Appendix A

Traffic Operations Technical Report Draft

Prepared for: City of Bloomington

October 2007

Prepared by:

SRF Consulting Group, Inc.

SRF No. 0065645

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1.0 INTRODUCTION

SRF Consulting Group, Inc. has completed an operations analysis of the roadway network in the Normandale Lake District, in the City of Bloomington (see Figure 1: Project Location). The traffic analysis area has approximate boundaries of East Bush Lake Road, Interstate 494 (I-494), 84th Street, Stanley Avenue and France Avenue. Development/Redevelopment of this area will include increased office density, hotel expansion, additional retail uses and multi-family residential. Potential development/redevelopment in the area has highlighted the need to better understand how the existing roadway network currently operates and will operate under future (year 2030) conditions. The traffic analysis structure is as follows:

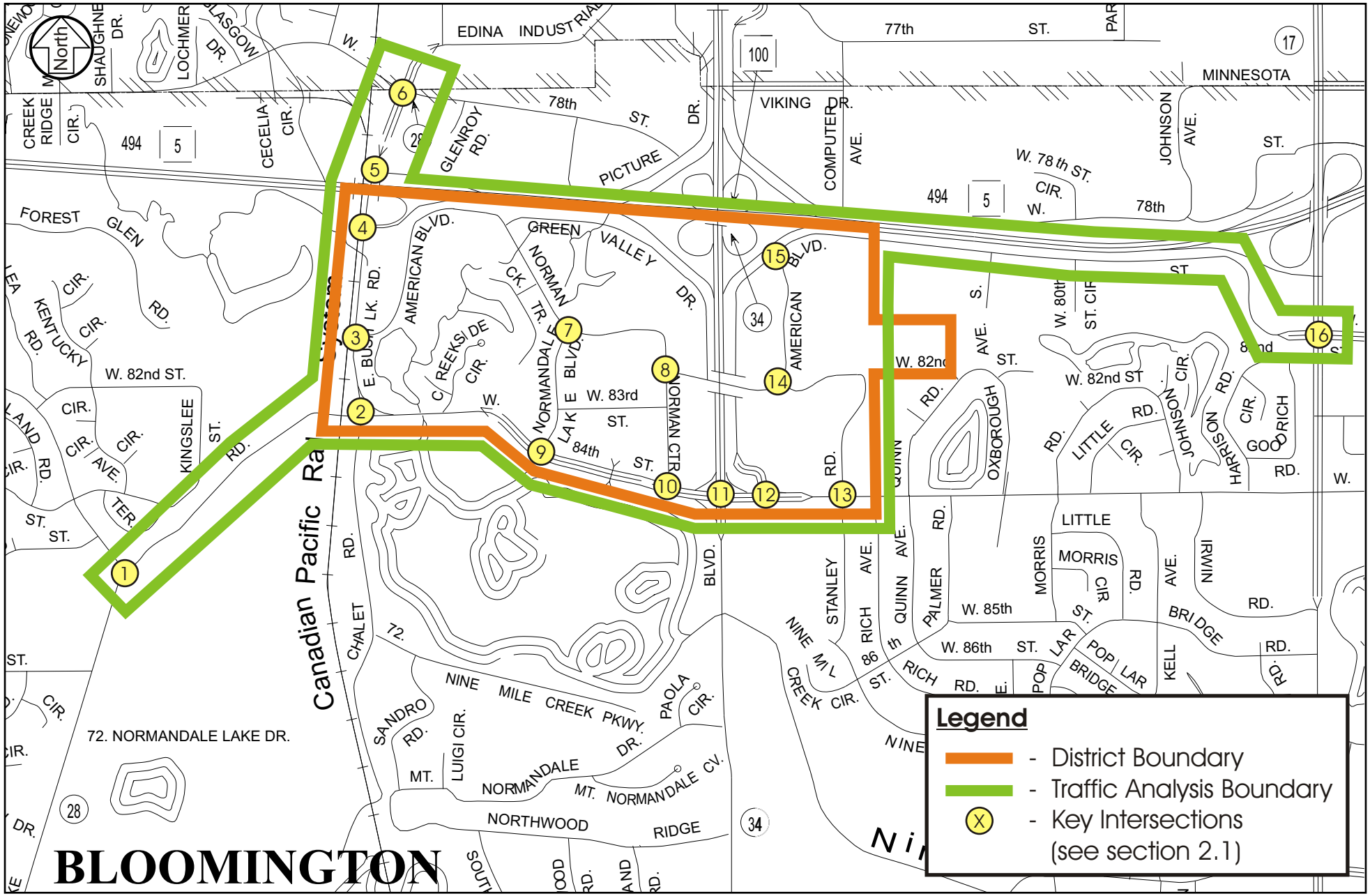
- Determine the local roadway network baseline conditions (i.e., operations analysis of existing (year 2005/2006) conditions during the morning and afternoon peak hours)
- Develop future (year 2030) traffic forecasts based on projected land use in the Normandale Lake District
- Identify the level of traffic mitigation necessary to accommodate the projected development/redevelopment
- Develop four roadway concept alternatives to mitigate operational issues identified under no build conditions
- Determine to what extent each concept alternative mitigates the operational issues and achieves a level of service D
- Develop preliminary cost estimates for four concept alternatives for comparison purposes
- Further refine two selected roadway concept alternatives in order to determine a preferred alternative
- Identify preferred roadway concept alternative to mitigate operational issues

2.0 EXISTING CONDITIONS

2.1 Data Collection

Traffic operations were analyzed at the following key intersections as labeled on Figure 1:

1. East Bush Lake Road/Highwood Drive
2. East Bush Lake Road/84th Street
3. East Bush Lake Road/American Boulevard
4. East Bush Lake Road/I-494 South Ramp
5. East Bush Lake Road/I-494 North Ramp
6. East Bush Lake Road/78th Street
7. Normandale Lake Boulevard/ American Boulevard
8. Norman Center Drive/American Boulevard
9. 84th Street/Normandale Lake Boulevard
10. 84th Street/Norman Center Drive
11. 84th Street/Normandale Boulevard
12. 84th Street/Normandale Service Road
13. 84th Street/Stanley Road
14. 82nd Street/American Boulevard
15. Normandale Service Road/ American Boulevard
16. France Avenue/American Boulevard



DISTRICT BOUNDARY AND TRAFFIC ANALYSIS STUDY AREA

Figure 1

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Current traffic controls include signalization at all key intersections, except:

- Normandale Lake Boulevard/American Boulevard
- Norman Center Drive/American Boulevard
- 84th Street/Normandale Service Road
- 82nd Street/American Boulevard
- Normandale Service Road/American Boulevard.

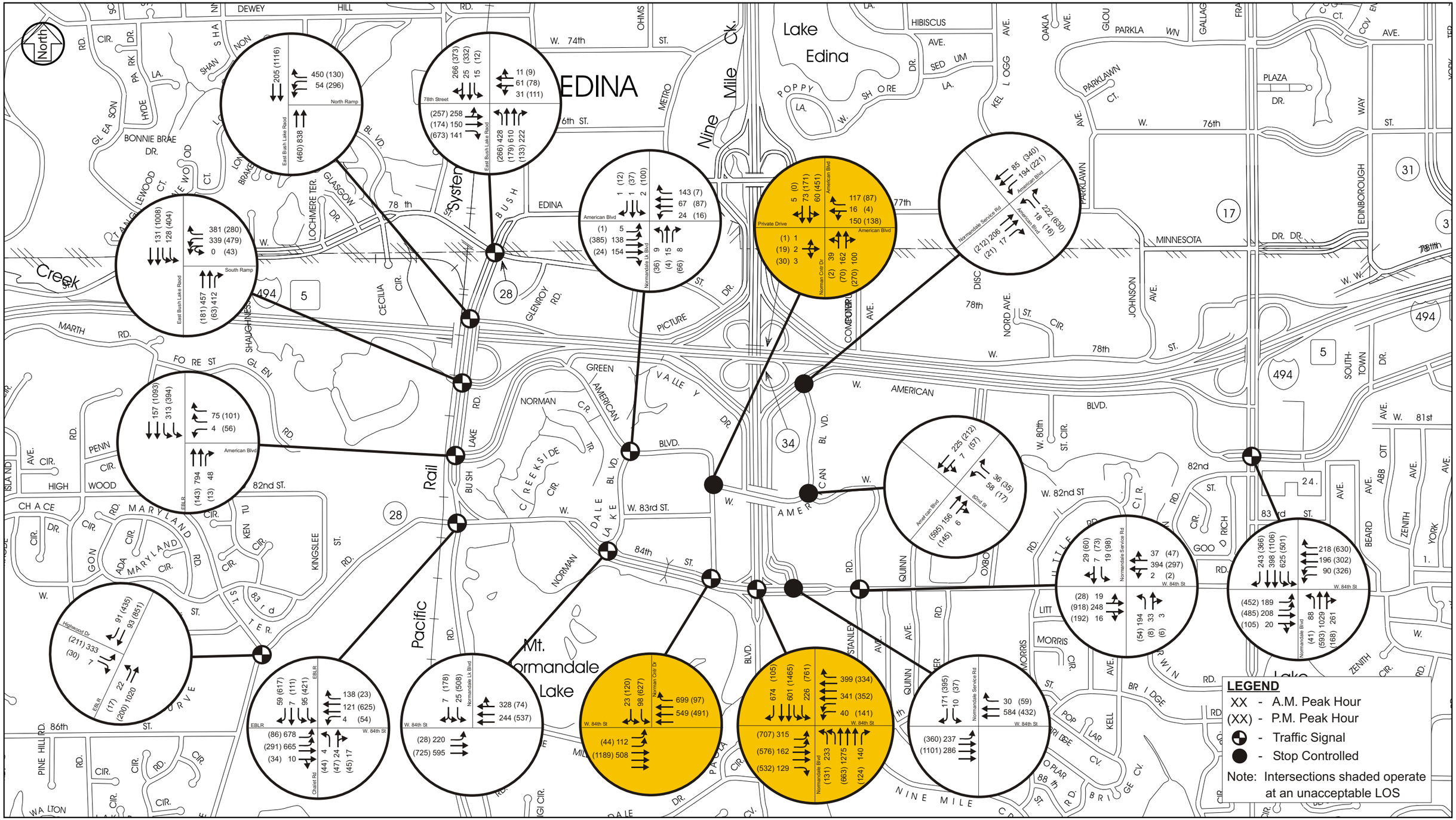
SRF Consulting Group, Inc. collected a.m. and p.m. peak hour turning movement counts at all key intersections in December 2005 and April 2006. Existing geometrics[1], traffic controls, and a.m. and p.m. peak hour traffic volumes for the key intersections are shown in Figure 2.

2.2 Existing Operations

An operations analysis was conducted for the a.m. and p.m. peak hours at each key intersection to determine how traffic currently operates within the project area. All signalized intersections were analyzed using the Synchro/SimTraffic software and unsignalized intersections were analyzed using the Synchro/SimTraffic and 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 traffic flows at or above the posted speed limit; vehicles are almost completely unimpeded in the ability to maneuver. Less than 10 seconds of average delay per vehicle is experienced at a signalized intersection under LOS A conditions. LOS F indicates an intersection where demand exceeds capacity, the number of vehicles arriving at an intersection is greater than the number that can move through it. More than 80 seconds of average delay per vehicle is experienced at signalized intersections under LOS F conditions. LOS A through D is considered acceptable by Hennepin County and the City of Bloomington.

For side-street stop controlled intersections, special emphasis is given to providing an estimate for the level of service of the minor approach. The traffic operations at an unsignalized intersection with side-street stop control can be described in two ways. First, consideration is given to the overall intersection level of service. This takes into account the total number of vehicles entering the intersection and the capability of the intersection to support those volumes. Second, it is important to consider the delay on the minor approach. Since the mainline does not have to stop, the majority of delay is attributed to the side-street approaches. When reporting level of service operations for side-street stop controlled intersections the overall intersection level of service is shown followed by the side-street level of service (i.e., LOS A/B).

[1] All existing geometrics are shown with the exception of the East Bush Lake Road/84th Street intersection; here the planned roadway improvements are displayed (planned construction year 2007/completion year 2008).



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EXISTING TRAFFIC VOLUMES

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Figure 2

Results of the analysis shown in Table 1 indicate that all key intersections operate at an acceptable overall LOS D or better during the a.m. peak hour, with existing traffic controls and geometric layout. However, three of the 16 key intersections currently operate at an unacceptable LOS E or worse during the p.m. peak hour:

- Norman Center Drive/American Boulevard
- 84th Street/Norman Center Drive
- 84th Street/Normandale Boulevard

Table 1
Existing Peak Hour Capacity Analysis
Level of Service Results

Intersection	Level of Service (Average Delay in seconds)	
	A.M.	**P.M.**
East Bush Lake Road/Highwood Drive	D	C
East Bush Lake Road/84th Street	B	C
East Bush Lake Road/American Boulevard	A	B
East Bush Lake Road/I-494 South Ramp	B	C
East Bush Lake Road/I-494 North Ramp	B	B
East Bush Lake Road/78th Street	C	C
Normandale Lake Boulevard/American Boulevard *	A/B	A/B
Norman Center Drive/American Boulevard *	A/C	**F/F (65)**
84th Street/Normandale Lake Boulevard	A	D (50)
84th Street/Norman Center Drive	A	**E (70)**
84th Street/Normandale Boulevard	D	**F (90)**
84th Street/Normandale Service Road *	A/E	A/F
84th Street/Stanley Road	B	B
82nd Street/American Boulevard *	A/B	A/C
Normandale Service Road/American Boulevard *	A/C	A/C
France Avenue/American Boulevard	D	D

Note: Values shown in parenthesis represent overall delay per vehicle.
* Indicates an unsignalized intersection. The overall LOS is shown followed by the worst approach LOS (as explained in Section 2.2).

The intersection of Normandale Boulevard/84th Street currently operates poorly due to the heavy southbound through and left-turn movements, as well as the heavy eastbound left-turn movement. Improvements to LOS are limited without complete reconstruction of the intersection. This topic will be discussed further under year 2030 conditions, and the concept alternative development sections. The poor operations of the intersection of Normandale Boulevard/84th Street negatively impact the adjacent intersection of 84th Street/Norman Center Drive with vehicles spilling back from this intersection into these adjacent intersections. The vehicles that spill back block the adjacent intersections, making it difficult for vehicles on the side-street of Norman Center Drive and the Normandale Service Road to complete their maneuver.

3.0 YEAR 2030 FORECASTS

3.1 Background Traffic Growth

Daily traffic forecasts were developed for year 2030 as part of the *Northwest Bloomington Neighborhood Study*, conducted by SRF Consulting Group in 2005. The City of Bloomington asked SRF to conduct an origin-destination study to identify commuter traffic patterns and the amount of through traffic due to increased congestion and additional development in the surrounding area. In addition, the *Northwest Bloomington Neighborhood Study* identified and quantified the traffic shifts that would result from major planned improvements on the regional system. Mn/DOT was in the process of improving TH 169 to a full freeway facility and planning for additional improvements to other major regional nodes (I-494). This project was an independent evaluation of the local roadway network. Based on these daily forecasts, traffic was estimated to grow at a range of zero to one and one-half percent per year, depending on location and roadway traveled. These growth ranges represent overall volume growth (background traffic, plus potential development/redevelopment). To provide perspective, a one-half percent growth per year results in approximately 13 percent additional trips over the next 24 years; one and one-half percent growth per year results in approximately 43 percent additional trips over the next 24 years. It should be noted that when applying the background growth rates, the potential trips generated by future development/redevelopment was taken into account to determine the appropriate amount of overall traffic growth for particular roadways.

3.2 Regional Roadway Improvement Assumptions

The regional roadway network surrounding the Normandale Lake District is currently deficient, with periods of congestion during the morning and afternoon peak periods. This congestion is well documented by the Minnesota Department of Transportation (Mn/DOT) as part of their Annual Congestion Report. The Mn/DOT Transportation Improvement Program (TIP) has identified various components of the regional roadway network surrounding the Normandale Lake District for improvement by year 2030. The key regional roadway improvements assumed as part of the year 2030 analysis, which affect operations and travel patterns in the area, are:

- Upgrade of Trunk Highway 169 (TH 169) to a full freeway facility, from Old Shakopee Road to I-494
- Reconstruction of the TH 169/I-494 interchange to improve capacity.
- Capacity expansion along I-494 from France Avenue through I-35W

A key improvement that was not assumed immediately within the year 2030 horizon is a westbound access from East Bush Lake Road to I-494. This additional access will modify the trip patterns on the local roadway system and influence the mitigation needs at the intersection of 84th Street/Normandale Boulevard. During the project study process this westbound access to I-494 was reviewed and its impacts were measured. However, based on conversations with Mn/DOT staff this improvement is not anticipated to occur within the foreseeable future and therefore was not included in our final analysis to determine the local roadway mitigation needs.

The regional improvement assumptions are important to note due to the impact they have on the local roadway network and its operation in the Normandale Lake District. Improvement to the regional system will alter trip patterns on the local roadway system and how trips access the regional network. In addition, these improvements will alter the trip diversion patterns currently occurring from the regional system to the local system in the Normandale Lake District.

3.3 Regional Improvement Implications on the Local Roadways

Consideration was given to adjacent regional roadway improvements, and their impact on route diversions through the area. Regional roadway improvements are expected to reduce the amount of trips that divert from the regional roadway network to use the local roadway system within the Normandale Lake District. Data developed as part of the *Northwest Bloomington Neighborhood Study* indicates that under year 2030 conditions, when regional improvements are completed, it is expected that traffic volumes on the local roadway system will be reduced. This reduction was taken into account when developing the overall background growth and year 2030 forecasts.

3.4 Trip Generation Estimates

Traffic forecasts for the Normandale Lake District were developed for year 2030 conditions. City Planning staff provided a table dated 5/16/06 showing potential areas of development/redevelopment and the associated land use types and sizes (see Figure 3: Future Areas of Development/Redevelopment). Trip generation estimates for the a.m. and p.m. peak hours and on a daily basis were calculated for the Normandale Lake District based on trip generation rates from the 2003 ITE Trip Generation Reports. Table 2 displays a summary of the trip generation calculations for each potential development/redevelopment site.

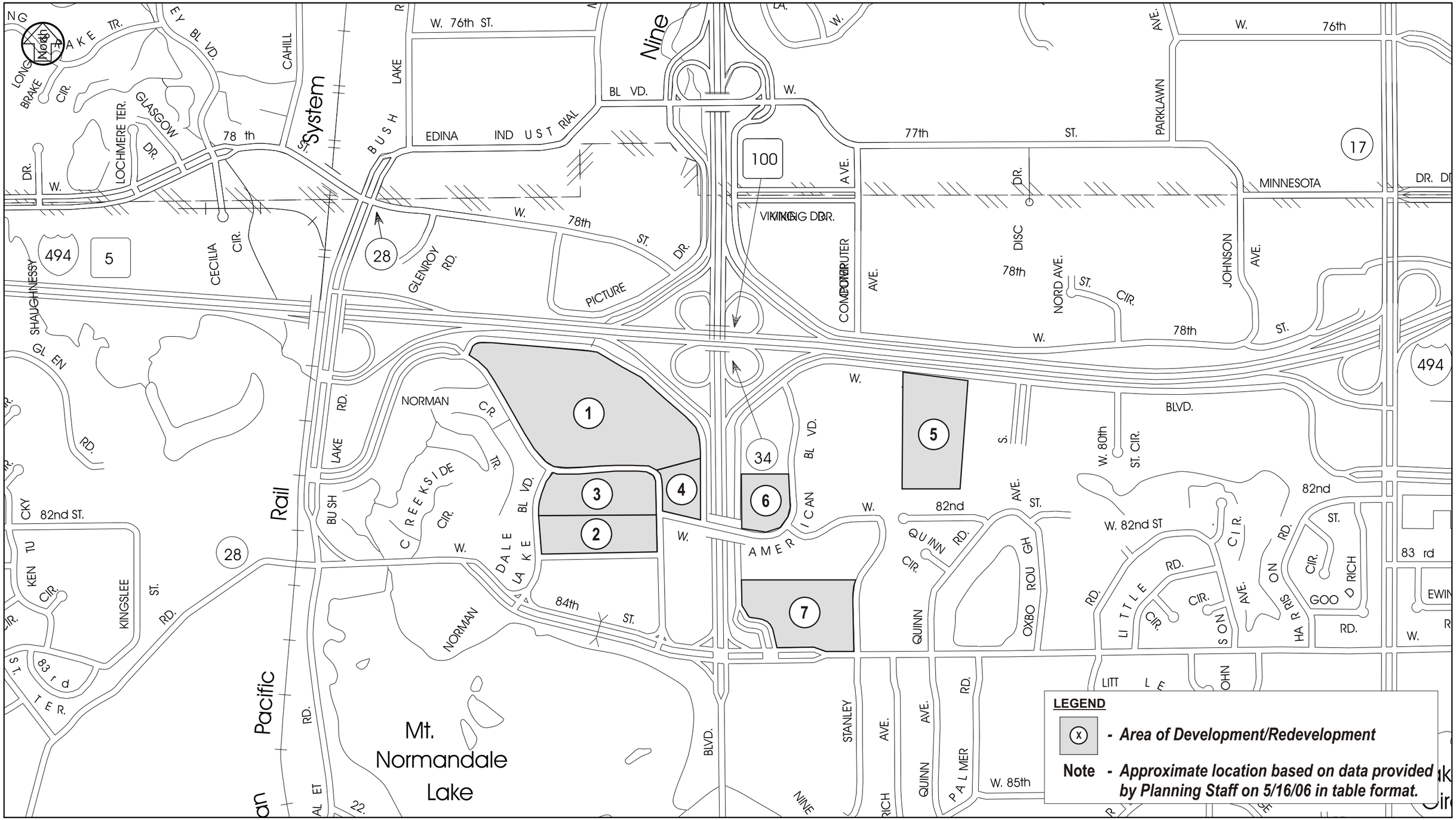
SRF conducted an Origin-Destination (O-D) Survey to determine current travel patterns for trips entering and exiting the office park area in the northwest quadrant of the 84th Street/Normandale Boulevard intersection during the peak periods. This information was used to develop the directional trip distribution for projected land uses in the area, along with regional daily traffic volumes. Figures 4A and 4B display the directional trip distribution.

3.5 Forecast Intersection Volumes

The following process was used to forecast the year 2030 peak hour turning movement volumes:

- The existing peak hour intersection volumes were increased to represent year 2030 conditions using a linear growth rate (compounded annually).
- Reductions were applied to account for regional trips that will no longer divert through the study area once the regional roadway system improvements (bulleted items from section 3.2) are in place (by year 2030).
- Trip generation estimates were distributed to the local roadway network, in addition to the background base volumes.

The combination of background traffic, reductions due to regional roadway improvements and trips generated by proposed, future development results in the year 2030 peak hour intersection volumes for the Normandale Lake District as shown in Figure 5.



FUTURE AREAS OF DEVELOPMENT/REDEVELOPMENT

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Figure 3

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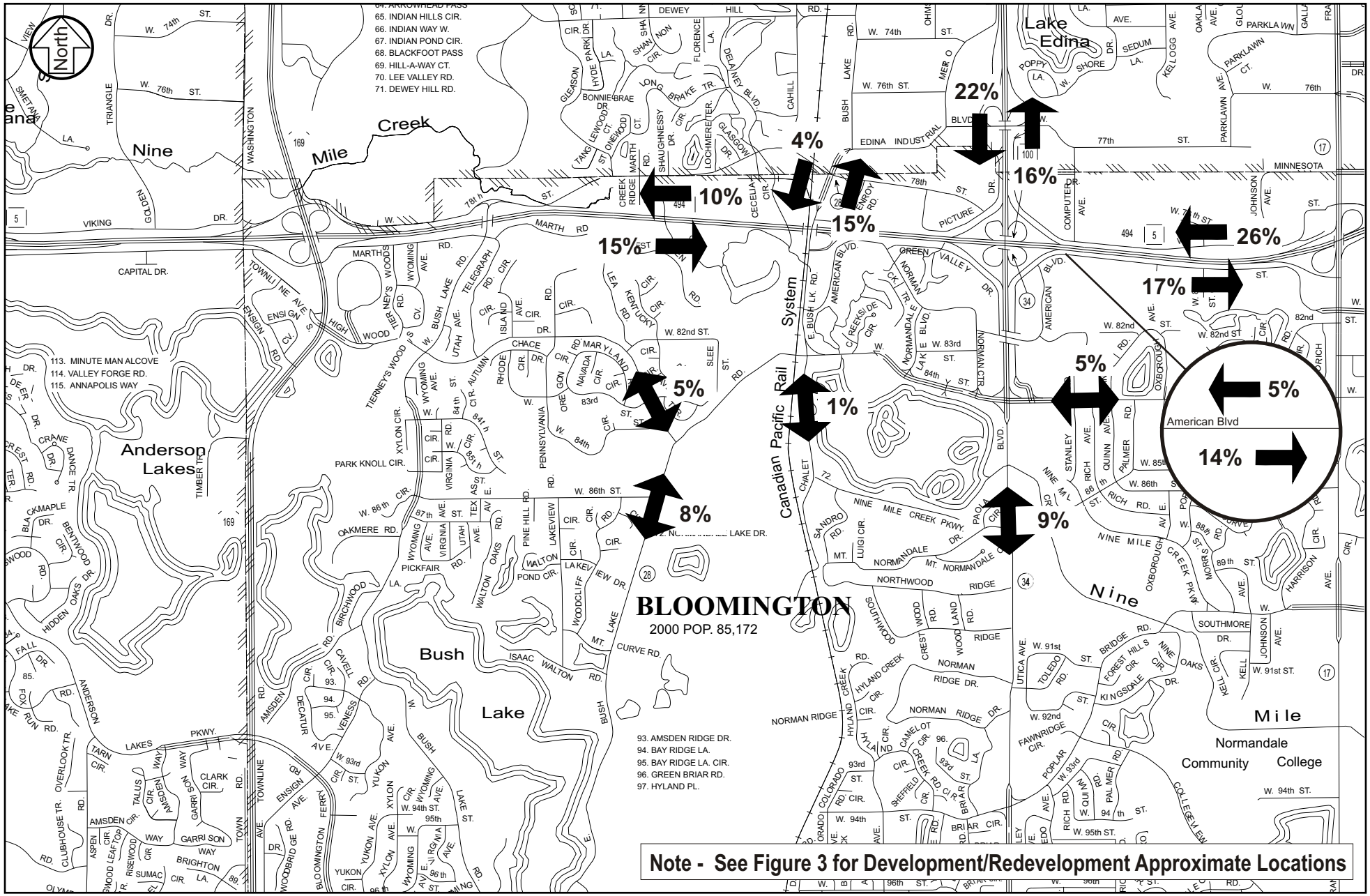

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DIRECTIONAL DISTRIBUTION - DEVELOPMENT/REDEVELOPMENT AREAS WEST OF NORMANDALE BOULEVARD

Figure 4A

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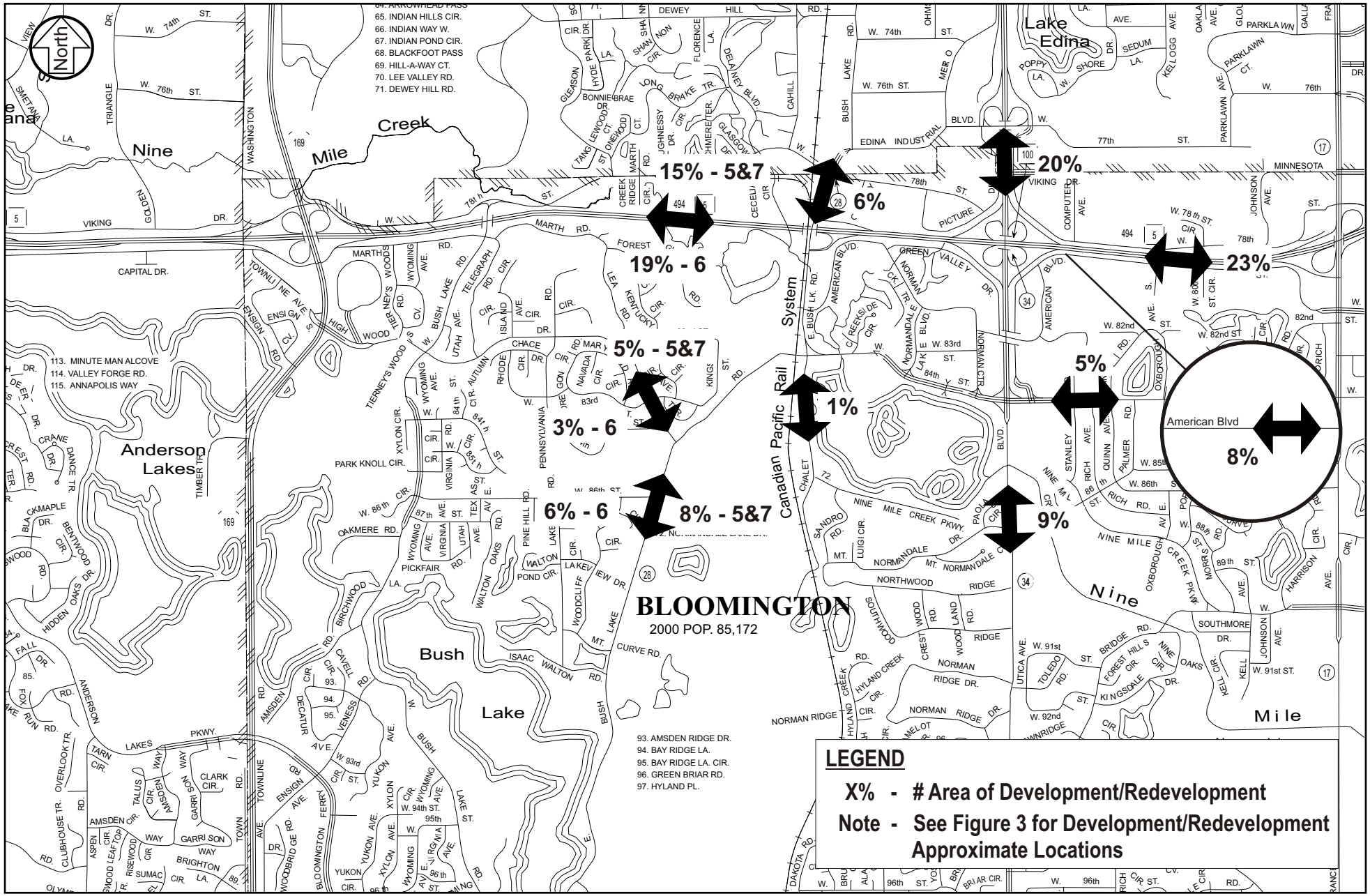
Table 2
Trip Generation Estimates

Area of Development/ Redevelopment	Development Description	ITE Code	Land Use	2006 Land Use Size (1,000 SF)	Change in Land Use Size from 2006-2030 (1,000 SF)	Total 2030 Land Use Size (1,000 SF)	A.M. In Veh.	A.M. Out Veh.	P.M. In Veh.	P.M. Out Veh.	Daily Trips
1	Norman Pointe IV - Office *	710	General Office Building	0	332	332	431	59	77	374	3,361
	Norman Pointe II and III - Office *	710	General Office Building	0	644	644	732	100	136	664	5,598
2	General Office (UP)	710	General Office Building	0	295	295	402	55	75	365	3,248
3	General Office (Jostens)	710	General Office Building	74.2	241	315.2	329	45	61	298	2,653
4	Freeway Commercial - Service	820	Shopping Center	2.8	32.5	35.3	20	13	59	63	1,396
5	Regional Commercial Retail	815	Free Standing Discount Store	78.6	97.6	176.2	56	26	247	247	5,468
6	General Office	710	General Office Building	38.1	75.7	113.8	103	14	19	94	833
7	Neighborhood Commercial Retail	820	Shopping Center	133.4	89.2	222.6	56	36	161	174	3,830
						Totals:	**2,130**	**348**	**834**	**2,279**	**26,387**

Notes:

- All trip generation is based on the year 2030 land use forecasts prepared by City of Bloomington Planning Staff dated 5/16/06
- Total 2030 land use size equals, 2006 land use plus change in land use size from 2006-2030
- Source: City of Bloomington "Normandale Lakes Development Area Study" table dated 5/16/06
- * Used equation for trip generation calculations to be consistant with Norman Pointe EIS



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DIRECTIONAL DISTRIBUTION - DEVELOPMENT/REDEVELOPMENT AREAS EAST OF NORMANDALE BOULEVARD

Figure 4B

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4.0 YEAR 2030 NO BUILD CONDITIONS

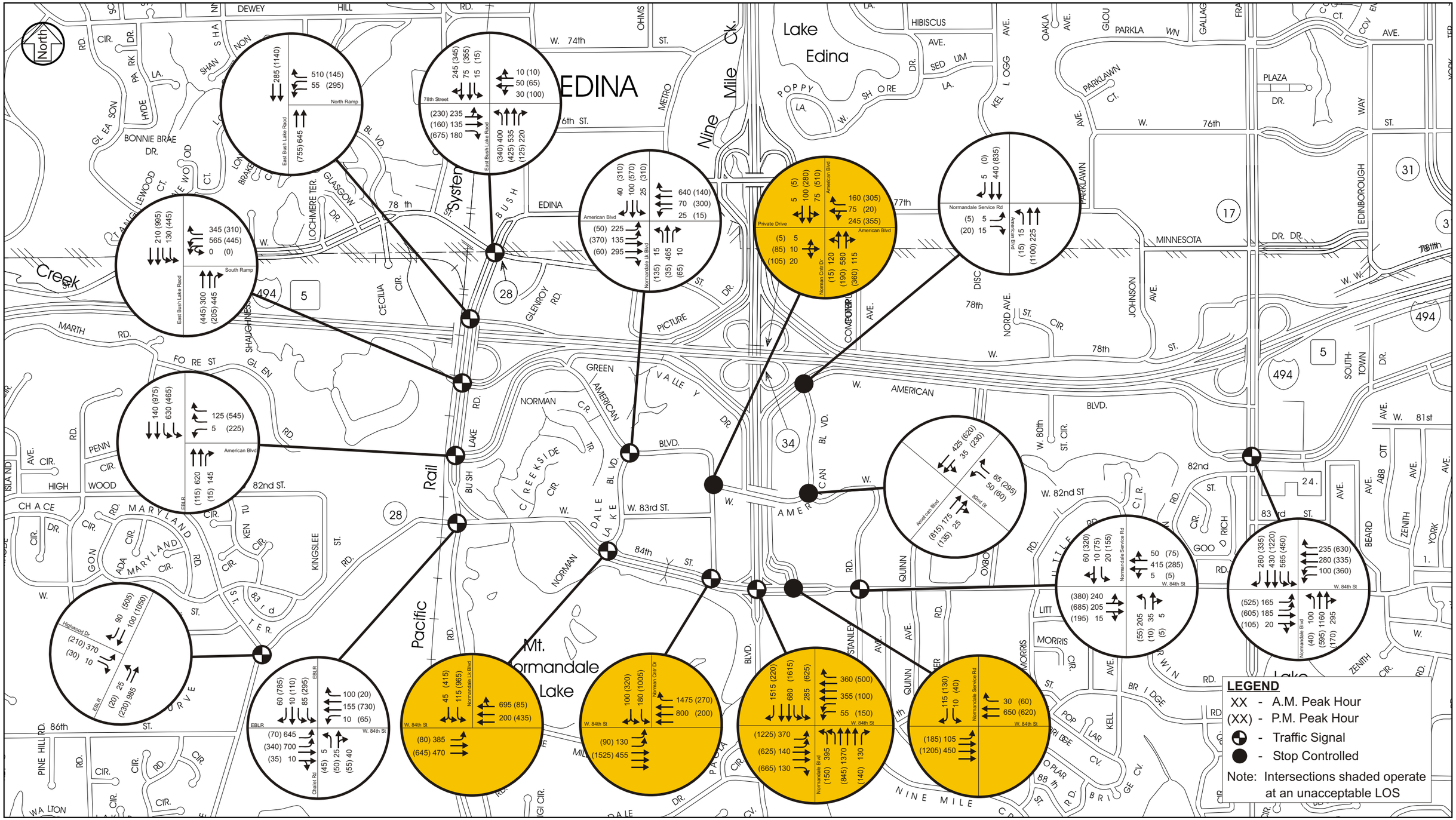
No build conditions represent year 2030 conditions without traffic control and geometric modifications to the local roadway network, assuming that all projected development has been constructed. An operations analysis was completed for year 2030 no build conditions during the a.m. and p.m. peak hours at each of the key intersections. All signalized intersections were analyzed using the Synchro/SimTraffic software and unsignalized intersections were analyzed using the Synchro/SimTraffic and Highway Capacity Software. All existing signal timing was assumed optimized under this scenario.

The analysis results shown in Table 3 indicate that all key intersections operate at an acceptable overall LOS D or better during the a.m. peak hour, with existing traffic controls and geometric layout. During the p.m. peak hour, five of the 16 key intersections will operate at an unacceptable LOS E or F. All operational problems along 84th Street, under year 2030 no build conditions, are due to the poor operations at the intersection of 84th Street/Normandale Boulevard. The queues along 84th Street will degrade to a point where they impact the adjacent intersections of 84th Street/Normandale Boulevard. While existing conditions exhibit a certain level of failure along 84th Street, year 2030 no build conditions indicate an expansion of these failures. The Norman Center Drive/American Boulevard intersection failure will also expand considerably under future year 2030 conditions.

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

Intersection	Level of Service (Average Delay in seconds)	
	A.M.	**P.M.**
East Bush Lake Road/Highwood Drive	C	C
East Bush Lake Road/84th Street	B	C
East Bush Lake Road/American Boulevard	B	B
East Bush Lake Road/I-494 South Ramp	C	C
East Bush Lake Road/I-494 North Ramp	B	B
East Bush Lake Road/78th Street	C	C
Normandale Lake Boulevard/American Boulevard	C	C
Norman Center Drive/American Boulevard *	C/F	**F/F (--)**
84th Street/Normandale Lake Boulevard	A	**F (270)**
84th Street/Norman Center Drive	B	**F (270)**
84th Street/Normandale Boulevard	D	**F (100)**
84th Street/Normandale Service Road *	A/E	**E/F**
84th Street/Stanley Road	B	B
82nd Street/American Boulevard *	A/B	A/D
Normandale Service Road/American Boulevard *	A/C	C/F
France Avenue/American Boulevard	D	D

Note: Values shown in parenthesis represent overall delay per vehicle.
* Indicates an unsignalized intersection. The overall LOS is shown followed by the worst approach LOS (as explained in Section 2.2).



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YEAR 2030 NO BUILD TRAFFIC VOLUMES

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Figure 5

5.0 YEAR 2030 CONCEPT ALTERNATIVES

Based on the existing and year 2030 no build condition analysis results the local roadway network requires modifications to mitigate the failures that currently exist and will continue into the future. Therefore, SRF completed a planning level analysis of various design alternatives to determine what type of intersection design best addresses the operational and physical location issues. Additional local roadway improvements are being recommended as part of the overall area mitigation plan, but this section focuses on the 84th Street/Normandale Boulevard concept alternatives.

5.1 Year 2030 Preliminary Alternative Evaluation

The intersection of 84th Street/Normandale Boulevard is immediately adjacent to an office tower development in the northwest quadrant, Normandale Lake in the southwest quadrant, a Mn/DOT water retention pond in the southeast quadrant and a commercial development in the northeast quadrant. Consideration was given to these constraints, as well as the following factors, during the concept development process:

- Ensure that there is an appropriate range of concept types developed
- Achieve acceptable function regarding traffic volumes and pedestrian movements
- Minimize negative impacts and enhance neighborhood livability

Prior to developing concept alternatives for City staff review, SRF conducted a preliminary alternative evaluation of the following intersection types:

- Typical at-grade design with increased capacity
- Continuous flow design
- Michigan U-turn design, Normandale Boulevard only and both roadways
- Grade-separated arterial interchange with four-way overlapping left-turns
- Three-lane roundabout
- Split-level single point interchange
- Innovative at-grade reduced conflict intersection (RCI) with 3/4 U-turns

Based on the following criteria:

- Volume to capacity (V/C) ratios based on critical turning movements. Intersections have a certain amount of conflicting volume that they can service. To determine the V/C ratio for a given intersection alternative you add up the sum of all conflicts and divide it by the theoretical capacity of that particular intersection design. 1.0 is at capacity and anything below 1.0 is under capacity.
- Overall intersection size/amount of right-of-way needed based on number of lanes and medians required

Following this preliminary alternative evaluation, SRF presented City staff with numerous concepts for initial consideration. Based primarily on functionality, the following four concept sketches were developed and moved forward for consideration:

Concept A – Typical at-grade intersection design with increased capacity (see Figure 6)
Concept B – Grade-separated partial single-point/partial arterial interchange (see Figure 7)
Concept C – Grade-separated left-turn movement interchange (see Figure 8)
Concept D – At-grade partial Michigan U-turn/RCI (see Figure 9)

Each of the four concept sketches presented in Figures 6–9 minimize the right-of-way impacts immediately adjacent to the roadway and present alternatives that have the potential to mitigate the operational issues observed under year 2030 conditions, based on a planning level analysis.

5.2 Year 2030 Cursory Concept Analysis

A cursory operations analysis was conducted in order to further determine the effectiveness of each concept alternative at mitigating the operational issues observed under year 2030 conditions. This analysis includes all development/redevelopment in the Normandale Lake District under year 2030 conditions during the p.m. peak hour at the key failure intersections along 84th Street (operating at an unacceptable LOS E or F, see Table 4). LOS D has been identified by the City of Bloomington and Hennepin County as the functional design goal for all intersections in order to receive City and County approval.

Table 4
Year 2030 Build P.M. Peak Hour Capacity Analysis
Level of Service Results – Concept Alternatives

Intersection	A	B	C	D
84th Street/Normandale Lake Boulevard	D	C	C	**E (70)**
84th Street/Norman Center Drive	C	C	C	**F (120)**
84th Street/Normandale Boulevard	**F (80)**	C	C	D (55)
84th Street/Normandale Service Road *	**E/F**	B/F	A/A	**F/F (70)**

* Indicates an unsignalized intersection. The overall LOS is shown followed by the worst approach LOS (as explained in Section 2.2).

As shown in Table 4, two of the four concept alternatives will result in acceptable operations at the key intersections along 84th Street. These two concept alternatives represent the grade-separated alternatives. Although Concepts A and D provide additional capacity to the intersection, they are not able to handle the amount of conflicting volume. As previously discussed under existing conditions, it is the heavy southbound through/left-turn and eastbound left-turn movements directly conflicting with one another that cause the major failures. Concept A improves upon the overall level of service at the intersection of 84th Street/Normandale Boulevard and manages the queues along 84th Street to minimize their impact on adjacent intersections. However, it does not achieve the desired acceptable LOS D. Refinement of this alternative is necessary to achieve an acceptable LOS D. Concept D does not come close to achieving an acceptable LOS D at the majority of intersections along 84th Street. The cursory operations analysis review indicates that queuing issues along 84th Street will be too great to overcome, without a significant volume reduction at the intersection. The local roadway realignment shown in Figure 9 depicts an attachment to this alternative that may modify travel patterns enough to reduce the volume through this intersection and thus improve its operations.

5.3 Preliminary Concept Cost Estimate

Preliminary cost estimates were developed for each of the four concept alternatives in order to provide decision makers additional comparative information. These estimates were comprised of a combination of the following:

1. Roadway Reconstruction (base concept)
2. Bridges/Retaining walls (base concept)
3. Right-of-Way (base concept)
4. Design/Miscellaneous/Contingency (base concept)
5. Pedestrian Bridge
6. Local Roadway Realignment

The preliminary cost estimates shown in Table 5 are based on the initial two dimensional concept sketches and do not account for topography changes. The right-of-way estimates for the local roadway realignments associated with Concept D vary considerably based on different relocation alignments.

Table 5
Preliminary Concept Cost Estimate

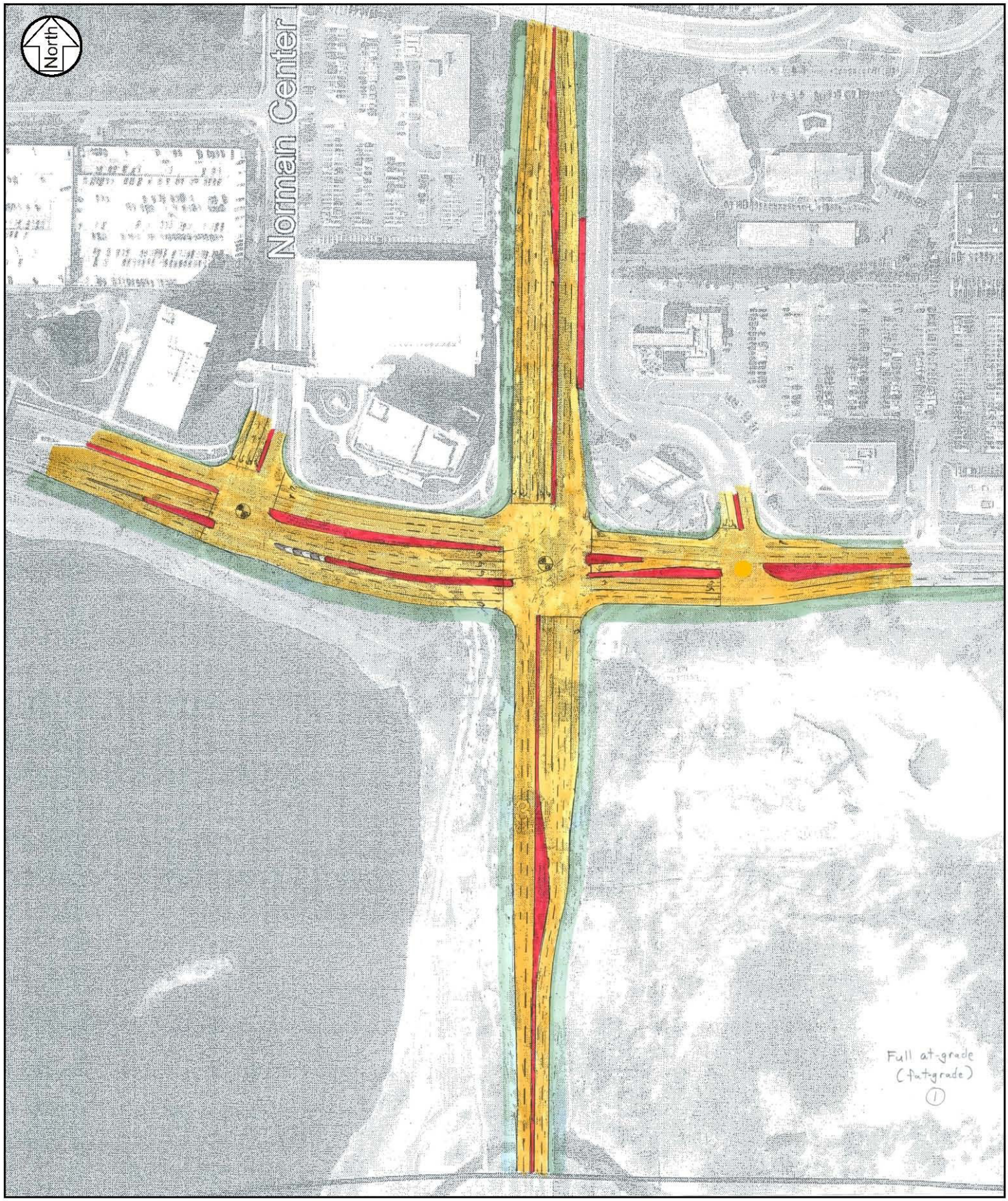
	A	B	C	D
Base Concept	$15 M	$28 M	$41 M	$15 M
Pedestrian Bridge	$1 M	--	--	$1 M
Local Roadway Realignment	--	--	--	$14 M
Total:	**$16 M**	**$28 M**	**$41 M**	**$30 M**

Note: Values shown are based on year 2005 dollars. These preliminary cost estimates were developed in year 2006 prior to Mn/DOT releasing their updated year 2006 average prices.

The pedestrian bridge and local roadway realignment under concept D were included with the concepts that require them as part of their designs, up to this point in the review process, to achieve an acceptable level of service.

6.0 SELECTING A PREFERRED ALTERNATIVE – PHASE I

A primary purpose of the Normandale Lake District Plan was to examine a full range of design alternatives for the 84th Street/Normandale Boulevard intersection, including non-traditional designs. As discussed in previous sections, numerous concepts were initially considered. From these, four concepts were selected based primarily on functionality. To narrow these alternatives, the City defined two levels of evaluation criteria related to six key considerations. The Phase I evaluation criteria were used to narrow the four leading concepts to two.



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CONCEPT A - AT GRADE

Figure 6

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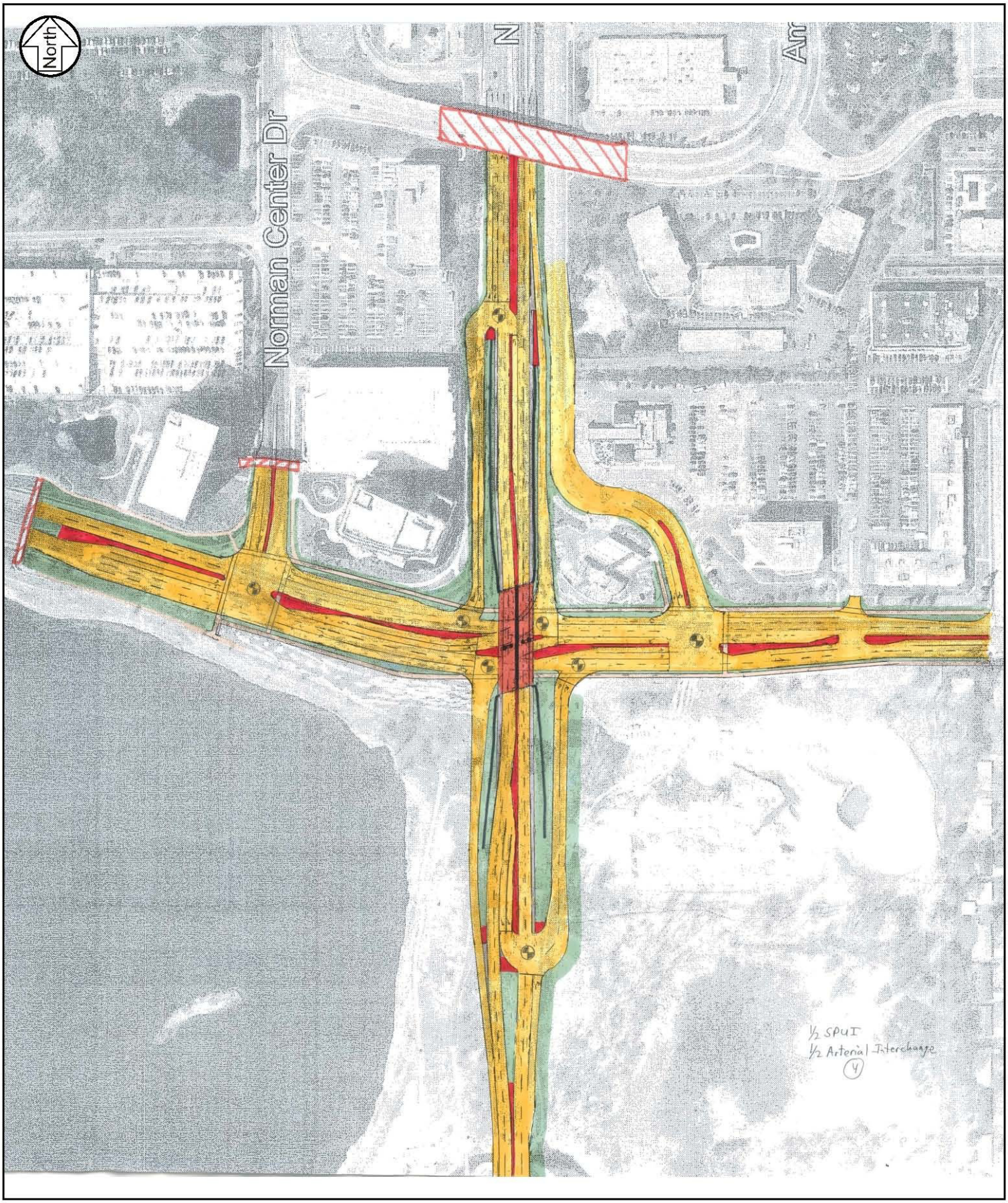

CONCEPT B - GRADE SEPARATED, PARTIAL SINGLE POINT

Figure 7

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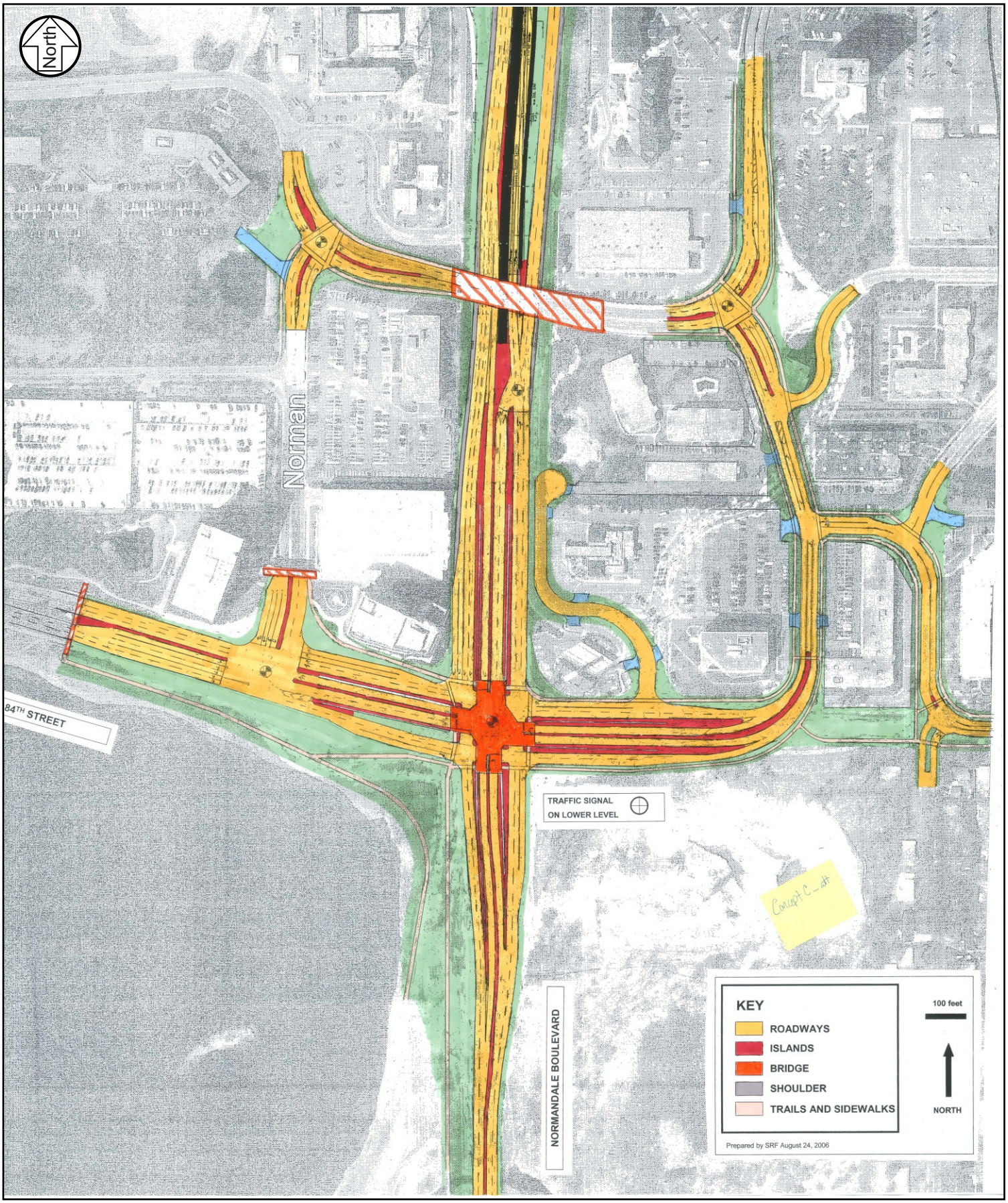

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CONCEPT C - GRADE SEPARATED WITH LEFT-TURN INTERCHANGE

Figure 8

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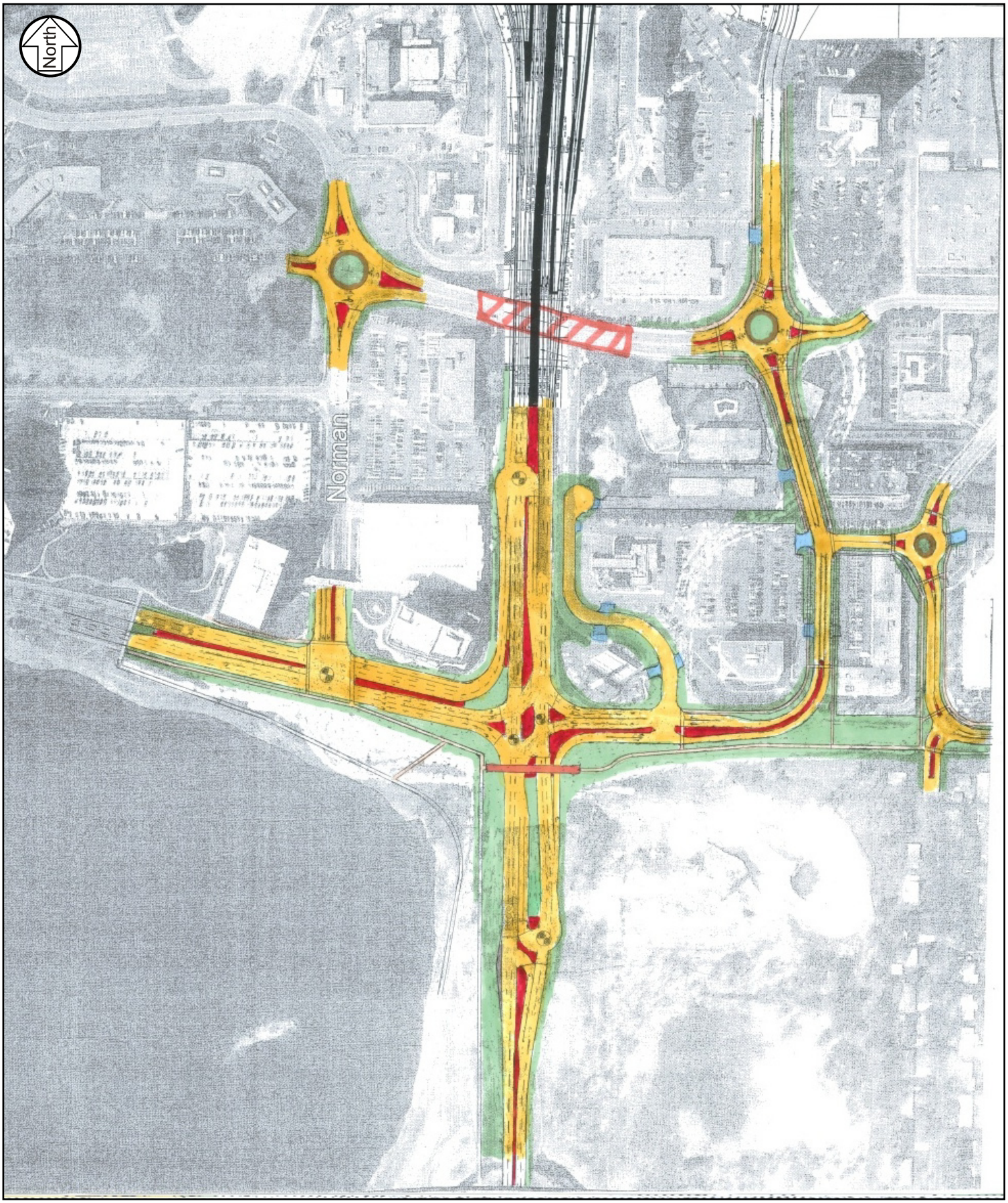

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CONCEPT D - AT GRADE WITH PARTIAL MICHIGAN U-TURNS

Figure 9

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6.1 Phase I Evaluation Criteria

Neighborhood Impacts (Aesthetics, Access) • Facilitates pedestrian access to parks by minimizing number of traffic lanes crossed or by separating pedestrians from vehicular traffic • Provides opportunity for a positive pedestrian experience (aesthetics, safety, weather protection, sightlines) • Facilitates wayfinding to area destinations
Traffic • The concept has potential to modify (or add) roadway capacity in the future. • Intersections operate at a Level of Service D or better
Parkland Impacts • The concept does not negatively affect the use of parkland and recreational areas (wayfinding, vehicular access/entry points). • The concept offers opportunity to make a regional trail connection to area parks.
Environmental Impacts • The concept minimizes area of potential wetland impacts. • The concept minimizes impacts to wooded areas.
Commercial Property Impacts • The concept maintains access to private property.
Implementation/Cost • Comparison of preliminary costs to construct the base intersection concept • Preliminary cost to construct other elements associated with the alternative (e.g., pedestrian bridge, local roadway realignment)

The Phase I evaluation resulted in selection of Concepts A and B for further consideration. Concept A is an at-grade intersection with enhanced turning capacities and a pedestrian bridge over Normandale Boulevard. Concept B is a grade-separated design where through traffic on Normandale Boulevard passes over through traffic on 84th Street; left turns are handled north and south of the intersection at signal-controlled J-turns in expanded medians on Normandale Boulevard.

A third concept was included, Concept N. Concept N was included for comparison purposes to represent an alternative where no substantial improvements are made to the intersection. This concept included only minor local roadway improvements to enhance traffic capacity without making lane additions or using structures at the 84th Street/Normandale Boulevard intersection.

7.0 YEAR 2030 CONCEPT A & B REFINEMENT

As indicated in the previous sections, Concept A required additional refinement in order to achieve an acceptable LOS D operation. Concept B achieves the required acceptable LOS D operation with its current configuration and thus did not require additional refinement. In addition to an operations analysis of the refined Concept A, updated cost estimates were presented to reevaluate Concepts A and B.

The concept design sketch shown in Figure 6 (Concept A) already proposes a reasonable amount of additional capacity for the eastbound left-turn movement (triple left-turn lanes). The southbound through movement capacity has been increased as well from existing conditions to accommodate three southbound through lanes exiting this intersection. Providing additional capacity for these movements is not feasible given right-of-way space limitations. In order to achieve the functional design goal of LOS D, the eastbound left-turn volume must be reduced by approximately 225 vehicles at the 84th Street/Normandale Boulevard intersection during the p.m. peak hour under year 2030 conditions.

The O-D survey data collected internal to the office park area indicates that a significant amount of vehicles exiting this area during the p.m. peak period use the 84th Street/Normandale Boulevard intersection to access the regional roadway network. This travel pattern includes a southbound left-turn movement from either Norman Center Drive or Normandale Lake Boulevard to access 84th Street, followed by an eastbound left-turn movement onto northbound Normandale Boulevard. There are two alternative methods to reduce this eastbound left-turn volume from 84th Street:

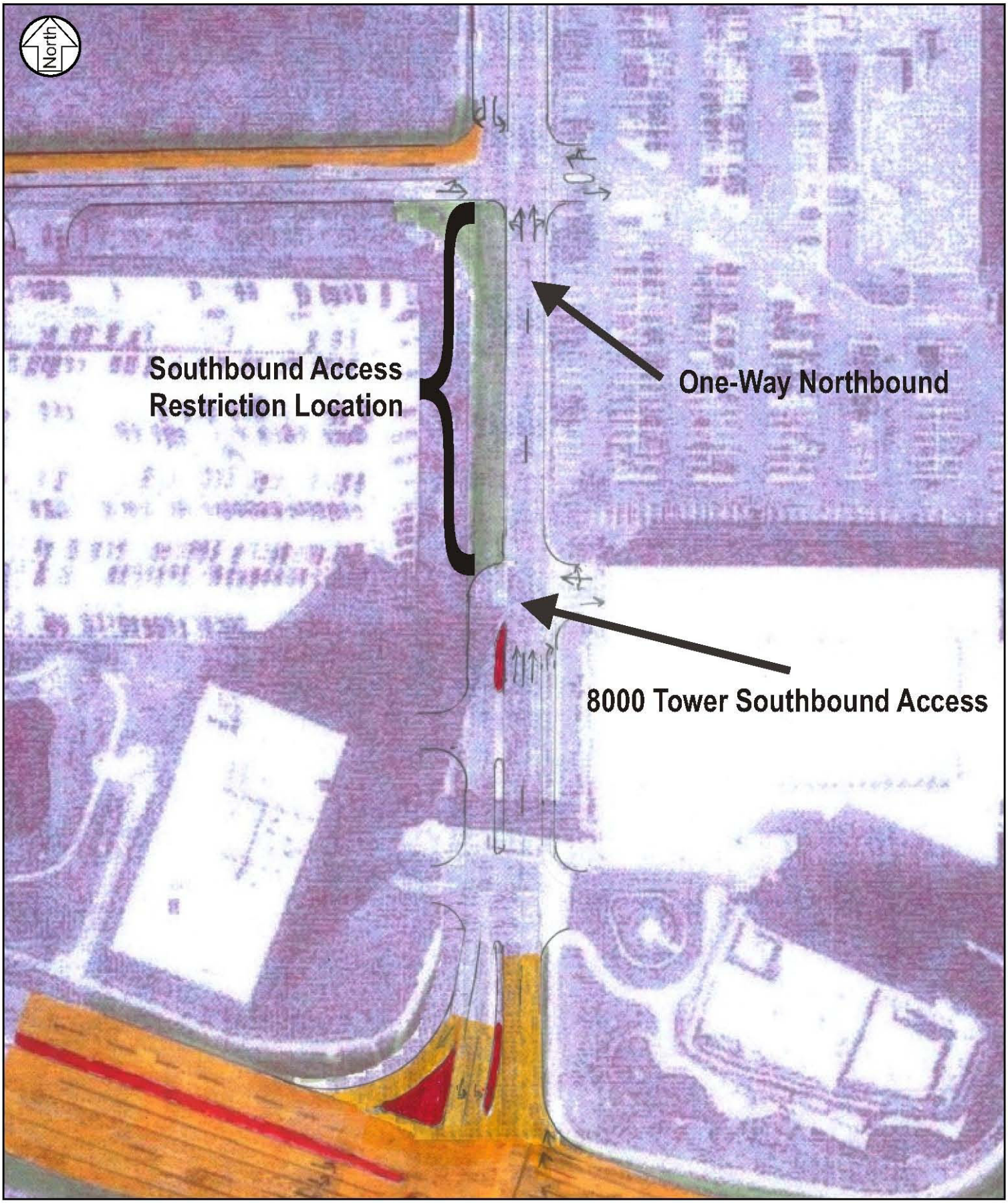
- Modify the land use assumptions (i.e., replace office with other land use, such as hotel) in the office park area to reduce the p.m. peak hour trips generated, subsequently reducing the amount of eastbound left-turns, or
- Develop internal office park circulation modifications to encourage diversions (i.e., restrict southbound access onto 84th Street along Norman Center Drive).

Based on meetings with City staff, elected officials, property owners and a cursory review of the impacts associated with each method, the access restriction alternative was preferred.

7.1 Access Restriction

As it exists, the Norman Center Drive access location onto 84th Street is not in compliance with typical access spacing guidelines and the close spacing contributes to its poor operation. Restricting the southbound movement at this intersection will cause a significant amount of trips to divert to alternate exit points from the office park area. It is important to note that the southbound left-turn access restriction will not be a total restriction. It is intended that the office tower located in the immediate northwest quadrant of the 84th Street/Normandale Boulevard intersection (8000 Tower) will have southbound access from Norman Center Drive to 84th Street. Figure 10 depicts how this access restriction will be accomplished. Vehicles exiting the 8000 Tower will be able to go southbound on Norman Center Drive from the parking ramp access drive, and make southbound left-turns onto 84th Street. Norman Center Drive will have a northbound one-way only section between the 8000 Tower access driveway and 83rd Street, restricting all others from making southbound left-turns from Norman Center Drive.

Using the O-D survey data and a route diversion curve, a model was developed to predict travel pattern shifts under year 2030 full development conditions. Route diversion curve data is based on the premise that vehicles will divert from their intended route/path if an alternate route is at least within 30 percent of the original route travel time. If the two routes are equal in travel time, 50 percent of the trips will divert their intended route. Trip diversion in this area occurs in the following manner:



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REFINED CONCEPT A - NORMAN CENTER DRIVE ACCESS RESTRICTION

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ACCESS RESTRICTION TRIP DISTRIBUTION (PERCENTAGE)

Figure 11

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RESTRICTION TRAFFIC ROUTING

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Figure 12

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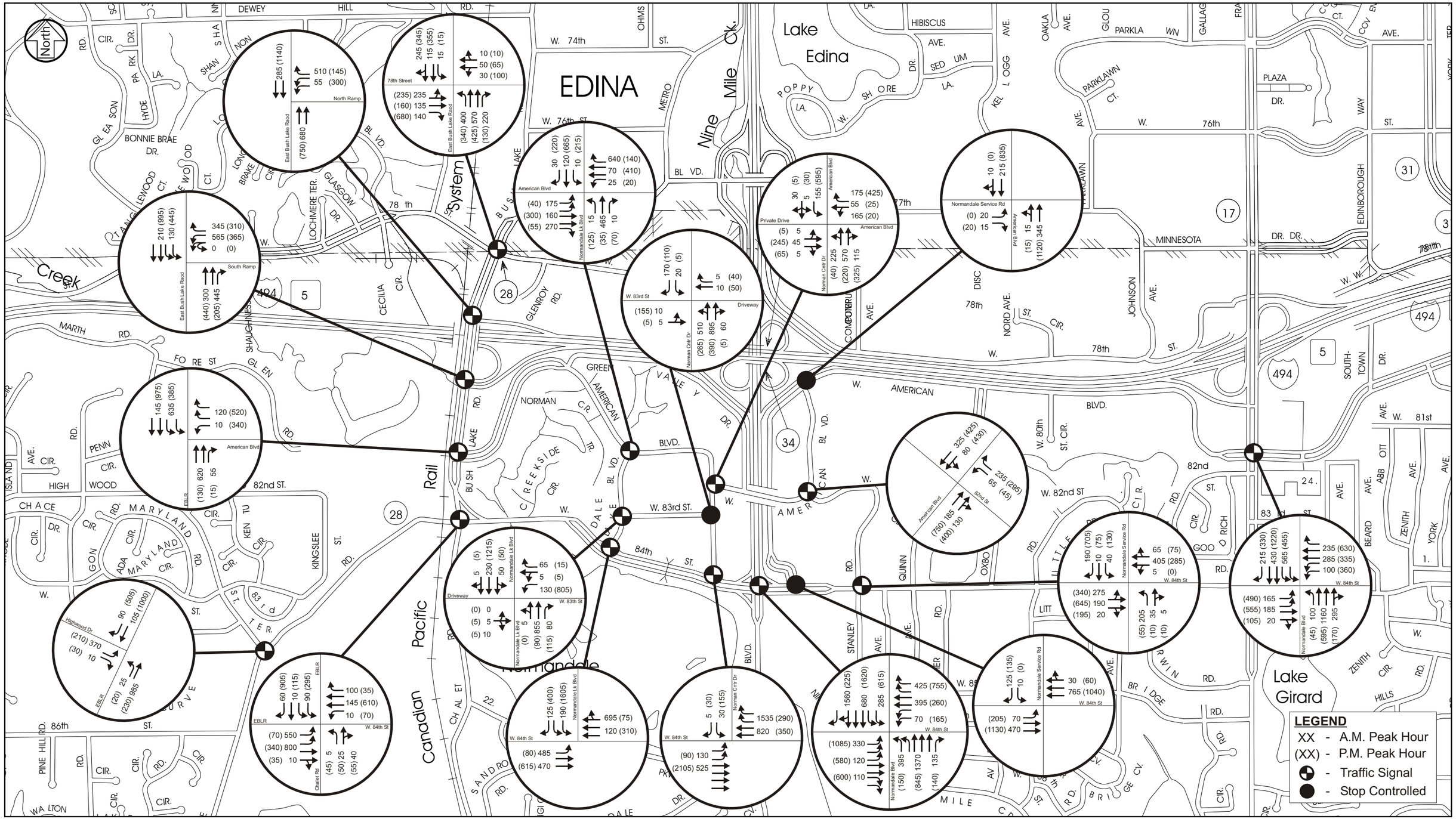

YEAR 2030 BUILD TRAFFIC VOLUME FORECASTS WITH ACCESS RESTRICTION

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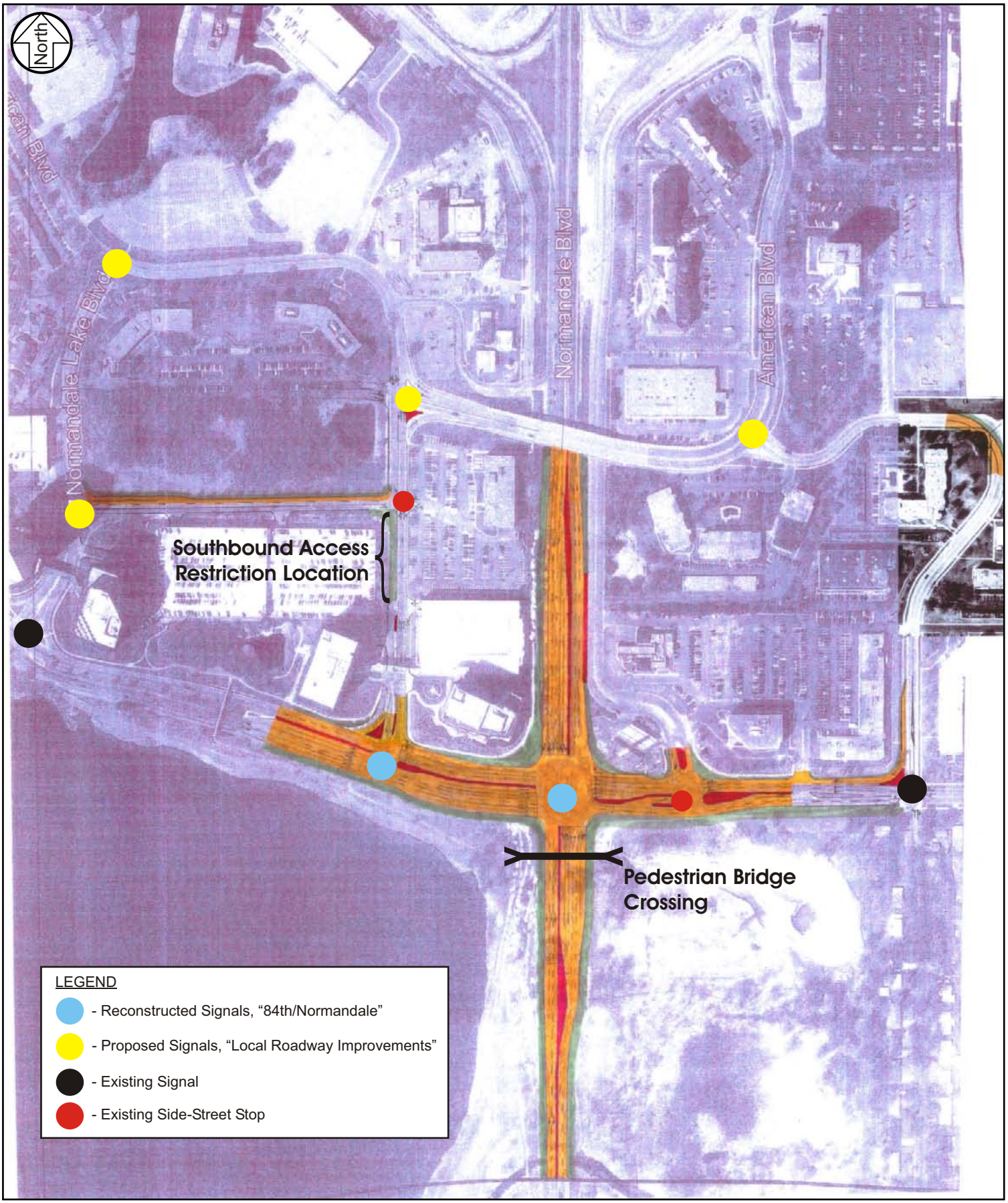
Figure 13



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REFINED CONCEPT A

Figure 14

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- American Boulevard to the west (to access East Bush Lake Road)
- American Boulevard to the east (to access 84th Street or France Avenue)
- Normandale Lake Boulevard to the south (to access 84th Street)

Figures 11 and 12 depict trip distribution and routing with the access restriction in place. The resultant traffic volume shifts are shown in Figure 13 for year 2030 full development conditions.

7.2 Refined Concept A Operations Analysis

In order to determine what impacts the access restrictions will have on the internal and external local roadway network, an operations analysis was completed for year 2030 full development conditions during the a.m. and p.m. peak hours at each of the key intersections. With the change in travel patterns, additional capacity is needed on the internal and external local roadways in order to accommodate the shift in volume. The following improvements are needed for all key intersections to operate at an acceptable LOS D or better:

- Reconstruct Norman Center Drive as a one-way only northbound from 8000 Tower ramp access driveway to 83rd Street.
- 83rd Street, internal to the office park area, needs more capacity to accommodate the additional trips that will now use this road to access 84th Street via Normandale Lake Boulevard.
- Normandale Lake Boulevard/83rd Street, Norman Center Drive/American Boulevard and 82nd Street/American Boulevard intersections require the installation of traffic signals.
- Stanley Avenue north of 84th Street requires some minor curve alignment modifications to increase the turning radius.
- 84th Street (east of Normandale Boulevard) requires an additional lane from Stanley Avenue to Normandale Boulevard due to the additional trips using this route to access the regional roadway network via American Boulevard, to Stanley Avenue, to 84th Street, then to Normandale Boulevard.
- 84th Street/Normandale Boulevard intersection requires additional capacity (as a refinement). Add dual right-turn lanes east and westbound on 84th Street. Add dual left-turn lanes westbound on 84th Street.
- A pedestrian bridge over Normandale Boulevard, south of 84th Street is a required improvement, as the optimal signal timing will not allow enough time for at-grade pedestrian movements.

Results of the analysis shown in Table 6 indicate that all key intersections will operate at an acceptable overall LOS D or better during the a.m. and p.m. peak hours, with the recommended traffic controls and geometric layout described above. Figure 14 depicts the final Concept A alternative based on the refinements stated above. Although all key intersections operate acceptably, congestion will occur internal to the office park area along Normandale Lake Boulevard and 83rd Street. As a result, queuing internal to the site will be heavy at the Normandale Lake Boulevard/83rd Street and 84th Street/Normandale Lake Boulevard intersections during the p.m. peak hour.

Table 6
Year 2030 Refined Concept A Peak Hour Capacity Analysis
Level of Service Results

Intersection	Level of Service (Average Delay in seconds)	
	A.M.	P.M.
East Bush Lake Road/Highwood Drive	D	D
East Bush Lake Road/84th Street	B	C
East Bush Lake Road/American Boulevard	B	B
East Bush Lake Road/I-494 South Ramp	C	C
East Bush Lake Road/I-494 North Ramp	B	B
East Bush Lake Road/78th Street	C	D
Normandale Lake Boulevard/American Boulevard	C	C
Normandale Lake Boulevard/83rd Street	A	C
Norman Center Drive/American Boulevard	C	C
Norman Center Drive /83rd Street *	A/F	B/F
84th Street/Normandale Lake Boulevard	B	D
84th Street/Norman Center Drive	A	A
84th Street/Normandale Boulevard	D	D
84th Street/Normandale Service Road *	A/E	A/D
84th Street/Stanley Road	B	C
82nd Street/American Boulevard	A	B
Normandale Service Road/American Boulevard *	A/C	A/C
France Avenue/American Boulevard	D	D

* Indicates an unsignalized intersection. The overall LOS is shown followed by the worst approach LOS (as explained in Section 2.2).

7.3 Refined Pedestrian Bridge

As stated in section 7.2, a pedestrian bridge is needed to remove pedestrians from at-grade movements. Removing pedestrian movements from the at-grade intersection allows the extra time required for pedestrian movements to be allocated back to vehicles, resulting in acceptable operations. All pedestrian movements will be restricted at-grade under the refined Concept A scenario. The design will not provide crosswalks, pedestrian crossing indications on the signal poles, push buttons, etc. At-grade movements will also be physically restricted where possible (i.e., physical earthen berms). The pedestrian bridge will be incorporated into the existing trail system, connecting to the existing pedestrian/bicycle paths around Normandale Lake and the existing pedestrian bridge over 84th Street west of Normandale Boulevard. Knowing that this improvement is needed for the intersection to operate acceptably for traffic movement, the pedestrian bridge cost estimate was included in the refined Concept A costs.

7.4 Refined Cost Estimates

Updated cost estimates were developed in order to reevaluate Concepts A and B. The previous cost estimate presented for Concept A was updated to include the additional improvements at the intersection of 84th Street/Normandale Boulevard and the other improvements needed to the local roadway network. It is important to note that the preliminary cost estimates shown in Table 7 are based on two dimensional concept sketches and do not account for topography changes.

Table 7
Refined Preliminary Concept Cost Estimate

	Original A	Refined A	B
Base Concept	$15 M	$16.5 M	$28 M
Pedestrian Bridge	$1 M	$2.5 M (1)	--
Local roadway improvements	--	$3.1 M	--
Total:	**$16 M (2)**	**$22.1 M (3)**	**$28 M (2)**

(1) Pedestrian bridge cost rose due to refined bridge cost estimates and modified bridge concept as project progressed.
(2) Values shown are based on year 2005 dollars.
(3) Values shown are based on year 2006 dollars.

Due to the Concept A refinements, the cost estimate has increased approximately 5.9 million dollars. This increase includes a change in the construction costs by one year (2006 vs. 2005). At the time the refined Concept A cost estimate was developed, updated pricing information was available from the Mn/DOT average price list. There is not a direct factor that can be applied to bring the original Concept A costs in line with the year 2006 dollars estimate used for refined Concept A. It is estimated that the difference due to the average yearly prices is approximately 6.5 percent.

8.0 SELECTING A PREFERRED ALTERNATIVE – PHASE II

8.1 Phase II Evaluation Criteria

These concepts were then evaluated more in-depth once the designs were refined and additional traffic modeling, impact data and cost estimates were developed. The expanded Phase II evaluation criteria are documented below.

Neighborhood Impacts (Aesthetics, Access)

- The concept encourages appropriate traffic speeds on 84th Street and on Normandale Boulevard south of study area.
- The concept would create gaps in Normandale Boulevard's traffic flow that would improve access to and from residential side streets.
- The concept can improve livability by reducing noise and improving pedestrian safety for land uses adjacent to 84th Street and Normandale Boulevard.

Parkland Impacts

- The concept minimizes the area of potential parkland impacts, based on worst case scenario construction limits.
- The concept facilitates wayfinding both to and within the park area.
- The concept offers opportunities to enhance park facilities.

Traffic • The concept meets appropriate design criteria and improves access routes to regional roadways. • Intersections operate at a Level of Service D or better. • The concept maintains acceptable transit route times. • The concept provides opportunity for transit services and facilities that serve the area as a transit destination. • The concept creates suitable locations for easy to use, comfortable and attractive transit stops.
Environmental Impacts • The concept minimizes area of potential wetland impacts. • The concept minimizes or enhances water quality in the study area. • The concept minimizes impacts to wooded areas.
Commercial Property Impacts • The concept minimizes the impacts on private property (acquisition and change of access points) based on worst case construction limits. • The concept roadway network enhances development opportunities as identified by the City's Comprehensive Plan, while ensuring that parcel size and access points do not preclude development.
Implementation/Cost • The concept will not require extraordinary levels of maintenance effort (roadway, drainage, bridge structures, landscaping and other amenities). • The concept has been determined to be potentially feasible by other jurisdictions involved in project approvals. • Additional public improvements required by new development are reasonable when compared to the benefit yielded to the city (ratio of net tax revenue generated to comprehensive project cost). • A reasonable financing strategy can be identified. • The concept can accommodate financial participation (leveraged private resources or phased public investment) within the construction sequence.

The following table summarizes how the concepts compared based on the six evaluation criteria.

	Concept A	Concept B	Concept N
Neighborhood impacts and access	Allows pedestrian bridge.	Pedestrian bridge not allowed. Visual impacts.	No change
Traffic	Achieves LOS D Easier to accommodate transit.	Achieves LOS D Difficult to accommodate transit.	Does not achieve LOS D.
Parkland	Some encroachment on parkland.	Slightly less encroachment on parkland.	No change.
Environmental	Similar under both	Similar under both	No change.
Commercial Neighborhoods	Similar under both.	Similar under both.	No change.
Cost and Implementation	Medium cost. Reasonable funding strategy available.	Highest cost	Lowest cost

The Bloomington City Council spent several meetings analyzing and comparing the alternatives, with most of the time spent on choosing between Concepts A and B. In the final analysis, three deciding factors led the City Council to choose a Concept A (with design modifications to improve traffic operations) as the preferred alternative. Each of the deciding factors is discussed below.

8.2 Cost

The City conducted a detailed examination of a complete range of sources to finance the public improvements required in the study area. To fund construction of refined Concept A, the City assumed it would succeed at obtaining $8 million in federal grants, $10 million in Hennepin County participation, $14 million in benefited office space assessments and use of the City's tax abatement authority. It was clear that no additional funding source was available to pay for the additional cost of Concept B. In spite of any advantages it possessed, Concept B was simply not affordable.

8.3 Neighborhood Objectives

Residents of neighborhoods east, south and west of the intersection were clear they wanted a solution that:

1. Discouraged or eliminated "cut-through traffic" that does not have an origin or destination within reasonable proximity to the intersection.
2. Does not extend "freeway conditions" into the neighborhoods. These were defined as high vehicle speeds, streams of traffic without gaps created by signal cycles and more dangerous conditions associated with higher speed, flow and volume.
3. Minimizes park impact. Normandale Lake and Hyland Park are important and well-used open space assets. Intersection structures and additional right-of-way taken from park land were seen as significant impacts. Federal requirements for park land replacement also had significant impact on costs of the concepts. Road overpass structures were perceived as having undesirable visual impacts on the park and on residential areas closest to the intersection.

8.4 Design Simplicity and Driver Comfort

Refined Concept A has the potential problems of eastbound to northbound triple left turn lanes and limited southbound left turn capacity at 84th Street and Norman Center Drive. Concept B has "J-turns" also called "Michigan lefts" in the Normandale Boulevard median north and south of 84th Street. These J-turns were viewed as a greater negative because local drivers would not be familiar with this geometry and they were considered harder to integrate with future improvements to the I-494/TH-100 interchange. Thus, refined Concept A was determined to provide the higher level of design simplicity and driver comfort.