APPENDIX E

Traffic Operations Technical Memoranda

TECHNICAL MEMORANDUM 2 – TRAFFIC OPERATIONS AND FORECASTS
FINAL MARCH 5, 2008

INTRODUCTION

The Trunk Highway 169 (TH 169) corridor is an important north-south principal arterial route in central Minnesota. In order for this corridor to continue to function efficiently in the future, a traffic operations analysis needs to be performed to determine the corridor changes that need to be made in the future. The limits of this analysis include TH 169 from Elk River to 239th Avenue NW and the study intersections are shown in Figure 1. The purpose of the study is to determine the impact to intersections along the TH 169 corridor due to the increase in travel demand in the year 2030 and to mitigate the impact of the additional future traffic. This traffic study includes a travel demand modeling process to determine the future traffic volume demand along TH 169 for the year 2030. Ultimately, TH 169 will close all at-grade intersections through Elk River and will become a freeway segment. Several concepts were developed for interchange alternatives at major cross streets along TH 169 through Elk River and the traffic forecasts were used to determine the interchange alternatives that best address future transportation needs of the corridor.

EXISTING CONDITIONS

Traffic operations were analyzed at the following key intersections:

- TH 169 and TH 169/10 South Ramps
- TH 169 and TH 169/10 North Ramps
- TH 169 and Great River Energy Entrance
- Main Street and Gates Street
- TH 169 and Main Street
- Main Street and Baldwin Avenue
- TH 169 and 5th Street
- School Street and Freeport Avenue
- TH 169 and School Street
- School Street and Dodge Avenue
- TH 169 and 191st Avenue
- Freeport Avenue and Jackson Street
- Jackson Street and Holt Street
- TH 169 and 193rd Avenue
- 193rd Avenue and Evans Street
- 197th Avenue and Irving Street
- TH 169 and 197th Avenue
- 197th Avenue and Evans Street
- 205th Avenue and TH 169 East Ramps
- TH 169 and 213th Avenue
- TH 169 and Elk River Bituminous Entrance
- TH 169 and 221st Avenue
- TH 169 and 225th Avenue
- TH 169 and Waste Management Entrance

Peak hour turning movement counts were collected at busier intersections and road tubes were placed at right-in/right-out access points and lower volume intersections (Figure 1). Road tubes were also used to determine the traffic volumes on ramps and mainline at the TH 169/10/101 interchange. Figures 2 and 3 reflect the existing a.m. and p.m. traffic volumes, geometrics, and traffic control at each intersection.

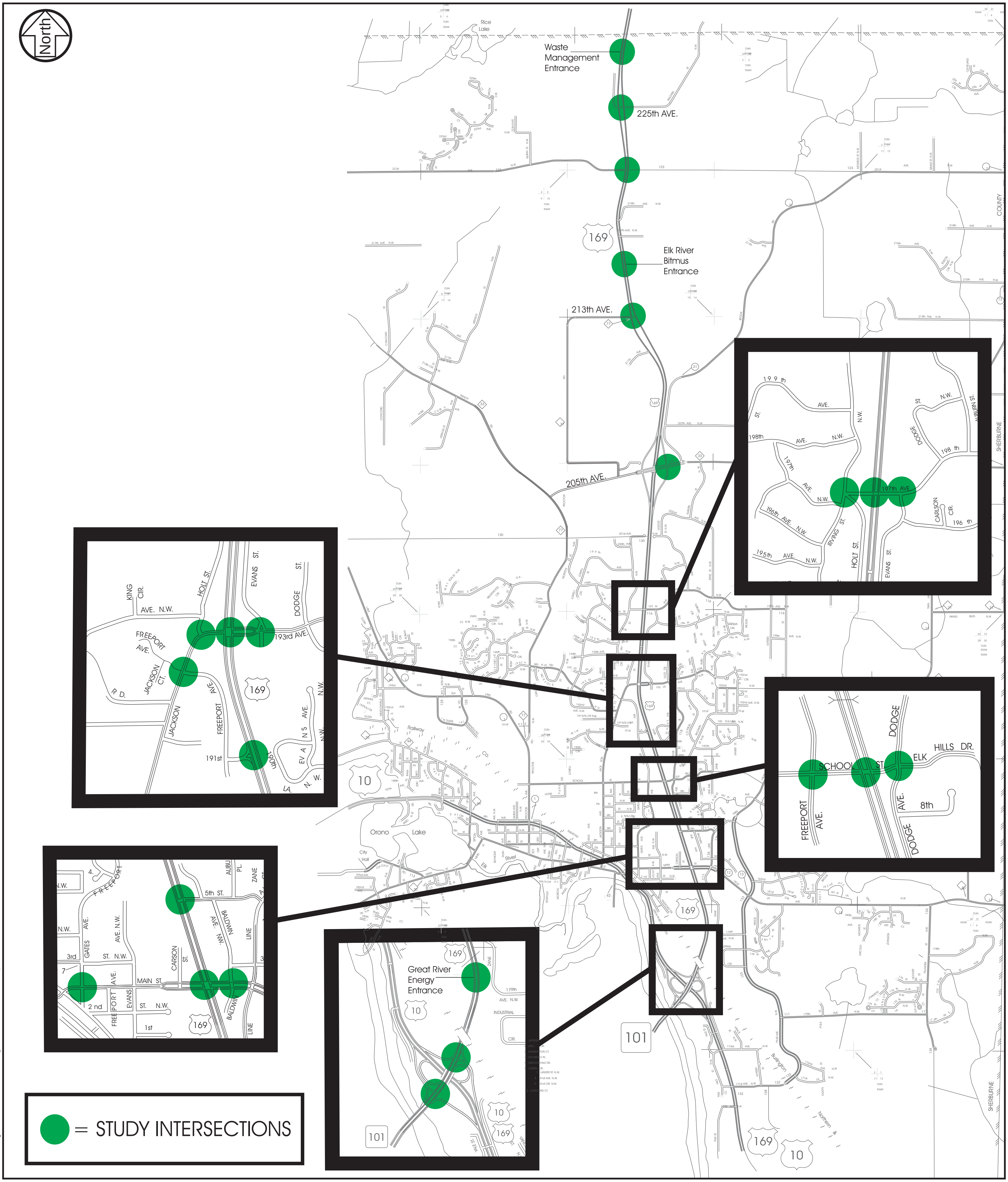
An operations analysis was conducted for the a.m. and p.m. peak hours at each of the respective peak hour key intersections to determine how traffic currently operates along the project segment. All signalized intersections were analyzed using the Synchro/SimTraffic software and unsignalized intersections were analyzed using the Highway Capacity Software. Capacity analysis results identify a Level of Service (LOS), which indicates how well an intersection is operating. The LOS results are based on average delay per vehicle. Intersections are given a ranking from LOS A through LOS F. LOS A indicates the best traffic operation and LOS F indicates an intersection where demand exceeds capacity. LOS A through D is generally considered acceptable by drivers (Table 1).

For the analysis of side-street stop controlled intersections, the operations can be described in two ways. First, the overall intersection level of service is documented, which provides the average delay per vehicle for all approaches. However, at an intersection with side-street stop control, the mainline does not stop. Therefore, the majority of delay is experienced by vehicles on the side street. In addition to providing an average delay for all approaches, it is important to indicate the level of service on the side-street approach. It is typical of intersections with higher mainline traffic volumes to experience high levels of delay (poor levels of service) on the side-street approaches, but an acceptable overall intersection level of service during the peak periods.

Table 1
Level of Service Criteria for Signalized and Unsignalized Intersections

Level of Service	Average Delay per Vehicle [seconds]	
	Signalized Intersections	Unsignalized Intersections(1)
A	< 10	< 10
B	10 – 20	10 – 15
C	20 – 35	15 – 25
D	35 – 55	25 – 35
E	55 – 80	35 – 50
F	> 80	> 50

(1) Stop-controlled intersection LOS criteria are the same for side-street and all-way stop controlled intersections



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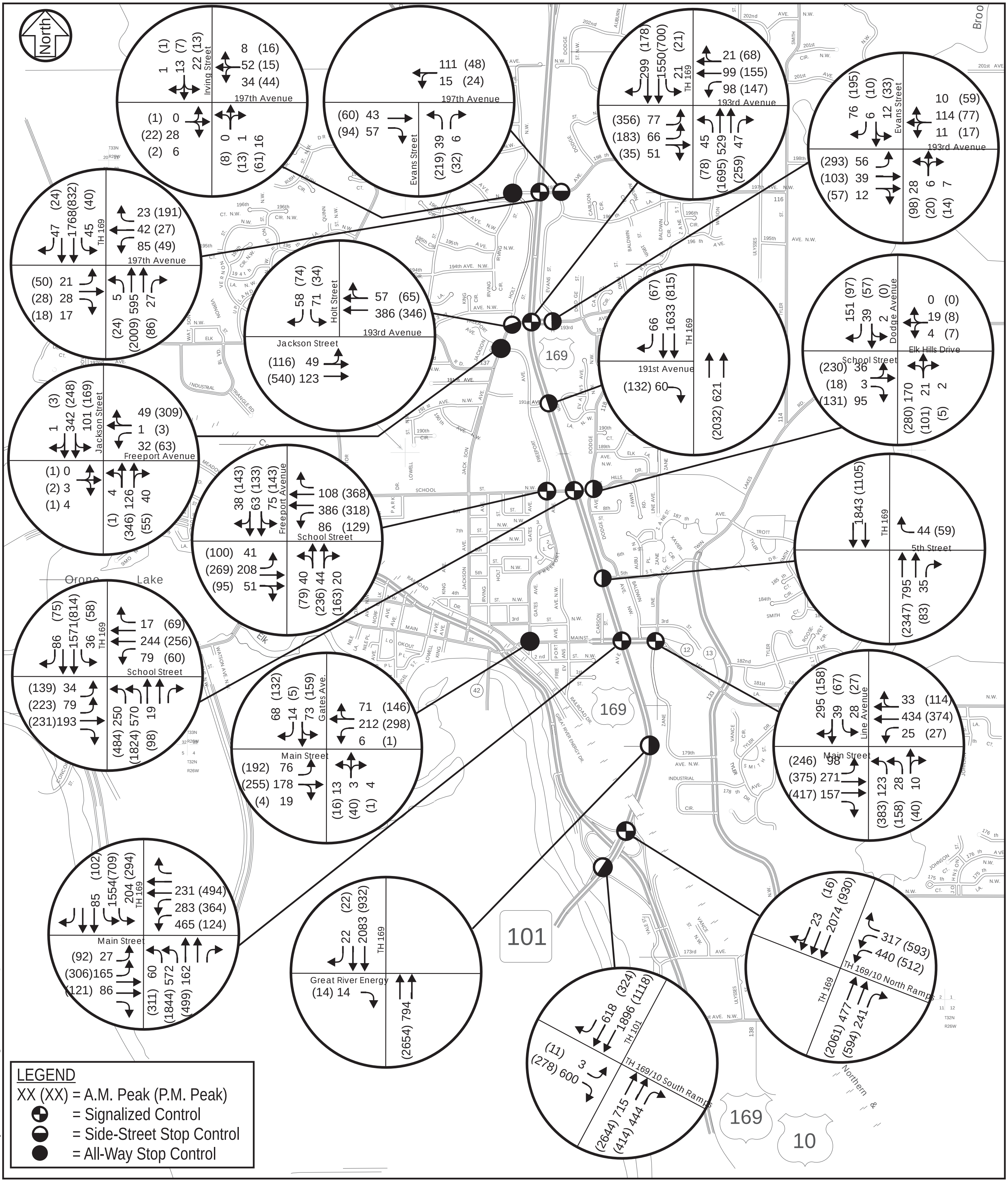
January 2008

Study Area Intersections

TH 169 in Elk River Traffic Study

City of Elk River

Figure 1



Existing Conditions (1 of 2)

TH 169 in Elk River Traffic Study

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Figure 2

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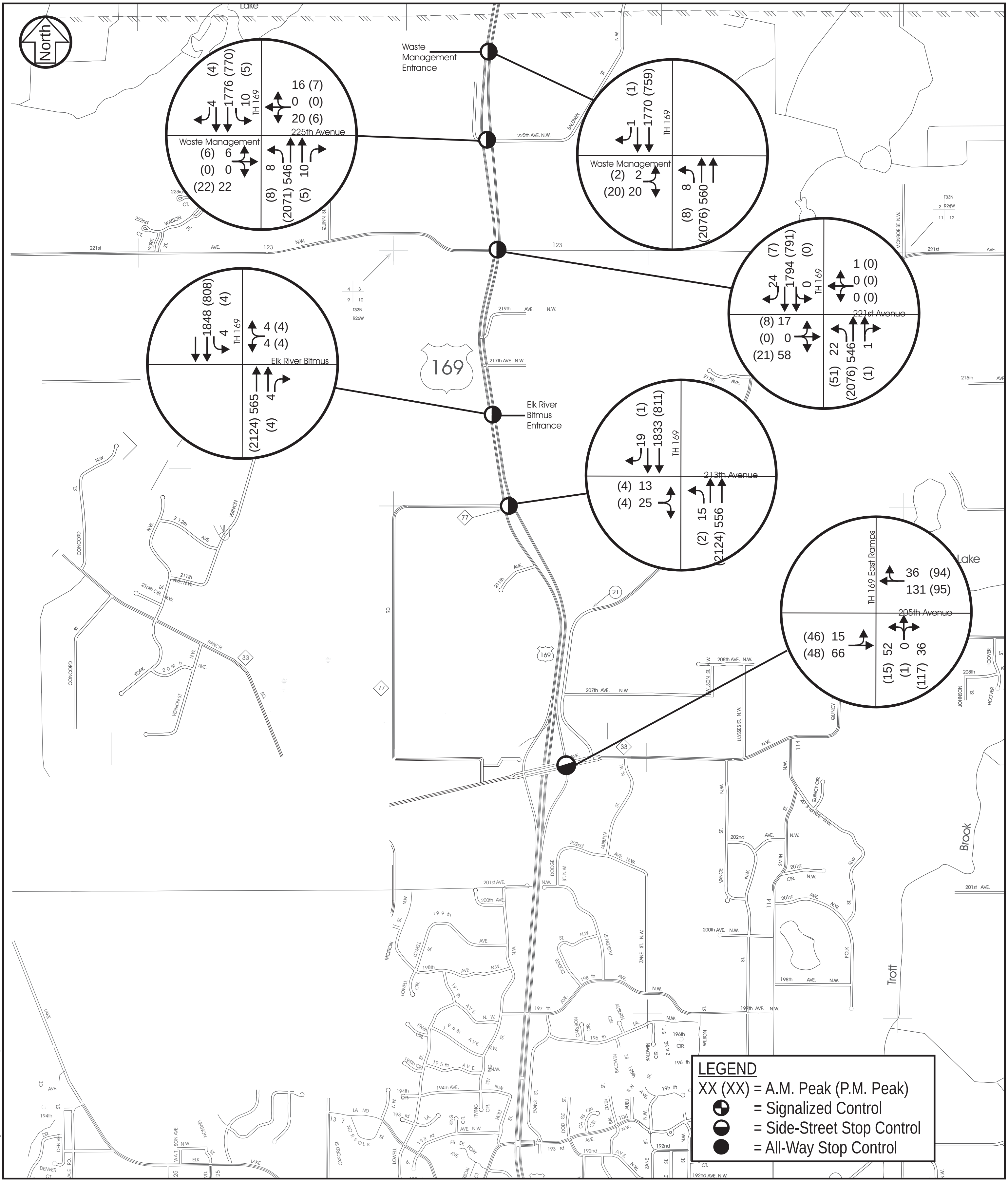

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Existing Conditions (2 of 2)

Figure 3

TH 169 in Elk River Traffic Study

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Results of the existing analysis are shown in Table 2. The existing a.m. peak hour analysis shows that all key intersections operate at an acceptable overall LOS D or better with the exception of the TH 169/213th Avenue intersection. Several intersections experience unacceptable LOS E or F under existing p.m. peak hour conditions. These include TH 169/TH 10 South Ramps, TH 169/TH 10 North Ramps, TH 169/Great River Energy Entrance, Main Street/Gates Avenue, TH 169/Main Street, Main Street/Baldwin Avenue, TH 169/Elk River Bituminous Entrance and TH 169/225th Avenue intersections. It should be noted that in addition to the poor level of service at the TH 169/Main Street intersection during the p.m. peak, vehicles often wait several cycle lengths to clear the intersection. This causes long queues in the northbound direction in the p.m. peak hour resulting in high delays at the TH 169/TH 10 intersections as well as along Main Street.

Table 2
Existing Peak Hour Capacity Analysis
Level of Service Results

Intersection	Intersection Control	Level of Service Results	
		A.M. Peak Hour	P.M. Peak Hour
Elk River			
TH 169/TH 10 South Ramps	Side Street Stop	A/B	D/**F**
TH 169/TH 10 North Ramps	Signalized	B	**E**
TH 169/Great River Energy Entrance	Side Street Stop	A/A	D/**E**
Main Street/Gates Avenue	All Way Stop	B	**E**
TH 169/Main Street	Signalized	D	**F**
Main Street/Baldwin Avenue	Signalized	B	**E**
TH 169/5th Street	Side Street Stop	A/B	A/A
School Street/Freeport Avenue	Signalized	B	C
TH 169/School Street	Signalized	D	C
School Street/Dodge Avenue	Side Street Stop	A/A	A/B
TH 169/191st Avenue	Side Street Stop	A/A	A/A
Freeport Avenue/Jackson Street	All Way Stop	A	A
Jackson Street/Holt Street	Side Street Stop	A/B	A/B
TH 169/193rd Avenue	Signalized	C	C
193rd Avenue/Evans Street	Side Street Stop	A/A	A/A
197th Avenue/Irving Street	All Way Stop	A	A
TH 169/197th Avenue	Signalized	B	B
197th Avenue/Evans Street	Side Street Stop	A/A	A/A
TH 169 East Ramps/205th Avenue	Side Street Stop	A/A	A/A
TH 169/213th Avenue	Side Street Stop	A/**F**	A/D
TH 169/Elk River Bituminous Entrance	Side Street Stop	A/B	B/**F**
TH 169/221st Avenue	Side Street Stop	A/C	A/C
TH 169/225th Avenue	Side Street Stop	A/D	A/**F**
TH 169/Waste Management Entrance	Side Street Stop	A/C	A/A

Note: Levels of service (LOS) for unsignalized intersections are reported by an overall LOS followed by the worst approach LOS.

YEAR 2030 NO BUILD ANALYSIS

A 2030 No Build operations analysis was performed in order to determine what the impact that 2030 travel demand will have upon the existing TH 169 corridor. In order to develop 2030 Average Daily Traffic volumes, a travel demand modeling process was developed using assumptions derived from the 2006 Sherburne County Transportation Plan forecasting process. To see a detailed summary of the Travel Demand Modeling process, please see Appendix A.

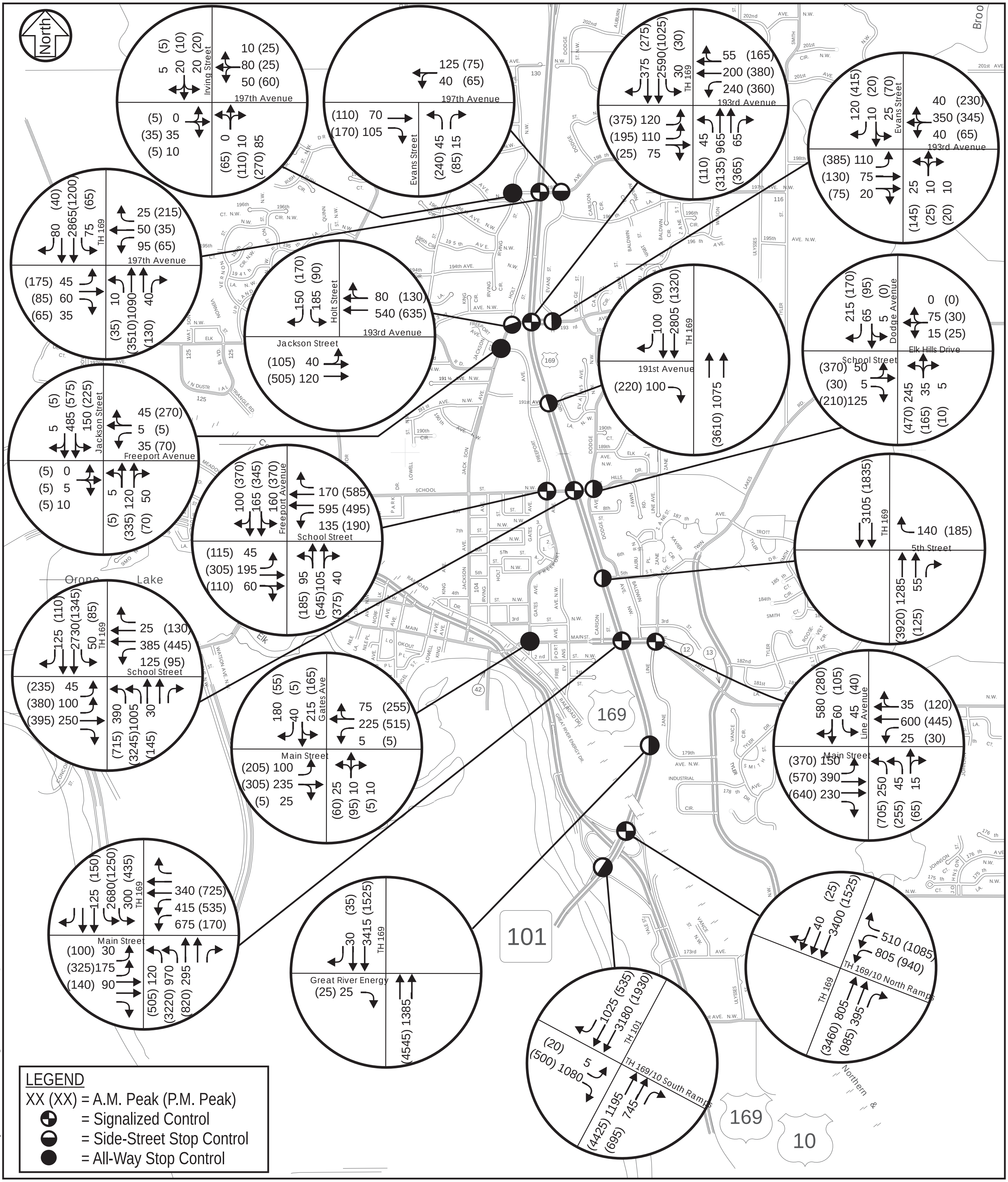
Once 2030 No Build Average Daily Traffic Volumes were developed from the Travel Demand Model, turning movements at each intersection could be produced using existing peak hour percentages and existing turning movement splits as an initial guideline. Volumes between adjacent intersections were then balanced. 2030 No Build turning movement volumes can be seen in Figures 4 and 5.

The results of the 2030 No-Build analysis are shown in Table 3. The results reveal that most intersections along the TH 169 corridor report high delays at unacceptable levels in both the a.m. and p.m. peak hour periods. This is primarily due to the expected growth in average daily traffic volumes within the TH 169 corridor without additional lane capacity.

Table 3
Year 2030 No Build Peak Hour Capacity Analysis
Level of Service Results

Intersection	Intersection Control	Level of Service Results	
		Peak Hour A.M.	Peak Hour P.M.
Elk River			
TH 169/TH 10 South Ramps	Side Street Stop	**F/F**	**E/F**
TH 169/TH 10 North Ramps	Signalized	**E**	**F**
TH 169/Great River Energy Entrance	Side Street Stop	A/A	D/**E**
Main Street/Gates Avenue	All Way Stop	C	**F**
TH 169/Main Street	Signalized	**F**	**F**
Main Street/Baldwin Avenue	Signalized	**E**	**F**
TH 169/5th Street	Side Street Stop	**F/F**	**F/F**
School Street/Freeport Avenue	Signalized	C	**F**
TH 169/School Street	Signalized	**F**	**E**
School Street/Dodge Avenue	Side Street Stop	**F/F**	**F/F**
TH 169/191st Avenue	Side Street Stop	**E/F**	B/B
Freeport Avenue/Jackson Street	All Way Stop	A	D
Jackson Street/Holt Street	Side Street Stop	C/**E**	**F/F**
TH 169/193rd Avenue	Signalized	**F**	**E**
193rd Avenue/Evans Street	Side Street Stop	D/**F**	**F/F**
197th Avenue/Irving Street	All Way Stop	A	**F**
TH 169/197th Avenue	Signalized	**F**	D
197th Avenue/Evans Street	Side Street Stop	A/C	A/B
TH 169 East Ramps/205th Avenue	Side Street Stop	A/A	A/A
TH 169/213th Avenue	Side Street Stop	**F/F**	**F/F**
TH 169/Elk River Bituminous Entrance	Side Street Stop	B/**F**	D/**F**
TH 169/221st Avenue	Side Street Stop	**F/F**	**F/F**
TH 169/225th Avenue	Side Street Stop	**E/F**	**E/F**
TH 169/Waste Management Entrance	Side Street Stop	D/**F**	C/**F**

Note: Levels of service (LOS) for unsignalized intersections are reported by an overall LOS followed by the worst approach LOS.



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Year 2030 No Build Conditions (1 of 2)

TH 169 in Elk River Traffic Study

City of Elk River

Figure 4

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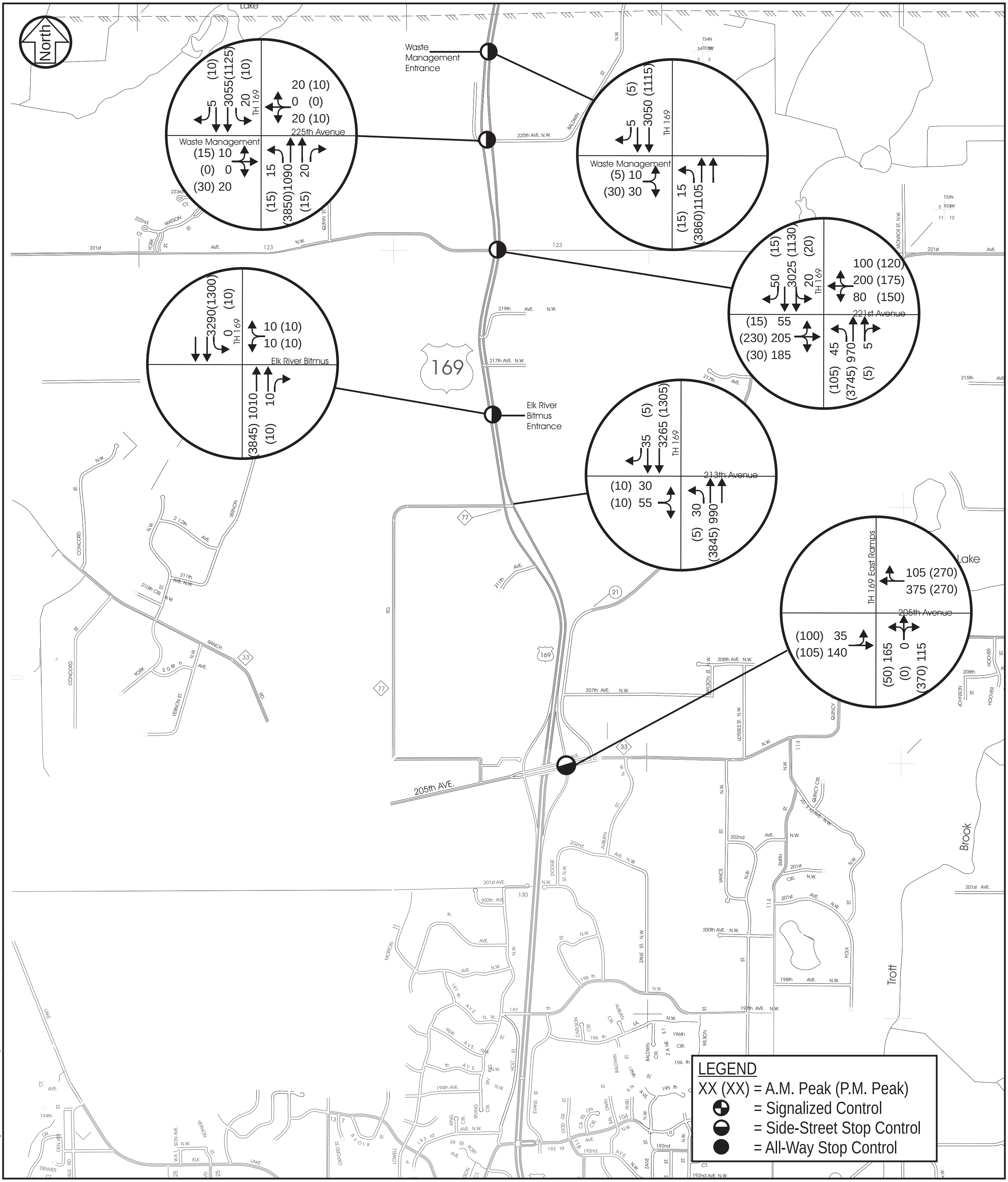

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Year 2030 No Build Conditions (2 of 2)

TH 169 in Elk River Traffic Study

City of Elk River

Figure 5

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YEAR 2030 BUILD ANALYSIS

The year 2030 Build analysis was performed to determine if the proposed build concepts will mitigate the congestion issues the existing roadway geometrics and traffic control will experience under 2030 Build conditions.

Year 2030 Build volumes were developed using a similar process used in the development of the 2030 No-Build volumes. The primary difference is that under year 2030 Build conditions, several improvements to the TH 169 corridor will result in higher average daily traffic volumes than year 2030 No-Build conditions since the improved corridor attracts more trips.

There are several improvements that will be made along the TH 169 Corridor. The entire study segment from the TH 10/101/169 Interchange in Elk River through north of Fremont Avenue in Zimmerman will be converted into a freeway segment. This eliminates all at-grade intersections and will limit the access points to TH 169. Interchange alternatives were formed and preferred alternatives were chosen based on their location and environmental impact. Listed are the detailed changes to the TH 169 corridor:

TH 10/101/169 Interchange
The TH 10/101/169 Interchange will be converted into a full systems interchange. The systems interchange eliminates all full-access at-grade intersections of the existing interchange. The new interchange includes two loops and two flyover ramps. The interchange also includes a two-phase signal TH 10/169 EB on ramp from TH 101 NB and TH 169 SB. This signal will serve to meter the merge movements between the ramp and mainline.

Great River Energy Entrance
Great River Energy will no longer have a driveway access to TH 169 but will have a relocated entrance at an adjacent street

Main Street Interchange
The TH 169/Main Street Intersection will be converted into a single point interchange. The south ramps will tie directly to TH 169 while the north ramps will tie into a collector-distributor road between Main Street and School Street.

Main Street/School Street Collector-Distributor Road
School Street and Main Street are too close to have independent interchanges, therefore, a collector-distributor road is needed between the two cross streets. The collector-distributor road will eliminate weaving on the TH 169 mainline.

School Street Interchange
The TH 169/School Street intersection will be converted into a standard diamond interchange configuration.

School Street/193rd Avenue Collector-Distributor Road
School Street and 193rd Avenue are too close to have independent interchanges, therefore, a collector-distributor road is needed between the two cross streets. The collector-distributor road will eliminate weaving on the TH 169 mainline.

193rd Avenue Interchange
The TH 169/193rd Avenue intersection will be converted to a folded diamond configuration on the east and a standard diamond configuration on the west. The east ramps will tie in with the north approach of Evans Street.

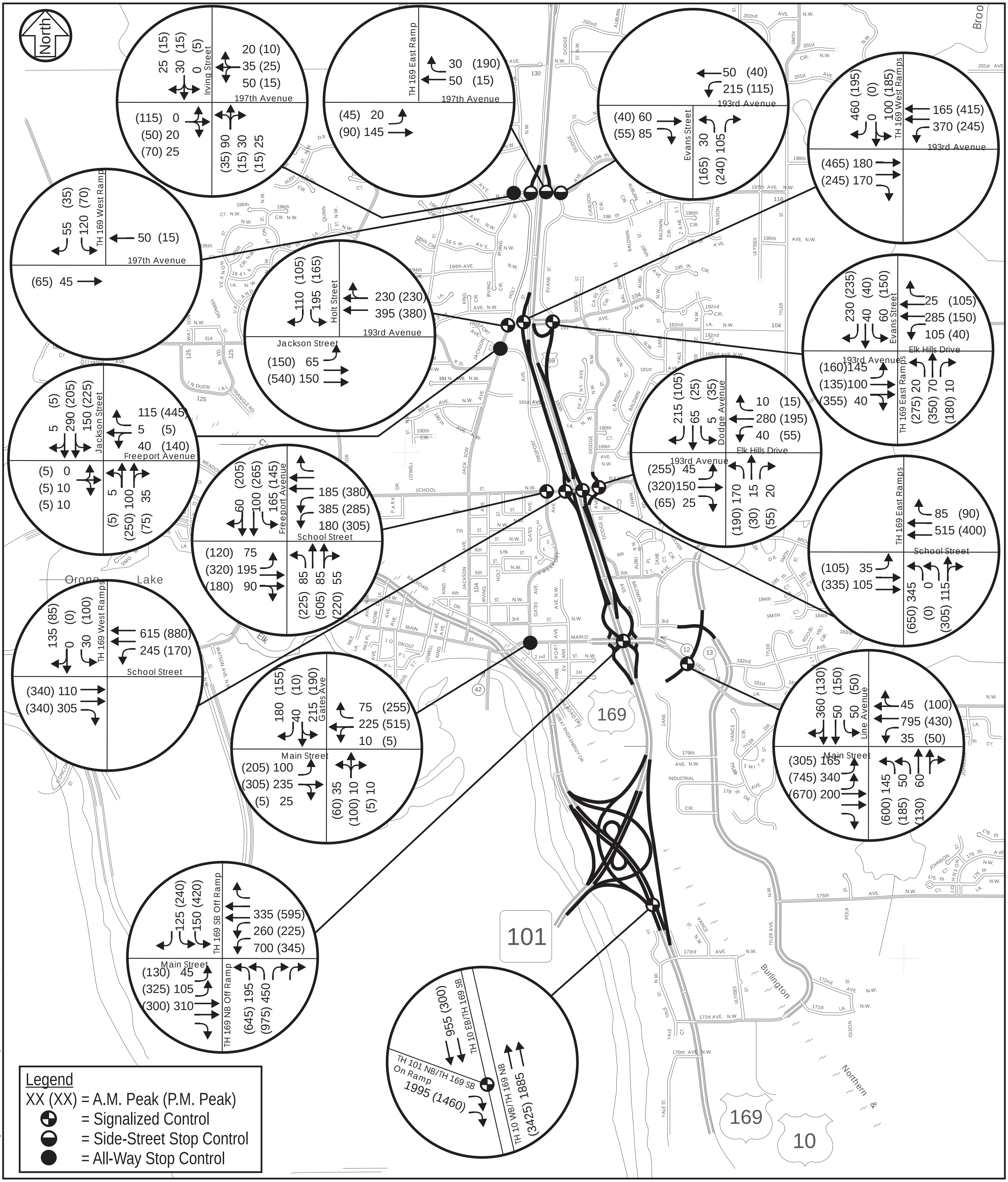
197th Avenue Interchange
The TH 169/197th intersection will be converted to a half diamond interchange to the north. There will be no access to 197th Avenue from the TH 169 south approach.

221st Avenue Interchange
The 221st Avenue/TH 169 intersection will be converted to a folded diamond on the east and buttonhook ramps on the west.

239th Avenue Overpass
The 239th Avenue/TH 169 intersection will be converted into an overpass.

All of these geometric improvements along with the year 2030 build turning movement volumes are illustrated in Figures 6 and 7.

A traffic operations analysis was performed at select build geometrics to determine if the new geometrics can accommodate the year 2030 turning movement volumes. The locations where SimTraffic and the Highway Capacity Software were used were at the Main Street Interchange, School Street Interchange, and the 193rd and 197th interchanges. The results of this analysis can be viewed in Table 4.



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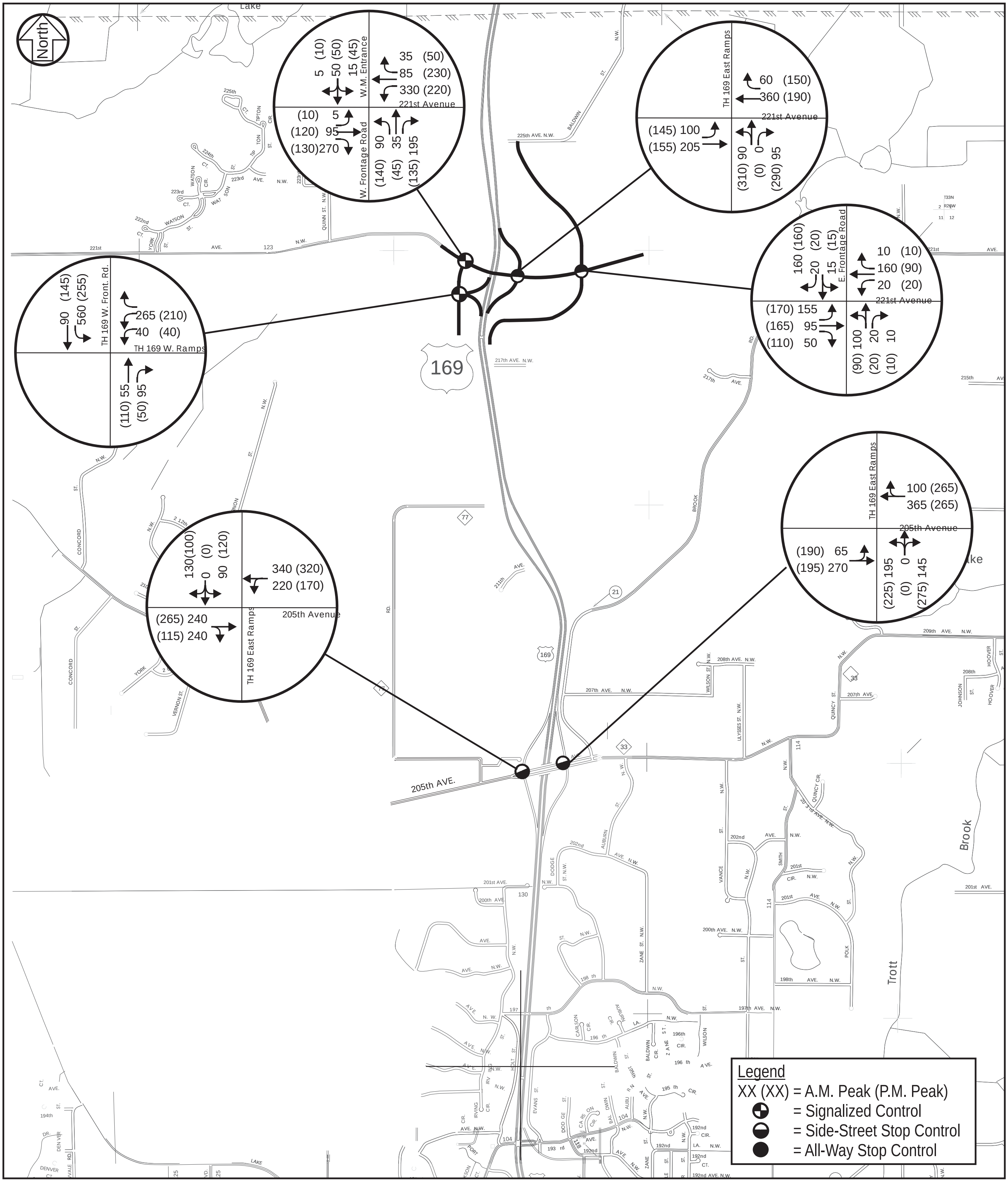
Year 2030 Build Conditions (1 of 2)

TH 169 in Elk River Traffic Study

City of Elk River

Figure 6



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Year 2030 Build Conditions (2 of 2)

TH 169 in Elk River Traffic Study

City of Elk River

Figure 7

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Year 2030 Build Peak Hour Capacity Analysis
Level of Service Results

Intersection	Intersection Control	Level of Service Results	
		Peak Hour A.M.	Peak Hour P.M.
Systems Interchange			
TH 10 EB/169 SB/On Ramp	Signalized	D	B
Main Street Interchange			
Main Street/Gates Avenue	All-Way Stop	C	B
Main Street/Carson Street	Side-Street Stop	A/B	A/A
Main Street/TH 169 SPIU	Signalized	B	C
Main Street/Line Avenue	Signalized	C	D
School Street Interchange			
School Street/Freeport Street	Signalized	C	C
School Street/West Ramps	Signalized	A	A
School Street/East Ramps	Signalized	B	C
School Street/Dodge Avenue	Signalized	C	C
193rd Avenue Interchange			
Jackson Avenue/Freeport Street	All-Way Stop	A	A
193rd Avenue/Holt Street	Signalized	B	B
193rd Avenue/West Ramps	Signalized	B	B
193rd Avenue/East Ramps/Evans Street	Signalized	B	B
197th Avenue Interchange			
197th Avenue/Holt Street/Irving Street	All-Way Stop	A	A
197th Avenue/West Ramp	Side Street Stop	A/A	A/A
197th Avenue/East Ramp	Side Street Stop	A/A	A/A
197th Avenue/Evans Street	Side Street Stop	A/A	A/A

Note: Levels of service (LOS) for unsignalized intersections are reported by an overall LOS followed by the worst approach LOS.

The analysis results from Table 4 indicate that all intersections in the a.m. and p.m. peak period for year 2030 build volumes operate at an acceptable LOS D or better.

Critical lane analysis was used to determine if the intersections at the interchange of TH 169/221st Avenue would perform under capacity given base geometrics. Year 2030 Build volumes were produced at these intersections by comparing 2030 ADTs at this location to existing ADTs and growing the existing turning movements accordingly. The thresholds of critical lane analysis are shown in Table 5 while the results of the critical lane analysis are shown in Table 6. The analysis results show that all four intersections operate well under capacity at base geometrics.

Table 5
Critical Lane Thresholds and Capacity Relationships

Signalized Intersections	
Sum of Critical Lane Volumes [vph]	**Relationship to Probable Capacity**
0 – 1,200	Under Capacity
1,201 – 1,400	At Capacity
≥ 1,400	Over Capacity

Table 6
Critical Lane Analysis Results

Intersection Description	Sum of Critical Lane Volumes [vph]		Relationship to Probable Capacity
	A.M. Peak Hour	P.M. Peak Hour	
TH 169/221st Avenue East Ramps	590	740	Under Capacity
TH 169/221st Avenue West Ramps	685	460	Under Capacity
TH 169/221st Avenue East Frontage Rd	525	460	Under Capacity
TH 169/221st Avenue West Frontage Rd	520	540	Under Capacity

CONCLUSIONS AND RECOMMENDATIONS

The surrounding communities along the TH 169 corridor plan to have significant socio-economic growth through year 2030. Because of this growth, the travel demand along TH 169 will also significantly increase. Traffic operations analysis show that the existing TH 169 corridor will not be able to accommodate the anticipated year 2030 traffic volumes. The conversion of TH 169 to a four-lane freeway section from TH 10 in Elk River, along with the proposed interchanges at Main Street, School Street, 193rd Avenue, 197th Avenue, and 221st Avenue will enable the TH 169 corridor to accommodate the year 2030 traffic volumes.

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APPENDIX A:

TH 169 TRAVEL DEMAND MODELING DOCUMENTATION

SRF No. 0065875

MEMORANDUM

TO: John Hagen, P.E., Senior Associate

FROM: Jonathan Ehrlich, P.E., Senior Engineer

DATE: March 5, 2007

SUBJECT: TH 169 IN ELK RIVER TRAVEL DEMAND MODELING

This memorandum documents assumptions for the highway network and socioeconomic data to be used in the TH 169 interchange study in Elk River, as well as the forecast model process. These assumptions are all derived from the 2006 *Sherburne County Transportation Plan* forecasting process. The text of this memorandum is intended to be incorporated into a larger traffic report.

TRAVEL DEMAND MODELING PROCESS

Travel demand models estimate the amount of travel on transportation facilities given sets of development and transportation system development. The forecast provide basic descriptors of facility use (such as roadway volumes or transit ridership) and generalized travel impacts such as vehicle miles of travel and vehicle hours of travel.

Travel demand models are based on mathematical relationships and assumptions regarding future conditions. Models provide a representation of the future, but lack of certainty regarding future-year conditions dictates that model results should not be considered as having unwarranted precision. Their best use is as a comparison among alternatives for relative differences and impacts. Decision-makers and designers should be aware of the uncertainty in long-range forecasts and whether that uncertainty would affect outcomes related to forecast volumes.

Travel forecasts for TH 169 in Elk River were prepared using a modified version of the Collar County travel demand models developed by the Minnesota Department of Transportation and the Metropolitan Council. These models are computerized procedures for systematically predicting travel demand changes in response to development and transportation facility changes. They were completed in 2006 using data from an extensive regional Travel Behavior Inventory (TBI) conducted by the Metropolitan Council and Mn/DOT in 2001.

The procedure used to simulate and forecast travel patterns is a complex battery of input data and computer processes that transform data into representations of travel. The process uses the standard "four-step" approach to travel forecasting with sequential generation, distribution, mode choice, and assignment models. Detailed documentation of model process and parameters is available from Mn/DOT.

Zonal Data Representation

The Collar County models divide the nineteen-county region into 1,664 geographic transportation analysis zones (or TAZs). The zones serve as the beginning and end locations of travel in the region. The zonal system was determined primarily on the basis of physical boundaries and major roadways.

Collar County TAZs were subdivided in within Sherburne County to better characterize trip patterns. Zonal boundaries were drawn consistent with on the 2003 I-94/TH 10 Interregional Connection EIS and the 2001 Elk River Transportation Plan. The TAZ refinement process converted the 37 zones in Sherburne County to 156 zones.

Highway Network Representation

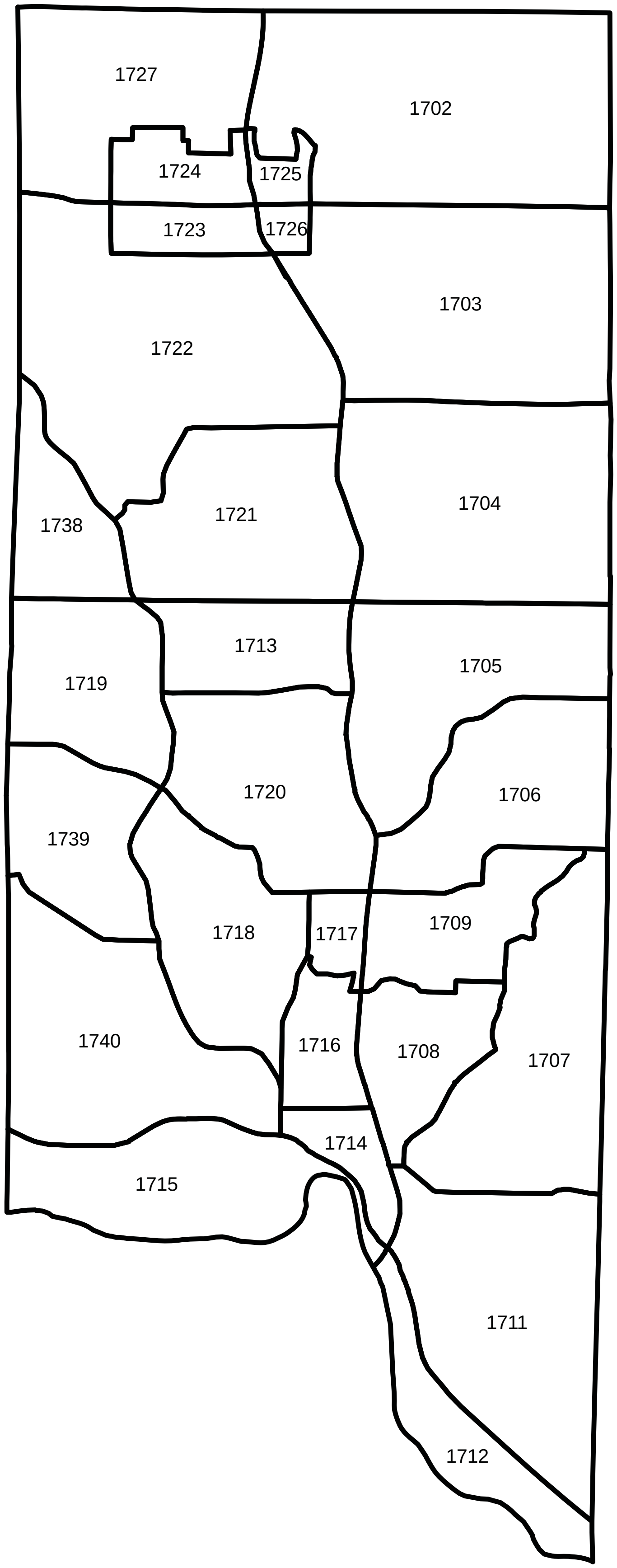
All of the freeways, expressways, and major arterial roadways in the region are compiled into a computer representation of the region's highway system. In addition, most minor arterials and many collector roads and other local streets are included. The attributes of the roadways are described in terms of area type, facility type, distance, free-flow speed, number of lanes, and capacity. The roadway network within Sherburne County was modified to include more detail: both as a result of the refinement of TAZs and the desire to include lower volume roadways in the model to better estimate travel patterns. All arterials in Sherburne County are included.

Trip Generation

Trip generation is the process by which the number of trips attributed to a zone is estimated based on the amount and type of activity in that zone. The end result of trip generation estimation is a total number of person-trips produced by and attracted to each zone. The trip generation phase of the forecasting process uses trip rates based on the 2001 regional TBI applied to each zone to calculate the number of person-trips taken, by purpose. The determinants of household trip production are household size, household income, the number of automobiles owned, and location. Several factors contribute to trip attractions, depending on the trip purpose. The main factors are retail employment, non-retail employment, and the amount of activity within a given proximity and area type.

Destination Choice

The destination choice process coverts the person-trips estimated in the generation step to movements between pairs of zones based on the amount of travel activity in a zone and the generalized travel time proximity of the producing zone to other zones. The resulting trip tables provide the number of trips between zones.



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Sherburne County Transportation Plan TAZs

Figure 1

Interchange Study - Elk River to Zimmerman

Minnesota Department of Transportation

Mode Choice

The mode choice phase of the regional model uses a nested discrete choice model to identify the number of person-trips between each pair of zones and determine whether the trips are made by single-occupant vehicles, carpools, or transit riders. The model is further used to determine if a trip is a candidate for a high-occupancy vehicle lane.

Temporal Distribution

The time-of-day or temporal distribution model takes the estimated daily vehicle trips and distributes them across periods of time in order to more accurately reflect peaking conditions on the roadway system. Four time periods representing the morning and afternoon peak periods, midday, and evening/night are differentiated.

Highway Assignment

The highway assignment model chooses the route between zones for any given trip. The process chooses routes based on travel times that reflect the appropriate traffic volume, roadway capacity, and speed relationship. It is an equilibrium model, which uses multiple iterations to balance demand with capacity, thereby reflecting capacity constraint.

Model Iterations

The regional model is run on an iterative process. Congested highway travel times are estimated by the highway assignment process, and then cycles back through the steps of the model. Congested travel times affect trip generation, destination choice, and mode choice. The end result is a set of travel demand forecasts that reflect the effects of congestion on travel choices. The model is run until sufficient convergence is reached, which for the purpose of this study, was four iterations.

FUTURE YEAR TRANSPORTATION FACILITY ASSUMPTIONS

- **TH 10 improvements included in 2030 base network**[1]
  - Big Lake bypass: 2024-2030 investment plan[2]
  - TH 10 / I-94 river crossing: 2015-2023 investment plan[3]
  - Freeway upgrades
    - TH 10 from Clear Lake to St Cloud
    - TH 10 from CSAH 15 east of Big Lake to CSAH 50 west of Big Lake
  - Additional interchanges
    - TH 10 and old TH 10 (Big Lake)
    - TH 10 and CSAH 16
    - TH 10 and CSAH 3
  - Additional overpasses
    - CSAH 65 N of Clear Lake

- **Other Regional Assumptions**
  - TH 101- Four Lane Freeway from I-94 to TH 10
  - I-94- Six lanes from TH 610 to TH 101, four lanes west TH 101

- **Local Elk River Improvements**
  - Connection of Sherburne CSAH 33 / Anoka CSAH 22
  - Connection of CSAH 12 with TH 101
  - Fillmore St NW extension south to TH 10(East of Elk River)
  - Realignment of CSAH 33 / CSAH 77 intersection

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[1] Source planning documents included Highway 10/Highway 24 IRC plan, TH 10 Corridor Management Plan, District Three Long Range Plan
[2] District Three Long Range Plan
[3] District Three Long Range Plan

FUTURE YEAR (2030) SOCIOECONOMIC ASSUMPTIONS

Forecast of future year socioeconomic data (populations, household, retail and non-retail employment) for each zone in the model area is a primary determinant of the amount and characteristics of travel. Future year growth in population and employment was developed from a variety of sources

Past experience has shown that county-level population projections from the Minnesota State Demographic Center underestimate population growth in Sherburne County. The 2004 populations of Sherburne County (79,000) almost equal the 2010 projection of 86,400. Therefore, overall county population and employment totals were based on extrapolations of fifteen year trends. These population estimated represent a reasonable and conservative estimate of growth.

Projections for St. Cloud City and Haven Township were taken from the St. Cloud Area Planning Organization, which regularly prepares future year development projections.

City staff at every incorporated community in Sherburne County was contacted and their best assessments of growth patterns within their communities were requested and used wherever available. The City of Elk River provided their most recent transportation plan. County staff was consulted regarding growth patterns in townships.

Where local data were unavailable, future growth was allocated based on projections in the 2003 Mn/DOT I-94/TH 10 Interregional Connection EIS.

Table 1 and Table 2 display Sherburne County socio-economic data assumptions by community. Table 3 and Table 4 display TAZ level socio-economic data assumptions within the project study area. The TAZ system is shown in Figure 1.

TABLE 1
MUNICIPAL POPULATION/HOUSEHOLD TOTALS FOR SHERBURNE COUNTY

City/Township	2000		2030	
	Population	Households	Population	Households
City of Becker	1,741	567	5,050	2,020
City of Big Lake	3,235	1,177	6,321	2,132
City of Clear Lake	64	23	691	258
City of Elk River	16,144	5,587	43,069	13,765
City of Princeton (part)	7	1	550	220
City of St. Cloud (part)	3,440	1,262	4,387	1,448
City of Zimmerman	3,447	1,141	6,559	2,239
Baldwin Township	4,623	771	20,725	8,340
Becker Township	3,665	1,183	16,457	6,420
Big Lake Township	9,071	2,876	23,361	7,750
Blue Hill Township	811	135	1,267	369
Clear Lake Township	1,295	444	4,420	1,807
Haven Township	2,236	752	13,362	4,410
Livonia Township	2,613	842	17,755	6,233
Orrock Township	2,608	842	5,184	1,835
Palmer Township	2,186	760	4,155	1,562
Santiago Township	1,553	259	1,279	426
Total	58,738	18,620	174,595	61,234

TABLE 2
MUNICIPAL EMPLOYMENT TOTALS FOR SHERBURNE COUNTY

City/Township	2000 Employment			2030 Employment		
	Retail	Non-Retail	Total	Retail	Non-Retail	Total
City of Becker	55	752	807	335	879	1,214
City of Big Lake	75	975	1,050	118	2,426	2,544
City of Clear Lake	9	129	138	40	164	204
City of Elk River	1,628	4,547	6,175	1,631	16,250	17,881
City of Princeton (part)	0	670	670	0	2,819	2,819
City of St. Cloud (part)	24	161	185	330	177	507
City of Zimmerman	99	1,339	1,438	172	2,297	2,469
Baldwin Township	0	0	0	0	0	0
Becker Township	2	214	216	1,518	4,764	6,282
Big Lake Township	48	1,212	1,260	241	3,517	3,758
Blue Hill Township	0	0	0	0	0	0
Clear Lake Township	0	94	94	618	471	1,089
Haven Township	363	1,406	1,769	1,903	1,756	3,659
Livonia Township	0	82	82	457	1,419	1,876
Orrock Township	1	116	117	284	1,020	1,304
Palmer Township	0	0	0	236	1,352	1,588
Santiago Township	0	0	0	0	0	0
Total	2,303	11,696	13,999	7,882	39,311	47,193

TABLE 3
STUDY AREA TAZ-LEVEL POPULATION/HOUSEHOLD TOTALS

TAZ	2000		2030	
	Population	Households	Population	Households
1702	496	164	2,419	931
1703	496	164	2,017	776
1704	496	164	1,325	509
1705	89	28	808	259
1706	444	139	1,021	327
1707	315	90	9,437	3,091
1708	1,462	451	2,594	821
1709	825	255	1,530	484
1711	379	127	5,420	1,512
1712	198	42	1,547	523
1713	46	15	859	258
1714	3,223	1,229	2,949	1,050
1715	3,573	1,114	6,162	1,777
1716	1,322	504	1,857	661
1717	166	63	110	39
1718	991	378	2,184	778
1719	134	41	1,233	369
1720	333	104	1,644	493
1721	296	92	1,333	446
1722	444	138	5,936	1,988
1723	551	182	9,572	3,061
1724	2,137	707	24,364	7,786
1725	724	240	8,265	2,639
1726	35	12	869	279
1727	330	103	4,604	1,542
1738	57	18	121	40
1739	248	94	655	233
1740	2,396	913	3,058	1,089

TABLE 4
STUDY AREA TAZ-LEVEL EMPLOYMENT TOTALS

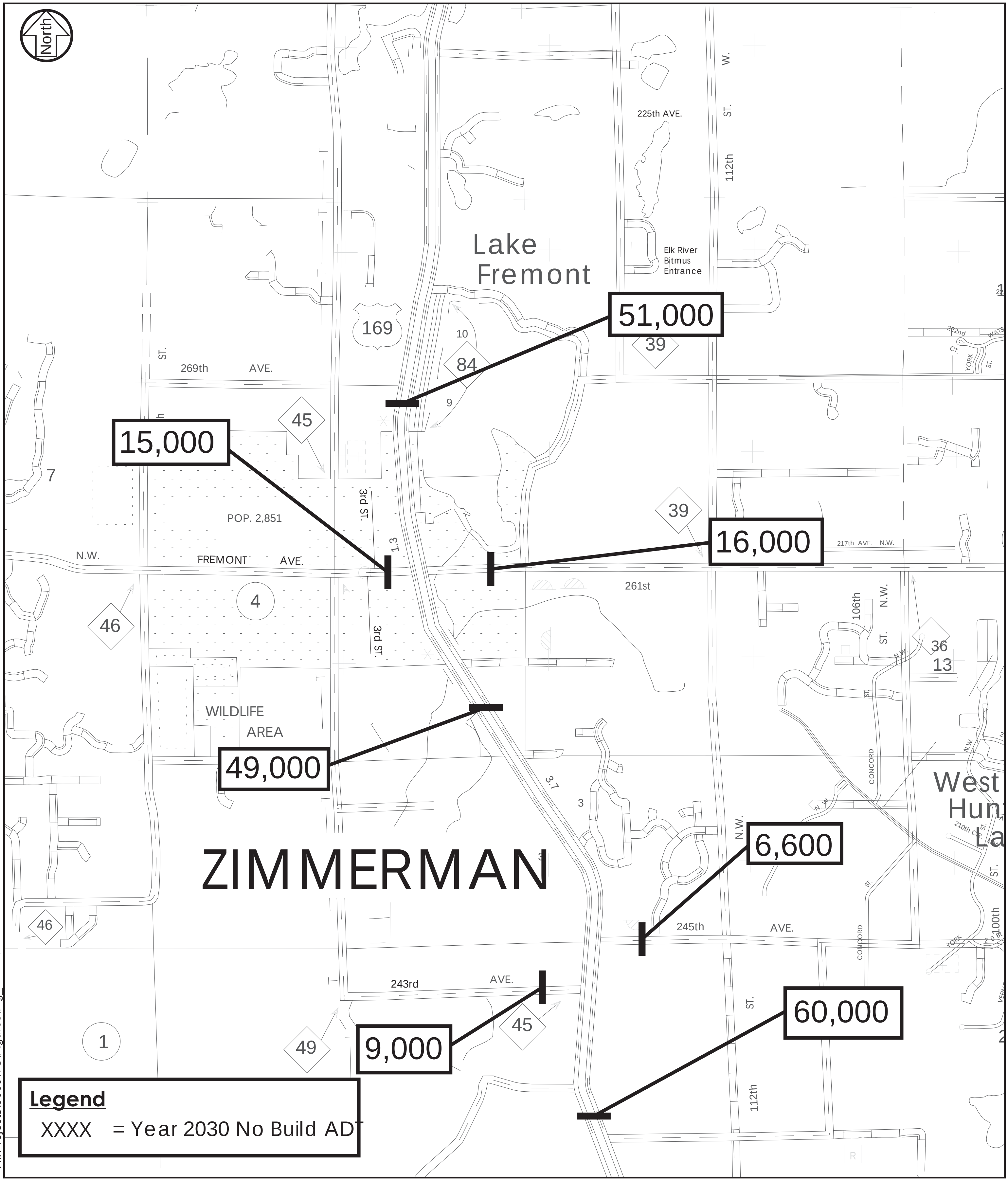
City/Township	2000 Employment			2030 Employment		
	Retail	Non-Retail	Total	Retail	Non-Retail	Total
1702	0	14	14	149	30	179
1703	0	14	14	31	116	147
1704	0	14	14	0	20	20
1705	0	5	5	0	4	4
1706	0	16	18	0	191	193
1707	0	43	50	0	45	46
1708	212	240	396	206	196	384
1709	58	48	88	56	39	91
1711	231	542	757	364	6,209	6,597
1712	95	180	261	50	59	104
1713	0	13	15	0	10	10
1714	783	1,016	1,614	649	999	1,597
1715	170	924	1,165	231	4,761	5,015
1716	8	339	397	7	370	379
1717	0	0	0	0	0	0
1718	0	121	140	0	149	150
1719	0	17	20	0	20	20
1720	20	101	128	19	977	1,003
1721	0	10	10	22	401	423
1722	0	16	16	100	602	701
1723	33	446	479	616	5,362	5,960
1724	33	446	479	673	5,362	6,004
1725	33	446	479	322	5,362	5,736
1726	0	0	0	19	163	181
1727	0	11	11	150	226	376
1738	0	3	3	6	25	31
1739	0	97	112	0	111	112
1740	50	847	1,009	50	2,109	2,174

2030 FORECASTS

2030 No Build and Build forecast results are shown in Figures 2 and 3.

While the collar county model is validated to base year (2000-2002) counts, there is always a certain base-year discrepancy in each link. To account for this discrepancy, forecast year volumes were adjusted on a link-by-link basis. Volume adjustments were be applied consistent with the methods described in *NCHRP 255 (Highway Traffic Data for Urbanized Area Project Planning and Design),* chapter four. This method averages adjustments derived from the ratio and the arithmetic difference of base year ground counts to assigned volumes.

A blind application of this technique is inappropriate under the Build condition, where TH 169 is experiencing a major change in capacity. Therefore, a staged approach was followed. For each arterial link, the model difference between the Build and No Build alternative was calculated. The future year percentage adjustment from the No Build volumes was applied to the difference, and then added to the No Build volume to produce a Build volume. The volume on TH 169 under the Build alternative was calculated by adding up forecast diversions (adjusted difference between No Build and Build) on parallel arterials.



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Year 2030 No Build Average Daily Traffic Forecasts

TH 169 in Zimmerman Traffic Study

City of Zimmerman

Figure A-2

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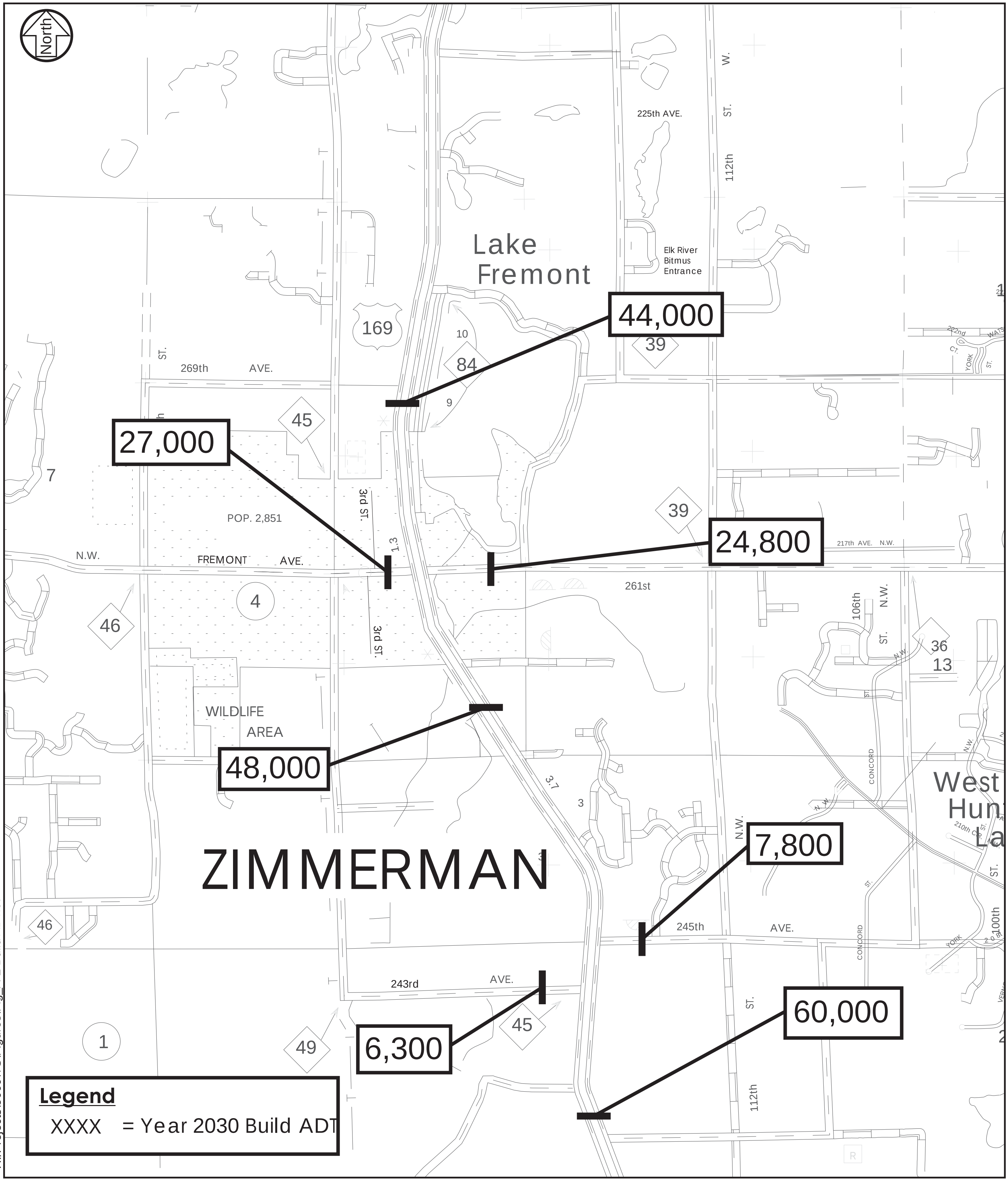
February 2008



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Year 2030 Build Average Daily Traffic Forecasts

TH 169 in Zimmerman Traffic Study

City of Zimmerman

Figure A-3

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TECHNICAL MEMORANDUM 2 – TRAFFIC OPERATIONS AND FORECASTS FINAL MARCH 5, 2008

INTRODUCTION

The Trunk Highway 169 (TH 169) corridor is an important north-south principal arterial route in central Minnesota. In order for this corridor to continue to function efficiently in the future, a traffic operations analysis needs to be performed to determine the corridor changes that need to be made in the future. The limits of this analysis include TH 169 from 243rd Avenue NW south of Zimmerman to CSAH 4 in Zimmerman and the study intersections can be viewed in Figure 1. The purpose of the study is to determine the impact to intersections along the TH 169 corridor due to the increase in travel demand in the year 2030 and to mitigate the impact of the additional future traffic. This traffic study includes a travel demand modeling process to determine the future traffic volume demand along TH 169 for the year 2030. Ultimately, at-grade intersections along TH 169 through Zimmerman will be closed and TH 169 will become a freeway segment. Concepts were developed for interchange alternatives at major cross streets along TH 169 through Zimmerman and the traffic forecasts were used to determine the interchange alternatives that best address future transportation needs of the corridor.

EXISTING CONDITIONS

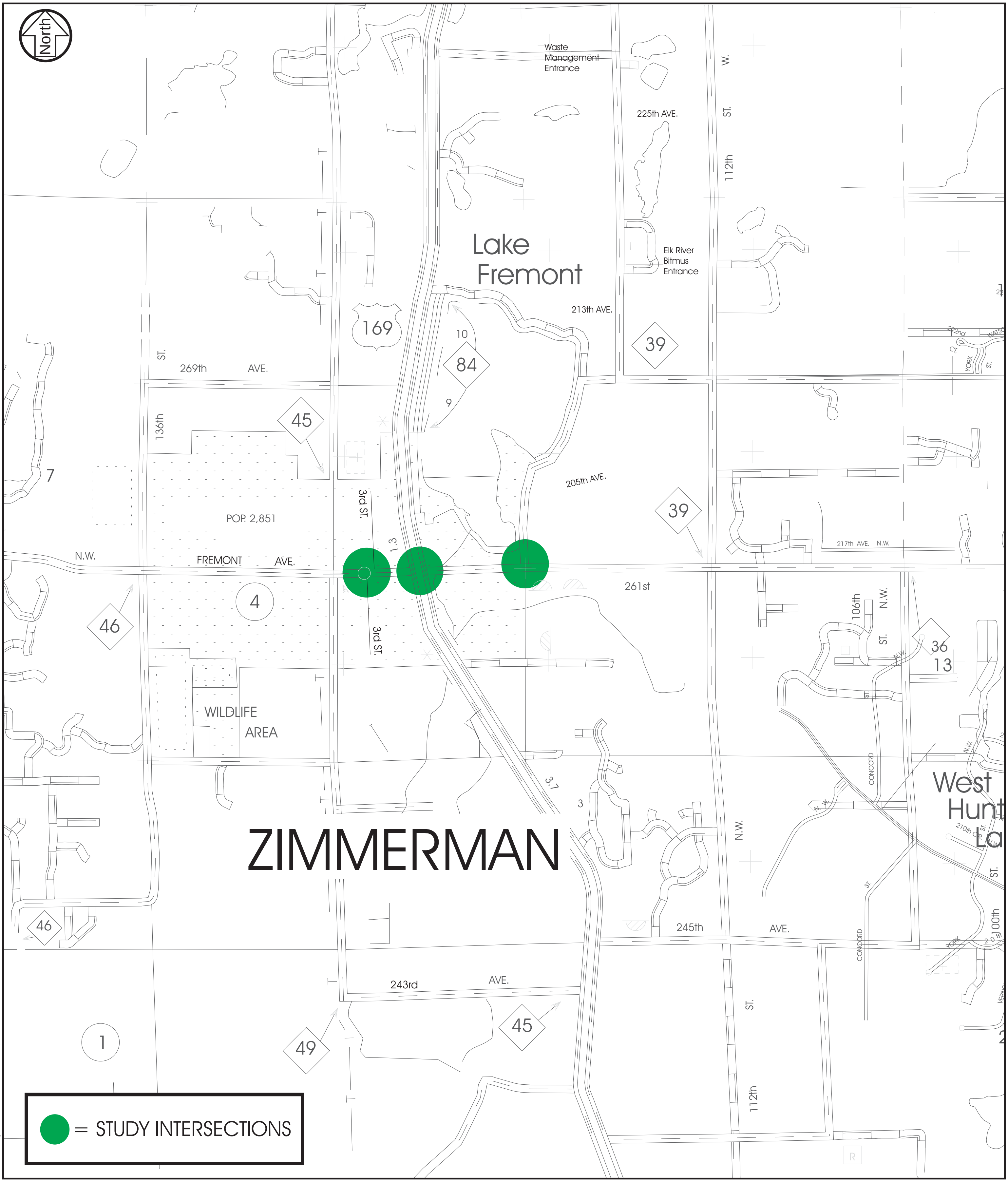
Traffic operations were analyzed at the following key intersections:

- Fremont Avenue (CSAH 4) and TH 169
- Fremont Avenue (CSAH 4) and Fremont Drive
- Fremont Avenue (CSAH 4) and 3rd Street (south leg)
- Fremont Avenue (CSAH 4) and 3rd Street (north leg)

SRF collected a.m. and p.m. peak hour counts at these key intersections. Figure 2 reflects the existing a.m. and p.m. traffic volumes, geometrics, and traffic control at each intersection.

An operations analysis was conducted for the a.m. and p.m. peak hours at each of the respective peak hour key intersections to determine how traffic currently operates. The signalized intersections were analyzed using the Synchro/SimTraffic software and unsignalized intersections were analyzed using the Highway Capacity Software. Capacity analysis results identify a Level of Service (LOS), which indicates how well an intersection is operating. The LOS results are based on average delay per vehicle. Intersections are given a ranking from LOS A through LOS F. LOS A indicates the best traffic operation and LOS F indicates an intersection where demand exceeds capacity. LOS A through D is generally considered acceptable by drivers (see Table 1).

For the analysis of side-street stop controlled intersections, the operations can be described in two ways. First, the overall intersection level of service is documented, which provides the average delay per vehicle for all approaches. However, at an intersection with side-street stop control, the mainline does not stop. Therefore, the majority of delay is experienced by vehicles on the side street. In addition to providing an average delay for all approaches, it is important to



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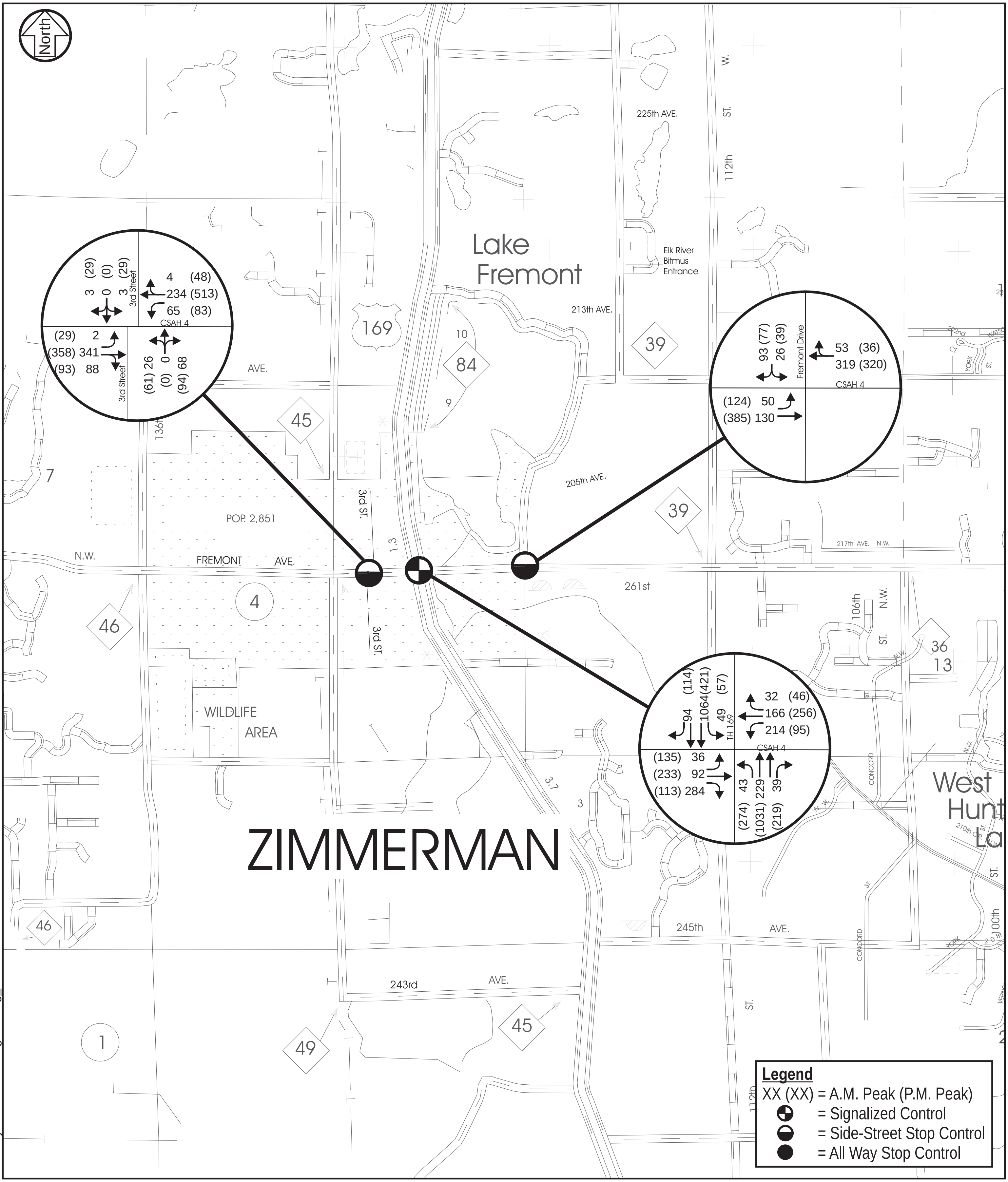
Study Area Intersections

TH 169 in Zimmerman Traffic Study

City of Zimmerman

Figure 1



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Existing Conditions

TH 169 in Zimmerman Traffic Study

City of Zimmerman

Figure 2

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indicate the level of service on the side-street approach. It is typical of intersections with higher mainline traffic volumes to experience high levels of delay (poor levels of service) on the side-street approaches, but an acceptable overall intersection level of service during the peak periods.

Table 1
Level of Service Criteria for Signalized and Unsignalized Intersections

Level of Service	Average Delay per Vehicle [seconds]	
	Signalized Intersections	Unsignalized Intersections(1)
A	< 10	< 10
B	10 – 20	10 – 15
C	20 – 35	15 – 25
D	35 – 55	25 – 35
E	55 – 80	35 – 50
F	> 80	> 50

(1) Stop-controlled intersection LOS criteria are the same for side-street and all-way stop controlled intersections

Results of the existing analysis are shown in Table 2. The existing a.m. peak hour analysis shows that all key intersections operate at an acceptable overall LOS D. The CSAH 4/Fremont Drive intersection shows high delay on the side-street approach during the a.m. peak hour which results in poor side-street levels of service. During the existing p.m. peak hour, the analysis shows that all of the key intersections experience operational problems with either an overall intersection or a side-street level of service at unacceptable levels (LOS E or F). This is a direct result of long queues and high delays on CSAH 4 from the TH 169/CSAH 4 intersection.

Table 2
Existing Peak Hour Capacity Analysis
Level of Service Results

Intersection	Intersection Control	Level of Service Results	
		A.M. Peak Hour	P.M. Peak Hour
Fremont Avenue (CSAH 4) / TH 169	Signalized	D	**E**
Fremont Avenue (CSAH 4) / Fremont Drive	Side-Street Stop	C/**E**	**E/F**
Fremont Avenue (CSAH 4) / 3rd Street (South Leg)	Side-Street Stop	A/A	**F/F**
Fremont Avenue (CSAH 4) / 3rd Street (North Leg)	Side-Street Stop	A/A	C/**F**

Note: Levels of service for unsignalized intersections are reported by an overall intersection LOS followed by the worst approach LOS.

YEAR 2030 NO-BUILD ANALYSIS

A 2030 No-Build operations analysis was performed in order to determine what the impact that 2030 travel demand will have upon the existing TH 169 corridor. In order to develop 2030 Average Daily Traffic volumes, a travel demand modeling process was developed using assumptions derived from the 2006 Sherburne County Transportation Plan forecasting process. To see a detailed summary of the Travel Demand Modeling process, please see Appendix A.

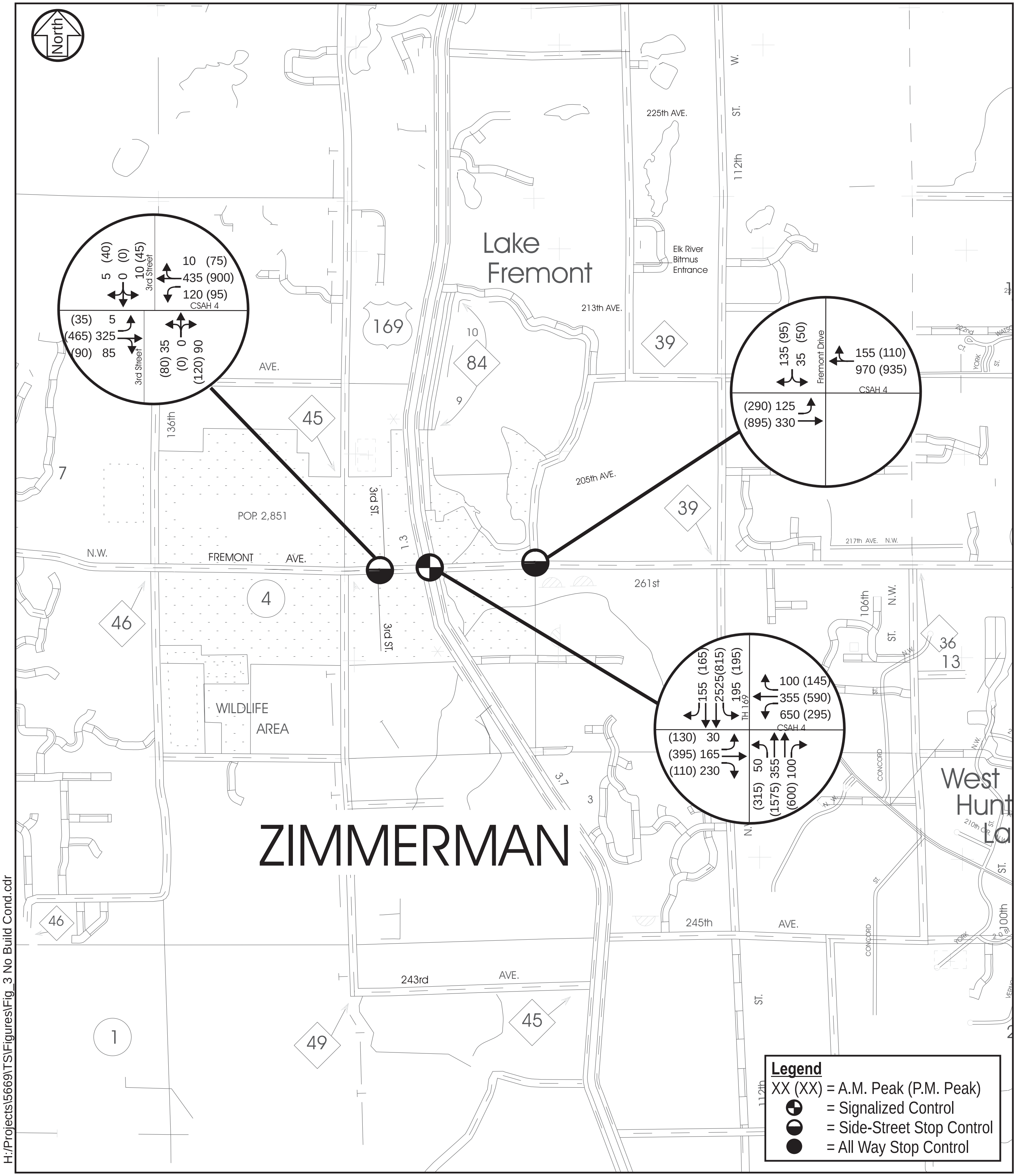
Once 2030 No-Build Average Daily Traffic Volumes were developed from the Travel Demand Model, turning movements at each intersection were produced using existing peak hour percentages and existing turning movement splits as an initial guide. Volumes between adjacent intersections were then balanced. 2030 No-Build turning movement volumes are shown in Figure 3.

The results of the 2030 No-Build operations analysis are shown in Table 3. The results reveal that most intersections along the TH 169 corridor report high delays at unacceptable levels in both the a.m. and p.m. peak hour periods. This is primarily due to the expected growth in traffic volumes along the TH 169 corridor without additional lane capacity.

Table 3
Year 2030 No-Build Peak Hour Capacity Analysis
Level of Service Results

Intersection	Intersection Control	Level of Service Results	
		A.M. Peak Hour	P.M. Peak Hour
Fremont Avenue (CSAH 4) / TH 169	Signalized	**F**	**F**
Fremont Avenue (CSAH 4) / Fremont Drive	Side Street Stop	**F/F**	**F/F**
Fremont Avenue (CSAH 4) / 3rd Street (South Leg)	Side Street Stop	A/**F**	**F/F**
Fremont Avenue (CSAH 4) / 3rd Street (North Leg)	Side Street Stop	**F/F**	**F/F**

Note: Levels of service for unsignalized intersections are reported by an overall intersection LOS followed by the worst approach LOS.



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Year 2030 No Build Conditions

Figure 3

TH 169 in Zimmerman Traffic Study

City of Zimmerman

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YEAR 2030 BUILD ANALYSIS

The year 2030 Build analysis was performed to determine if the proposed build alternatives will mitigate the congestion issues that the existing roadway geometrics and traffic control will experience under the year 2030 Build conditions.

Year 2030 Build volumes were developed using a similar process used in the development of the year 2030 No-Build volumes. The primary difference is that under year 2030 Build conditions, several improvements to the TH 169 corridor will result in higher average daily traffic volumes than year 2030 No-Build conditions since the improved corridor attracts more trips.

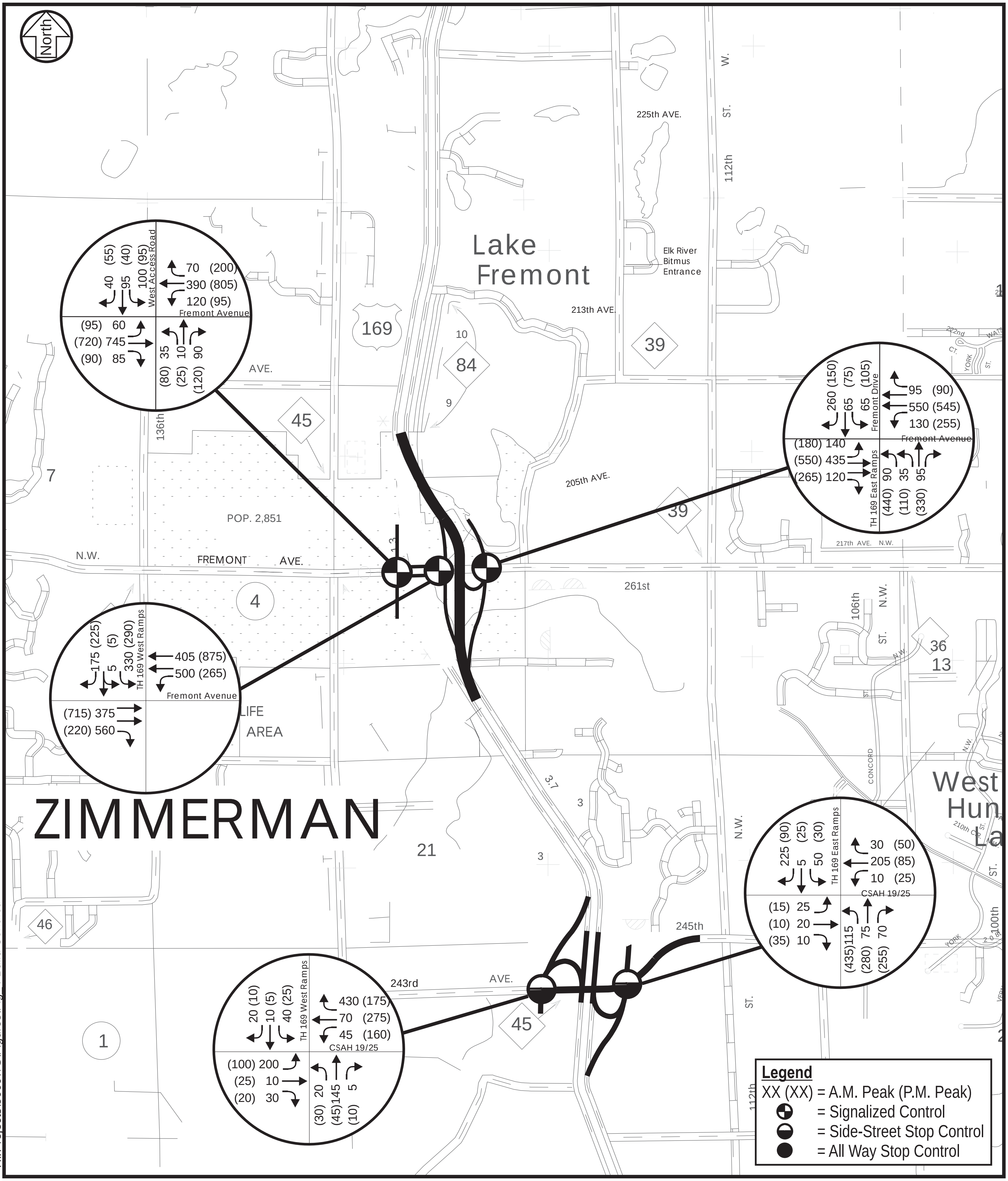
The improvements along the TH 169 Corridor include the conversion of TH 169 to a freeway segment. This will eliminate all at-grade intersections and will limit the access points to TH 169. Interchange alternatives were developed and preferred alternatives were chosen based on their location and overall impacts. The detailed changes to the TH 169 corridor in Zimmerman are listed below:

Fremont Avenue (CSAH 4) Interchange
The Fremont Avenue (CSAH 4)/TH 169 intersection will be converted into an interchange with a folded diamond configuration to the east and a standard diamond configuration to the west. The east ramps tie in with the north approach of Fremont Drive.

CSAH 19/25 Interchange
The intersections of TH 169/243rd Avenue NW and TH 169/245th Avenue will be converted into a folded diamond interchange with the west route becoming CSAH 19 and the east route becoming CSAH 25. While the CSAH 4 interchange is proposed to address both existing and year 2030 No-Build operational concerns, the CSAH 19/25 interchange is being proposed to provide a grade-separated alternative to the existing off-set, at-grade intersections of 243rd and 245th Avenues.

All of these geometric improvements along with the year 2030 build turning movement volumes are illustrated in Figures 6 and 7.

A traffic operations analysis was performed (using either SimTraffic and the Highway Capacity Software, or a critical lane analysis) at select build geometrics to determine if the new geometrics can accommodate the year 2030 turning movement volumes. SimTraffic and the Highway Capacity Software were used were at the Fremont Avenue (CSAH 4) Interchange intersections in Zimmerman. A critical lane analysis was used to determine if the intersections at the interchange of TH 169/CSAH 19/CSAH 25 would perform under capacity given base geometrics. The results of this 2030 Build analysis are described in the following sections.



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Year 2030 Build Conditions

TH 169 in Zimmerman Traffic Study

City of Zimmerman

Figure 4

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Fremont Avenue (CSAH 4) Interchange

The results of the 2030 Build analysis at the Fremont Avenue (CSAH 4) interchange are shown in Table 4.

Table 4
Year 2030 Build A.M. and P.M. Peak Hour Capacity Analysis
Level of Service Results

Intersection	Intersection Control	Level of Service Results	
		A.M. Peak Hour	P.M. Peak Hour
Fremont Avenue (CSAH 4) Interchange			
Fremont Avenue (CSAH 4) / West Access Road	Signalized	D	C
Fremont Avenue (CSAH 4) / West Ramps	Signalized	C	C
Fremont Avenue (CSAH 4) / East Ramps/Fremont Drive	Signalized	D	D

The analysis results from Table 4 indicate that all intersections operate at an acceptable LOS D or better under year 2030 peak hour Build conditions given the proposed lane designations and traffic control shown in Figure 4.

CSAH 19/25 Interchange

Year 2030 Build volumes were produced at these intersections by comparing year 2030 Build daily traffic volumes at this location to existing average daily traffic volumes. The thresholds of critical lane analysis at the CSAH 19/25 Interchange are shown in Table 5 while the results of the critical lane analysis are shown in Table 6. The analysis results show that both intersections will operate well under capacity under year 2030 conditions given the lane designations shown in Figure 4.

Table 5
Critical Lane Thresholds and Capacity Relationships

Signalized Intersections	
Sum of Critical Lane Volumes [vph]	Relationship to Probable Capacity
0 – 1,200	Under Capacity
1,201 – 1,400	At Capacity
≥ 1,400	Over Capacity

Table 6
Year 2030 Build Peak Hour
Critical Lane Analysis Results

Intersection	Sum of Critical Lane Volumes [vph]		Relationship to Probable Capacity
	A.M. Peak Hour	P.M. Peak Hour	
TH 169/CSAH 19/25 East Ramps	635	790	Under Capacity
TH 169/CSAH 19/25 West Ramps	940	655	Under Capacity

CONCLUSIONS AND RECOMMENDATIONS

The surrounding communities along the TH 169 corridor plan to have significant socio-economic growth through year 2030. As a result of this growth, the travel demand along the TH 169 corridor will also significantly increase. Traffic operations analysis show that the existing TH 169 corridor will not be able to accommodate the year 2030 No-Build traffic volumes. The conversion of TH 169 to a four-lane freeway from 243rd Avenue NW through CSAH 4 in Zimmerman, along with the proposed interchanges at CSAH 4 and the future CSAH 19/25 will enable the TH 169 corridor to accommodate year 2030 traffic volumes.

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APPENDIX A:

TH 169 TRAVEL DEMAND MODELING DOCUMENTATION

Refer to the travel demand modeling memorandum included with the traffic operations memorandum for Highway 169 in Elk River (*TH 169 in Elk River Travel Demand Modeling* dated March 7, 2007). This memorandum includes travel demand modeling results for the entire length of the project corridor from Highway 10 in Elk River to CSAH 4 in Zimmerman.