159th Street and US 69 Break-In-Access Request

Engineering and Operational Concept

April 21, 2006

prepared for:
City of Overland Park, Kansas
Kansas Department of Transportation

HNTB

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159th Street and US 69 Interchange Break-In-Access Request

1.0 Introduction

The City of Overland Park requests approval from the Kansas Department of Transportation (KDOT) for a new point of access on US 69 at 159th Street. This break-in-access request provides the necessary documentation regarding access breaks as outlined in the Kansas Department of Transportation's Standard Operating Manual dated March 1, 1999. This break-in-access request includes the necessary analysis and documentation that the proposed access break at 159th Street and US 69 meets the eight requirements required by KDOT.

1.1 BACKGROUND

The City of Overland Park, Kansas, is a rapidly growing community of 162,728 (2004 census estimate) and ranks as the second largest city in the state of Kansas. The city is located in Johnson County along the south side of the greater Kansas City metropolitan area. Overland Park is located within the Kansas City urbanized boundary and is part of the Mid-America Regional Council's (MARC) metropolitan planning boundary. Major highways serving Overland Park are I-35, I-435, and US 69.

Figure 1
Regional Map

The U.S. Census indicates that Johnson County's population has increased 46% since 1990. Overland Park has experienced significant growth southward along the US 69 corridor, and to accommodate the continued growth in this region, the I-35/US 69 Major Investment Study (MIS) was undertaken. Completed in 2001, the MIS identified the need for improvements to the US 69 corridor, most notably a new interchange at 159th Street.

The South Metro Corridor Study, led by MARC, is currently underway to study a new or improved east/west roadway that would connect US 69 to US 71. The corridor study limits are 175th Street to the north and 199th Street to the south. The study limits for the South Metro Corridor Study are outside the limits of the Break-in-Access study.

1.2 LOCATION

The proposed interchange will be located along US 69 at 159th Street. The study area for the break-in-access request extends north/south along US 69 from the 151st Street interchange to the 167th Street interchange. The study area also includes Metcalf Avenue on the east and Antioch Road on the west as shown in Figure 2.

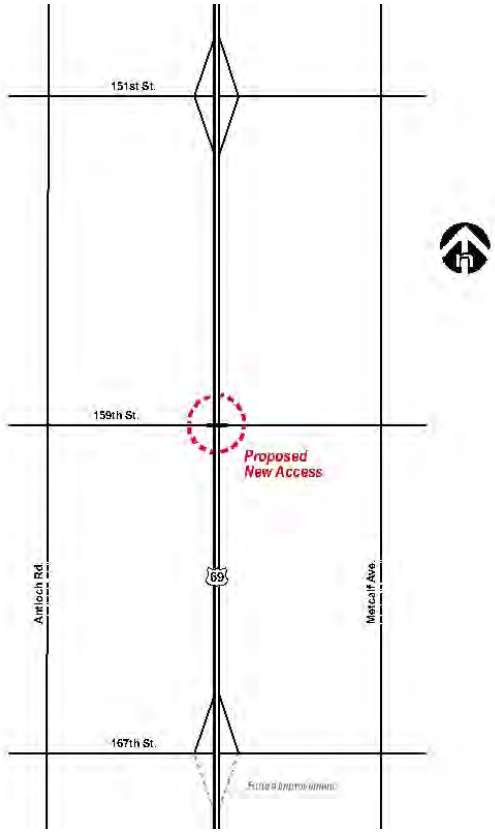


Figure 2
Study Area

1.3 PROJECT HISTORY

The need for an interchange at 159th Street and US 69 has been anticipated for almost 20 years. The I-35/US 69 Major Investment Study (2001), sponsored by the Kansas Department of Transportation (KDOT), identified new highway access at 159th Street as part of an overall plan to improve the US 69 corridor. In addition, the following studies have documented the need for the proposed interchange.

- Interchange Feasibility Study (US 69 and 159th Street), 1989
- 151st Street from Antioch Road to Metcalf Avenue Preliminary Design Study, 1994
- 159th Street from Antioch Road to Metcalf Avenue Preliminary Engineering Study, 1999

1.4 PURPOSE

A new interchange is needed to relieve congestion at the existing US 69/151st Street interchange and along the 151st Street corridor, increase traffic safety through the study area, provide access to existing and future community facilities in the study area, and to support economic development in the area.

At the initial stage of the study, a coordination meeting was held with KDOT to establish the break-in-access study criteria. During this initial stage of the study, 2035 was agreed upon by KDOT and the City of Overland Park as the design year for the break-in-access request. This met the criteria of setting a design year that was 20 years beyond when the proposed interchange improvements would be constructed.

Traffic Relief

The interchange will reduce traffic on the heavily used corridors in the study area. The traffic analysis (see Traffic Report, Appendix A) estimated a reduction in traffic demand along the heavily traveled 151st Street corridor and interchange with US 69, as well as a reduction in traffic on Metcalf Avenue and Antioch Road.

Safety

Because the proposed interchange will reduce traffic on heavily used corridors in the study area, a reduction in accident rates can be expected. Less congested travel corridors will improve safety for motorists who use those corridors. Currently, the 151st Street Corridor, and 151st and US 69 Interchange, has one of the City's highest accident rates. The 159th and US 69 Interchange is expected to reduce traffic congestion and improve safety in the study area.

Access to Community Facilities

The construction of the interchange will serve existing and future community facilities in the study area.

- Cedar Hills Elementary School, Pleasant Ridge Middle School, Blue Valley West High School, and Westminster School are all located along Antioch Road between 159th Street and 167th Street. Blue Valley High School and Stanley Elementary School are located on 159th Street east of Metcalf Avenue.
- There are numerous churches within the study area, and more are expected to be constructed. Four are located in the study area west of US 69, and one is currently located east of US 69.
- A fire station of the Overland Park Fire Department is located at the intersection of 159th Street and Metcalf Avenue.

Economic Development

The US 69 and 159th Street interchange will provide access to the planned commercial, office, residential, and industrial land use in this area, where there are tremendous development opportunities for mixed-use office/retail development. Land-use forecasts from the Overland Park travel model indicate that the area south of 151st Street is only 13% fully built out.

2.0 Break-In-Access

The following addresses the requirements for a break-in-access identified in the Kansas Department of Transportation's Standard Operating Manual dated March 1, 1999.

2.1 EXISTING FACILITIES

> *"The existing interchanges and/or local roads and streets in the corridor can neither provide the necessary access nor be improved to satisfactorily accommodate the design-year traffic demands while at the same time providing the access intended by the proposal."*

The study area is currently served by full local highway access at 151st Street and partial (to and from the north) local highway access at 167th Street. Currently the interchange at 151st Street and US 69, and the 151st Street corridor (between Antioch Road and Metcalf Avenue), experience traffic congestion and delays on individual movements during peak travel hours.

With the projected development in the study area, the existing interchanges will be unable to handle the future traffic demands in this area. Improvements to the 151st Street corridor were completed in 1997. The design for these improvements was based on the assumption that the 159th Street interchange would be constructed to help relieve traffic along the 151st Street corridor. A second southbound right turn lane is currently being designed for the 151st Street Interchange off-ramp. The purpose of the improvement is to improve safety at the intersection

of the southbound off-ramp and 151st Street by bringing the southbound to eastbound movements under signal control. This improvement is planned to be constructed in 2007.

Planned development in this area includes residential, office, business park and commercial development that will be better served with adjacent access to 159th Street. The proposed interchange also will help stimulate economic development in this region. Development in the area is currently in the early stages and at less than half of the 2035 design year and full build-out. Table 1 below indicates the percentage of projected 2035 development that has been built. As development continues within the area, traffic will increase, creating operational and safety problems at existing interchanges and on the major corridors within the study area.

Table 1
Percent of 2035 and Full Build-out Land Use Currently Built

Land Use	Study Area[1]		South of 151st Street[2]	
	Housing	Office, Commercial, Industrial	Housing	Office, Commercial, Industrial
Percent current land use of 2035 projections	53%	43%	14%	17%
Percent current land use of full build-out (2050) projections	52%	30%	13%	11%

Source: Overland Park Travel Model
1 Break-In-Access Study Area shown in Figure 2.
2 Overland Park Travel Model south of 151st Street. Model boundary is east to State Line, South to 215th Street and west to Renner Road.

2.1.1 Existing (2005) Conditions

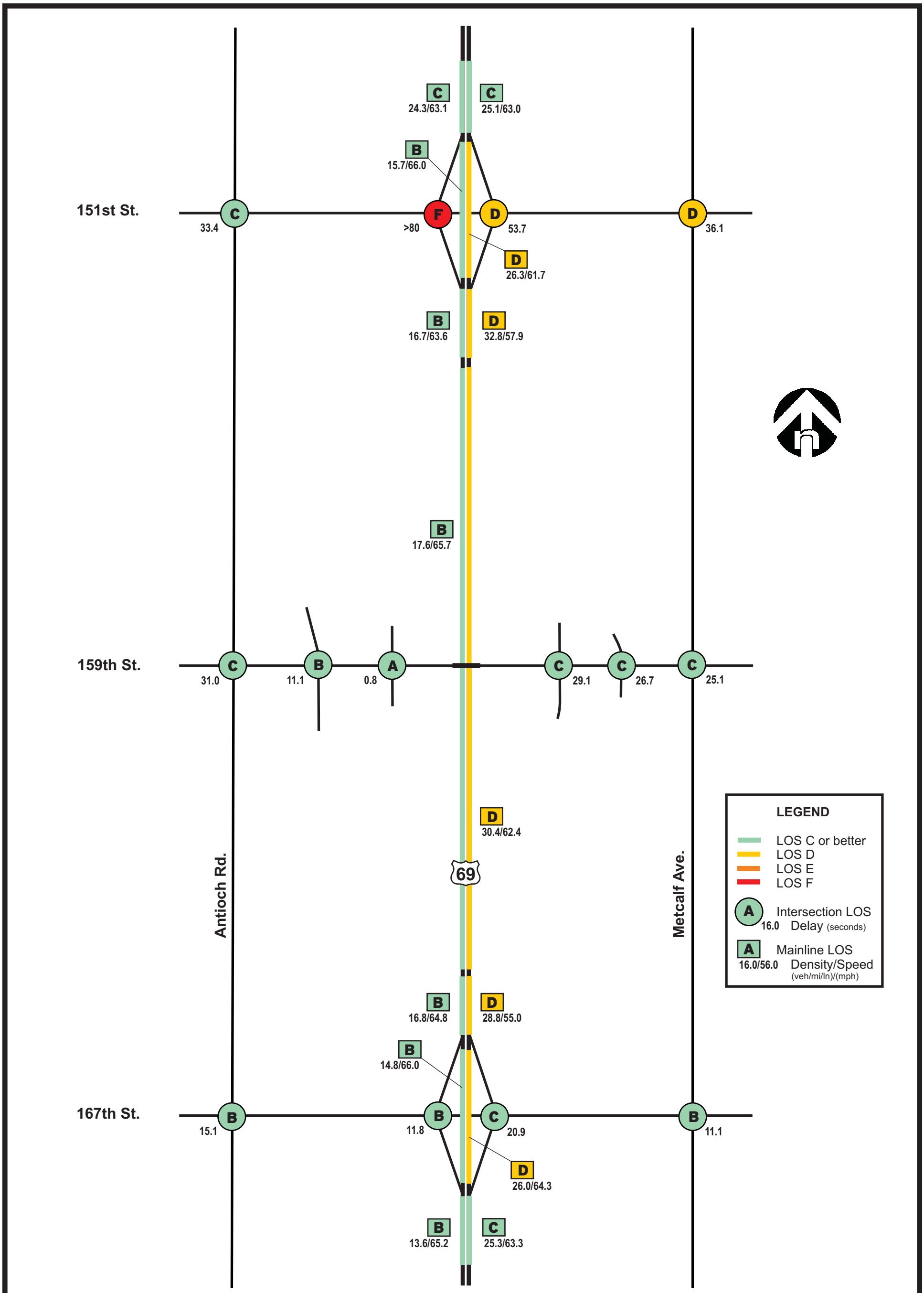
Existing traffic operations for the AM and PM peak hours were analyzed using the VISSIM simulation model. Desirable levels of service currently exist along US 69 and at the signalized study intersections. However, the traffic analysis indicates that individual movement failures are occurring, causing individual movement level of service (LOS) problems and long queues. As traffic volumes increase through the 151st Street and US 69 interchange and along the corridor, increases in vehicle queues and delay will push intersection levels of service to undesirable levels for the city and for KDOT.

2.1.2 Future (2035) No-Build Conditions

A future (2035) no-build traffic analysis was performed to provide an understanding of the traffic impacts associated without the addition of an interchange at 159th Street and US 69. "No-build" for this alternative means no interchange at 159th Street; however, other state and local roadway improvements would be completed. The future no-build alternative is defined as:

- No US 69 highway access at 159th Street
- Future widening of US 69 (six lanes south of 135th Street to 179th Street) including auxiliary lanes along US 69 both northbound and southbound, north of 151st Street
- Full access Interchange at US 69 and 167th Street
- Local street network improvements (i.e., widening of Antioch Road, Metcalf Avenue, 159th Street and 167th Street)

Figures 3 and 4 (also shown in the Traffic Report, Appendix A) show the future no-build AM and PM peak hour traffic operational analysis results. As shown in the exhibits, desirable levels of service are expected for the study area during the AM and PM peak hours with the exception of the southbound off-ramp to 151st Street.



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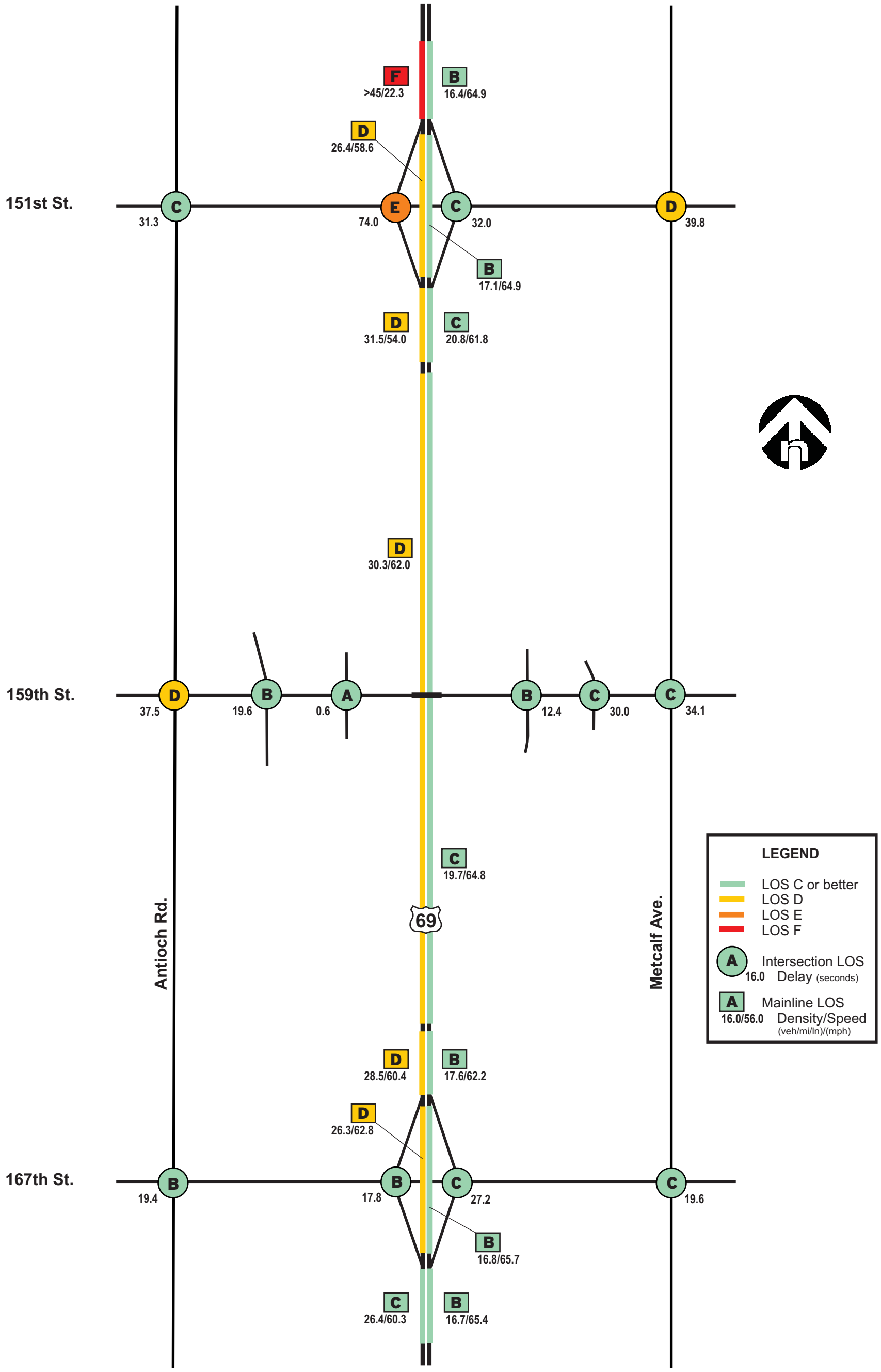
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 AM Peak Level of Service
No-Build

FIGURE
3



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TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 PM Peak Level of Service
No-Build

FIGURE
4

Significant delays and long vehicle queues are expected at the southbound off-ramp to 151st Street in the future in the no-build alternative due to two issues: (1) Continued development in south Overland Park would be primarily served by the 151st Street interchange. (2) This access point is not able to handle the increased traffic as a result of development south of the 151st Street corridor. As a result, the congestion at the southbound ramp terminal is expected to back up onto the highway mainline and create undesirable highway density and travel speeds, even after the planned 2007 project to add a second right turn lane to the southbound off-ramp at 151st Street is included in the analysis.

2.2 TRANSPORTATION SYSTEM MANAGEMENT

"All requests for new or revised access must be consistent with the metropolitan and/or statewide transportation system management plan."

The proposed interchange is consistent with *Mid-America Regional Council's (MARC) Transportation Outlook 2030.* Transportation Outlook 2030 is MARC's current long-range transportation plan (LRTP). The US 69 and 159th Street interchange is identified on a map of planned major corridor and interchange studies for the Kansas City metropolitan area. A map showing regionally significant capacity projects also identifies the interchange.

As documented in the I-35/US 69 MIS, US 69 highway will continue to serve as a transportation corridor for commuters into the Kansas City metropolitan area. Continued development southward is creating increased traffic demands on this corridor and the adjacent city street network. The study concluded that direct access to adjacent land will be important for the overall benefit of travelers in the area. The I-35/US 69 MIS limits extend south to 179th Street along US 69.

The I-35/US 69 MIS evaluated transportation system management (TSM) improvements to enhance the corridor operations. Some TSM improvements noted for the corridor include intelligent transportation system (ITS) and transit alternatives.

ITS within the study area is consistent with those being planned for the metropolitan area. In the urbanized Kansas City area, KDOT's policy is that any new interchanges should be designed to accommodate ramp metering. The I-35/US 69 MIS assumed that ramp metering would be included within the 159th Street and US 69 interchange. Ramp-metering analysis conducted in this study is provided in Appendix B.

2.3 OPERATIONAL ANALYSIS

"The proposed access point does not have a significant adverse impact on the safety and operation of the Interstate facility based on an analysis of current and future traffic."

Traffic analysis was performed to assess the impact of the proposed interchange on US 69 and the surrounding street network (see Appendix A – Traffic Report).

The analysis was performed to provide a comprehensive understanding of the impacts of adding an interchange at 159th Street. Alternatives analyzed include:

2035 No-Build Alternative

- No US 69 highway access at 159th Street

- Future widening of US 69 (six lanes south of 135th Street to 179th Street) including auxiliary lanes along US 69 both northbound and southbound, north of 151st Street
- Full access Interchange at US 69 and 167th Street
- Local street network improvements (i.e., widening of Antioch Road, Metcalf Avenue, 159th Street, and 167th Street)

2035 Build Alternative

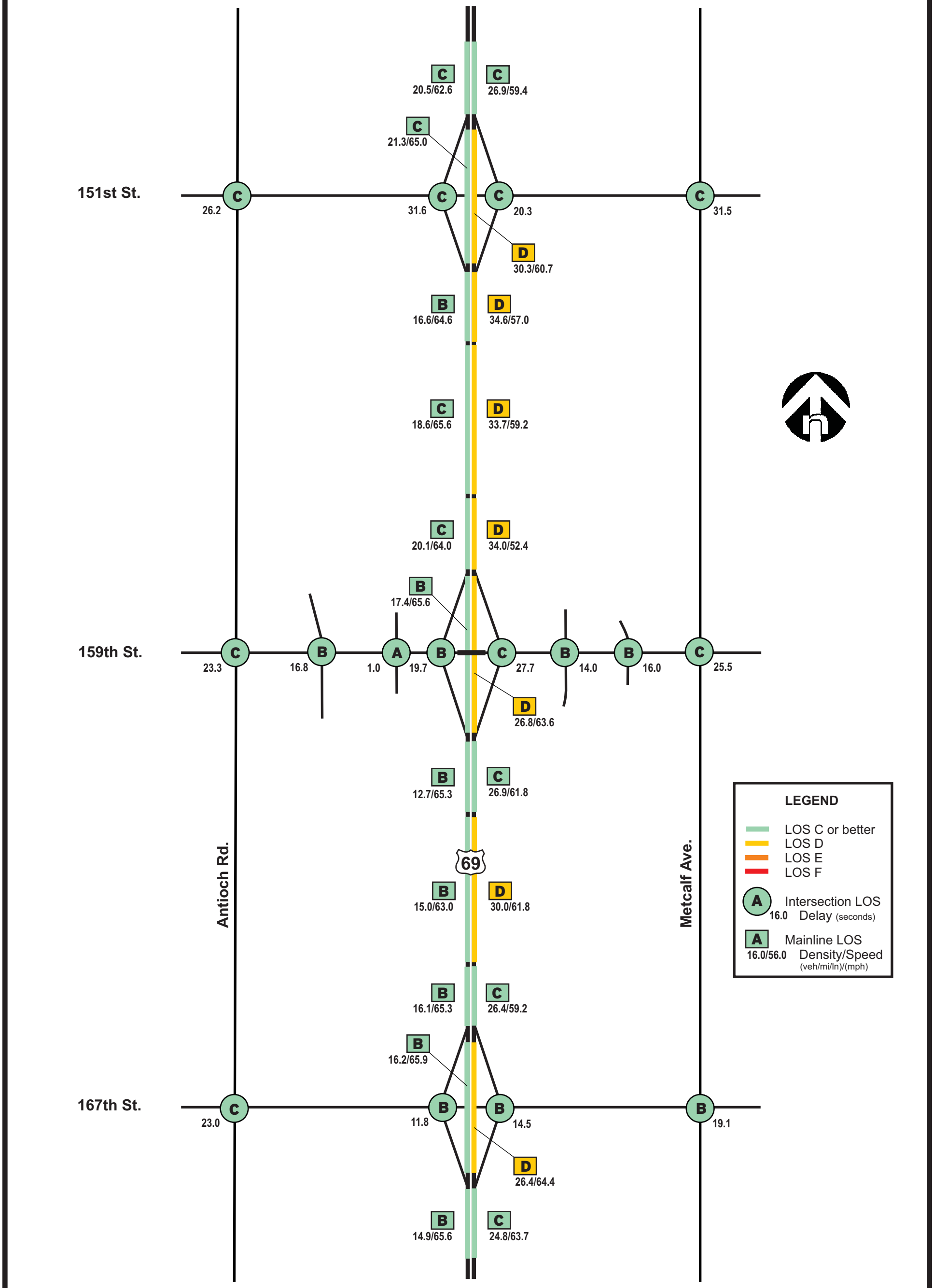
- Highway access at 159th Street (various interchange types were evaluated)
- Future widening of US 69 (six lanes south of 135th Street to 179th Street) including auxiliary lanes along US 69 both northbound and southbound, north of 151st Street plus southbound auxiliary lanes from 151st Street to 167th Street
- Full access Interchange at US 69 and 167th Street
- Local street network improvements (i.e. widening of Antioch Road, Metcalf Avenue, 159th Street, and 167th Street)

A VISSIM simulation model was developed to analyze the traffic impact on the freeway and local road network during future 2035 conditions. The traffic analysis used the Highway Capacity Manual (HCM*) 2000* methods to analyze VISSIM simulation output. Traffic studies, discussed in detail in Appendix A – Traffic Report, indicate that with the 2035 build alternative, desirable level of service results (LOS A through D) are achieved during the AM and PM peak hours in the build alternative as shown in Figures 5 and 6.

The build alternative initially included 6-lanes plus auxiliary lanes in both directions along US 69 north of 151st Street. From 151st Street to 159th, and 159th to 167th, the build alternative included only a 6–lane US 69. After initial analysis was completed, it was determined that an auxiliary lane in the southbound direction between 151st Street and 167th Street was necessary to achieve desirable level of service results. No auxiliary lane was necessary along the northbound lanes between 167th and 151st Street to meet capacity needs in the 2035 design year.

Delays and long vehicle queues shown in the no-build alternative are eliminated in the build alternative as a result of providing the additional 159th Street interchange access. As a result of the new access, traffic is spread over two off-ramps instead of just one at 151st Street and an improved level of service occurs along southbound US 69 highway and at the ramp terminals.

In summary, for the 2035 no-build condition, significant delays and congestion are expected to occur at the 151st Street interchange and along southbound US 69 in the vicinity of the 151st Street interchange. These problems are a result of future traffic growth exceeding available capacity at the 151st Street interchange. The analysis found that constructing the proposed 159th Street interchange and adding southbound auxiliary lanes between 151st Street and 167th Street on US 69 would allow all facilities, as defined in Exhibit A-14 – 2035 Intersection and Lane Geometry (Appendix A), to operate at acceptable levels of service during both peak hours through 2035. The new interchange would provide relief to adjacent interchanges and parallel corridors.



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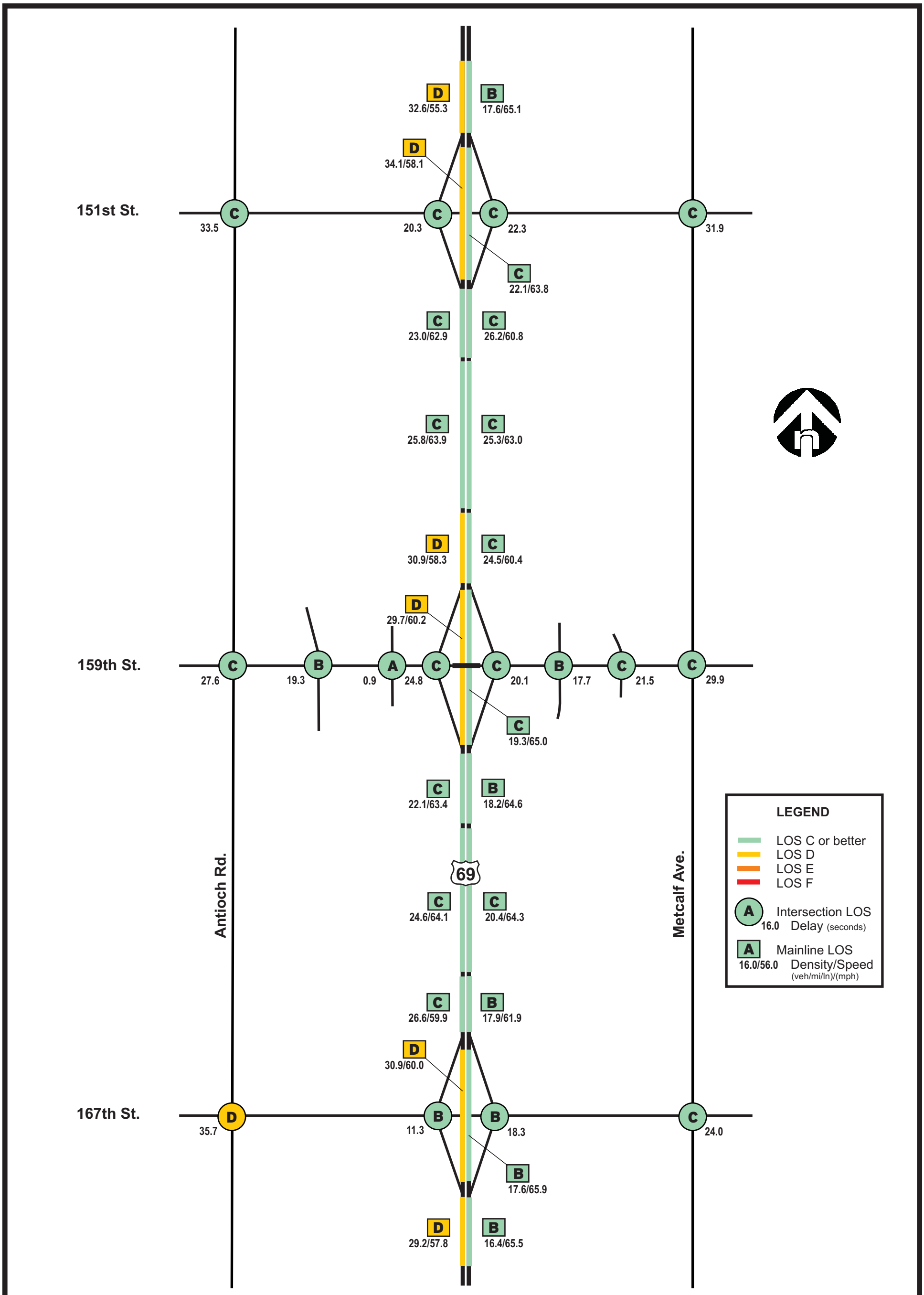
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 AM Peak Level of Service
Build

FIGURE
5



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TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 PM Peak Level of Service
Build

FIGURE
6

2.4 ACCESS CONNECTIONS AND DESIGN

"Less than full interchanges for special purposes may be considered on a case-by-case basis."

The proposed interchange will be designed with full access from both southbound and northbound lanes of US 69. The interchange will connect to existing 159th Street. Detailed plan plates of the 159th Street and US 69 interchange study area are shown in Appendix C.

2.4.1 Diamond Interchange

A diamond interchange is proposed at 159th Street and US 69, providing full access to 159th Street. This includes a 10-foot hike-and-bike path along the south side of 159th Street. The interchange impacts the WaterOne facility located in the northwest corner of the interchange. The WaterOne facility contains a maintenance building structure, an above-ground water storage facility, and associated pump facility. Figure 7 shows a general layout of the interchange, and a detailed plan of the interchange is located in Appendix C.

Alternative interchange types for this location were investigated. Previous studies identified a folded diamond for the southbound ramps and a standard diamond configuration for the northbound ramps. The folded diamond for the southbound ramps reduced the impact on the existing water storage/pump facility in the northwest quadrant of 159th Street and US 69. However, with the folded diamond interchange type, the southbound ramps are located farther away from US 69 and limit intersection locations between US 69 and Antioch Road.

The ramp terminal for a folded diamond interchange is typically located 800 ft. to 1000 ft. from the crossing facility (US 69). The ramp terminal for a diamond interchange is typically located 275 ft. to 400 ft. from the crossing facility. Using the folded diamond configuration will constrain the number of access points along 159th Street west of US 69 due to the required offset of the ramp terminal. This constraint will create problems with providing access to existing and proposed development in the area. The folded diamond configuration also requires much more right-of-way than a diamond interchange configuration.

Additional alternative interchange types were evaluated with the purpose of minimizing right-of-way needs, avoiding the water storage facility, and providing maximum distance between access points west of the interchange. A single-point urban interchange and tight urban diamond were investigated as alternative interchange options. Although there were benefits associated with right-of-way and access management for these two alternative interchange types, the physical impacts to the water storage facility could not be avoided. The cost of these two alternatives is significantly higher than the standard diamond interchange configuration.

Due to reasons stated above, the diamond interchange configuration was selected as the best overall option.

Figure 7
159th and US 69 Diamond Interchange

2.5 TRANSPORTATION LAND-USE PLANS

"The proposal considers and is consistent with local and regional land use and transportation goals."

The need for a new interchange along US 69 has been recognized in local and regional land use and transportation plans. Over the past 17 years the following studies have incorporated the proposed interchange in their planning efforts:

Overland Park

- Future Development Plan (last adopted in 2005)
- 159th Street Preliminary Engineering Study (1999)
- Interchange Feasibility Study (US 69 and 159th Street) (1989)

Regional

- Transportation Improvement Program -TIP (2006)
- MARC's 2030 Long-Range Transportation Plan (2005)
- I-35/US 69 MIS (2001)

2.5.1 City of Overland Park

Future Development Plan (2005)

The 159th Street interchange is included in Overland Park's future development plan, which is part of the city's comprehensive master plan. Last adopted in October 2005 (and updated on an annual basis), the future development plan identifies Overland Park's future vision for the study area. The plan is a graphic representation of land-use goals and policies of the city as identified in the text of the master plan.

While the study area is sparsely developed at the current time, rapid growth is occurring. The city's future development plan shows all types of land uses, including retail centers, office parks, residential neighborhoods, and public facilities. Figure 8 shows the 2005 adopted future development plan. To accommodate economic growth of the future land use, a transportation plan is also represented in the development plan. The transportation plan identifies the street functional classifications as well as the proposed 159th Street and US 69 interchange.

159th Street from Antioch Road to Metcalf Avenue Preliminary Engineering Study (1999)

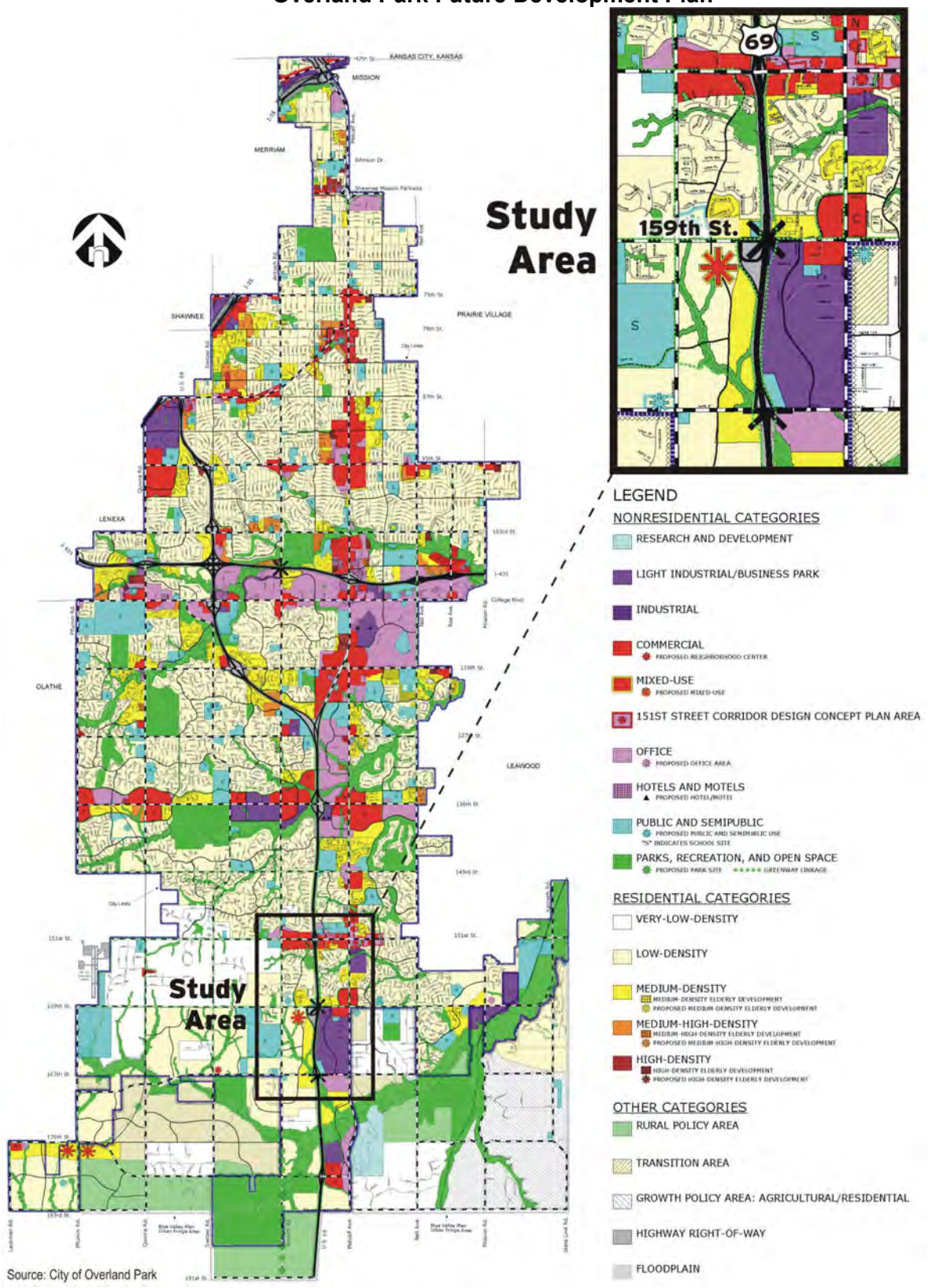
A study was performed to establish preliminary horizontal/vertical alignments for 159th Street (Antioch Road to Metcalf Avenue), Antioch Road (151st Street to 159th Street), and the proposed 159th Street and US 69 interchange. The purpose of the study was to develop a preliminary design to minimize impact to existing infrastructure and to serve as a planning tool for future development.

The recommended interchange configuration identified was a partial folded diamond interchange with the folded ramps in the southwest quadrant. This change from the 1989 study (see below) was made in response to comments from KDOT regarding the water storage facility being located within the loop ramp area.

Interchange Feasibility Study (US 69 and 159th Street) (1989)

An interchange feasibility study was performed for Overland Park and Johnson County in 1989 to identify the needed intersection improvements at 159th Street and Metcalf Avenue and to perform a study of the feasibility of an interchange at 159th Street and US 69. The study identified existing conditions, future growth patterns, facility needs, and interim improvements. It was concluded that an interchange between 151st Street and 167th Street was needed. A partial folded diamond interchange was identified, with the folded ramps in the northwest corner for the southbound direction and traditional diamond ramps for the northbound direction.

Figure 8
Overland Park Future Development Plan



2.5.2 Region

Transportation Improvement Program -TIP (2006)

As the designated metropolitan planning organization (MPO) for the Greater Kansas City area, the Mid-America Regional Council (MARC) maintains a financially-constrained transportation improvement program (TIP) for the region. The TIP contains individual transportation improvements and projects to be implemented in the next five years. Only the first three years are included in the state transportation improvement program (STIP).

The 159th Street and US 69 interchange is identified in MARC's project listing as TIP # 350021 – Widen 159th Street from two lanes to four lanes and construct interchange at US 69. Before construction and right-of-way phases proceed, a determination of engineering and operational acceptability will need to be made by KDOT.

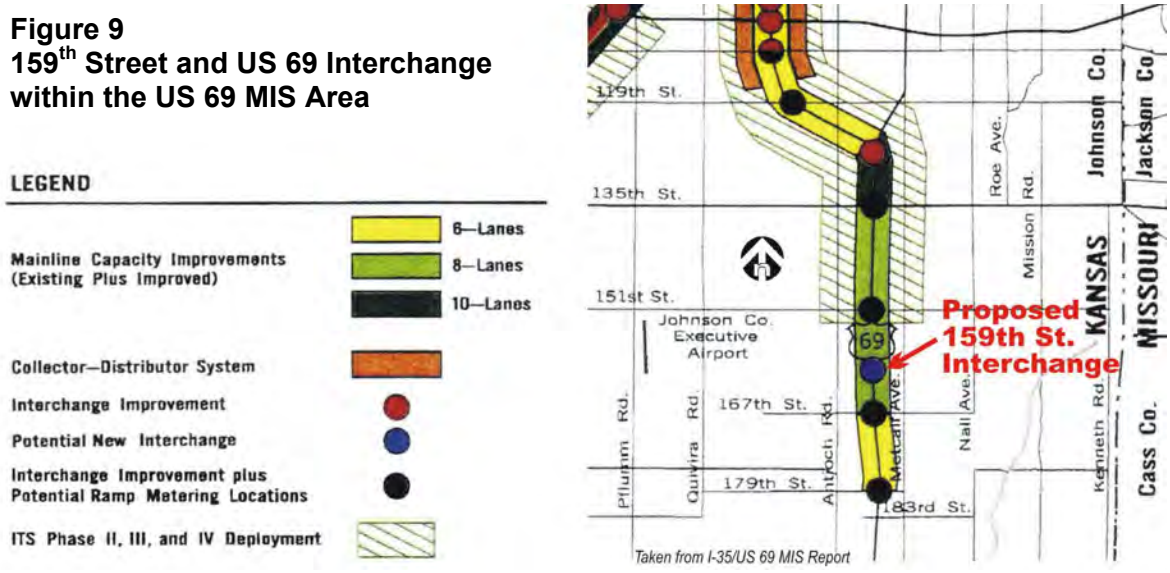
Mid-America Regional Council's Transportation Outlook 2030 (2005)

Transportation Outlook 2030 is MARC's current long-range transportation plan (LRTP). The US 69 and 159th Street interchange is listed on a map of major corridor and interchange studies for the Kansas City metropolitan area. A map showing regionally significant capacity projects also identifies the interchange.

I-35/US 69 Major Investment Study (MIS) (2001)

The I-35/US 69 MIS was sponsored by KDOT in coordination with MARC and several transportation agencies in Johnson County. The purpose of the study, with a design year of 2020, was to identify needed future improvements for the I-35 and US 69 highway corridors. The MIS southern study terminus along US 69 was 179th Street. Figure 9 illustrates the interchange study for the area of 159th Street and US 69 in relation to the US 69 MIS corridor.

Figure 9
159th Street and US 69 Interchange within the US 69 MIS Area



The primary study objectives were characterized as follows:

- Determine how to widen I-35 and US 69
- Determine impacts of widening
- Establish where new interchanges should be considered
- Plan for other modes of transportation within the study corridors
- Provide guidance to local agencies when making land-use decisions
- Provide guidance to the MPOs when making transportation planning and programming decisions

Based on the overall comparison of the benefits and impact of each combination strategy alternative using the evaluation methodology described in the report, and considering the trade-offs of each evaluation factor, the full build-out alternative (including modified C-D roadway, I-35 commuter rail upgrades, ITS improvements, and ramp metering) was recommended by the study management team as the most appropriate design concept and scope for the I-35/US 69 corridors. Specific recommendations regarding the implementation of alternative D within the 159th Street and US 69 interchange study area include the recommendation that US 69 be widened to a six-lane facility and that a new interchange be included at 159th Street. Improvements to adjacent US 69 interchanges at 151st Street and 167th Street were also identified in the study.

2.6 COMPREHENSIVE INTERSTATE NETWORK STUDY

"In areas where the potential exists for future multiple interchange additions or modifications, all requests for new or revised access are supported by a comprehensive interstate network study with recommendations that address all proposed desired access within the context of a long-term plan."

It is the position of the City of Overland Park that, other than the proposed access at 159th Street, no additional access will be pursued within the study area between 151st Street and 167th Street.

2.7 COORDINATION WITH TRANSPORTATION SYSTEM IMPROVEMENTS

"The request for a new or revised access generated by new or expanded development demonstrates appropriate coordination between the development and related or otherwise required transportation system improvements."

The City of Overland Park has been coordinating development of the area that will be served by the proposed interchange since the mid 1980s. As a consequence, city planners have programmed necessary local roadway improvements to coordinate with the design and construction of the proposed interchange. This has been accomplished through the Overland Park Capital Improvement Plan (CIP) process and in coordination with MARC through its transportation improvement plan (TIP). Projects are either underway or are planned to improve the local roads in the study area including 151st Street, 159th Street, Antioch Road, and Metcalf Avenue.

2.8 PLANNING AND NEPA PROCESS

"The request for new or revised access contains information relative to the planning requirements and the status of the environmental processing of the proposal."

The break-in-access request at 159th Street will undergo a National Environmental Protection Act (NEPA) review prior to the start of final design for the interchange. Because final approval for the break-in-access request cannot precede the completion of the NEPA process, this request is for a determination of engineering and operational acceptability. A screening-level environmental investigation has been performed in the vicinity of the proposed interchange. This review included archival research and review of published information regarding the corridor. On-site evaluations have not yet been performed; these will be accomplished during subsequent studies and evaluations. At the study screening level, terrestrial vegetative communities were documented with regard to threatened and endangered species of wildlife and plants within this area of Johnson County. Riparian corridors were also noted, including wetlands. In addition, cultural-resources documents were reviewed during the screening process. A summary of the noted general conditions follows by subject heading.

Topography

There is a rolling topography in the vicinity of the proposed interchange at US 69 and 159th Street. The difference in elevation varies from approximately 980 feet to 1070 feet, with a ridge located near the proposed interchange. The area drains both north and south of the proposed interchange.

Drainage Patterns

There are two major creeks in the vicinity of the intersection: Negro Creek to the northeast and an unnamed tributary of the Blue River to the southwest. Both of these streams flow eastward to their confluence with the Blue River. No stream crossings are located near the proposed US 69 and 159th Street interchange. Floodplains are defined for these streams and within areas north of the proposed interchange.

Wetlands

MARC recently released a report "On the Map: Conservation Planning for the Kansas City Region, February 2005". This included a number of environmental features drawn from a variety of sources, including the National Wetlands Inventory (NWI) maps. Any wetlands that might be identified within the general vicinity of the proposed interchange would be associated with streams, farm ponds, and detention areas.

Terrestrial Communities

Terrestrial communities, including grasslands, woodlands, and marsh, can be found in this area of the county. Both grassland and cultural grassland make up the majority of the communities in the vicinity of the proposed interchange. There are also small areas of marsh and wet herbaceous vegetation associated with farm ponds.

Urban forest is found in several locations in this vicinity, but this classification appears to show up in pockets of vegetation within developed areas. Deciduous woodland and immature forest include those areas previously altered through agriculture or forestry activities and can exhibit minimal subsequent management activities. These woodlands have self-regenerated and can exhibit a wide variety of species, composition, size, class, and appearance. These occur in a few areas near the proposed interchange.

Threatened and Endangered Species

For purposes of the screening-level study, research was done using the Kansas Department of Wildlife and Parks web site. Of the threatened and endangered species listed for the entire Johnson County area, five are noted as "endangered" by the state of Kansas and 10 are noted as "threatened." Within the entire Johnson County area, four species are listed as "endangered" by the US Fish and Wildlife Service and one is listed as "threatened." Further review of the site will be necessary to determine if any of these species are found within this specific vicinity.

Most of the grasslands, forests, and wetlands within this area of Johnson County have been degraded through past land-use practices and have minimal potential for providing habitat for resident or migratory species. These degraded habitats do have value, however, as they can form a buffer to high-quality habitats.

Cultural Resources

There are no known cultural sites in the vicinity of the proposed US 69 and 159th Street interchange. A review of the site files at the Kansas State Historical Society indicated a low probability for sites within the vicinity of the proposed interchange.

2.9 CONCLUSION

The City of Overland Park wishes to construct a new interchange along US 69 highway at 159th Street. Therefore a break in highway access is being requested to KDOT. The purpose of the new interchange is to relieve traffic congestion at the existing US 69/151st Street interchange and along the 151st Street corridor, increase traffic safety through the study area, provide access to existing and future community facilities in the study area, and to assist economic development in the area.

To ensure that the highway system is able to provide the best level of service in terms of safety and mobility, eight KDOT requirements were evaluated. The proposed highway plan and the attached report provide KDOT with the necessary information to demonstrate that acceptable levels of safety and mobility are achieved within the study area in the 2035 design year with the addition of the 159th Street and US 69 interchange.

Appendix C identifies the 2035 design year build project used in the break-in-access analysis. Once the access break review is completed, a next step will require KDOT and Overland Park to develop a plan defining the implementation of the build conditions including the specific improvements to be included with the interchange construction project.

APPENDIX A
Traffic Report

159th Street and US 69 Traffic Report

Appendix A

April 21, 2006

prepared for:
City of Overland Park, Kansas
Kansas Department of Transportation

HNTB

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Table of Contents (continued)

Attachments

APPENDIX A

159th Street and US 69 Interchange Traffic Report

1.0 Introduction

The City of Overland Park requests a break in highway access along US 69 at 159th Street. The purpose of this technical report is to document the detailed traffic operational analysis of the proposed changes to the surrounding transportation system.

The proposed interchange will be constructed along US 69 at 159th Street. The study area extends north/south along US 69 from the 151st Street interchange to the 167th Street interchange. The study extends from Metcalf Avenue on the east to Antioch Road on the west as shown in Exhibit A-1.

2.0 Methodology

2.1 DATA COLLECTION

The following data was gathered at the beginning of the study to assist in the evaluation of the traffic.

- 2005 Overland Park Travel Model
- Existing daily AM and PM peak hour traffic counts
- Existing lane geometrics and intersection control
- Existing travel-time studies conducted on all study area streets
- 2000 – 2005 accident data

2.2 FORECASTING

In 2005 a new Overland Park travel model was developed to forecast traffic for 2030 PM peak hour conditions. Existing 2005 and future 2030 land-use data was developed for the new model. The 2030 long-range regional model developed by the Mid-America Regional Council (MARC) was used as input for the regional travel characteristics. Compared to the previous Overland Park model, the roadway network was expanded south. The travel model was calibrated to 2005 existing conditions, and as a result, a 2030 PM peak hour traffic forecast was developed.

KDOT requested 2035 design year forecasts. To develop the forecasts, additional land use by location and intensity between 2030 and 2035 was identified by Overland Park's planning department. The travel model was then used to forecast 2035 PM peak hour traffic. Adjustments to future traffic volumes were made based on the base models ability to replicate existing traffic. The 2035 AM peak hour traffic was developed by transposing the PM trip table and applying an AM:PM ratio of trip generation by land-use type. The 2035 AM and PM peak hour forecasts were reviewed and approved by KDOT.

2.3 OPERATIONAL ANALYSIS

Operational results were characterized using analysis methods from the Highway Capacity Manual (HCM). The fundamental HCM parameter describing operational quality is level of service (LOS), an A (best) through F (worst) ranking scale. Overland Park and KDOT considered LOS D or better in the design year as the acceptable threshold for this study.

For freeway elements, LOS is based on density, defined as the number of vehicles per mile per lane. For intersections, LOS is based on the average control delay per entering vehicle. Control delay includes not only stops at intersections, but also slower speeds as vehicles advance in queue or decelerate upstream of an intersection. For the purposes of this study, the computer program VISSIM (version 4.10) was used to evaluate traffic operations. VISSIM is a micro-simulation model. The VISSIM model was calibrated to replicate existing conditions using field-measured travel speeds and existing traffic volumes. A Synchro model was developed to perform a preliminary assessment of needed intersection turning lanes and signal timings to be used in the VISSIM model. To determine anticipated operational conditions, the VISSIM models were run five times and the operational data was averaged.

The simulation model was used to evaluate freeway density and intersection delay in a way that would be analogous to HCM procedures. Table 1 shows the LOS ranges used to evaluate freeway lanes, signalized intersections, and unsignalized intersections.

Table 1
Level of Service Thresholds

LOS	**Freeways Mainline** Max Density (pc/mi/ln)	**Freeways Merge/Diverge** Max Density (pc/mi/ln)	**Signalized Intersections** Avg. Delay (sec/veh)	**Unsignalized Intersections** Avg. Delay (sec/veh)
A	≤ 11	≤ 10	≤ 10	≤ 10
B	> 11 – 18	> 10 – 20	> 10 - 20	> 10 - 15
C	> 18 – 26	> 20 – 28	> 20 - 35	> 15 - 25
D	> 26 – 35	> 28 – 35	> 35 - 55	> 25 - 35
E	> 35 – 45	> 35	> 55 - 80	> 35 - 50
F	> 45	Demand Exceeds Capacity	> 80	> 50

Source: Highway Capacity Manual 2000

3.0 Existing (2005) Conditions

3.1 TRAFFIC VOLUMES

Existing (2003-2004) AM and PM peak hour traffic counts for the signalized intersections in the study area were provided. Existing (2004) US 69 counts were obtained from a KDOT highway map. Exhibit A-2 shows the existing peak hour traffic volumes. A summary of US 69 and arterial traffic volumes are shown in Tables 2 and 3.

Table 2
Existing Counts
US 69 Traffic

Location	AM	PM
US 69 south of 151st Street	1,854 NB	1,660 SB
151st Street Interchange[1]	4,025	4,504

Source: Estimated based on 2004 ADT KDOT highway count map and I-35/US 69 existing directional distribution and percent in peak hour.
1 Interchange counts are represented by the total of all the interchange approach vehicles.

Table 3
Existing Counts
Arterial Traffic (Two-Way)

Location	AM	PM
Metcalf Avenue (South of 151st Street)	1,230	1,726
Antioch Road (South of 151st Street)	535	479

Source: City of Overland Park, 2003-2004

3.2 ROADWAY NETWORK

Exhibit A-3 shows the existing (2005) transportation network within the study area. The only four-lane divided roadway corridors that have been improved within the study area are 151st Street between Antioch Road and Metcalf Avenue and Metcalf Avenue between 151st Street and 159th Street. The remainder of the study area roadway network consists of rural two-lane roadways. There are currently signalized intersections along the 151st Street corridor. The only other signalized intersections within the study area are located along Metcalf Avenue at the intersections with 158th Street and with 159th Street.

US 69 currently has a full-access interchange at 151st Street and a partial access to and from the north at 167th Street within the study area.

3.3 OPERATIONAL ANALYSIS

Exhibits A-4 and A-5 show the existing AM and PM peak hour traffic operational analysis results. Existing signal timings were optimized for this analysis. As shown in the exhibits, desirable level of service currently exists along US 69 and at the signalized study intersections. However, traffic analysis indicates that individual movement failures are occurring. During the AM peak hour, a significant volume of westbound (i.e., right-turning) vehicles at 151st Street and the US 69 northbound on-ramp results in long vehicle queues and delay. During the PM peak hour, significant southbound volumes at the 151st Street and US 69 southbound off-ramp results in long vehicle queues and delay. As traffic volumes increase through the 151st Street and US 69 interchange and along the corridor, increases in vehicle queues and delay will push intersection level of service to undesirable levels for the city and for KDOT.

3.4 SAFETY

The traffic on the 151st Street corridor from Antioch Road to Metcalf Avenue will increase as development in south Overland Park continues. The City of Overland Park keeps extensive safety data for many of its roadways. Accidents that occurred between 2003 and 2005 are shown below.

Accidents on 151st Street (Antioch Road to Metcalf Avenue)

- 2005: 132 total accidents (31 mid-block accidents, 101 intersection-related accidents) – 18 were injury accidents
- 2004: 103 total accidents (18 mid-block accidents, 85 intersection-related accidents) – 23 were injury accidents
- 2003: 123 total accidents (31 mid-block accidents, 92 intersection-related accidents) – 18 were injury accidents

The interchange at 151st Street and US 69 is of particular concern regarding traffic accidents. Thirty-three accidents occurred in 2005 at the US 69 and 151st Street southbound off-ramp. This number ranks 12th on the list for high accident locations for 2005 in Overland Park. None of the other locations within the study area rank higher than 36th.

151st Street and US 69 Interchange Accidents

- 2005: 46 total accidents (33 on US 69 west side, 13 on US 69 east side) – six were injury accidents
- 2004: 32 total accidents (21 on US 69 west side, 11 on US 69 east side) – seven were injury accidents
- 2003: 42 total accidents (24 on US 69 west side, 18 on US 69 east side) – six were injury accidents

Exhibit A-17 in the addendum outlines the accidents that occurred along the 151st Street corridor from 2003 to 2005.

4.0 Future (2035) No-Build Conditions

4.1 TRAFFIC VOLUMES

Traffic forecasts for the future no-build and build conditions were developed from the Overland Park travel model. Exhibit A-6 shows the traffic growth from 2005 to 2035 during the PM peak hour in terms of trip origins and destinations from each traffic zone. The exhibit shows the magnitude of increased traffic, represented by the size of the pie graph, in each traffic zone. As indicated, a significant increase in traffic is anticipated south of 159th Street and west of US 69.

Exhibit A-7 shows the future 2035 no-build peak hour traffic volumes. A summary of US 69 and arterial traffic volumes are shown in Tables 4 and 5.

Table 4
Future 2035 No-Build
US 69 Traffic Forecasts

Location	AM	PM
US 69 south of 151st Street	5,568 NB	5,952 SB
151st Street Interchange[1]	6,151	6,713
167th Street Interchange[1]	2,412	2,789

1 Interchange forecasts are represented by the total of all the interchange approach vehicles.

Table 5
Future 2035 No-Build
Arterial Traffic Forecasts (Two-Way)

Location	AM	PM
Metcalf Avenue (South of 151st Street)	3,932	3,861
Antioch Road (South of 151st Street)	1,930	2,651
151st Street (East of US 69)	3,802	4,425
159th Street (West of US 69)	2,276	3,025
167th Street (West of US 69)	1,574	1,869

4.2 ROADWAY NETWORK

The future (2035) no-build provides a base condition to compare the future build network. The no-build network describes no interchange access at 159th Street and US 69. However, it does include other future network improvements programmed in the area. Exhibit A-8 provides a detailed description of the future no-build roadway network in the study area with more detailed lane geometrics shown along the 159th Street corridor. The future no-build alternative is defined as:

- No US 69 highway access at 159th Street
- Future widening of US 69 (six lanes south of 135th Street to 179th Street) including auxiliary lanes along US 69 both northbound and southbound, north of 151st Street
- Full access Interchange at US 69 and 167th Street
- Local street network improvements (i.e., widening of Antioch Road, Metcalf Avenue, 159th Street, and 167th Street)

4.3 OPERATIONAL ANALYSIS

The VISSIM simulation model was used to analyze future no-build conditions. Exhibits A-9 and A-10 show the future no-build AM and PM peak hour traffic operational analysis results. Table A-1a-d in the addendum shows the detailed results of the AM and PM peak hour operational analysis. As shown in the exhibits, desirable level of service is expected for the study area during the AM and PM peak hours with the exception of the southbound diverge to 151st Street and the southbound ramp terminal at 151st Street.

Significant delays and long vehicle queues are expected at the southbound off-ramp to 151st Street in the future with the no-build alternative, as continued development in south Overland Park would be served by the 151st Street interchange. High delay and poor level of service at the southbound ramp terminal is indicative of significant congestion within the entire interchange area. This access point is not able to handle the increased traffic as a result of development south of 151st Street corridor. As a result, the congestion at the southbound ramp terminal is expected to back up onto the highway mainline and create undesirable highway density and travel speeds.

5.0 Future (2035) Build Conditions

5.1 TRAFFIC VOLUMES

Traffic forecasts for the future build were developed from the Overland Park travel model. Exhibit A-11 shows the future 2035 build peak hour traffic volumes. A summary of US 69 and arterial traffic volumes are shown in Tables 6 and 7.

Table 6
Future 2035 Build
US 69 Traffic Forecasts

Location	AM	PM
US 69 south of 151st Street	6,025 NB (8% Increase)	6,508 SB (9% increase)
151st Street Interchange[1]	4,668 (24% decrease)	5,399 (20% decrease)
167th Street Interchange[1]	2,141 (11% decrease)	2,505 (10% decrease)

1 Interchange forecasts are represented by the total of all the interchange approach vehicles.

Table 7
Future 2035 Build
Arterial Traffic Forecasts (Two-Way)

Location	AM	PM
Metcalf Avenue (South of 151st Street)	3,510 (11% decrease)	3,681 (5% decrease)
Antioch Road (South of 151st Street)	1,856 (4% decrease)	2,481 (6% decrease)
151st Street (East of US 69)	2,965 (22% decrease)	3,743 (15% decrease)
159th Street (West of US 69)	3,027 (33% increase)	3,529 (17% increase)
167th Street (West of US 69)	1,555 (1% decrease)	1,852 (1% decrease)

As shown in these tables, shifts in peak hour traffic demand are expected as a result of the new 159th Street access. The US 69 interchanges at 151st Street and 167th Street would be expected to have a reduction in traffic as a result of the new access point at 159th Street, with the 151st Street interchange receiving the greatest reduction-in-traffic benefit. Exhibits A-12 and A-13 show the change in traffic between 2035 AM and PM peak hour traffic flow difference with and without an interchange at 159th Street and US 69.

5.2 ROADWAY NETWORK

The future (2035) build roadway network provides new freeway access at 159th Street compared to the no-build condition. The build condition provides a new full access diamond interchange at 159th Street and US 69 in addition to the no-build improvements identified in Section 4.2. Based on operational analysis, auxiliary lanes would be needed in the southbound direction between 151st Street Interchange and 167th Street Interchange.

Initially, the build alternative included a 6-lane US 69 plus auxiliary lanes in both directions along US 69 north of 151st Street. From 151st Street to 159th and 159th to 167th the build alternative included only a 6-lane US 69. After initial analysis was completed, it was determined that an auxiliary lane in the southbound direction was necessary to achieve desirable level of service thresholds. No auxiliary lane was necessary along the northbound lanes between 167th and 151st Street to achieve capacity needs in the 2035 design year.

Exhibit A-14 provides a detailed description of the future build roadway network in the study area with more detailed lane geometrics shown along the 159th Street corridor. Some of the important components of the network include:

- Highway access at 159th Street (various interchange types were evaluated)
- Future widening of US 69 (six lanes south of 135th Street to 179th Street) including auxiliary lanes along US 69 both northbound and southbound, north of 151st Street, plus southbound auxiliary lanes from 151st Street to 167th Street.
- Full access Interchange at US 69 and 167th Street
- Local street network improvements (i.e. widening of Antioch Road, Metcalf Avenue, and 167th Street)

5.3 OPERATIONAL ANALYSIS

The VISSIM simulation model was used to develop the operational analysis for the future build conditions. Exhibits A-15 and A-16 show the future build AM and PM peak hour traffic operational analysis results. Detailed results of the AM and PM peak hour operational analysis are shown in Table A-1a-d. The VISSIM model results indicated that a desirable level of service is expected within the study area during the AM and PM peak hours.

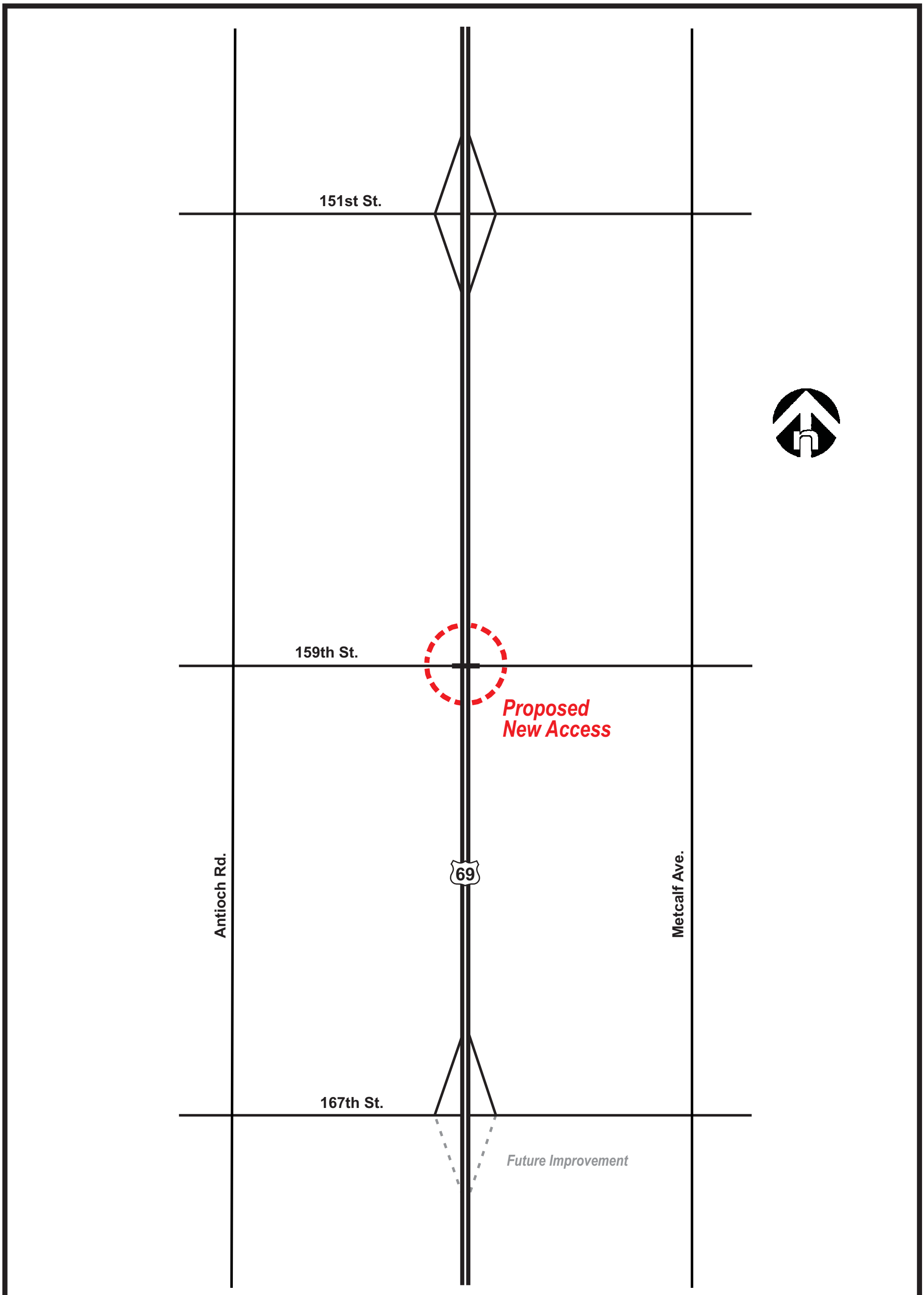
Delays and long vehicle queues that were observed in the future no-build alternative at the 151st Street interchange were eliminated in the build alternative as a result of the additional 159th Street interchange access. The addition of the new interchange also allows traffic to spread over two off-ramps instead of impacting just one interchange at 151st Street. Therefore, an improved level of service occurs along US 69 at the existing 151st Street ramp terminals as a result of the addition of the 159th Street interchange.

Auxiliary lanes in the northbound direction from the 167th Street on-ramp to the 151st Street off-ramp could be added to maximize safety due to the one-mile interchange spacing and close proximity of on-ramp and off-ramps, however, they are not needed for capacity reasons. In addition, auxiliary lanes in the northbound direction would help extend the capacity of US 69 mainline beyond the 2035 design year.

6.0 Conclusions

The analysis indicates that, under existing conditions, there are no locations that experience comprehensive undesirable level-of-service conditions. However, some individual movements have begun to fail in the 151st Street corridor. Increased traffic in the study area will worsen the traffic congestion around the 151st Street interchange to undesirable conditions. By the 2035 design year and under no-build conditions, significant delay and congestion are expected at the 151st Street interchange and along southbound US 69. These conditions are a result of problems associated with the 151st Street interchange as future traffic growth overtakes available capacity. Further, the analysis found that constructing the proposed interchange at 159th Street with US 69 mainline and auxiliary lane improvements would allow all facilities evaluated in the study area to operate at acceptable levels of service during both peak hours in 2035. The new interchange would provide relief to adjacent interchanges and parallel corridors thus enhancing safety in the area.

ATTACHMENTS



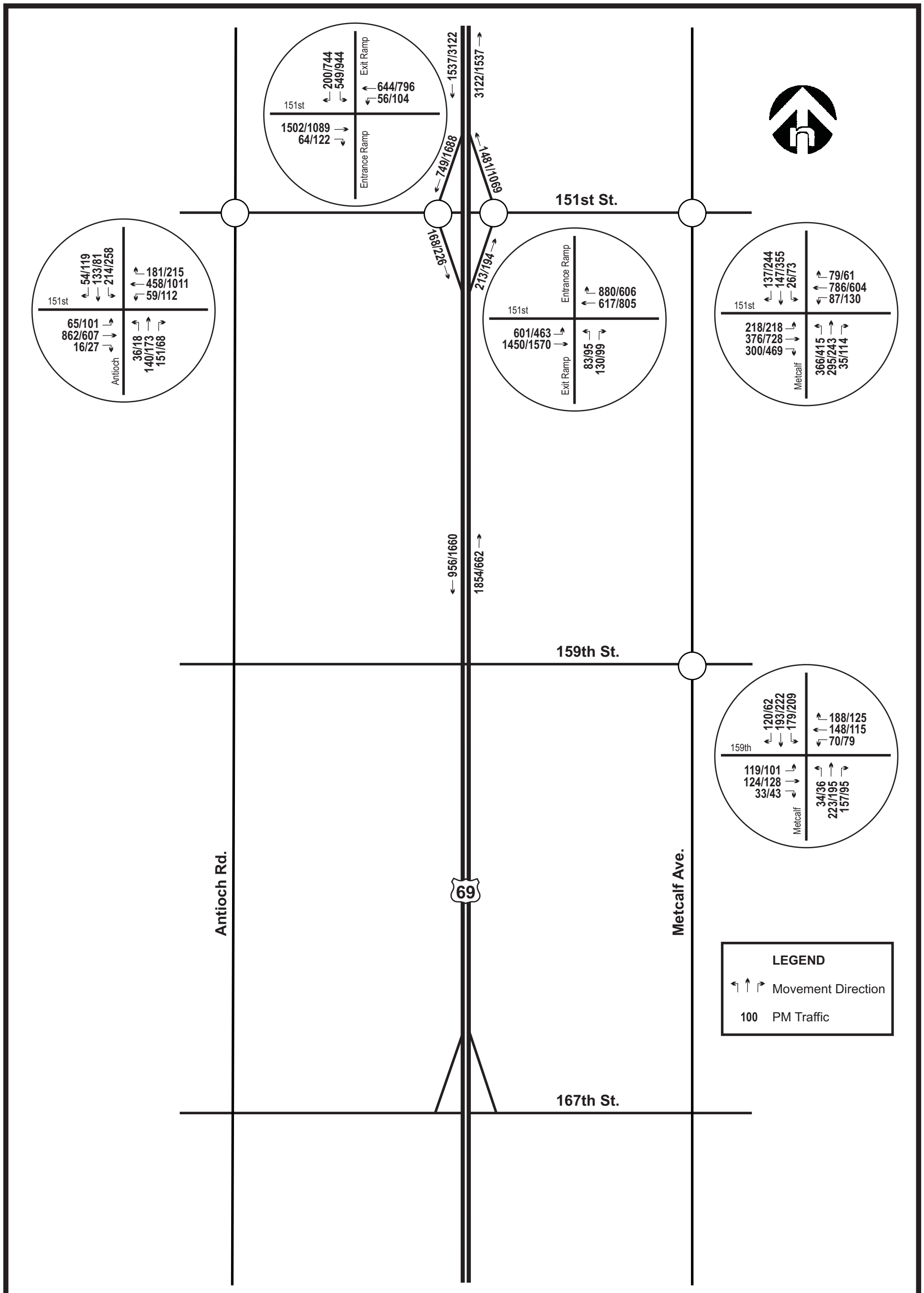
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

HNTB

Study Area

EXHIBIT

A-1



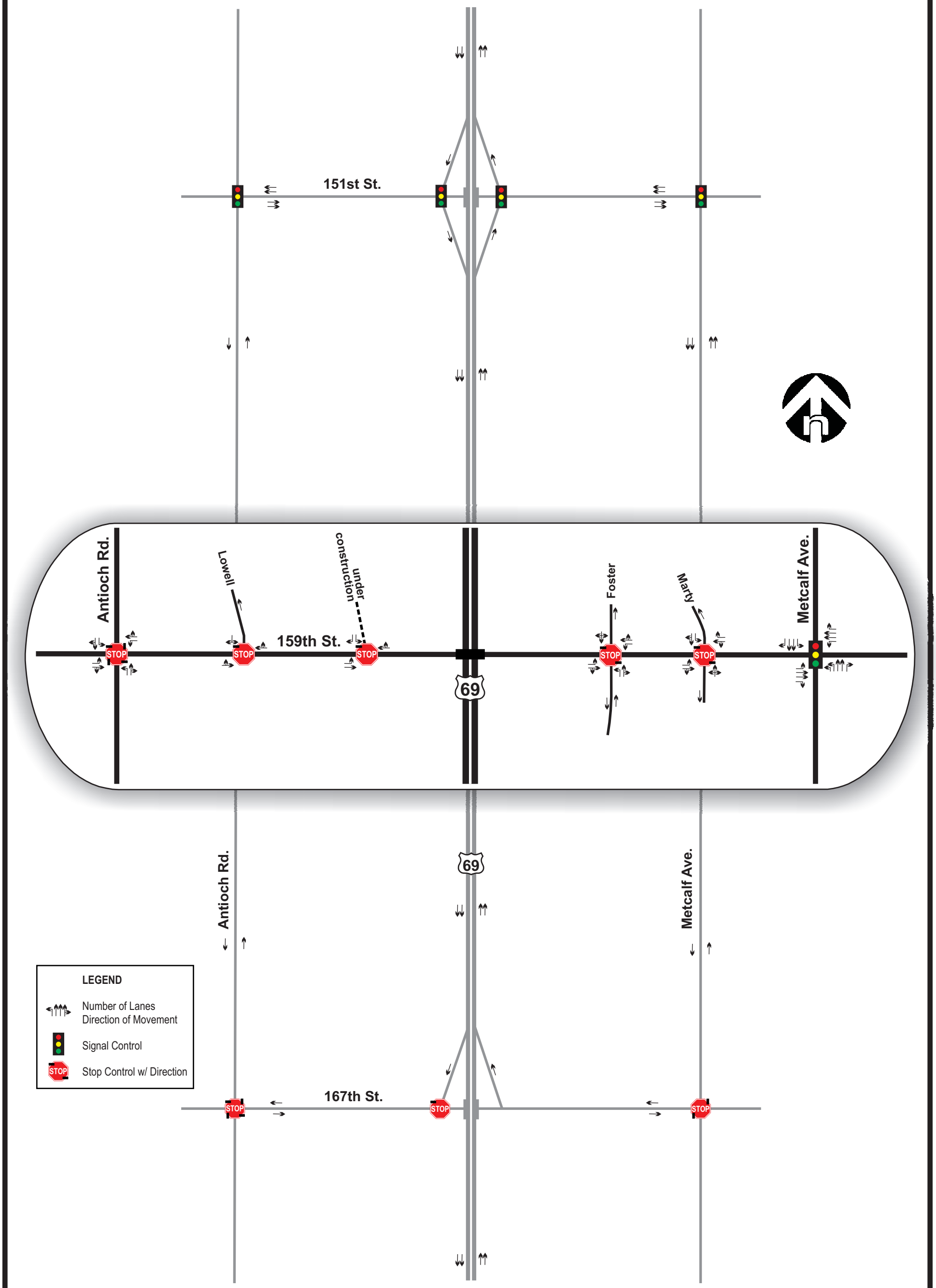
HNTB

TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

Existing AM/PM Peak Hour Traffic

EXHIBIT

A-2



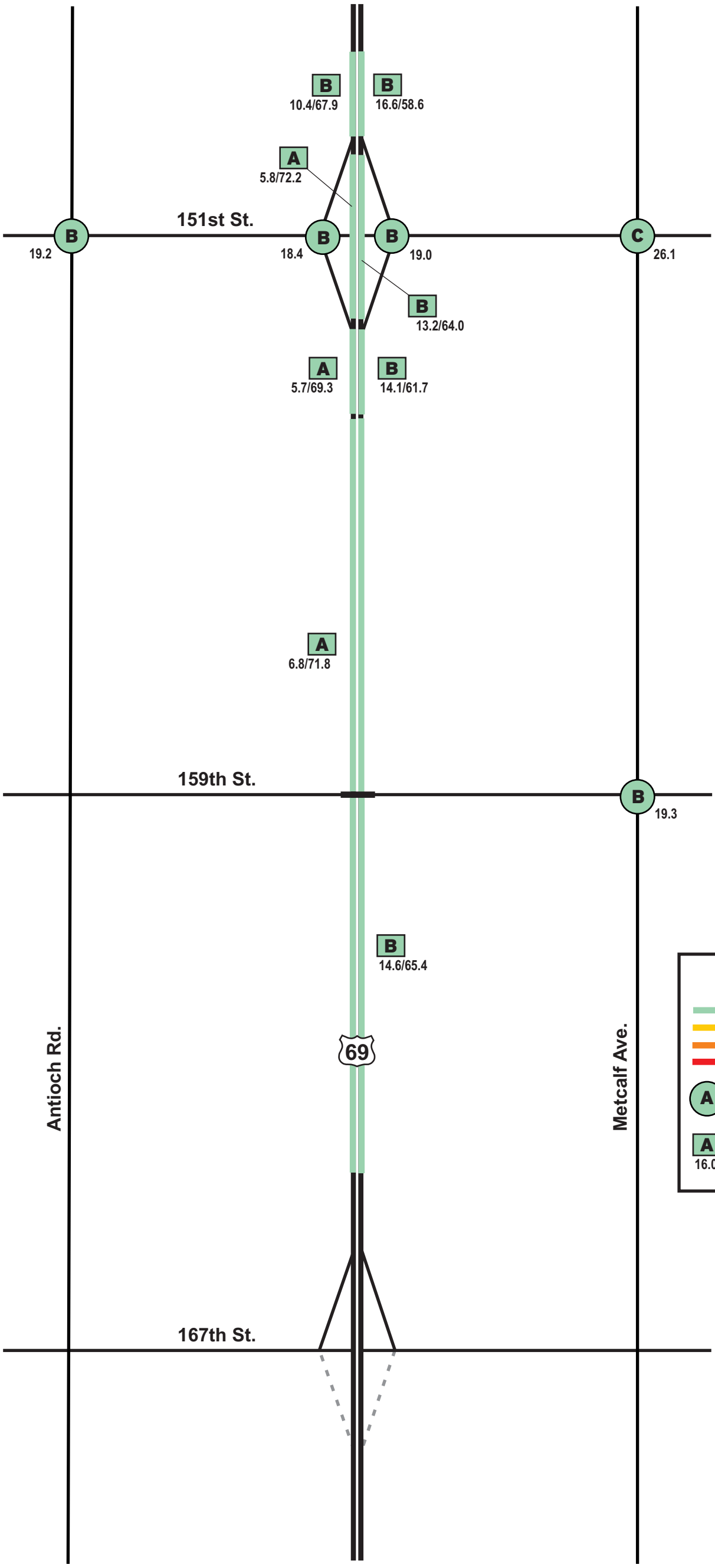
HNTB

TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2005 Intersection and Lane Geometry

EXHIBIT

A-3



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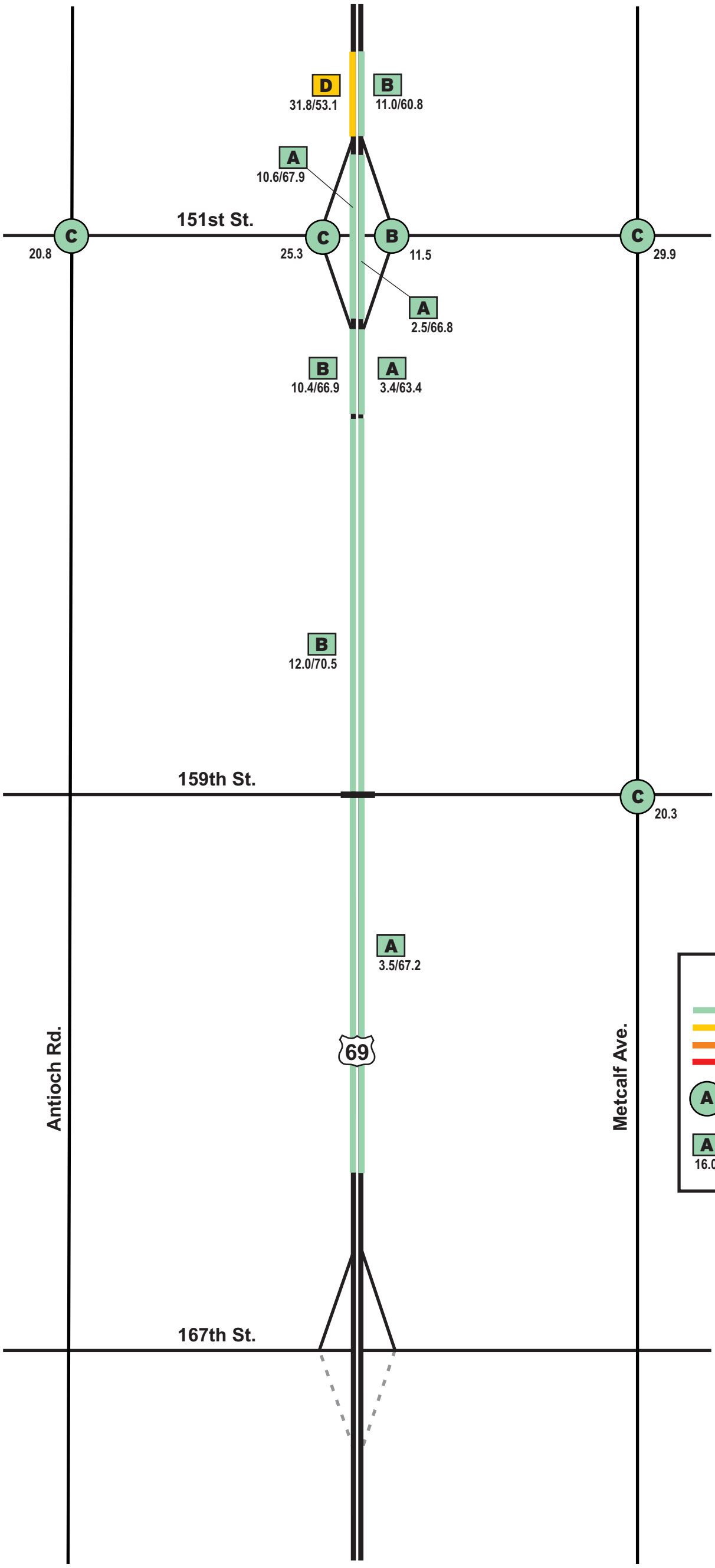
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2005 AM Peak Level of Service

EXHIBIT

A-4



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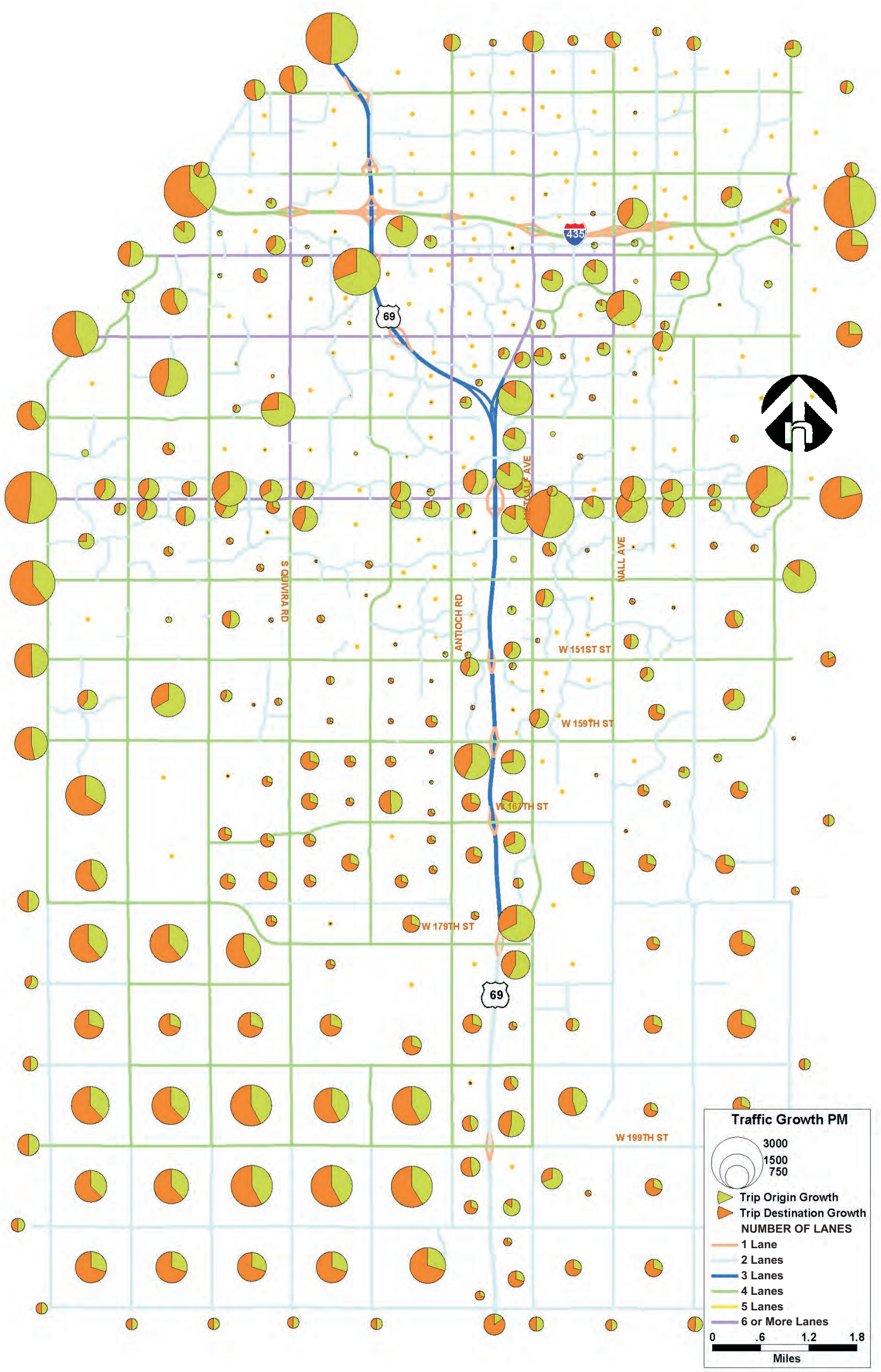
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2005 PM Peak Level of Service

EXHIBIT

A-5



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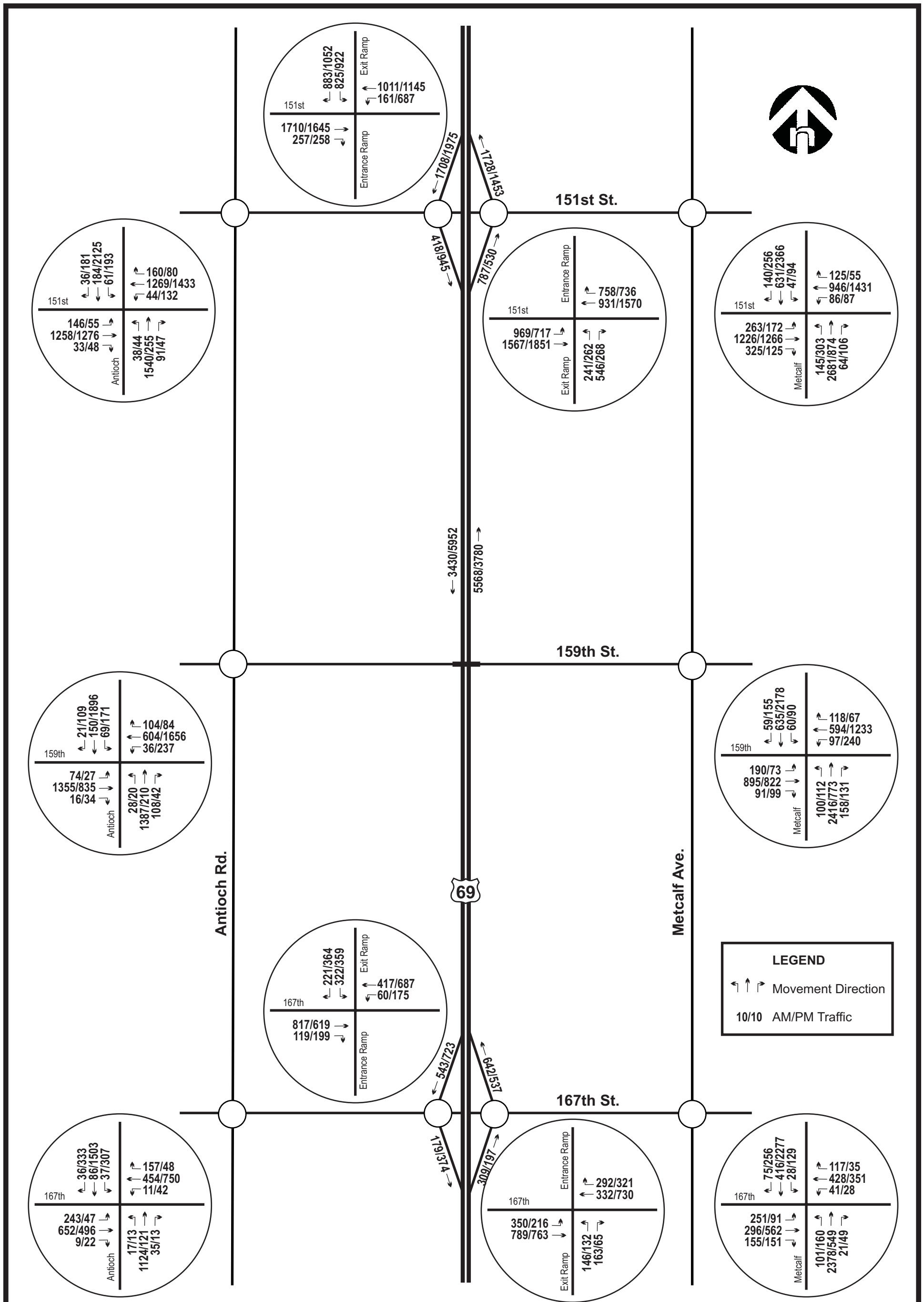
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

PM Peak Hour Traffic Growth
from 2005 to 2035

EXHIBIT

A-6



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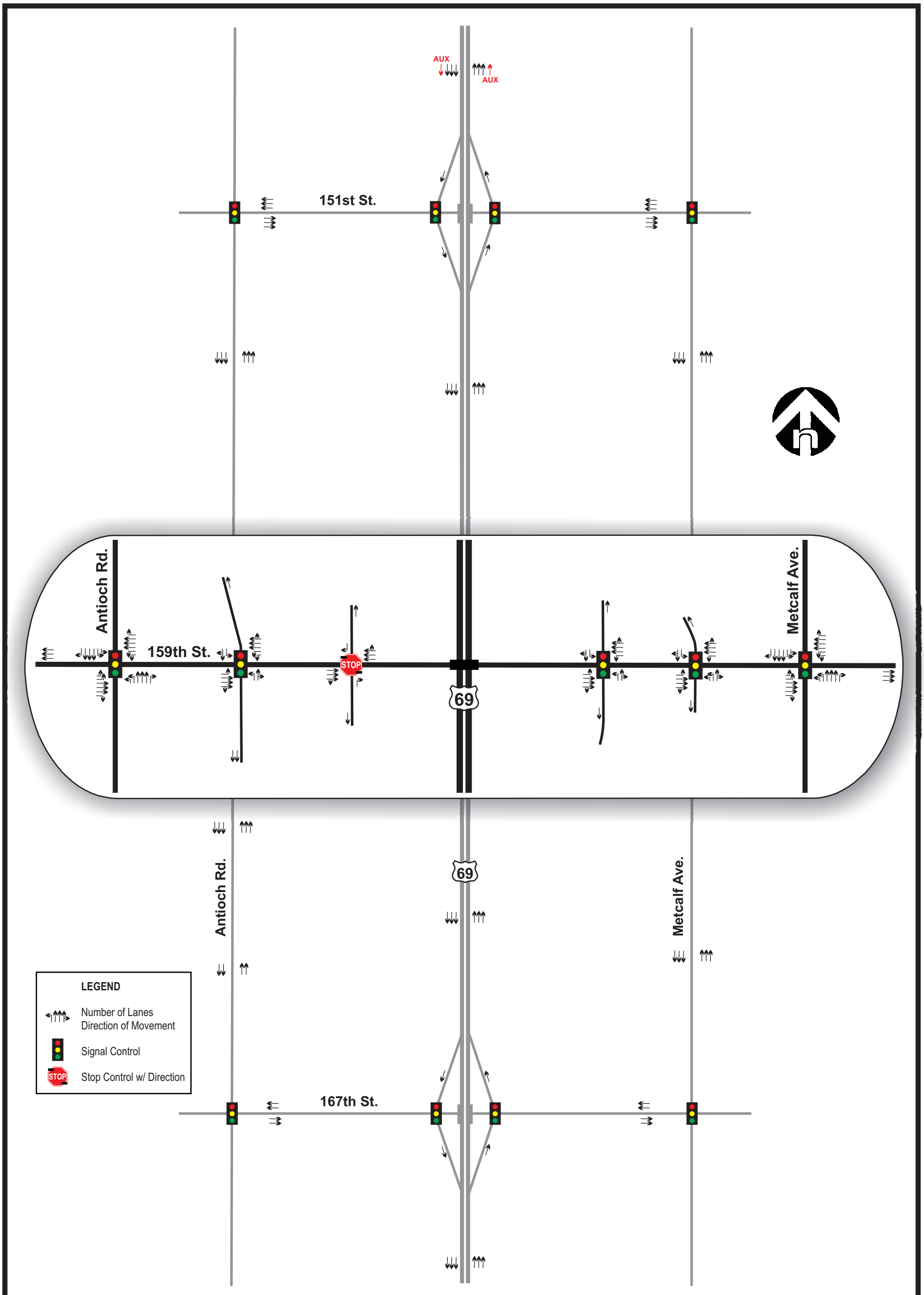
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 AM/PM Peak Hour Traffic
No-Build

EXHIBIT
A-7



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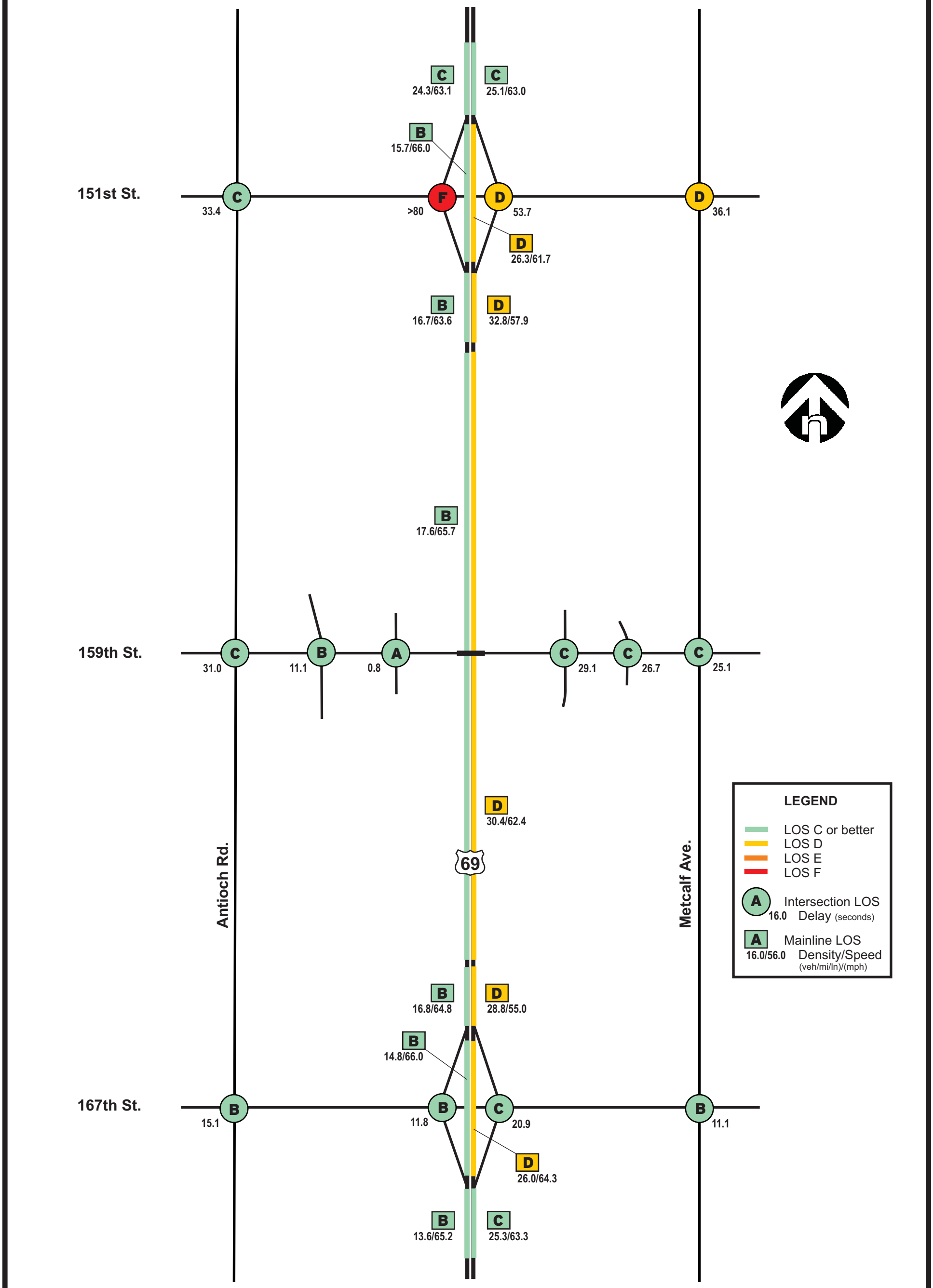
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 Intersection and Lane Geometry
No-Build

EXHIBIT
A-8



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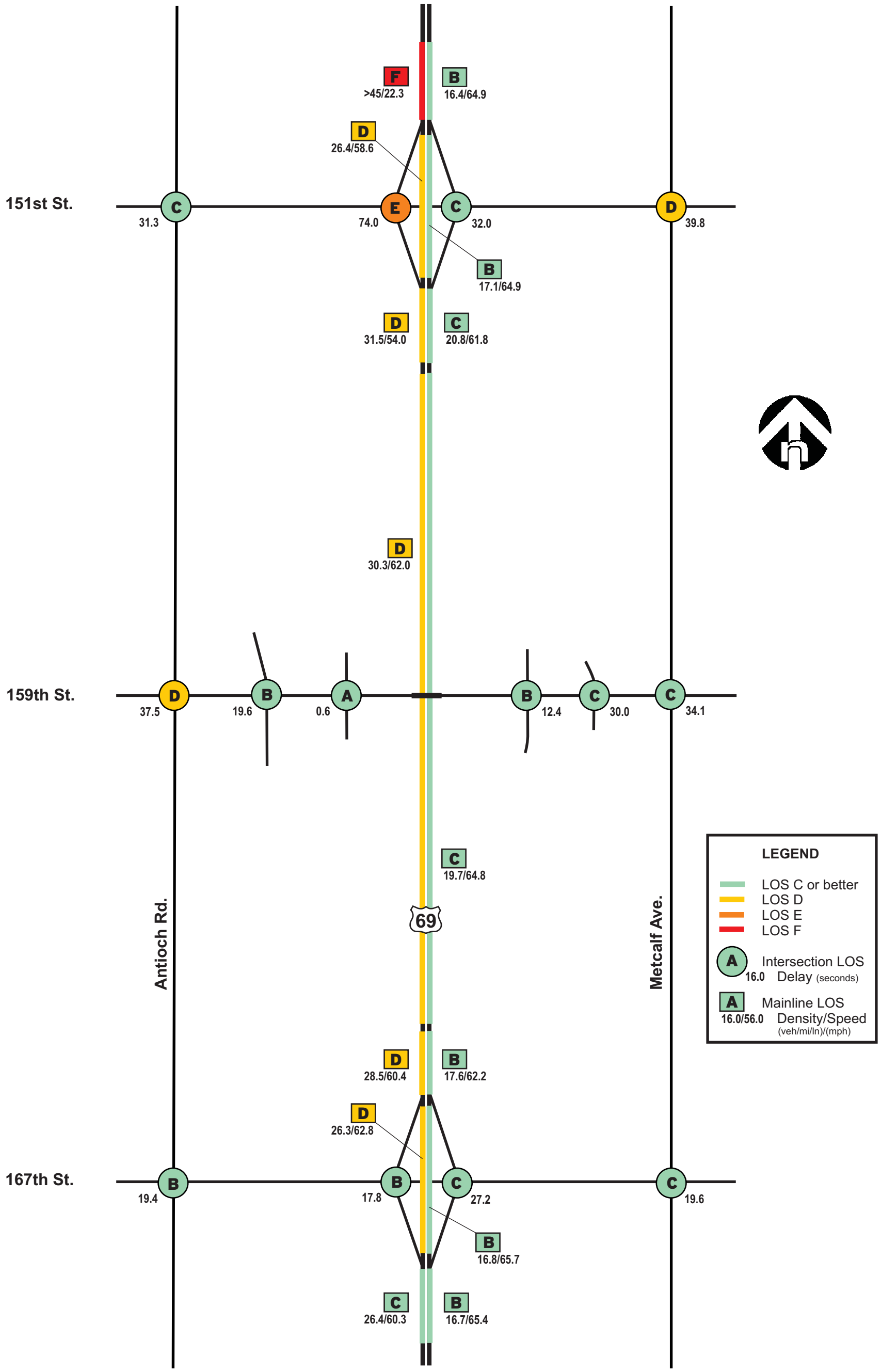
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 AM Peak Level of Service
No-Build

EXHIBIT
A-9



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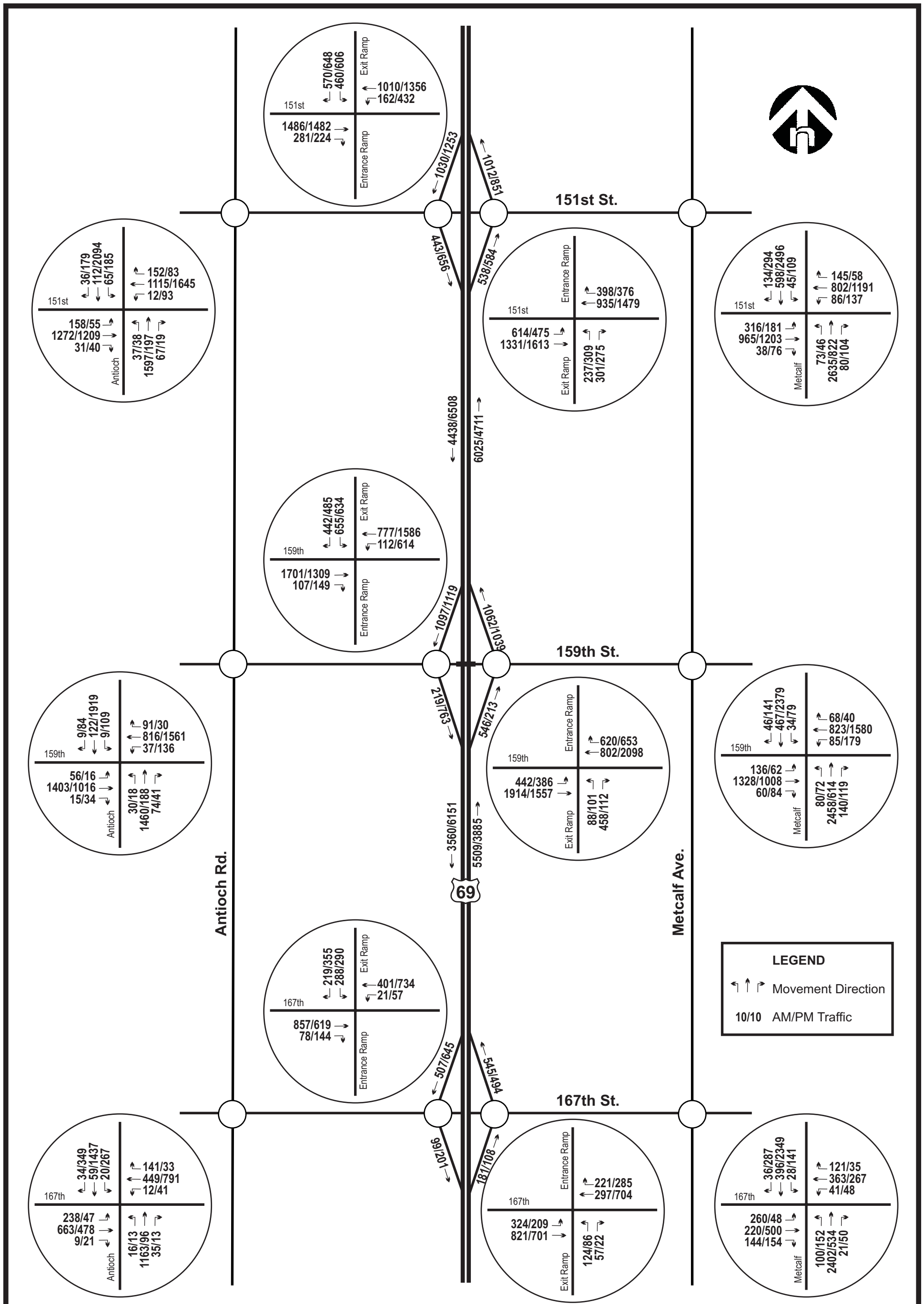
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 PM Peak Level of Service
No-Build

EXHIBIT
A-10


151st St.
159th St.
167th St.
Antioch Rd.
Metcalf Ave.
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1030/1253
1012/851
443/656
538/584
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6025/4711
1097/1119
1062/1039
719/763
546/213
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507/645
545/494
991/201
181/108
151st
159th
167th
Antioch
Metcalf
Entrance Ramp
Exit Ramp
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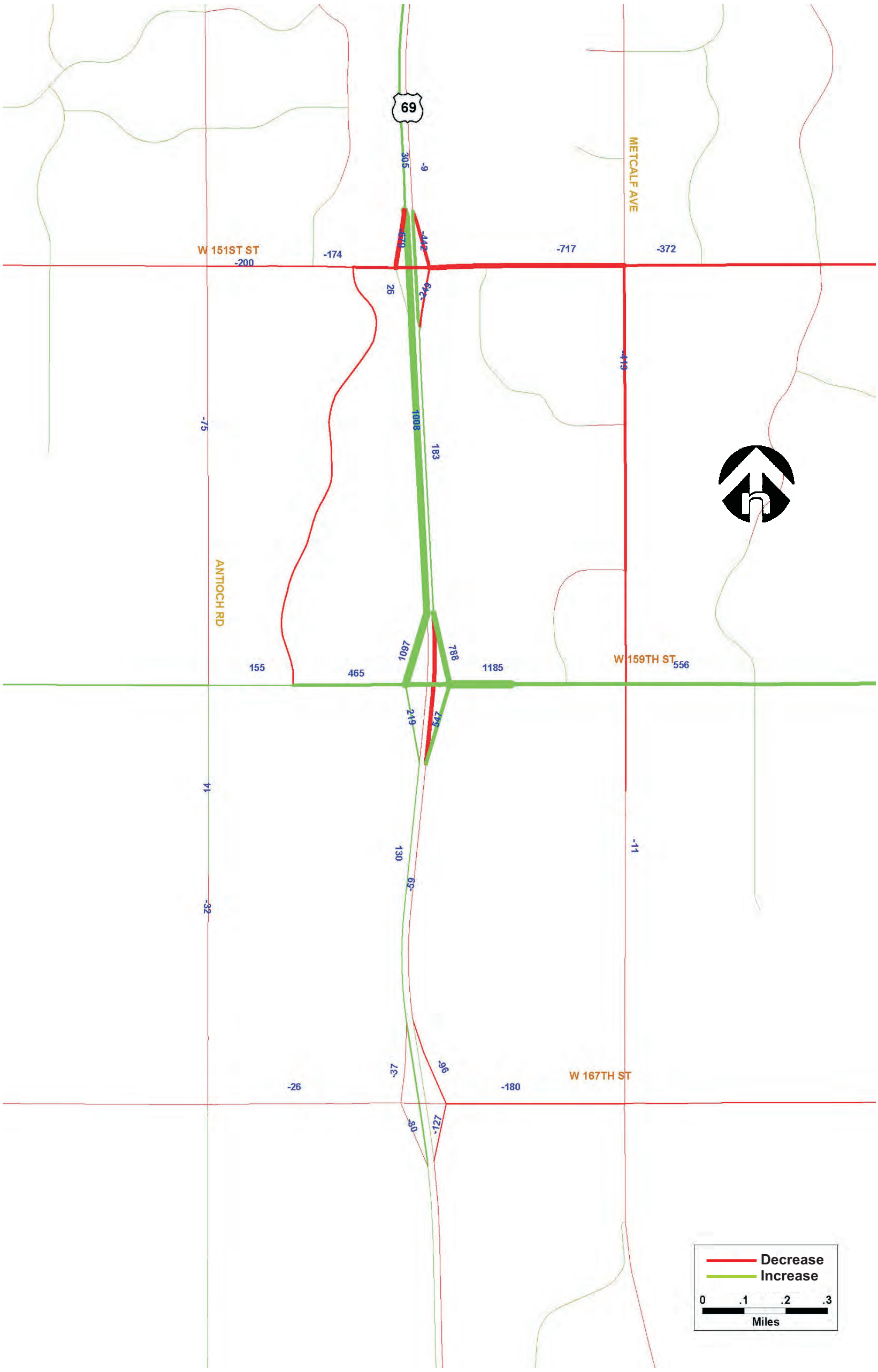
21/50
LEGEND
Movement Direction
10/10 AM/PM Traffic
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS
HNTB
2035 AM/PM Peak Hour Traffic
Build
EXHIBIT
A-11



TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

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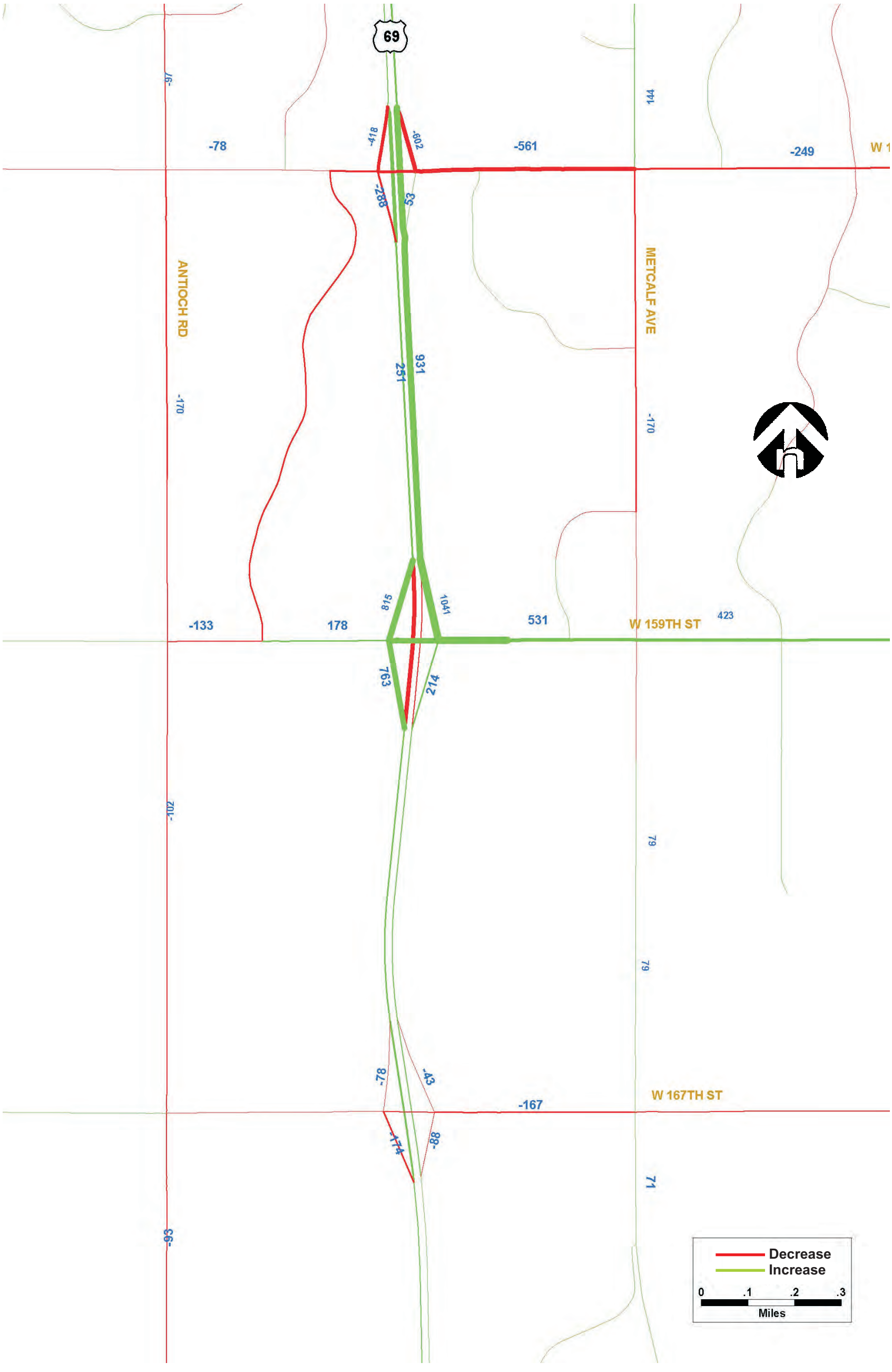
2035 AM Flow Difference
with and without 159th Interchange

EXHIBIT

A-12



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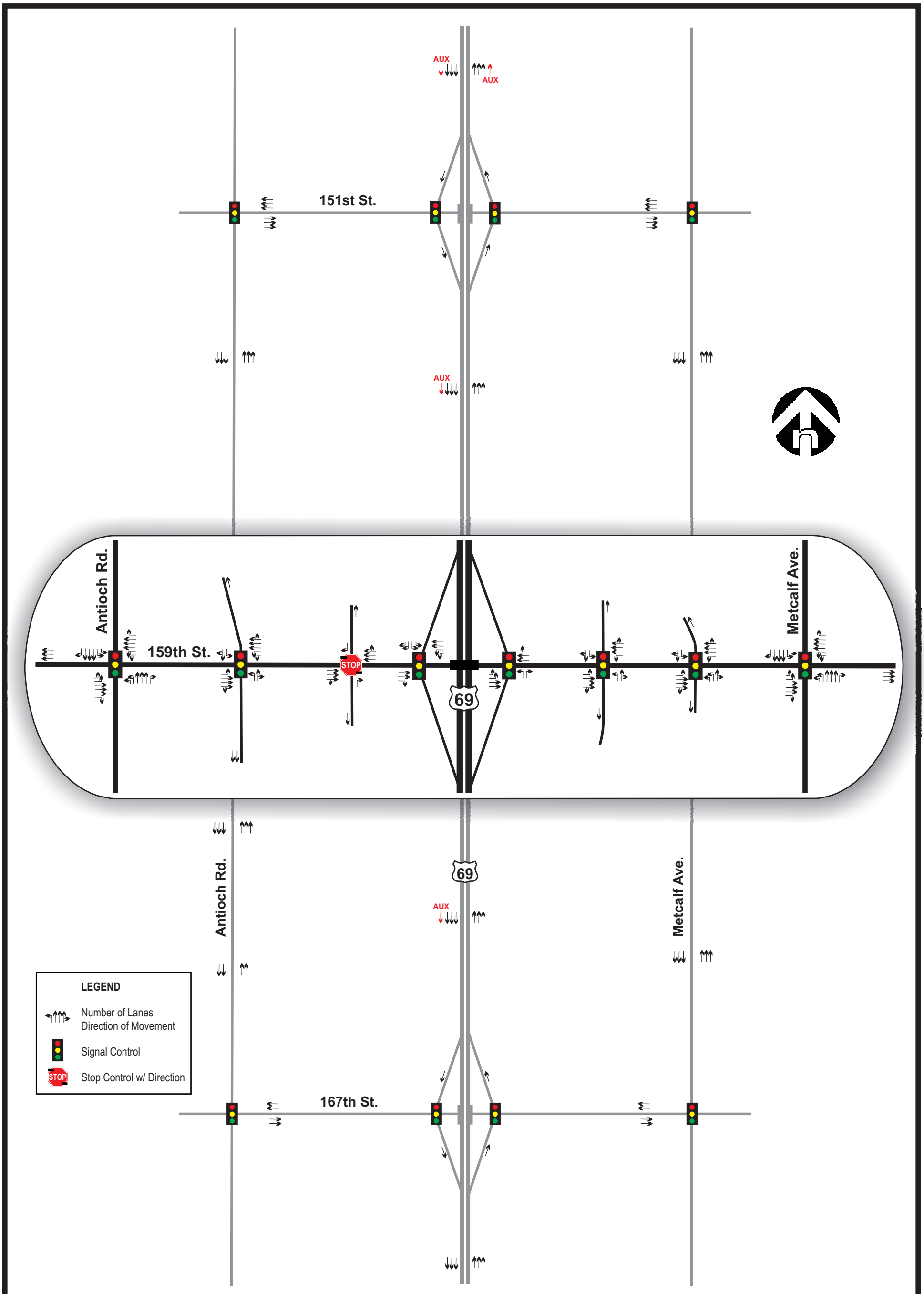
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 PM Flow Difference
with and without 159th Interchange

EXHIBIT

A-13



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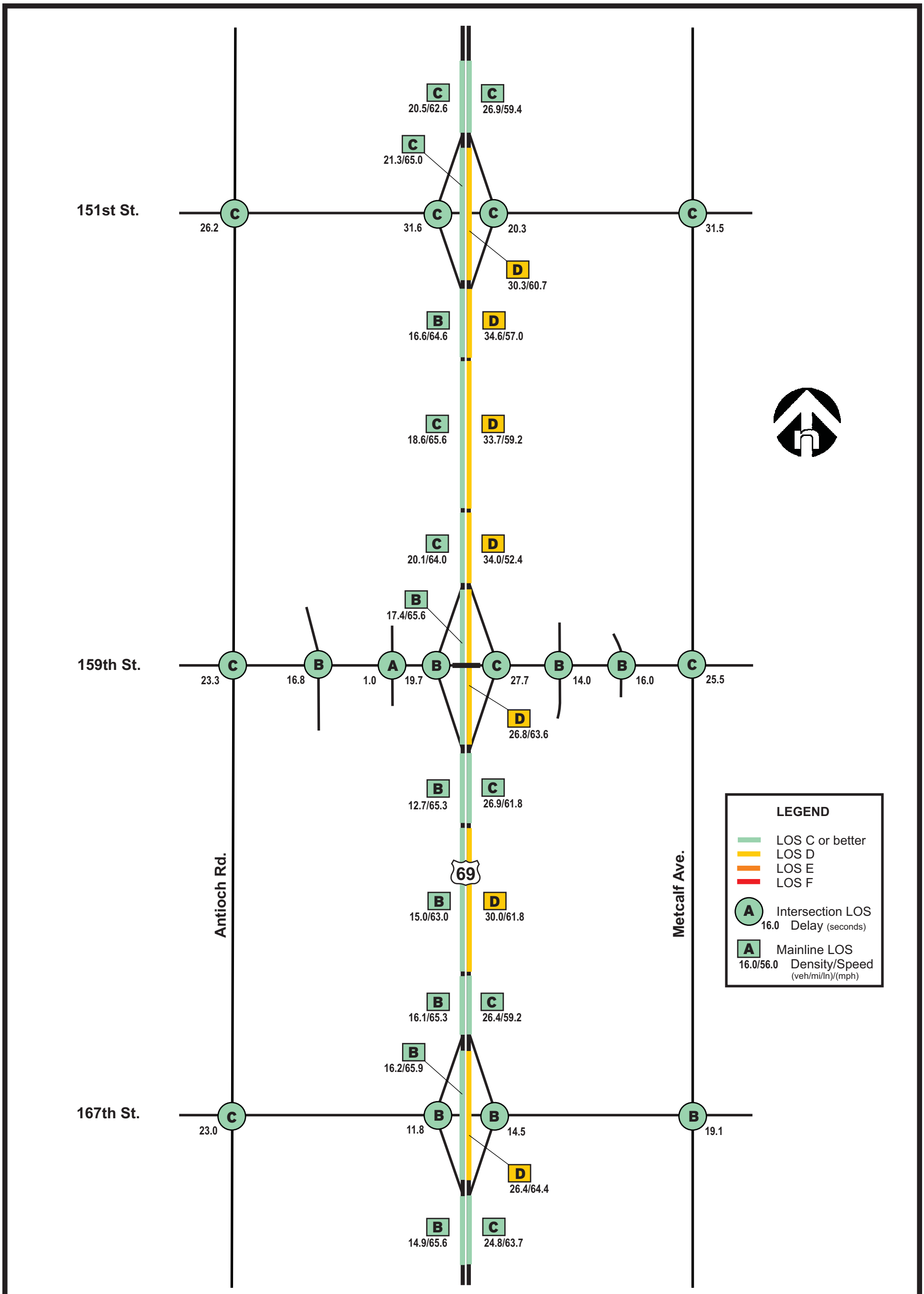
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 Intersection and Lane Geometry
Build

EXHIBIT
A-14



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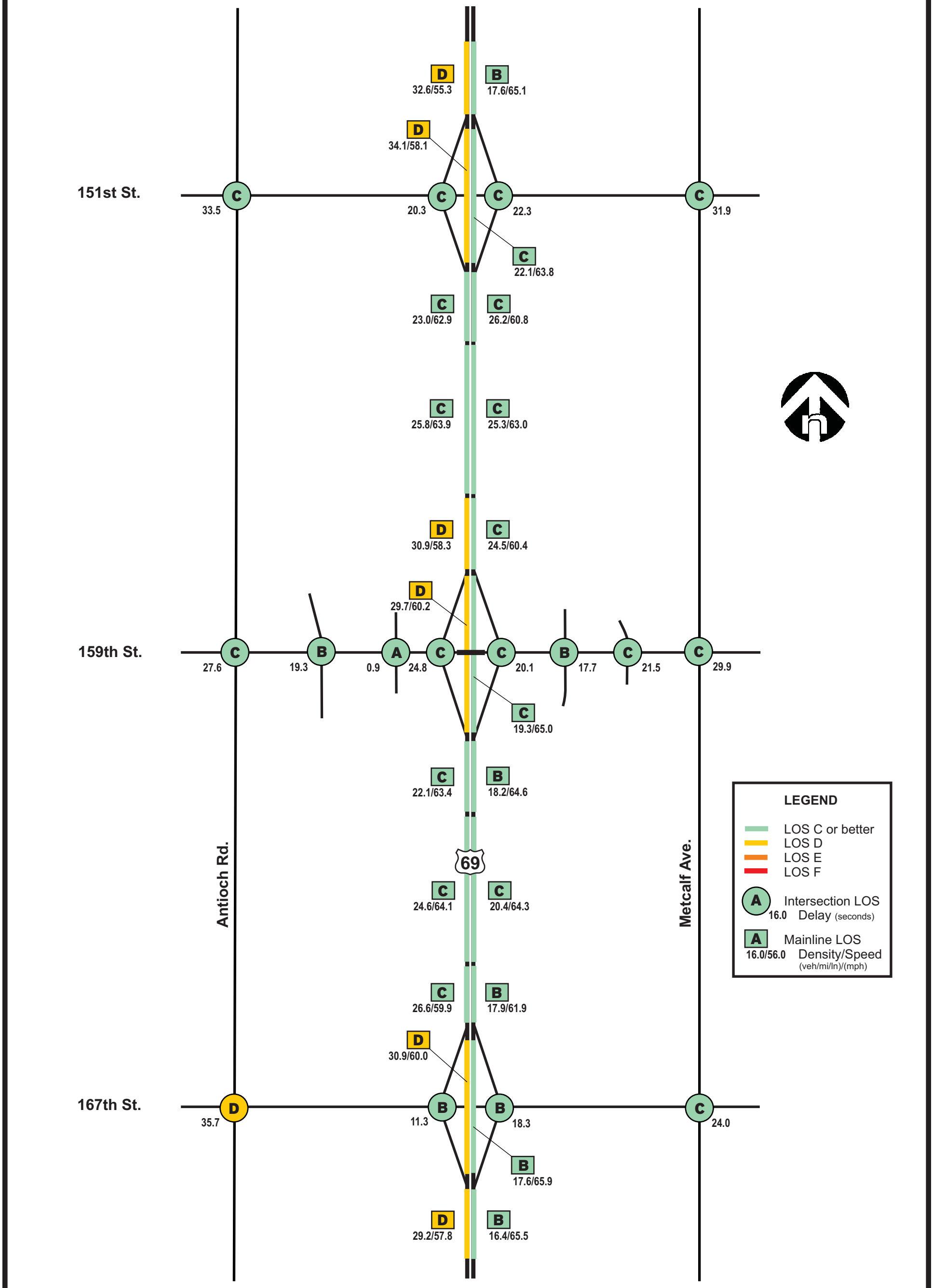
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

2035 AM Peak Level of Service
Build

EXHIBIT
A-15



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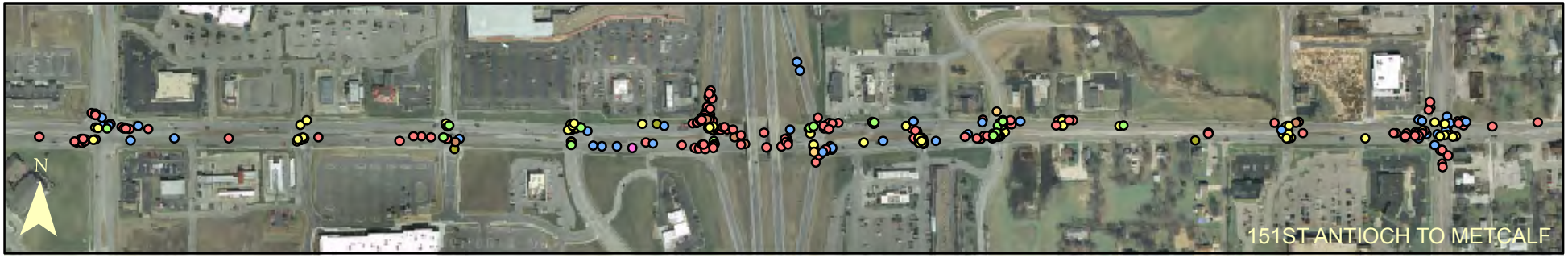
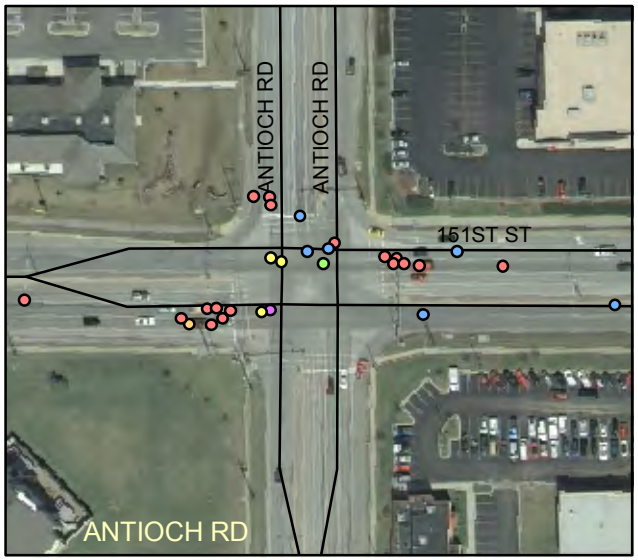
TRAFFIC STUDY 159th St. Interchange – Overland Park, KS

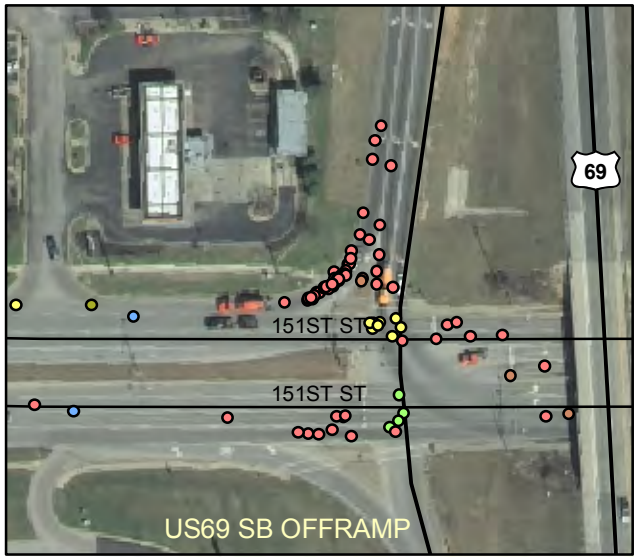
2035 PM Peak Level of Service
Build

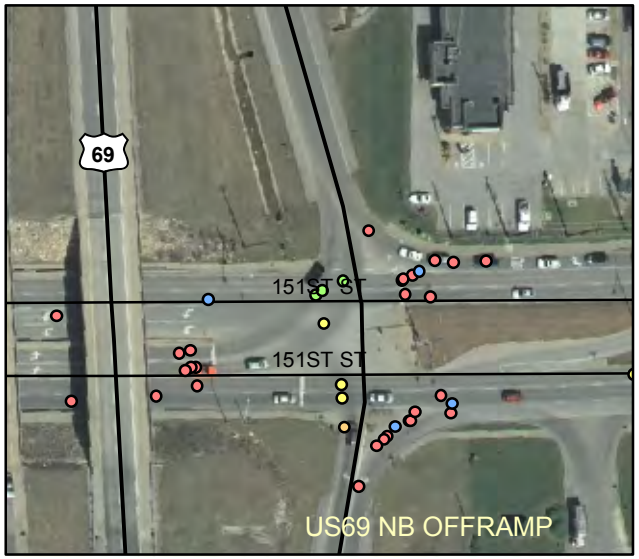
EXHIBIT
A-16

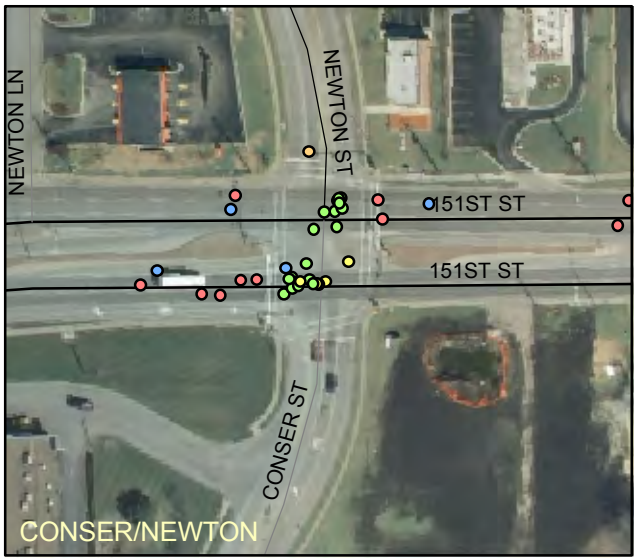
Exhibit A-17 151st Street: Antioch to Metcalf Accident Data (2003-2005)

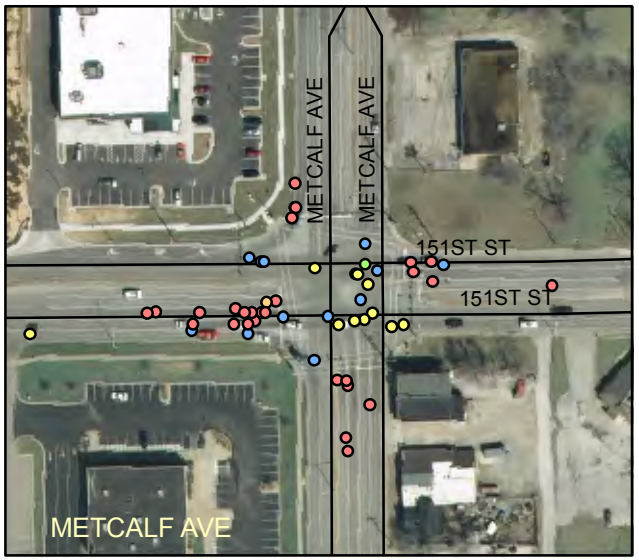












Legend

151st Street Corridor

Accident Type

- Rear End - 166
- Angle - 89
- Sideswipe - 40
- Backed into - 5
- Loss of Control - 3
- Fixed object - 7
- Left turn opp. - 46
- Bike - 1
- Other - 1

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2/10/2006

Table A-1a
159th Street Break-In-Access Study
Existing Freeway Level of Service Analysis

Location	EXISTING					
	AM			PM		
	LOS	Density (pc/mi/ln)	Speed (mph)	LOS	Density (pc/mi/ln)	Speed (mph)
US 69 Southbound						
151st Off-Ramp Diverage	B	10.4	67.9	D	31.8	53.1
151st Off-Ramp to On-Ramp	A	5.8	72.2	A	10.6	67.9
151st Street On-Ramp Merge	A	5.7	69.3	B	10.4	66.9
US 69 Mainline	A	6.8	71.8	B	12.0	70.5
US 69 Northbound						
US 69 Mainline	B	14.6	65.4	A	3.5	67.2
151st Street Off-Ramp Diverge	B	14.1	61.7	A	3.4	63.4
151st Street Off-Ramp to On-Ramp	B	13.2	64.0	A	2.5	66.8
151st On-Ramp merage	B	16.6	58.6	B	11.0	60.8

Table A-1b
159th Street Break-In-Access Study
Existing Intersection Level of Service Analysis

Location	AM				PM			
	HCM LOS	HCM Delay	VISSIM LOS	VISSIM Delay	HCM LOS	HCM Delay	VISSIM LOS	VISSIM Delay
151st Street								
Antioch	B	19.4	B	19.2	C	21.7	C	20.8
SB US 69 Ramps	B	12.2	B	18.4	B	19.4	C	25.3
NB US 69 Ramps	B	14.9	B	19.0	B	13.9	B	11.5
Metcalf	C	26.8	C	26.1	C	26.1	C	29.9
159th Street								
Antioch								
Metcalf	C	20.4	B	19.3	B	19.0	C	20.3

Table A-1c
159th Street Break-In-Access Study
Future Freeway Level of Service Analysis

Location	2035 Future Build (with 159th Street Access)						2035 Future No-Build (without 159th Street Access)					
	AM			PM			AM			PM		
	LOS	Density (pc/mi/ln)	Speed (mph)	LOS	Density (pc/mi/ln)	Speed (mph)	LOS	Density (pc/mi/ln)	Speed (mph)	LOS	Density (pc/mi/ln)	Speed (mph)
US 69 Southbound												
151st Off-Ramp Diverge	C	20.5	62.6	D	32.6	55.3	C	24.3	63.1	F	>45	22.3
151st Off-Ramp to On-Ramp	C	21.3	65.0	D	34.1	58.1	B	15.7	66.0	D	26.4	58.6
151st Street On-Ramp Merge	B	16.6	64.6	C	23.0	62.9	B	16.7	63.6	D	31.0	54.0
151st to 159th Mainline	C	18.6	65.6	C	25.8	63.9						
159th Street Off-Ramp Diverge	C	20.1	64.0	D	30.9	58.3						
159th Street Off-Ramp to On-Ramp	B	17.4	65.6	D	29.7	60.2	B	17.6	65.7	D	30.3	62.0
159th Street On-Ramp Merge	B	12.7	65.3	C	22.1	63.4						
159th to 167th Street Mainline	B	15.0	63.0	C	24.6	64.1						
167th Street Off-Ramp Diverge	B	16.1	65.3	C	26.6	59.9	B	16.8	64.8	D	28.5	60.4
167th Off-Ramp to On-Ramp	B	16.2	65.9	D	30.9	60.0	B	14.8	66.0	D	26.3	62.8
167th On-Ramp Merage	B	14.9	65.6	D	29.2	57.8	B	13.6	65.2	C	26.4	60.3
US 69 Northbound												
167th Off-Ramp Diverage	C	24.8	63.7	B	16.4	65.5	C	25.3	63.3	B	16.7	65.4
167th Off-Ramp to On-Ramp	D	26.4	64.4	B	17.6	65.9	D	26.0	64.3	B	16.8	65.7
167th Street On-Ramp Merge	C	26.4	59.2	B	17.9	61.9	D	28.8	55.0	B	17.6	62.2
167th to 159th Mainline	D	30.0	61.8	C	20.4	64.3						
159th Street Off-Ramp Diverge	C	26.9	61.8	B	18.2	64.6						
159th Street Off-Ramp to On-Ramp	D	26.8	63.6	C	19.3	65.0	D	30.4	62.4	C	19.7	64.8
159th Street On-Ramp Merge	D	34.0	52.4	C	24.5	60.4						
159th to 151st Street Mainline	D	33.7	59.2	C	25.3	63.0						
151st Street Off-Ramp Diverge	D	34.6	57.0	C	26.2	60.8	D	32.8	57.9	C	20.8	61.8
151st Street Off-Ramp to On-Ramp	D	30.3	60.7	C	22.1	63.8	D	26.3	61.7	B	17.1	64.7
151st On-Ramp Merge	C	26.9	59.4	B	17.6	65.1	C	25.1	63.4	B	16.4	64.9

Table A-1d
159th Street Break-In-Access Study
Future Intersection Level of Service Analysis

Location	2035 Future Build (with 159th Street Access)								2035 Future No-Build (without 159th Street Access)							
	AM				PM				AM				PM			
	HCM LOS	HCM Delay	VISSIM LOS	VISSIM Delay	HCM LOS	HCM Delay	VISSIM LOS	VISSIM Delay	HCM LOS	HCM Delay	VISSIM LOS	VISSIM Delay	HCM LOS	HCM Delay	VISSIM LOS	VISSIM Delay
151st Street																
Antioch	C	33.4	C	26.2	D	44.9	C	33.5	C	29.5	C	33.4	D	46.1	C	31.3
SB US 69 Ramps	C	25.5	C	31.6	C	26.5	C	20.3	D	48.1	F	>80	E	59.3	E	74.0
NB US 69 Ramps	C	21.5	C	20.3	C	26.5	C	22.3	E	64.9	D	53.7	D	35.4	C	32.0
Metcalf	D	37.2	C	31.5	D	53.7	C	31.9	E	61.3	D	36.1	E	75.6	D	39.8
159th Street																
Antioch	C	32.2	C	23.3	C	23.6	C	27.6	C	23.5	C	31.0	C	35	D	37.5
Full Access	B	14.6	B	16.8	B	19.6	B	19.3	B	10.9	B	11.1	B	14.8	B	19.6
Right-In, Right-Out			A	1.0			A	0.9			A	0.8			A	0.6
SB US 69 Ramps	C	28.2	B	19.7	C	24.9	C	24.8			-	-			-	-
NB US 69 Ramps	C	32.8	C	27.7	C	31.6	C	20.1			-	-			-	-
Full Access	C	23.4	B	14.0	B	11.8	B	17.7	B	10.3	C	29.1	B	12.2	B	12.4
Full Access	B	23.0	B	16.0	C	26.9	C	21.5	B	17.8	C	26.7	B	14.7	C	30.0
Metcalf	D	43.0	C	25.5	D	49.3	C	29.9	C	22.4	C	25.1	D	40.6	C	34.1
167th Street																
Antioch	C	26.9	C	23.0	C	33.2	D	35.7	C	29.3	B	15.1	B	19.7	B	19.4
SB US 69 Ramps	B	11.9	B	11.8	B	12.8	B	11.3	B	17.4	B	11.8	B	19.9	B	17.8
NB US 69 Ramps	A	6.9	B	14.5	B	11.2	B	18.3	B	11.8	C	20.9	B	12	C	27.2
Metcalf	C	31.6	B	19.1	C	32.2	C	24.0	C	32.7	B	11.1	C	20.2	B	19.6

APPENDIX B
Ramp Metering

Appendix B
RAMP METERING
U.S. 69 & 159th Street Interchange

April 2006

This ramp metering review evaluates whether the proposed 159th Street interchange ramp designs will accommodate ramp metering in the design year of 2035. This assessment does not attempt to determine whether or not ramp metering is desirable at a system level for the U.S. 69 corridor. To assess the desirability and impacts of implementing ramp metering in the corridor, a comprehensive corridor analysis would be required.

Ramp metering is the use of traffic signals on the freeway on-ramps to regulate traffic entering the freeway. Ramp meters can operate at a fixed time of day rate or can be adjusted in real-time to manage mainline freeway demand. Ramp meters are generally active only during peak traffic volume periods of the day. Ramp meters are most often placed on service interchange ramps and not on system interchange ramps. An appropriate balance between freeway mainline traffic flow improvements (generally speed increase and crash reduction) and vehicle wait times in queues on entrance ramps needs to be determined.

Ramp metering can be implemented to reduce traffic turbulence resulting from the merging of platoons of traffic and can be used to regulate traffic entering a freeway upstream of a bottleneck. Typical diamond interchanges with traffic signal controlled crossroad intersections tend to create platoons of traffic as left and right turning streams of traffic are allowed to access the ramp. These platoons of on-ramp traffic can result in increased turbulence within the on-ramp merge area. This turbulence can cause safety and congestion problems. The ramp meter holds the platoon and releases the vehicles at a uniform rate so that a gap exists between vehicles. Implementing ramp metering has resulted in crash rate reductions ranging from 15% to 50%[1].

Regulating traffic depends on the mainline by limiting the flow rate of vehicles entering the freeway is a dynamic control measure. Vehicles are stored on the ramps and approach roadways to allow the mainline volume to remain below critical volume thresholds above which congestion will occur. The objective is to allow the mainline to operate in a free flow condition. Free flow operations on the mainline will result in overall travel time savings and emissions reductions[1].

As traffic grows along the U.S. 69 corridor, ramp metering should be considered. When mainline volumes reach a level at which available gaps in the outside lane traffic are significantly reduced, platoons of on-ramp traffic begin to generate undesirable turbulence. The level at which this occurs depends on the mainline volume and the ramp volume.

[1] *Ramp Management and Control Handbook*. TMC Pooled Funds Study. Draft May 2005.

The KDOT policy has been to limit ramp metering to service interchanges. The 159th Street interchange is a service interchange, so the on-ramps are candidates for implementation of ramp meters.

Number of Ramp Meter Lanes

The number of lanes at a ramp meter is determined by the ramp volume and whether or not certain classes of vehicles will have priority. The capacity of a ramp meter lane is dictated by the minimum time between vehicle releases. A minimum amount of time is required to release the vehicle and have the next vehicle in the queue reach the stop bar. The minimum amount of time is 4.0 seconds. With a release rate of 4.0 seconds per vehicle the hourly volume that can be processed is 900 vehicles.

If ramp volumes exceed 900 vehicles per hour, a platoon release scheme can be implemented or an additional ramp meter lane can be added. With a platoon release scheme two vehicles are allowed to enter per green indication. This approach can increase the ramp meter capacity to 1,200 vehicles per hour. This approach increases the required gap in mainline traffic for merging of the two vehicles, so more turbulence can result. With a second ramp meter lane, each lane is controlled by separate signals. Vehicles can be released in an alternating fashion at 4.0 second per vehicle, which results in a vehicle being released every 2.0 seconds. The capacity of a two-lane ramp meter is 1,700 vehicles per hour.

The northbound on-ramp at the 159th Street interchange has a forecast peak hour volume of 1,039 vehicles per hour in the year 2035. To allow a ramp meter to process this forecast volume, a platoon release scheme or two-lane ramp meter will be required. A one-lane ramp meter will be able to service the on-ramp volume until the peak hour volume exceeds 900 vehicles per hour. The two-lane ramp meter is recommended over the platoon release scheme to provide an optimal merge condition. The southbound 159th Street on-ramp peak hour volume in 2035 is forecast to be 763 vehicles per hour, so a one-lane ramp meter should be sufficient through the year 2035.

Interchange Ramp	Dir.	Year 2035 Volume			Ramp Meter Type	
		AM Peak	PM Peak	Maximum Peak Hour	Single Lane Meter (240- 900 vehicle/ hour)	Two- Lane Meter or Platoon Release (900-17,00 vehicle/ hour)
159th Street On-Ramp	NB	788	1,039	1,039		X
159th Street On-Ramp	SB	219	763	763	X	

Minimum Desirable Storage Requirements

The amount of storage required at each ramp meter is dependent on the ramp volume, the rate at which vehicles are released by the ramp meter and how vehicles arrive. The ramp volume will be somewhat less than forecast because the delay caused by the ramp meters will influence some drivers to use other routes. The rate at which vehicles are released (metering rate) can depend on the mainline volume upstream of the on-ramp or the overall traffic demands in the ramp metering corridor.

A corridor wide assessment of ramp metering strategies is beyond the scope of this ramp metering assessment, so the storage required reflects a minimum desirable storage capacity that will allow metering at or above demand. Storage to accommodate meter rates that will cause capacity to drop below demand, as can be required to manage mainline demand, is considered desirable to provide operational flexibility, but additional storage length is not included in determining the minimum desirable storage.

At the 159th Street interchange the ramp terminal/crossroad intersections will be controlled by traffic signals. Ramp traffic from the signalized intersections will generally arrive in platoons at the ramp meter.

The forecast year 2035 ramp volumes are used in the analysis to assess ramp metering feasibility and vehicle storage requirements. No diversion of traffic to alternative routes was assumed, which reflects the worse case scenario at each ramp. The exception would be a low volume ramp that might attract traffic diverted from higher volume ramps.

To estimate vehicle arrival from the traffic signals an assumed cycle length of 120 seconds is used to reflect the worst case scenario of stored vehicles. Given the 120-second cycle length, every 2 minutes 1/30th of the hourly traffic will queue at the ramp meter on average. This volume of 1/30th of the hourly volume must be able to queue upstream of the ramp meter without blocking the cross street. The assessment of minimum desirable vehicle storage is based on this estimated storage requirement. The minimum desirable storage lengths are calculated using an assumed average vehicle length of 25 feet (see table).

Interchange Ramp	Dir.	Upstream Traffic Control	Ramp Meter Type	Minimum Desirable Queue Storage (vehicles)	Minimum Storage Length (feet)
159th Street On-Ramp	NB	Traffic Signal	Two-Lane	35	875
159th Street On-Ramp	SB	Traffic Signal	One-Lane	26	650

Available Ramp Meter Storage

It is generally desirable to store all ramp meter queues on the ramp, although in some cases storage occurs on the cross streets as well. If ramp vehicle queues are stored on the cross street, the cross street/ramp terminal intersection must be designed to minimize the impact of the stored ramp traffic on through traffic and other turning traffic. For this analysis it is assumed that the ramp meters will be operated to maintain all ramp meter queue storage on the ramps.

The available storage space for vehicles on an on-ramp is dependent on the length of the ramp, the number of lanes, the grade of the ramp and mainline in the merging zone, and the geometrics of the merge area. Based on ramp design principles, the ramp meter stop bar is located so that a vehicle can accelerate from a stop and reach a desirable merging speed prior to the point where the parallel acceleration lane taper

begins. With the U.S. 69 design speed of 75 mph, the length required to accelerate from a stop to the acceptable merge speed of 55 mph is 1,790 feet[2]. This desired acceleration distance must also be adjusted for grades that are 3.0% or steeper. Upgrades lengthen the desired acceleration distance and downgrades reduce the acceleration distance. At the 159th Street interchange no grades are expected to exceed 3%, so no adjustment in the acceleration length was required.

Ideally, a ramp meter stop bar could be located upstream of the ramp merge sufficient distance to allow vehicles to accelerate to the acceptable merge speed on a standard length parallel merge auxiliary lane and taper. With the proposed on-ramp lengths for the 159th interchange, the ramp meter stop bars cannot be located at this ideal location and provide sufficient ramp meter vehicle storage on the ramps. The ramp meter stop bar must be located toward the ramp merge with the mainline to provide adequate minimum storage, which necessitates accepting much of the acceleration taking place on the auxiliary lane.

The *AASHTO Policy on Geometric Design of Highways and Streets* does not provide guidance on the desired on-ramp vehicle speed at the point where the mainline and ramp traveled ways meet (theoretical nose) for a parallel type ramp terminal. For this analysis it was assumed that a reasonable ramp vehicle speed at the theoretical nose was 31 mph, which equates to a design speed of 40 mph[3]. This speed exceeds the minimum design speed for loop ramps of 25 mph, so the assumed design speed is considered reasonable[4]. A ramp meter is considered similar to a loop ramp in that the need for storage makes accommodating ideal design speeds impractical. For the 159th Street interchange on-ramps, the stop bar is located 360 feet upstream of the theoretical ramp nose to maximize the storage provided on the ramp.

With the stop bar located 360 feet upstream of the theoretical ramp nose, the northbound parallel acceleration lane must be 1,430 feet in length to facilitate acceleration to 55 mph before reaching the taper. Given this long acceleration lane, constructing a continuous auxiliary lane northbound between the 159th Street on-ramp and the 151st Street off-ramp may be warranted when ramp metering is deployed. Southbound a continuous auxiliary lane is provided between the 159th Street interchange on-ramp and the 167th Street off-ramp, so no geometric modifications will be needed to allow acceleration to the acceptable merge speed.

Once the ramp meter stop bar is positioned, the available storage on the ramp is the distance from the stop bar to the cross street. If the ramp has more than one lane, the storage length is increased assuming that vehicles will queue in all available lanes. The following table summarizes the available vehicle storage and compares the available storage to the minimum storage length needed:

[2] Exhibit 10-70, Page 847, *A Policy on Geometric Design of Highways and Streets*, AASHTO, 2004
[3] Exhibit 10-70, Page 847, *A Policy on Geometric Design of Highways and Streets*, AASHTO, 2004
[4] Page 825, *A Policy on Geometric Design of Highways and Streets*, AASHTO, 2004.

Interchange Ramp	Dir.	Available Storage Length (feet)			Minimum Storage Length Needed (feet)	Excess Storage Length (feet)
		Two-Lane	One-Lane	Total		
159th Street On-Ramp	NB	455	0	910	875	35
159th Street On-Ramp	SB	460	60	980	650	330

As shown in the table, both of the proposed ramps provide adequate minimum storage for ramp metering based on the forecast volumes used in the analysis.

Recommended Geometric Modifications

To provide minimum ramp meter vehicle storage on the northbound on-ramp even with the two-lane storage area, the stop bar must be located within 360 feet of the ramp merge with the mainline. To allow vehicles to accelerate to an acceptable merging speed, the acceleration auxiliary lane must be lengthened to 1,430 feet or a continuous auxiliary lane must be provided. With the proposed southbound on-ramp having two lanes for storage and the continuous auxiliary lane between the 159th Street and 167th Street ramps the minimum storage requirements for ramp metering are met, so no geometric modifications are suggested.

APPENDIX C
Plan Plates

159th Street & US 69 Interchange Study

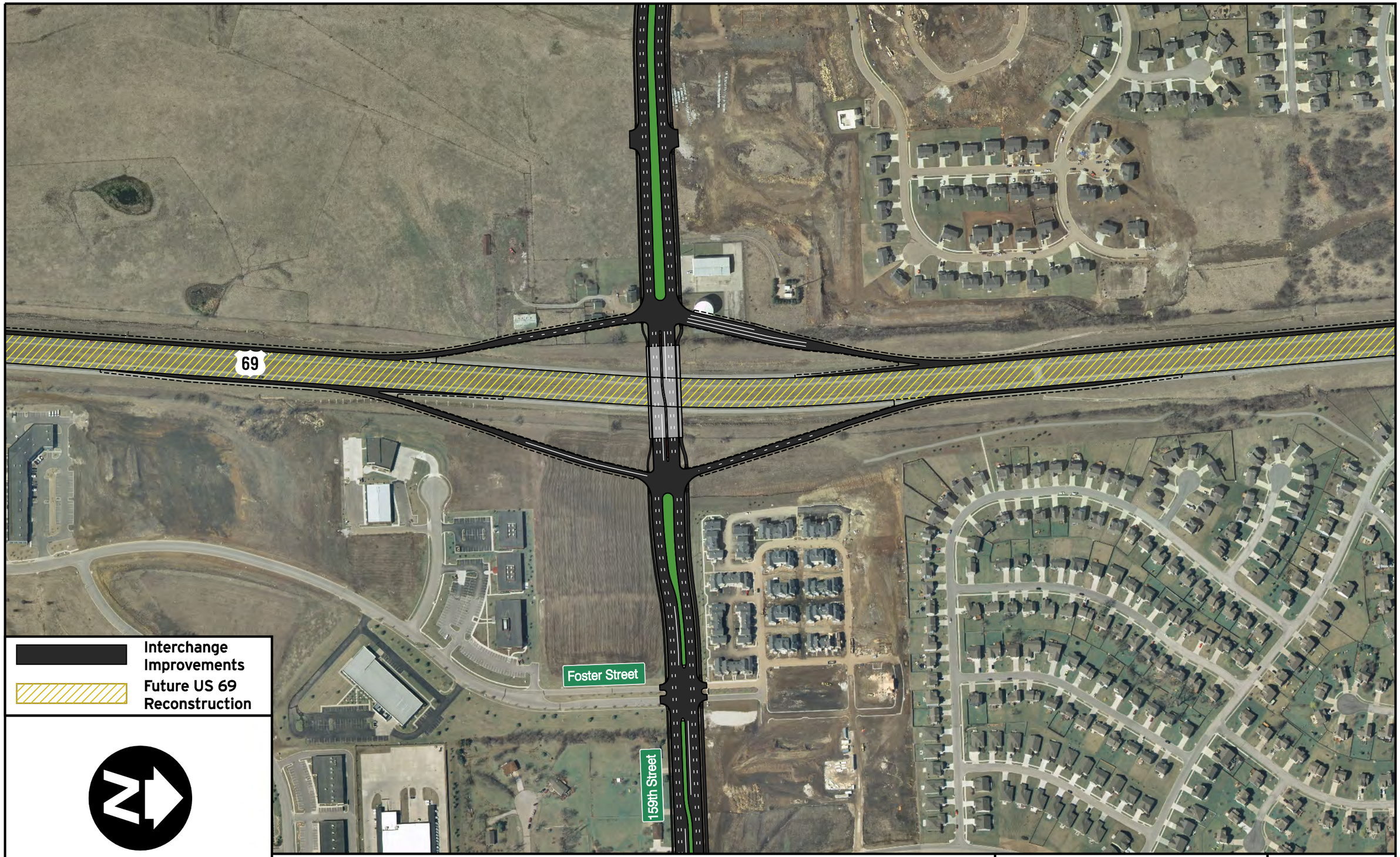
2035 Build

Overland Park KANSAS

HNTB

Exhibit C–1

April 2006

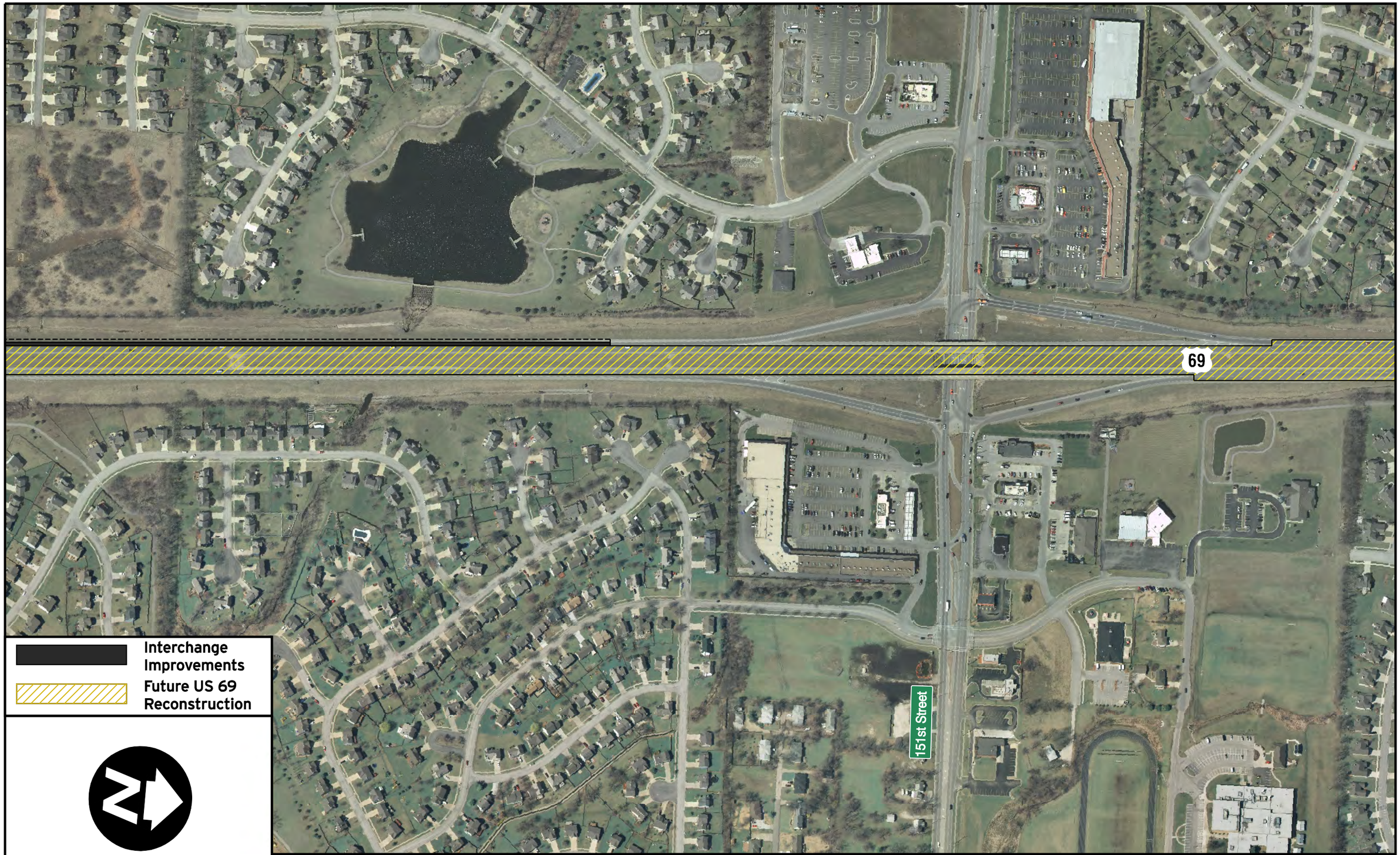


159th Street & US 69 Interchange Study

2035 Build

Exhibit C–2

April 2006



159th Street & US 69 Interchange Study

2035 Build

Overland Park KANSAS

HNTB

Exhibit C–3

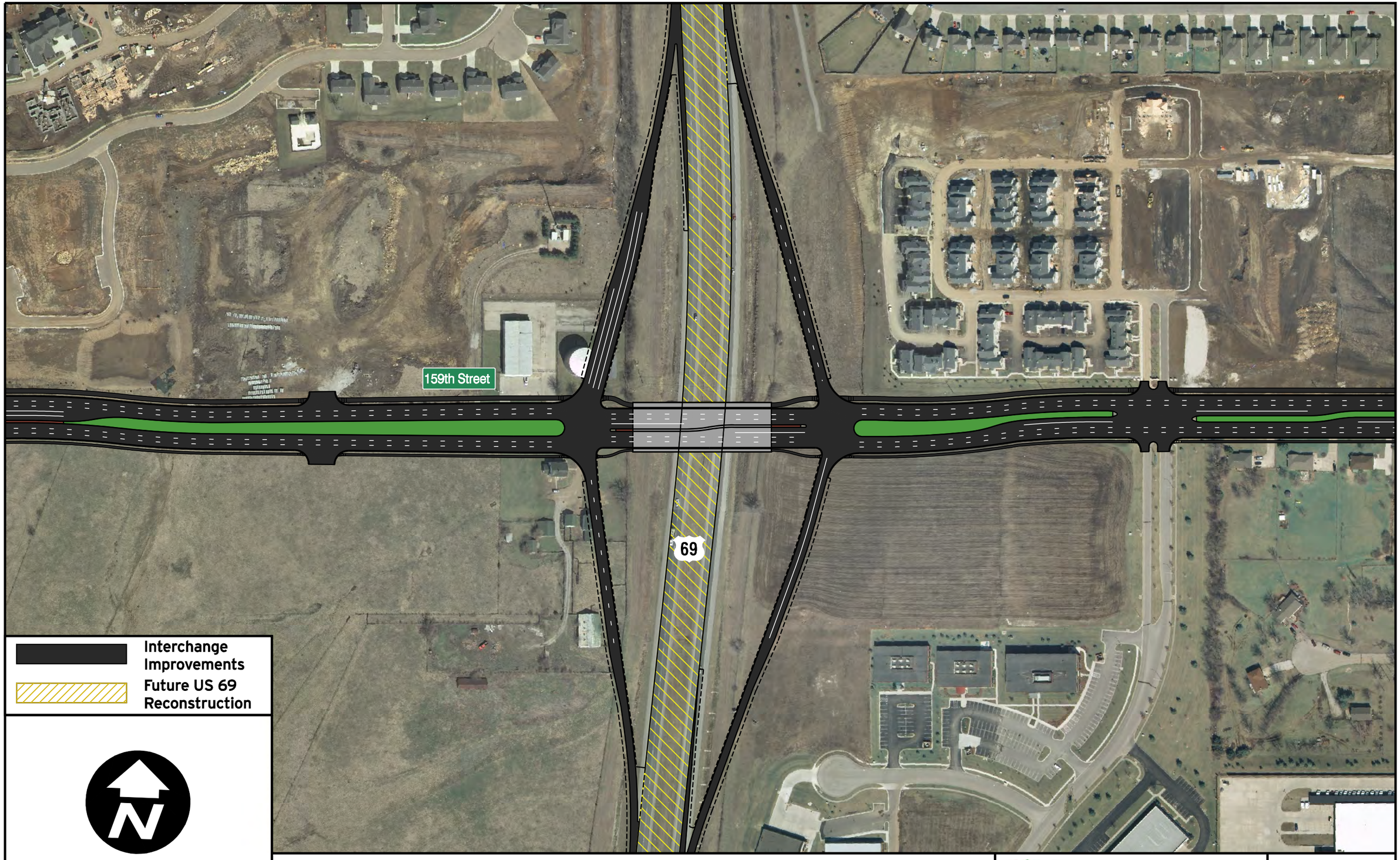
April 2006

159th Street & US 69 Interchange Study

2035 Build

Exhibit C–4

April 2006

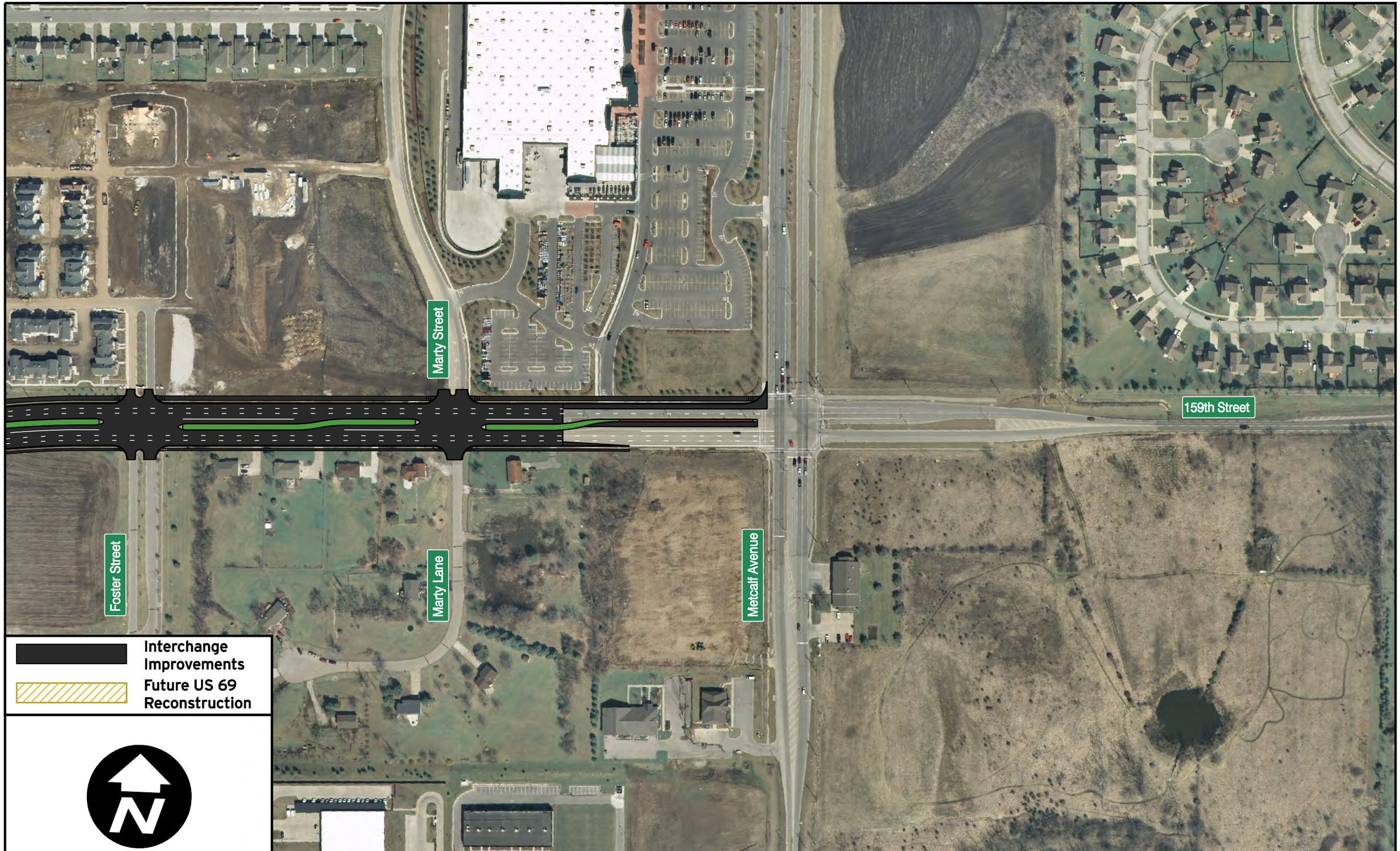


159th Street & US 69 Interchange Study

2035 Build

Exhibit C–5

April 2006



159th Street & US 69 Interchange Study

2035 Build

The City of Overland Park KANSAS

HNTB

Exhibit C–6

April 2006