Christensen St
Wall St
Lyndale St
Cedar St
Wanda St
169
Robel St
North Mankato City Hall
South Ave
Lookout Dr

Legend

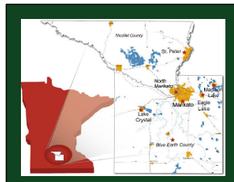
- Study Corridor

ACTIVITY

- Construction Stormwater Permit
- Hazardous Waste, Small to Minimal QG
- Multiple Activities
- Petroleum Brownfield
- Tank Site
- Wastewater Discharger

0 0.1 Miles

Map Document: \\Arcserver1\gis\MAPO_MUT\42111862\ESRI\Maps\Belgrade - Contaminated Properties.mxd
Date Saved: 7/18/2016 1:05:44 PM



Belgrade Avenue Corridor Study

Mankato/North Mankato Area Planning Organization

Figure 3: Parks, Trails & Cultural Spaces

July, 2016

BOLTON & MENK Engineers & Surveyors

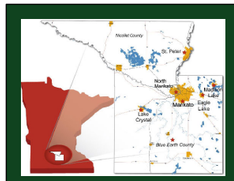
Nottingham Dr
Sherwood Dr
Lake View Ave
Bennett St
Garfield Ave
Wheeler Park
Wall St
Lyndale St
Wanda St
169
Grant Ave
Page Ave
Page Ave
Page Ave
Cedar St
Wheeler Ave
Wheeler Ave
Belltower Apartments
Lee Blvd
Belvista Dr
Centennial Park
Belgrade Ave
Park Ave
Lake St
Cornelia St
Belgrade Avenue United Methodist Church
Sherman St
Center St
Cross St
Top Shop/ PJ's Liquors
Spinner's Bar
Range St
U.S. Post Office
Water Plant No. 1
Nicollet Ave
Taylor Library
Robel St
Christensen St
North Mankato City Hall
South Ave
South Avenue Playlot
Lookout Dr
169

Legend

- Study Corridor
- Regional Trails
- Water Plant No. 1
- Police Annex
- Taylor Library
- City Hall
- National Register Properties
- Belgrade Avenue United Methodist Church
- U.S. Post Office
- On-Road Bicycle Trails
- Parks

0 0.1 Miles

Map Document: \\Arcserver1\gis\MAPO_MUIT4211186\2\ESRI\Maps\Belgrade - Community Spaces.mxd
Date Saved: 7/18/2016 11:55:39 AM



Belgrade Avenue Corridor Study

Mankato/North Mankato Area Planning Organization

Figure 4: Zoning

July, 2016

BOLTON & MENK Engineers & Surveyors

Lee Blvd
Lookout Dr
Belvista Dr
Lake St
Robert St
Cornelia St
Sherman St
Center St
Cross St
Range St
Christensen St
Grant Ave
Page Ave
Park Ave
Wheeler Ave
Belgrade Ave
Nicollet Ave
South Ave
Wall St
Lyndale St
Cedar St
Wanda St
169
Belltower Apartments
Belgrade Avenue United Methodist Church
Top Shop/ PJ's Liquors
Spinner's Bar
North Mankato City Hall

Legend

- Study Corridor

Zoning

Residential

- R-A Residential Agricultural
- R-1 One Family Living
- R-2 One and Two Family Dwelling
- R-3 Limited Multiple Dwelling
- R-4 Multiple Dwelling

Business

- OR-1 Office Residential
- CBD Central Business
- B-1 Neighborhood Business
- B-3 General Commercial
- B-2 Community Business

Industrial

- M-2 Heavy Industrial
- M-1 Light Industrial
- I-1 Planned Industrial

Miscellaneous

- TUD Transitional Unzoned District
- P-1 Public Park

0 0.1 Miles

Map Document: \\Arcserver1\gis\MAPO_MUT\42111862\ESRI\Maps\Belgrade - Zoning.mxd
Date Saved: 7/18/2016 1:21:11 PM

Appendix I: Future Traffic Conditions Technical Memorandum

BOLTON & MENK
Real People. Real Solutions.

12224 Nicollet Avenue
Burnsville, MN 55337-1649

Ph: (952) 890-0509
Fax: (952) 890-8065
Bolton-Menk.com

MEMORANDUM

Date: May 3, 2017

To: Paul Vogel

From: Ross B. Tillman, P.E.
Kelsey E. Retherford, E.I.T.

Subject: Future Traffic Analysis
Belgrade Avenue Corridor Study
Mankato/North Mankato Area Planning Organization
Project No.: T42.111862

Introduction

The Mankato/North Mankato Area Planning Organization in cooperation with the City of North Mankato have requested a corridor study along Belgrade Avenue from Lee Boulevard to TH 169 North Ramp. Riverfront Drive is located along the western edge of the City of Mankato. Belgrade Avenue is located along the southern edge of the City of Northern Mankato. This memorandum provides a summary of the future conditions and potential solutions.

Traffic Forecasting

Future traffic volumes for 2041 (25-yr forecast) were developed using historical data and the Mankato/North Mankato Area Planning Organization (MAPO) 2045 Long Range Transportation Plan while recognizing population growth trends in the area, which are likely to affect traffic volumes.

The historical growth rates (1997-2013) along Belgrade Avenue were all found to be negative based on historical data except east of the TH 169 North Ramp which was found to have a growth rate of 2.4%. Historical growth rates on the side streets were found to be between -3.9% and 0.5%. The historical growth rate on Lee Boulevard north of Belgrade Avenue was found to be 0.5% and south of Belgrade Avenue it was found to be 1.3%. The MAPO 2045 Long Range Transportation Plan indicated future growth rates to be between 0.9% and 1% on Belgrade Avenue. For Lee Boulevard north of Belgrade Avenue the MAPO 2045 Long Range Transportation Plan showed growth of 1.5% north of Belgrade Avenue and 0.5% south of Belgrade Avenue.

Taking all sources into account a 0.5% growth rate was used along Belgrade Avenue between Lee Boulevard and the TH 169 South Ramp as the historical data shows a decrease in traffic, but the Transportation Plan shows a 1% growth rate. A 0.5% growth rate was assumed for all side streets off of Belgrade Avenue as well between Lake Street and Range Street. A 1% growth rate was used on Belgrade Avenue east of the TH 169 North Ramp as the historical growth rate of 2.4% was assumed to be too high and the Transportation Plan had a growth rate of 0.9%. A 1% growth rate was used on Lee Boulevard both north and south of Belgrade Avenue.

Figure 1 in the **Appendix** shows the most recent AADT, the 2041 forecasted AADT based on historical growth, the 2045 forecasted AADT from the MAPO 2045 Long Range Transportation Plan and a 2041 forecasted AADT based on the recommended growth rate. **Figure 2** in the **Appendix** shows the 2041 forecasted turning movement counts.

Future Operations Analysis

A level of service (LOS) analysis of the peak hours was completed using the forecasted turning movement counts in SimTraffic. **Table 1** shows the results of the 2041 no build traffic analysis.

Table 1 - 2041 Existing Geometry (No Build) Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay*		Maximum Delay-LOS**		Limiting Movement ***	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
NB TH 169 Exit Ramp & Belgrade Ave	AM	5	A	15	B	NBL	WBT	75	200
Signalized Intersection	PM	7	A	20	C	NBL	WBT	100	500
SB TH 169 Exit Ramp & Belgrade Ave	AM	14	B	24	C	SBL	WBL	125	250
Signalized Intersection	PM	16	B	30	C	SBL	WBT	75	350
Range St & Belgrade Ave	AM	7	A	9	A	EBT	SBL/T/R	50	125
Stop Controlled	PM	9	A	12	B	WBL	WBL/T	100	225
Center St & Belgrade Ave	AM	8	A	9	A	WBT	EBL/T	75	125
Stop Controlled	PM	9	A	11	B	WBT	WBT	75	150
Sherman St & Belgrade Ave	AM	3	A	10	B	SBT	SBL/T/R	50	100
Stop Controlled	PM	3	A	10	B	SBT	SBL/T/R	50	100
Belgrade Ave & Lake St	AM	2	A	6	A	SBL	SBL/R	50	75
Stop Controlled	PM	2	A	8	A	SBL	EBL/T	25	75
Lee Blvd & Belgrade Ave	AM	9	A	245	F	WBL	SBT/R	25	275
Stop Controlled	PM	7	A	86	F	WBL	SBL	75	200

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

- Intersection delay is acceptable with LOS A or B at all of the intersections during both peak hours.
- The limiting movement operates with LOS F at the intersection of Lee Boulevard at Belgrade Avenue during both peak hours. All other intersection operate with LOS C or better during both peak hours.
- Queuing Issues:
    - Maximum westbound left at SB TH 169 Exit Ramp during both peak hours
    - Maximum westbound thru at SB TH 169 Exit Ramp during PM peak hour
    - Maximum westbound left and thru at Range St during AM peak hour
    - Average westbound left and thru at Range St during PM peak hour
    - Maximum westbound right at Range St during PM peak hour
    - Maximum westbound left and thru at Lee Boulevard during both peak hours
    - Maximum southbound left, thru and right at Lee Boulevard during AM peak hour
    - Maximum southbound left at Lee Boulevard during PM peak hour

Tables A1 and **A2** in the **Appendix** show the delay and queue lengths for each movement at all of the intersections.

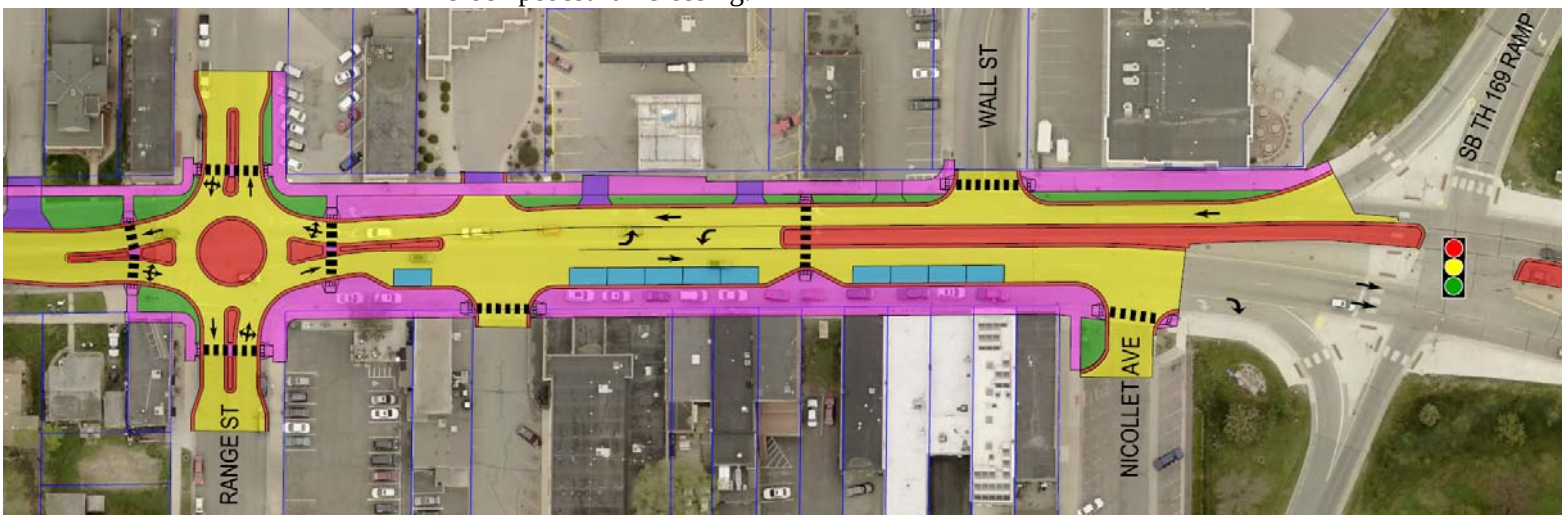
Alternative Concepts

Alternatives were identified and evaluated based on the existing and no build analysis. The alternatives studied for the Belgrade Avenue corridor are described below.

200 Block of Belgrade Avenue (Range Street to SB TH 169 Ramp):

- A three lane was analyzed with a mini roundabout at Range Street, a mid-block pedestrian crossing with a bump-out west of Wall Street, and parking maintained along south side of the roadway. The westbound through lane is dropped along the bridge between the NB and SB TH 169 Ramps by eliminating the existing westbound left turn lane and changing the left most westbound through lane to a westbound left lane. This allows for a smooth transition of the roadway from a four lane to three lane. This alternative was analyzed with multiple sub-options:

    - Extend median along Belgrade Avenue from the SB TH 169 Ramp to the mid-block pedestrian crossing.



    - Extend median along Belgrade Avenue from the SB TH 169 Ramp to Nicollet Avenue to eliminate left turn from Belgrade Avenue onto Nicollet Avenue.

- Install turn lane on Belgrade Avenue for vehicles turning left onto Nicollet Avenue west of the SB TH 169 Ramp.

- A three lane was analyzed along Belgrade Avenue from the SB TH 169 Ramp to Range Street with an all way stop at Range Street (which is the existing traffic control), a mid-block pedestrian crossing with a bump-out west of Wall Street, and parking is maintained along south side of the roadway.

- Keep existing four lane section, adding bump-outs for a mid-block crossing and on the east leg of the intersection of Range Street at Belgrade Avenue.

Lee Boulevard at Belgrade Avenue:

- A single lane roundabout was analyzed at this intersection to reduce the failing westbound left delay issue.

Alternative Operations Analysis

A traffic operational analysis was completed using the forecasted turning movement counts in SimTraffic for each option.

200 Block Alternative: Three Lane with Median along Belgrade Avenue, Mini-Roundabout at Range Street

The 200 block was analyzed as a three lane with a mini roundabout at Range Street. Counts were not taken at Nicollet Avenue or Wall Street so the operations of the two alternatives with a median along Belgrade Avenue was assumed to be the same. With the median extending from the TH 169 SB Ramp to the mid-block crossing, Wall Street and Nicollet Avenue would become right in right outs which would shift traffic normally making left turns at these intersections to Range Street and other intersections. With the median extending from the TH 169 SB Ramp to Nicollet Avenue, Nicollet Avenue would become a right in right out which would shift traffic normally making left turns at this intersections to Range Street or other locations. Nicollet Avenue is currently restricted with it signed for people not to make a westbound left turn, however so drivers were observed to currently make this movement. **Table 2** show the results of the 2041 traffic analysis.

Table 2 - 2041 Three Lane with Median and Mini Roundabout Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay*		Maximum Delay-LOS**		Limiting Movement ***	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
NB TH 169 Exit Ramp & Belgrade Ave	AM	5	A	20	C	NBL	EBT	25	150
Signalized Intersection	PM	6	A	18	B	NBL	WBT	125	275
SB TH 169 Exit Ramp & Belgrade Ave	AM	14	B	24	C	SBL	WBL	125	250
Signalized Intersection	PM	16	B	30	C	SBL	WBL	225	400
Range St & Belgrade Ave	AM	5	A	8	A	EBL/T/R	EB/WB/SB	-	25
Mini-Roundabout	PM	8	A	9	A	WBL/T/R	WB	-	75

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

- The delay at the NB TH 159 Ramp is acceptable with LOS A for the intersection overall and LOS C or better for all movements for both peak hours.
- The delay at the SB TH 169 Ramp is acceptable and the same as 2041 no build operations with LOS B for the intersection overall and LOS C for the limiting movement during both peak hours.
- The SB TH 169 Ramp maximum queue extends the full length of the bridge during the PM peak hour.
- The delay at the Range Street is acceptable with LOS A for the intersection overall and all movements during both peak hours.
- The westbound maximum queue is decreased from 225 to 75 feet in the PM peak hour at Range Street.

Tables A3 and **A4** in the **Appendix** show the delay and queue lengths for each movement at both of the intersections.

200 Block Alternative: Three Lane, Mini-Roundabout at Range Street, EBL Turn Lane for Nicollet Avenue

Since counts were not taken at Nicollet Avenue a sensitivity analysis was completed in order to determine if there were adequate gaps for a westbound left from Belgrade Avenue onto Nicollet Avenue as only an 85 feet turn lane would fit at this location. **Table 3** shows the operational analysis for Nicollet Avenue and the SB TH 169 Ramp.

Table 3 – 2041 Left Turn Lane for Nicollet Avenue Traffic Operations Analysis

Peak Hour	Number of Left Turning Vehicles	Belgrade Ave & Nicollet Ave - WBL				Belgrade Ave & SB TH 169 Ramp - WBT			
		Average Queue (ft)	Max Queue (ft)	Movement Delay (sec/veh)		Average Queue (ft)	Max Queue (ft)	Movement Delay (sec/veh)	
AM	25	10	40	10	B	50	135	5	A
PM	25	15	70	25	D	130	350	7	A
AM	50	20	50	9	A	50	105	4	A
PM	50	25	80	21	C	140	390	9	A
AM	75	25	70	7	A	45	100	4	A
PM	75	30	100	17	C	145	395	9	A
AM	100	35	80	13	B	55	190	7	A
PM	100	40	110	22	C	165	375	12	B

Table 3 shows that with 75 or more left turning vehicles in the PM peak hour at the intersection of Belgrade Avenue and Nicollet Avenue the westbound left queue extends beyond the channelized left turn lane. The westbound thru is blocked at most for 3 minutes in the PM peak hour with 100 left turning vehicles or just over one minute with 75 left turners. Since the westbound thru movement is not blocked for long operations at the SB TH 169 Ramp remain acceptable with LOS B or better for the WBT movement.

200 Block Alternative: Three Lane, All-Way Stop at Range Street

The 200 block was analyzed as a three lane roadway with the existing all way stop control at Range Street. The three lane configuration allows for a designated left turn lane in addition to a thru and right turn lane on the east leg of the intersection of Range Street at Belgrade Avenue. **Table 4** show the results of the 2041 traffic analysis

Table 4 - 2041 Three Lane with All Way Stop Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay*		Maximum Delay-LOS**		Limiting Movement ***	Max Approach Queue		
							Direction	Average Queue (ft)	Max Queue (ft)
NB TH 169 Exit Ramp & Belgrade Ave	AM	5	A	16	B	NBL	WBT	50	150
Signalized Intersection	PM	10	B	20	C	NBL	WBT	175	500
SB TH 169 Exit Ramp & Belgrade Ave	AM	14	B	30	C	SBT	WBL	125	300
Signalized Intersection	PM	18	C	35	D	SBL	WBL	200	400
Range St & Belgrade Ave	AM	9	A	12	B	EBT	EBL/T/R	75	150
Stop Controlled	PM	10	B	12	B	EBT	WBT	100	200

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

- The intersection delay remains acceptable with LOS C or better for all of the intersections during both peak hours.
- The limiting movement during the PM peak hour at the SB TH 169 Ramp is LOS D, but delay is only increased by 5 seconds from the 2041 no build condition. All other limiting movement delay operates with LOS C or better during both peak hours.
- The SB TH 169 Ramp maximum queue extends the full length of the bridge during the PM peak hour.
- The westbound maximum queue is decreased by one vehicle from 2041 no build analysis in the PM peak hour at Range Street.

Tables A5 and **A6** in the **Appendix** show the delay and queue lengths for each movement at both of the intersections.

Lee Boulevard at Belgrade Avenue: Single Lane Roundabout

A single lane roundabout was analyzed at the intersection of Lee Boulevard at Belgrade Avenue. The results of the 2041 traffic analysis is shown in **Table 5** below.

Table 5 - 2041 Roundabout Traffic Operations Analysis

Intersection	Peak Hour	Intersection Delay*		Maximum Delay-LOS**		Limiting Movement ***	Max Approach Queue	
							Direction	Max Queue (ft)
Lee Blvd & Belgrade Ave	AM	12	B	14	B	WB	NB	150
Roundabout	PM	12	B	13	B	SB	SB	175

*Delay in seconds per vehicle

**Maximum delay and LOS on any approach and/or movement

***Limiting Movement is the highest delay movement.

- The intersection delay and the delay of all movements during both peak hours is acceptable with LOS B or better.

- The westbound left delay with the existing side street stop traffic control is anticipated to have 245 seconds of delay in 2041, but with a single lane roundabout this delay is reduced to 14 seconds.
- The southbound queue is reduced from 275 in the AM peak hour under existing conditions in 2041 to 100 feet with the single lane roundabout.

Tables A7 and **A8** in the **Appendix** show the delay and queue lengths for each movement at both of the intersections.

Appendix

Belgrade Avenue Corridor Study

Mankato/North Mankato Area Planning Organization

Figure 1: Traffic Forecasting

September 2016

BOLTON & MENK
Real People. Real Solutions.

Lee Blvd
Lake St
Sherman St
Center St
Belgrade Ave
Nicollet Ave
Range St
Lookout Dr
169
MINNESOTA 60

20,300 (1.5%)
15,110 (0.5%)
16,300 (1%)
12,600

250 (-3.1%)
1,800 (0.5%)
1,550

9,000 (1%)
5,740 (-0.5%)
7,100 (0.5%)
6,200

10,500 (0.5%)
12,810 (1.3%)
11,900 (1%)
9,200

180 (-3.4%)
1,300 (0.5%)
1,150

40 (-3.9%)
2,200 (0.5%)
1,900

1,900 (0.5%)
1,900 (0.5%)
1,700

9,600 (1%)
4,730 (-1.5%)
7,200 (0.5%)
6,300

2,380 (-1.3%)
4,100 (0.5%)
3,600

13,100 (1%)
7,410 (-0.9%)
9,900 (0.5%)
8700

28,000 (0.9%)
40,050 (2.4%)
28,400 (1%)
21,500

Legend

- *X,XXX* Most Recent AADT
- *X,XXX* 2041 Forecasted AADT (Recommended)
- *X,XXX* 2041 Forecasted Based on Historical Growth
- *X,XXX* 2045 Forecasted AADT from "MAPO 2045 Transportation Plan"

0 800 Feet

Source: MnDOT, Google Imagery, MAPO

Map Document: \\metrosouth1\GIS\MAPO_MUT\42111862\ESRI\Maps\111862_TrafficForecasting_11x17L.mxd | Date Saved: 9/9/2016 2:40:34 PM

Belgrade Avenue Corridor Study

Mankato/North Mankato Area Planning Organization

Figure 2: 2041 Forecasted Turning Movement Counts

September 2016

BOLTON & MENK
Real People. Real Solutions.

Lee Blvd
0 (0)
515 (535)
190 (310)
305 (265)
0 (5)
20 (50)
0 (0)
0 (5)
5 (5)
0 (5)
630 (395)
55 (70)
Belgrade Ave

Lake St
90 (65)
5 (15)
5 (25)
200 (225)
45 (90)
165 (230)
Belgrade Ave

Center St
60 (40)
40 (45)
40 (35)
180 (205)
20 (55)
170 (330)
25 (40)
105 (120)
55 (60)
Belgrade Ave

SB TH 169 Exit Ramp
SB TH 169 Entrance Ramp
20 (20)
5 (0)
225 (175)
265 (710)
405 (655)
435 (475)
45 (55)
Belgrade Ave

Belgrade Ave
Lookout Dr
Lee Blvd
Sherman St
Center St
Range St
Nicollet Ave
S Riverfront Dr

Sherman St
30 (20)
70 (45)
20 (25)
20 (40)
175 (265)
60 (80)
15 (25)
200 (225)
25 (25)
Belgrade Ave

Range St
40 (45)
10 (20)
155 (125)
80 (225)
155 (365)
25 (55)
20 (35)
235 (270)
10 (20)
5 (10)
10 (10)
25 (35)
Belgrade Ave

NB TH 169 Entrance Ramp
NB TH 169 Exit Ramp
50 (45)
620 (600)
135 (235)
680 (1385)
20 (40)
5 (0)
840 (460)
Belgrade Ave

169
MINNESOTA
60

Legend

2041 Forecasted TMC

AM (PM)

0 500 Feet

Source: MnDOT, Google Imagery

Google

Map Document: \\METROSOUTH1\gis\MAPO_MUT\4211862\ESRIMaps\111862_2041_TMC_11x17L_RAW.mxd | Date Saved: 9/26/2016 12:07:41 PM

Table A1. 2041 Traffic Operational Analysis - Existing Geometry

Intersection	Peak Hour	Intersection Delay*- LOS		Movement Delay (sec/veh)																					
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
NB TH 169 Ramp at Belgrade Ave	AM	5	A	5	A	2	A	-		-		4	A	3	A	15	B	0	A	8	A	-		-		-	
Signalized Intersection	PM	7	A	10	B	3	A	-		-		9	A	4	A	20	C	4	A	4	A	-		-		-	
SB TH 169 Ramp at Belgrade Ave	AM	14	B	-		18	B	4	A	12	B	4	A	-		-		-		-		24	C	14	B	2	A
Signalized Intersection	PM	16	B	-		29	C	4	A	17	B	5	A	-		-		-		-		30	C	0	A	2	A
Range St at Belgrade Ave	AM	7	A	9	A	9	A	6	A	7	A	8	A	4	A	6	A	7	A	3	A	7	A	8	A	5	A
All-Way Stop Controlled	PM	9	A	9	A	10	B	7	A	12	B	11	B	6	A	6	A	8	A	4	A	7	A	9	A	5	A
Center St at Belgrade Ave	AM	8	A	7	A	8	A	-		-		10	A	6	A	6	A	9	A	5	A	7	A	-		5	A
All-Way Stop Controlled	PM	9	A	9	A	9	A	-		-		11	B	7	A	7	A	10	A	5	A	7	A	-		5	A
Sherman St at Belgrade Ave	AM	3	A	3	A	1	A	1	A	5	A	3	A	2	A	-		-		-		9	A	10	A	5	A
Side-Street Stop Controlled	PM	3	A	4	A	2	A	2	A	5	A	3	A	2	A	-		-		-		9	A	10	A	5	A
Lake St at Belgrade Ave	AM	2	A	3	A	1	A	-		-		1	A	1	A	-		-		-		6	A	-		4	A
Side-Street Stop Controlled	PM	2	A	4	A	2	A	-		-		1	A	1	A	-		-		-		8	A	-		3	A
Lee Blvd at Belgrade Ave	AM	9	A	0	A	0	A	5	A	240	F	0	A	3	A	0	A	6	A	7	A	22	C	2	A	0	A
Side-Street Stop Controlled	PM	7	A	0	A	16	C	6	A	86	F	10	A	2	A	13	B	6	A	7	A	8	A	1	A	0	A

*Delay in seconds per vehicle

Table A2. 2041 Peak Hour Queues by Movement - Existing Geometry

Intersection	Peak Hour	Queue Lengths																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
NB TH 169 Exit Ramp & Belgrade Ave	AM	25	75	25	100	-	-	-	-	25	125	-	-	25	50	25	50	-	-	-	-	-	-	-	-
Signalized Intersection	PM	25	100	25	125	-	-	-	-	100	500	-	-	25	75	25	75	-	-	-	-	-	-	-	-
SB TH 169 Exit Ramp & Belgrade Ave	AM	-	-	75	200	25	100	125	250	50	100	-	-	-	-	-	-	-	-	100	175	100	175	-	-
Signalized Intersection	PM	-	-	125	225	25	100	200	325	75	350	-	-	-	-	-	-	-	-	75	175	75	175	-	-
Range St & Belgrade Ave	AM	75	100	75	100	25	50	50	100	50	100	50	75	25	50	25	50	25	50	50	125	50	125	50	125
Stop Controlled	PM	75	125	75	125	25	50	100	225	100	225	75	125	50	75	50	75	50	75	50	100	50	100	50	100
Center St & Belgrade Ave	AM	75	125	75	125	-	-	-	-	50	100	25	50	25	50	50	100	50	100	50	100	50	100	50	100
Stop Controlled	PM	75	125	75	125	-	-	-	-	75	150	25	50	25	75	50	100	50	100	25	75	25	75	25	75
Sherman St & Belgrade Ave	AM	25	50	25	50	25	50	25	75	25	75	25	75	-	-	-	-	-	-	50	100	50	100	50	100
Stop Controlled	PM	25	75	25	75	25	75	25	75	25	75	25	75	-	-	-	-	-	-	50	100	50	100	50	100
Belgrade Ave & Lake St	AM	25	50	25	50	-	-	-	-	0	25	0	25	-	-	-	-	-	-	50	75	50	75	50	75
Stop Controlled	PM	25	75	25	75	-	-	-	-	25	50	25	50	-	-	-	-	-	-	25	75	25	75	25	75
Lee Blvd & Belgrade Ave	AM	25	25	25	25	25	25	50	150	50	150	25	75	-	-	25	50	25	50	75	250	25	275	25	275
Stop Controlled	PM	25	25	25	25	25	25	50	150	50	150	25	100	25	75	25	75	25	50	75	200	25	75	25	75

Table A3: 2041 Three Lane with Median Traffic Operations Analysis - Belgrade Avenue Corridor Study

Intersection	Peak Hour	Intersection Delay*		Movement Delay (sec/veh)																					
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
NB TH 169 Exit Ramp & Belgrade Ave	AM	5	A	5	A	3	A	-		-		4	A	3	A	20	C	-		8	A	-		-		-	
Signalized Intersection	PM	6	A	9	A	4	A	-		-		8	A	4	A	18	B	-		4	A	-		-		-	
SB TH 169 Exit Ramp & Belgrade Ave	AM	14	B	-		18	B	4	A	12	B	5	A	-		-		-		-		24	C	19	B	1	A
Signalized Intersection	PM	16	B	-		26	C	8	A	16	B	7	A	-		-		-		-		30	C	-		2	A
						EBL/T/R						WBL/T/R						NBL/T/R						SBL/T/R			
Range St & Belgrade Ave	AM	5	A	-		6	A	-		-		5	A	-		-		5	A	-		-		5	A	-	
Mini-Roundabout	PM	8	A	-		7	A	-		-		9	A	-		-		5	A	-		-		7	A	-	

*Delay in seconds per vehicle

Table A4: 2041 Three Lane with Median Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
NB TH 169 Exit Ramp & Belgrade Ave	AM	25	75	25	150	-	-	-	-	50	150	-	-	25	75	25	75	-	-	-	-	-	-	-	-
Signalized Intersection	PM	25	75	50	175	-	-	-	-	125	275	-	-	50	75	50	75	-	-	-	-	-	-	-	-
SB TH 169 Exit Ramp & Belgrade Ave	AM	-		100	175	100	175	125	250	50	125	-		-		-		-		100	250	100	250	-	
Signalized Intersection	PM	-		125	175	125	175	225	400	175	350	-		-		-		-		100	200	100	200	-	
				EBL/T/R						WBL/T/R						NBL/T/R						SBL/T/R			
Range St & Belgrade Ave	AM	-		-	25	-		-		-	25	-		-		-	0	-		-		-	25	-	
Mini-Roundabout	PM	-		-	25	-		-		-	75	-		-		-	0	-		-		-	25	-	

Table A5: 2041 Three Lane with All-Way Stop - Traffic Operations Analysis - Belgrade Avenue Corridor Study

Intersection	Peak Hour	Intersection Delay*		Movement Delay (sec/veh)																							
				EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
NB TH 169 Exit Ramp & Belgrade Ave	AM	5	A	5	A	2	A	-		-		3	A	3	A	16	B	-		9	A	-		-		-	
Signalized Intersection	PM	10	B	9	A	4	A	-		-		16	B	5	A	20	C	-		4	A	-		-		-	
SB TH 169 Exit Ramp & Belgrade Ave	AM	14	B	-		18	B	5	A	13	B	5	A	-		-		-		-		24	C	30	C	2	A
Signalized Intersection	PM	18	C	-		26	C	10	B	18	B	11	B	-		-		-		-		35	D	-		2	A
Range St & Belgrade Ave	AM	9	A	9	A	12	B	9	A	6	A	8	A	4	A	6	A	8	A	5	A	8	A	9	A	7	A
Stop Controlled	PM	10	B	11	B	12	B	8	A	7	A	12	B	7	A	7	A	9	A	5	A	9	A	9	A	6	A

*Delay in seconds per vehicle

Table A6: 2041 Three Lane with All-Way Stop - Peak Hour Queues By Movement

Intersection	Peak Hour	Queue Lengths																							
		EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
		Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
NB TH 169 Exit Ramp & Belgrade Ave	AM	25	75	25	125	-	-	-	-	50	150	-	-	25	75	25	75	-	-	-	-	-	-	-	-
Signalized Intersection	PM	25	100	50	150	-	-	-	-	175	500	25	225	25	75	25	75	-	-	-	-	-	-	-	-
SB TH 169 Exit Ramp & Belgrade Ave	AM	-	-	100	175	100	175	125	300	50	150	-	-	-	-	-	-	-	-	100	200	100	200	-	-
Signalized Intersection	PM	-	-	125	175	125	175	200	400	150	375	-	-	-	-	-	-	-	-	100	175	100	175	0	25
Range St & Belgrade Ave	AM	75	150	75	150	75	150	25	50	50	100	50	100	25	75	25	75	25	75	50	125	50	125	50	125
Stop Controlled	PM	75	150	75	150	75	150	50	100	100	200	75	175	50	75	50	75	50	75	50	150	50	150	50	150

Table A7: 2041 Roundabout Traffic Operations Analysis - Belgrade Avenue Corridor Study

Intersection	Peak Hour	Intersection Delay*		EBL/T/R		WBL/T/R		NBL/T/R		SBL/T/R	
Lee Blvd & Belgrade Ave	AM	12	B	6	A	14	B	14	B	9	A
Roundabout	PM	12	B	7	A	9	A	11	B	13	B

*Delay in seconds per vehicle

Table A8: 2041 Roundabout Peak Hour Queues By Movement

Intersection	Peak Hour	Maximum Queue Lengths (ft)			
		EBL/T/R	WBL/T/R	NBL/T/R	SBL/T/R
Lee Blvd & Belgrade Ave	AM	0	75	150	100
Roundabout	PM	0	50	75	175