URS Transportation

MEMORANDUM

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To: **Project File**

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Subject: Solberg Avenue / I-229 Grade Separation: Traffic Analysis

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INTRODUCTION

This technical memorandum documents the findings of a traffic analysis for the Solberg Avenue grade separation of I-229. The proposed Solberg Avenue grade separation would extend Solberg Avenue from approximately 59th Street to 69th Street. This traffic analysis report discusses the evaluation of existing traffic conditions and the No Build alternative under future year traffic volume conditions. The objective of the No Build alternative analysis is to define the expected future operational characteristics of the current arterial and freeway roadway systems within the project study area. The analysis consists of a detailed traffic operations analysis of the arterial intersections, freeway mainline and the ramp junctions within the project study area. The rest of this document contains a discussion of the following:

- Study Area Roadways
- Traffic Operations Analyses Methodologies
- Existing Condition Traffic Volumes
- Findings of the Existing Conditions Traffic Analyses
- Future Year (2033) Traffic Forecast
- Findings of the Future Year (2033) No-Build Conditions Traffic Analyses

STUDY AREA ROADWAYS

A description of the key freeway and arterial roadways within the study is provided below:

Freeway Facilities

- Four lanes are provided on I-29 (2 lanes in each direction)
- Four lanes are provided on I-229 between I-29 and the Louise Avenue interchange (west ramps). East of the Louise Avenue interchange, I-229 has six lanes.
- The existing I-29 / I-229 system interchange has three legs and uses a trumpet type interchange design.

- All ramps at the I-29 / I-229 system interchange contain a single lane at the merge/diverge ramp junction.
- The I-229 / Louise Avenue interchange uses a diamond design with one loop ramp provided in the southwest quadrant for the southbound Louise Avenue to northbound I-229 traffic movement.
- All ramps at the I-229 / Louise Avenue interchange contain a single lane at the merge/diverge ramp junction, except for the southbound off-ramp. At that ramp junction there is a two lane off-ramp with vehicles in the center lane on southbound I-229 (upstream of the ramp junction) have the option of either continuing southbound on I-229 or exiting to Louise Avenue.

Arterial Roadways

- Solberg Avenue is currently a four-lane divided arterial roadway between 57th and 59th Street. Traffic signal control is provided for the intersection with 57th Street.
- Louise Avenue is currently a five-lane divided arterial roadway between 57th and 74th Street. In that segment there are two northbound lanes and three southbound lanes. Traffic signal control is provided for the Louise Avenue intersections with 57th Street, 59th Street, I-229 southbound ramp, I-229 northbound ramp and 69th Street.
- Tallgrass Avenue is currently a two-lane dirt/gravel roadway between 69th and 85th Street.
- 57th Street is currently a four-lane divided arterial roadway between Marion Road and Louise Avenue. West of Marion Road, 57th Street has two-lanes plus a continuous two-way left-turn lane.
- 69th Street currently has a variety of cross sections and surface conditions. East of Louise Avenue, it is currently a four-lane divided arterial roadway. Between Louise Avenue and Connie Avenue (one block segment), a four-lane divided roadway is provided. Between Connie Avenue to just west of Sharon Avenue, 69th Street has two-lanes plus a continuous two-way left-turn lane. Between Sharon Avenue and Medical Court West (western access point to Avera Health Center), 69th Street is currently a two-lane undivided roadway. Between Medical Court West and SolbergAvenue / Tallgrass Avenue, 69th Street is currently a two-lane dirt/gravel roadway. All intersections along 69th Street, west of Louise Avenue, utilize stop sign control with 69th Street as the free-flow movement.

The roadway and intersection geometrics were primarily derived from aerial photography and GIS data provided by the City of Sioux Falls and supplemented through fieldwork. Traffic signal timing was also obtained from the City of Sioux Falls.

ANALYSIS METHODOLOGY

The evaluation of existing and future traffic conditions for these three interchanges consisted of traffic operations analyses for the freeway system and the arterial street system. A brief summary of the analysis methodologies is provided below.

Freeway System

Traffic capacity and level of service determinations for the study area freeway system were made based on the theory and methodologies contained in the *2000 Highway Capacity Manual* (HCM). The Highway Capacity Software (HCS, Release 4.1e) was used to facilitate the application of the HCM procedures. The HCS was used for the operational analyses of basic freeway segments, ramp junctions, and weaving segments.

For the purposes of this project, a deficiency is defined as level of service D (LOS D) or worse. Level of service is a term used to qualitatively describe roadway and intersection traffic operations. Level of service is expressed as letters A to F, with LOS A representing the best operating conditions and LOS F the worst. The measures of effectiveness for basic freeway segments and ramp junctions are discussed below:

- *Basic Freeway Segments* – The level of service of a basic freeway segment is defined by the density of traffic flow in passenger cars per mile per lane (pc/mi/ln). Density is a measure of the quality of the speed of flow, the ability to maneuver, and the proximity to other vehicles on the freeway. Table 1 provides the LOS criteria for basic freeways.
- *Ramp Junctions* – The level of service of a ramp junction is also defined by the density of traffic flow in passenger cars per mile per lane (pc/mi/ln) within the influence (merge or diverge) area of the ramp junction. Table 2 provides the LOS criteria for ramp junctions.

Arterial Street System

Traffic capacity and level of service determinations for study area intersections were also made based on the theory and methodologies contained in the HCM. These procedures and methodologies were facilitated using the Synchro (version 6) program. For the purposes of this study, a deficiency is defined as LOS D or worse.

At signalized intersections, level of service is based on the weighted average of all approach delays. For unsignalized intersections, the LOS is based on the worst minor street movement delay (usually the left turn movements on the cross street). Table 4 provides the LOS criteria for signalized and unsignalized intersections.

Table 1. Level of Service Criteria for Basic Freeway Segments [a]

Level of SERVICE	Maximum [b] Density	Minimum [c] Speed	Max. Service [d] Flow Rate	Max. v/c Ratio
A	11	70	770	0.32
B	18	70	1260	0.53
C	26	68.2	1770	0.74
D	35	61.5	2150	0.90
E	45	53.3	2400	1.00

Notes:
a – Assumed free-flow speed = 70 mph.
b – Density is the primary determinant of LOS. Density is measured as passenger cars per mile per lane (pc/mi/ln).
c – Speed is measured at the maximum density for a given LOS. Speed is measured as miles per hour (mph)
d – Maximum service flow rate is measured as passenger cars per hour per lane (pc/hr/ln).

Source: 2000 Highway Capacity Manual, Exhibit 23-2.

Table 2. Level of Service Criteria for Ramp Junctions

LEVEL OF Service	Density (pc/mi/ln)
A	≤ 10.0
B	> 10.0 – 20.0
C	> 20.0 – 28.0
D	> 28.0 – 35.0
E	> 35.0
F	Demand exceeds Capacity

Note: Density is the primary determinant of LOS for ramp junctions. Other factors (e.g., maximum volumes for merge/diverge area) can result in lower LOS.

Source: 2000 Highway Capacity Manual, Exhibit 25-4.

Table 4. Level of Service Criteria for Intersections

Level of Service	Control Delay per Vehicle (s/veh)	
	Signalized Intersections	Unsignalized Intersections
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

Source: 2000 Highway Capacity Manual, Exhibit 16-2 and Exhibit 17-2 .

EXISTING CONDITION TRAFFIC VOLUMES AND GEOMETRICS

Existing condition traffic volumes for the AM and PM peak hours is provided in Figure 1. These traffic volumes were derived from the following data sources:

- Intersection turn movement counts were provided by the City of Sioux Falls.
- Freeway ramp counts that included hourly and daily volumes were conducted by the SDDOT for the I-29 / I-229 interchange.
- Average daily traffic (ADT) was obtained from three sources listed below:
  - *Traffic Volumes Counts for the City of Sioux Falls, 2002-2006*
  - *2006 South Dakota Traffic Flow Map* produced by the SDDOT
  - A spreadsheet of roadway link volumes provided by the SDDOT

The intersection turn movement counts were collected over a number of years and at different times of the year. These factors result in traffic volume differences that were adjusted during a "smoothing" process in order to develop more consistent turn movement volumes between up and downstream intersections. The intersection turn movement counts at interchange ramp terminal intersections were also used to determine the interchange ramp volumes.

The SDDOT ramp counts for the interchange of I-29 / I-229 provided the peak hour volumes for I-229 between the I-29 and Louise Avenue interchanges. Development of other peak hour freeway volumes required a conversion from daily traffic volumes. In urban areas, the percentage of daily traffic volume that occurs during a peak hour typically ranges from 8.0 to 10.0% on freeways. For a freeway like I-229 the peak hour percentage may be a little higher because there are less through vehicles using this facility as opposed to I-90. All of these factors were used to develop "smoothed" traffic volumes for the freeway facilities.

EXISTING CONDITION TRAFFIC ANALYSIS

The results of the traffic operations analyses for existing conditions are summarized in Figure 2. A summary of the traffic analyses results is provided below:

- Two ramp junctions currently operate at LOS C during at least one peak period.
  - I-229 / Louise Avenue southbound off-ramp
  - I-29 southbound on-ramp from southbound I-229
- Three signalized intersections within the study currently operate at LOS D or worse during at least one peak period.
  - 57th Street / Marion Road
  - 57th Street / Louise Avenue
  - Louise Avenue / I-229 southbound ramp

The intersection of Louise Avenue / I-229 southbound ramp currently experiences heavy delays and queuing during both the AM and PM peak periods.

FUTURE YEAR (2033) TRAFFIC FORECAST

The purpose of this section is to give a brief overview of the future year (2033) no-build traffic forecasts developed for both the freeway and arterial roadways within the study area. These forecasts were originally developed as part of the larger I-29 Corridor Study that is evaluating improvement alternatives along I-29 between 41st Street and Highway 106 (Tea interchange). The I-29 Corridor Study takes into account recent land use modifications within the study area and also revised the future analysis year from 2025 to 2033.

The traffic forecasts were developed based on application of the Sioux Falls MPO Regional Travel Model. The Sioux Falls regional model currently has a base year (2000) scenario and future year (2025) scenario. URS staff worked with MPO staff to making refinements to the 2025 model in the I-29 Corridor Study area to produce a model that reflects anticipated 2033 travel demand conditions in the I-29 Corridor Study area. URS staff also coordinated forecasting efforts with HDR Engineering staff for the Sanford Research Park property, a major proposed medical research and retail development on Tallgrass Avenue south of the proposed Solberg Avenue overpass. HDR is responsible for the traffic impact study for the Sanford development. URS worked with HDR and MPO staff to ensure that the 2033 land use assumptions in the model reflect the Sanford Development.

Daily Traffic Forecast Development

The traffic forecasts are based on application of the updated 2033 Sioux Falls MPO Regional Travel Model. The following bullets summarize the model and how it was applied for the forecasts:

- Subdividing the 2025 model's traffic analysis zone (TAZ) structure in and around the study area. Based on discussions with local planning staff and developers, there is significant land development growth anticipated in the study area, particularly in the area south of 69th Street / north of County Route 106 / west of Tallgrass / east of Sundowner. In the original 2025 TAZ structure, this area was defined by portions of three TAZs. In the subdivided zone structure used for the 2033 study model, this area was defined by nine TAZs. This refined TAZ structure provided much more precise model traffic assignments for the Solberg Study area compared to the previous TAZ structure.
- The base 2033 model network and forecasts includes an extension of 59th Street between Solberg and Louise Avenue and also includes both the east side and west side corridors.
- The travel model output includes AM peak (7:00 to 9:00), PM peak (4:00 to 6:00), Off-peak and daily assignments. The model was calibrated for daily conditions only. Thus, the daily traffic assignments for the base year (2000) and the refined 2033 model were the basis for the forecasts.
- The daily forecasts were developed by comparing existing daily traffic counts (from SDDOT inventory data and daily counts from the City of Sioux Falls) to the existing condition daily model assignments, and applying the observed base year absolute difference to 2033 traffic assignments. Due to the high growth in traffic assignments between 2000 and 2033, only absolute adjustments were made to 2033 assignments.

The 2033 daily traffic forecasts are shown in Figure 3, with 2007 average daily traffic counts also shown. As shown in the daily traffic forecasts, there is significant traffic growth anticipated in the study area over the planning horizon, as this area has been targeted for large increases in employment and housing between today and 2033.

Peak Hour Traffic Forecast Development

The daily forecasts were the basis for developing the 2033 peak hour forecasts. The peak hour traffic forecasts were developed by reviewing:

- *Current peak hour traffic characteristics.* In currently established corridors, the existing peak hour percentages of daily traffic and turning movement proportions were used as a starting point for developing 2033 peak hour turning movement forecasts. However, several of the interstate segments currently experience peak hour volumes that are in the range of 12 to 13 percent of daily traffic. It was assumed that as traffic volumes increase substantially through the planning horizon that the percentage of daily traffic occurring during the peak hours would moderate somewhat. This adjustment accounts for the tendency for peak hour percentages to decline as peak hour traffic levels / congestion increases.
- *Model Projected Travel Patterns*: In the corridors that were anticipated to experience the most growth (e.g. Louise Avenue south of I-229), a select link analysis of model-projected travel desire lines were reported and reviewed. This review was used to establish forecasted general travel patterns along high-growth segments, and was applied as an

element in forecasting travel patterns and turning movements during the 2033 peak hours.

- *Sanford Site Traffic Forecasts*: The Sanford site analysis traffic information provided by HDR, including turning movements, peak hour percentages of daily traffic and directional traffic patterns had a significant impact on the forecasts that URS developed for the remainder of the Solberg Study area, particularly on our intersections that are adjacent to the Sanford study area.
- *MPO-Projected Socio-Economic Patterns:* The updated 2033 socio-economic/land use scenario was reviewed to evaluate how peak hour travel would likely change from existing patterns. Adjustments were made to peak hour percentages of daily traffic and peak hour directional split based on identified locations of new employment and housing.

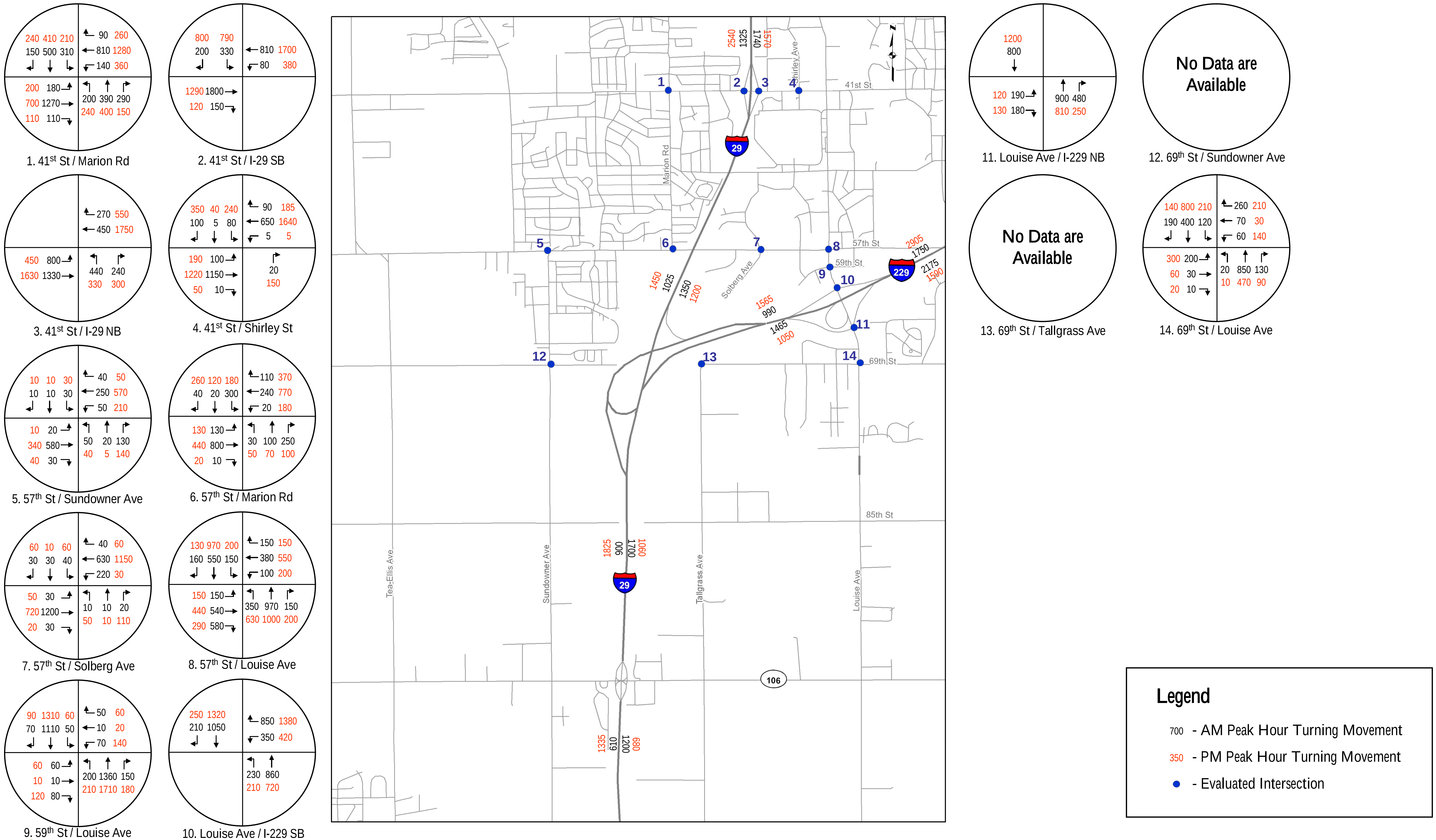
These adjustments were made to the currently observed peak hour traffic patterns and applied to the daily forecasts to develop the 2033 peak hour traffic volumes. The 2033 peak volumes were then smoothed between intersections and ramps so that the volumes leaving an upstream intersection / interchange were equal to those entering the downstream intersection / interchange. These adjustments were applied to the 2033 daily forecasts to develop both AM and PM peak hour forecasts in the Solberg study area.

FUTURE YEAR (2033) TRAFFIC ANALYSIS

The results of the traffic operations analyses for future year (2033) no-build conditions are summarized in Figure 4. A summary of the traffic analyses results is provided below:

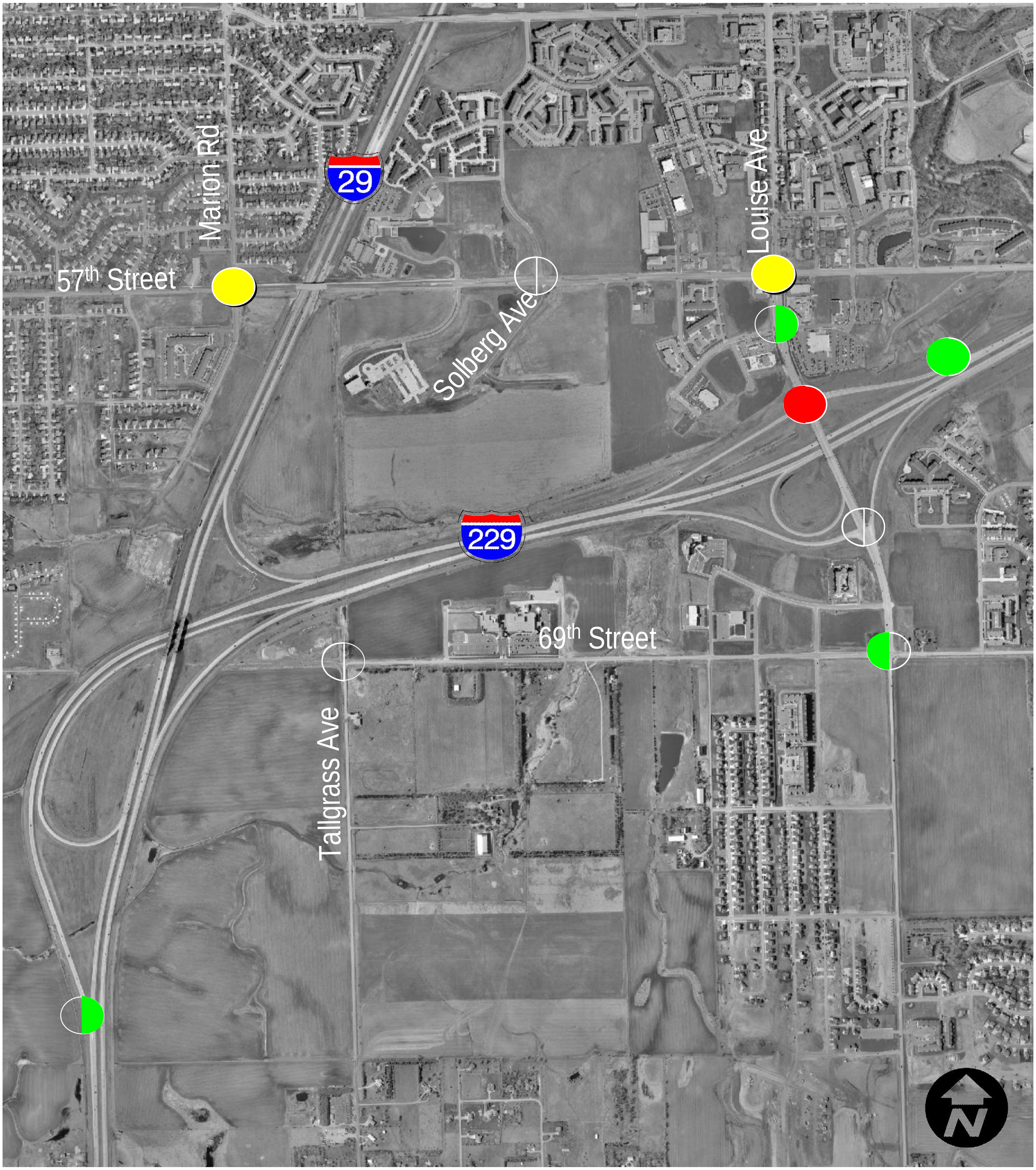
- Three basic freeway segments are projected at LOS D or worse during at least one peak period. This analysis assumes no additional improvements (e.g., auxiliary lanes) are provided to increase mainline capacity.
  - Southbound I-29 between 41st Street and I-229 (PM peak)
  - Southbound I-29 between I-229 and Tea [Highway 106] (PM peak)
  - Northbound I-29 between Tea and I-229 (AM peak)
- All of the I-29 / I-229 system interchange ramp junctions and both southbound I-229 ramp junctions at Louise Avenue are projected to operate at LOS D or worse during at least one peak period.
- Each of the signalized intersections along the Louise Avenue and 57th Street corridors are projected to operate at LOS D or worse during at least one peak period.
- The 69th Street / Solberg Avenue (Tallgrass Avenue) intersection only has two legs under the no-build scenario and operations are projected to LOS B or better.

Many of the signalized intersections with poor levels of service (LOS F) for are projected to significantly exceed the 80 second threshold established for LOS F operations.



I-29 Corridor Study
41st Street to CR 106
URS

Figure 1. I-29 Corridor Study Existing (2007) Peak Hour Traffic Volumes



Legend

- LOS C (Segment/Junction)
- LOS D (Segment/Junction)
- LOS E/F (Segment/Junction)
- AM/PM Junction LOS

FIGURE 2. I-29 / 69th Street Overpass and I-229 / Solberg Avenue – Tallgrass Overpass Traffic Operations Summary, Existing Conditions

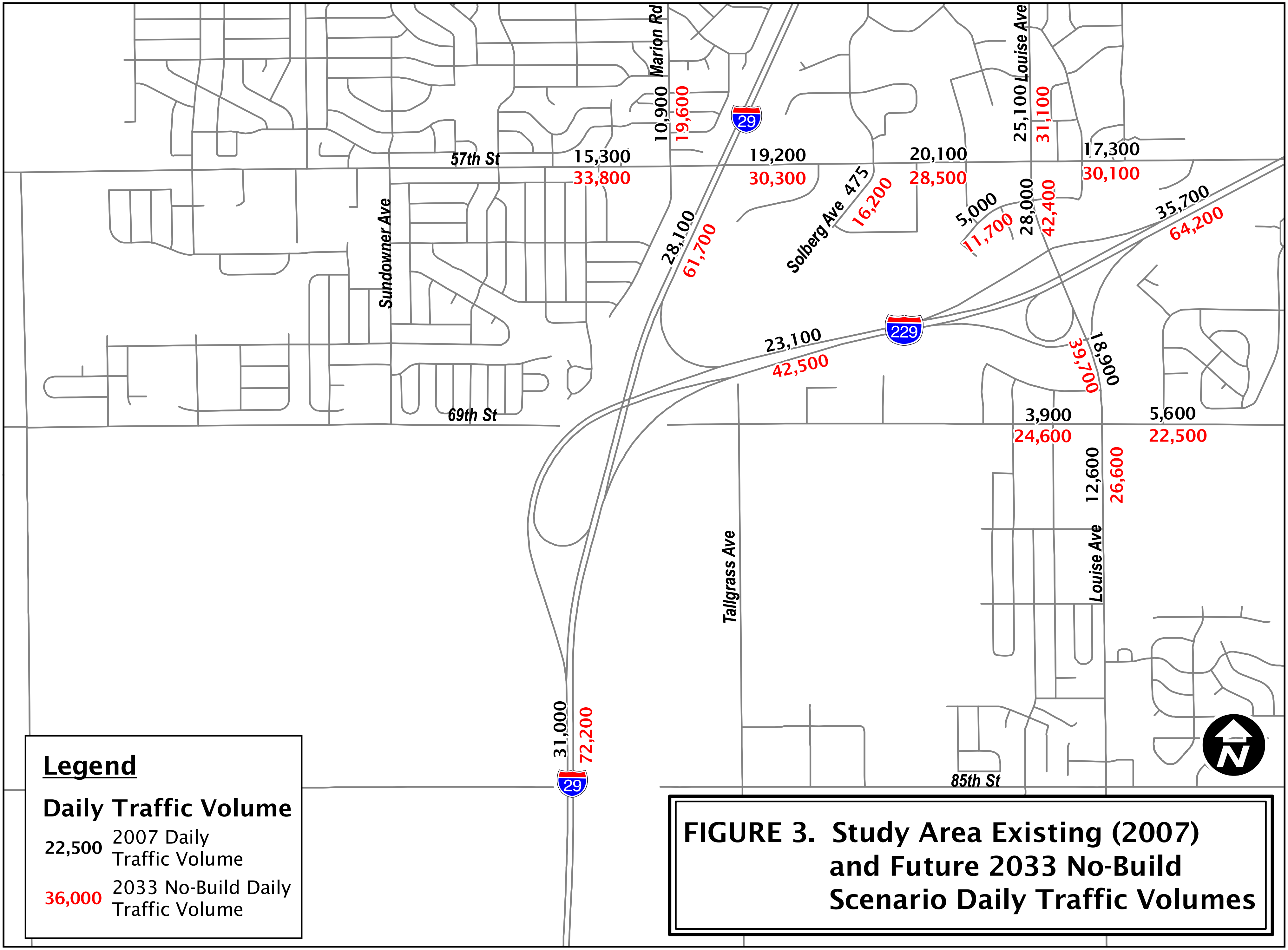
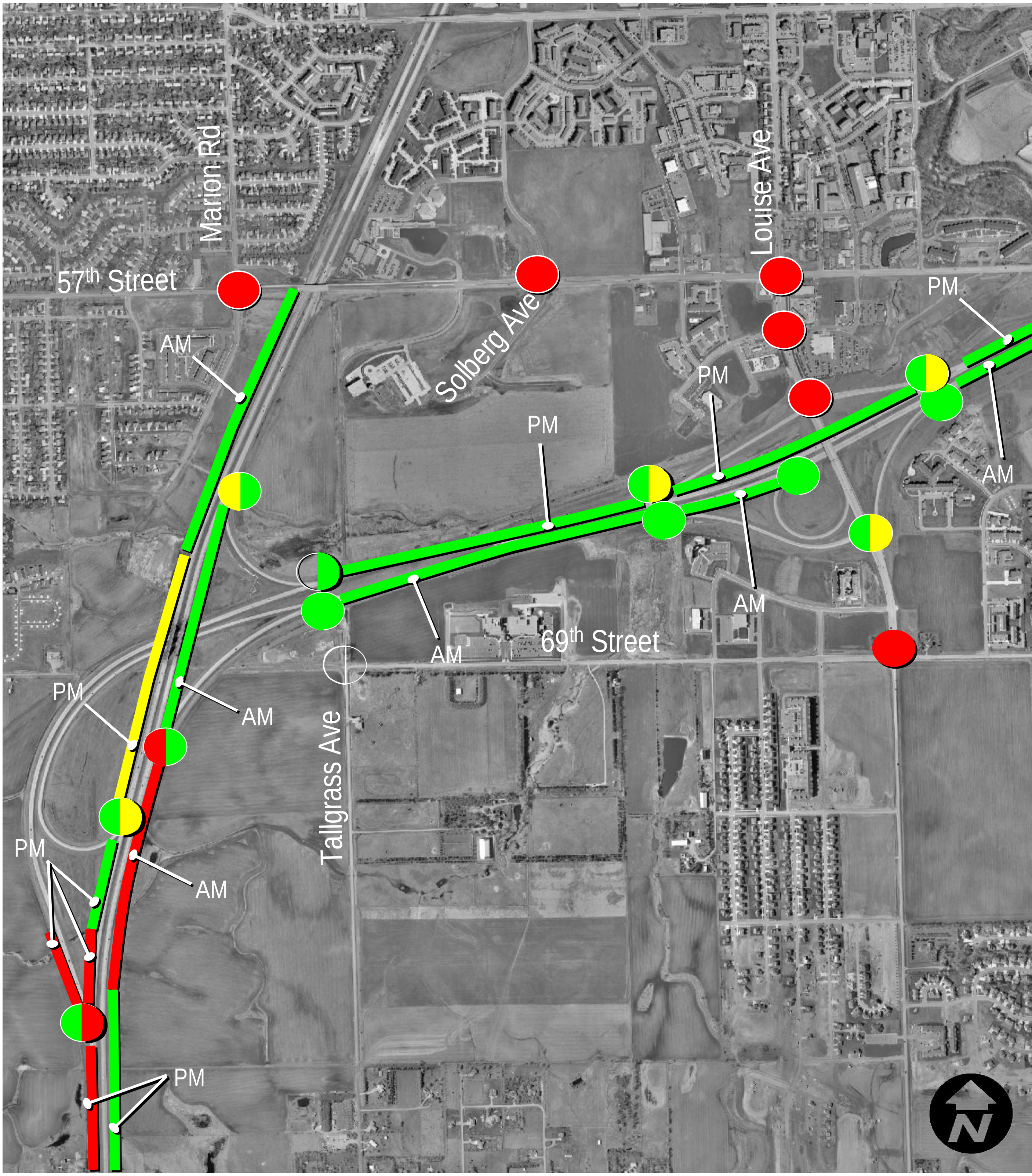


FIGURE 3. Study Area Existing (2007) and Future 2033 No-Build Scenario Daily Traffic Volumes



Legend

- LOS C (Segment/Junction)
- LOS D (Segment/Junction)
- LOS E/F (Segment/Junction)
- AM/PM Junction LOS

FIGURE 4. I-29 / 69th Street Overpass and I-229 / Solberg Avenue – Tallgrass Overpass Traffic Operations Summary, Future No-Build Conditions