I-35 Break-in-Access Study
near Gardner, KS

October 2, 2007

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Summary of Findings

The I-35 Break-in-Access Study near Gardner, KS examined the I-35 corridor from Edgerton Road north past US-56. It considered both current traffic conditions as well as projected 2030 traffic conditions in the corridor both with and without a proposed new interchange between Sunflower Road and Gardner Road. The study findings include:

1. Existing traffic operations within the Traffic Study Corridor (I-35, its interchanges, and nearby study intersections) are generally acceptable.

2. By 2030, planned and anticipated local land-use growth, coupled with regional growth, are forecasted to cause large traffic-volume increases throughout the Traffic Study Corridor. These volumes are anticipated to result in unacceptable traffic operations at critical intersection, ramp, and freeway mainline locations, including both the US-56 and Gardner Road interchanges. Peak hour access to and from I-35 in the Gardner area will be considerably constrained due to these capacity shortfalls.

3. At I-35/Gardner Road, the interchange configuration dictated by the forecasted volumes would be unreasonably out-of-scale for a local service interchange. This, plus anticipated growth in the vicinity of the City of Gardner (and associated access needs) points toward the need for a new interchange on I-35 between Gardner Road and Sunflower Road.

4. Two potential locations appear to be viable for a new I-35 interchange: Waverly Road/199th Street, and Homestead Lane. Each could be designed to provide public access and full movements, and could serve anticipated traffic demand.

5. A new interchange would be forecasted to relieve the I-35/Gardner Road interchange to the point that a potentially reasonable interchange configuration could be developed to accommodate forecasted 2030 volumes, although complete reconstruction would still be necessary.

6. Regardless of the presence of a new interchange, it is anticipated that the I-35/US-56 interchange may need substantial improvements by 2030.

Chapter 4 describes additional findings and conclusions, including a summary of the potential for other congestion-reducing options, and a discussion of next steps related to the potential interchange.

1. Introduction

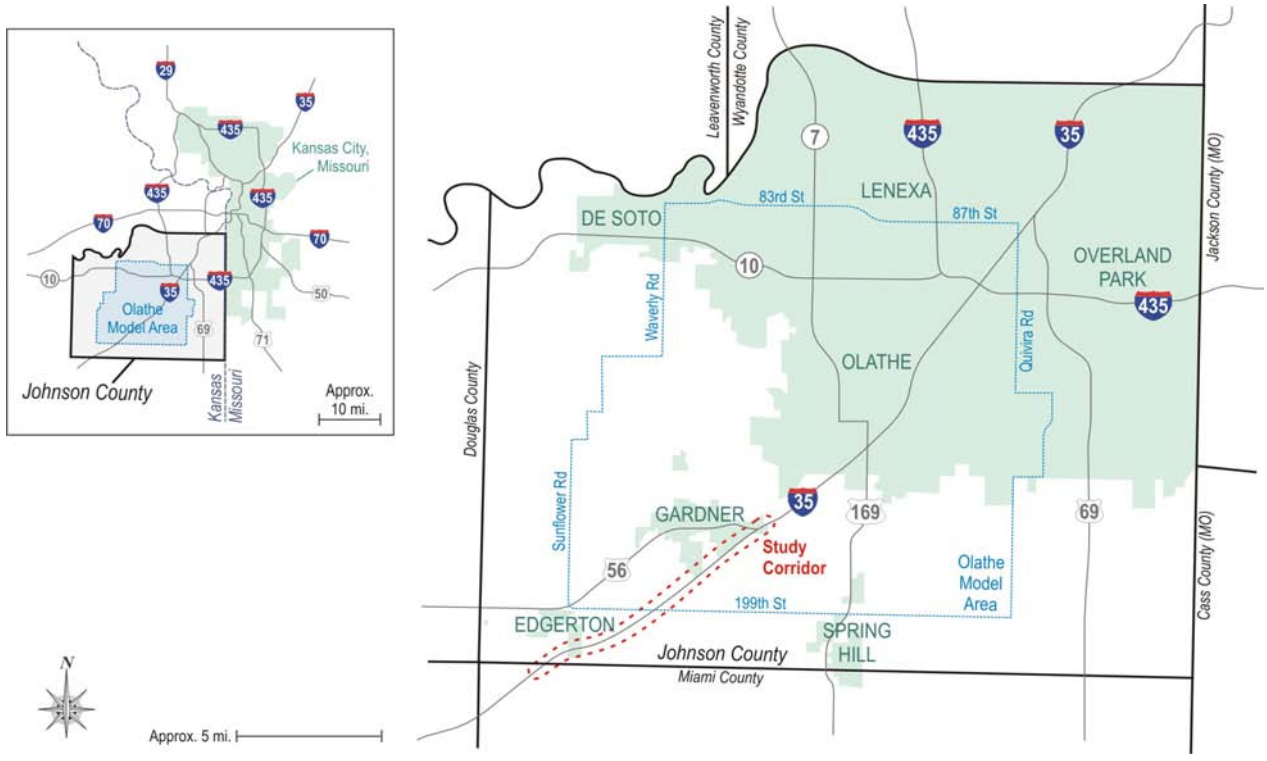
1.1. Background

The I-35 corridor through southern Johnson County (see **Figure 1.1**) has experienced substantial growth over the last decade. For example, the population of the City of Gardner has more than tripled in the last 16 years from under 5,000 in 1991 to over 17,000 in 2007. The City of Olathe's population also increased by nearly 50 percent between 1990 and 2000 (64,000 to 94,000 people).[1] The rate of population growth in the City of Edgerton has also been increasing. Growth in the area has not been limited to residential or bedroom community development, but includes commercial development as well. For example, employment in Gardner nearly doubled in the last 15 years and countywide employment grew by more than 50 percent in the 1990s with more than 123,000 new jobs.[2]

The strong historic growth is projected to continue well into the future. Based on local planning documents, additional residential development is predicted throughout much of the area. There are also plans for new retail development, especially along US-56, Gardner Road, and I-35. Non-retail commercial development is also expected in many parts of the corridor as well as industrial development such as the proposed new BNSF Intermodal Center just west of Gardner. All of this new development is expected to lead to considerable increases in traffic volumes on I-35 and its interchanges within the corridor.

The projected traffic growth is substantial enough that an I-35 break-in-access study was determined to be necessary. Break-in-access studies assess the need for, and impact of, new or modified interchanges on

Figure 1.1: Vicinity Map



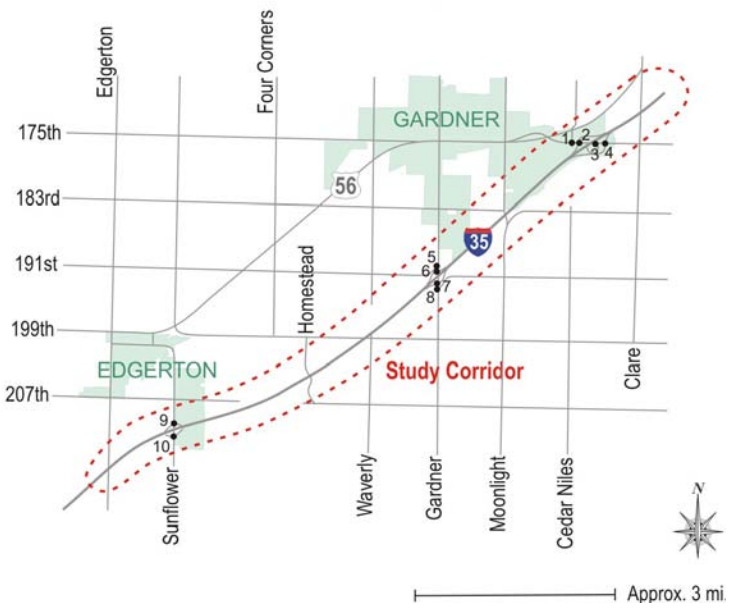
[1] New Century AirCenter Airport Mater Plan (accessed online at http://jcac.jocogov.org/pdf/IXD_MasterPlan_ChapterTwo.pdf on 7/31/07)

existing interstate system facilities; addressing eight specific criteria set by the Federal Highway Administration (FHWA) in the policy statement *Additional Interchanges to the Interstate System*. (FHWA, 1998) In this case, the break-in-access study (BIA) examined the need for and implications of a new interchange on I-35 in the vicinity of Gardner.

1.2. Traffic Study Corridor and Study Scenarios

Selection of the Traffic Study Corridor for this break-in-access study took into account two primary factors. First, the interstate-related facilities (mainline, ramps, and nearby intersections) function as a system with changes in one area potentially affecting other areas. Second, FHWA policy specifically states that all BIAs should include "at least the first adjacent existing or proposed interchange on either side" of the proposed access point as well as "crossroads and other roads and streets … to the extent necessary to assure their ability to collect and distribute traffic to and from the interchange." In light of these factors, it was recommended that the study corridor extend from the US-56 interchange south to Edgerton Road to capture all of the system effects of a new access point in the vicinity of the City of Gardner (See **Figures 1.1 and 1.2**). The final extents of the Traffic Study Corridor were agreed upon in consultation with FHWA, Kansas Department of Transportation (KDOT), Mid-America Regional Council, Johnson County, Miami County, City of Gardner, City of Edgerton, and the City of Olathe.

Figure 1.2: Traffic Study Corridor and Intersections



Within the Traffic Study Corridor, ten primary (existing) intersections were evaluated (illustrated in Figure 1.2). The ten intersections included the seven I-35 ramp intersections as well as three additional intersections that were added to the study due to their proximity and functional relationship to the existing I-35 interchanges. The three additional intersections were US-56 / Cedar Niles Road and 191st Street / Gardner Road, both north and south of the I-35 / Gardner Road interchange, illustrated as intersections 1, 5, and 8 in Figure 1.2. In addition, the analysis considered all I-35 ramp merge and diverge locations and the eight I-35 mainline sections within the corridor.

The study scenarios considered in the BIA include:

1. Existing Conditions
2. 2030 No-Build (no new I-35 interchange)
3. 2030 Build Waverly Road Interchange
4. 2030 Build Homestead Lane Interchange

It is important to note that the projected 2030 land use assumptions were the same in all three future scenarios. The 2030 network (highway) assumptions were also the same with the exception of the

[2] The Gardner Advantage, County Economic Research Institute, 2007 (accessed online at http://www.thinksouthwestjohnsoncounty.com/pdf/GardnerAdv07.pdf on 7/31/07)

potential Waverly Road and Homestead Lane interchanges. More discussion is provided on these topics in Section 2.

1.3. Study Purpose

In broad terms, the purpose of the BIA is to assess the need for, and implications of, constructing a new interchange on I-35 between Sunflower Road and Gardner Road, in order to help provide the "justification and documentation needed for requests to add access (interchanges and ramps) to the existing Interstate System" (FHWA, 1998). However, in discussions with KDOT and FHWA, it was determined that the study should specifically focus on the documentation necessary to support conditional approval for new access on I-35 in keeping with a "Determination of Engineering and Operational Acceptability." (FHWA, 1998) Therefore, this study evaluates the need for the interchange, the operational feasibility of potential new interchange alternatives, and the operational impacts of a new interchange on the existing transportation system. It does not compare the interchange locations, nor does it address environmental, cost, or public opinion issues. The study was conducted in accordance with the FHWA policy for assessing additional interchanges on the interstate system, which were effective on February 11, 1998. It addresses all eight of the FHWA requirements to the extent possible given the study parameters described above.

2. Study Methodology

While the BIA traffic analysis directly addresses each of the eight FHWA criteria, it still includes the principal elements of a comprehensive traffic study (i.e. data collection, traffic forecasting, and an assessment of existing and future traffic conditions) with each element placed where appropriate in the discussion. This section outlines the methodologies employed for the various analyses, including the forecasting and operational assessment approaches.

2.1. Data Collection

The study team gathered a wide range of traffic and highway data to support the assessment of current and future traffic conditions in the study corridor. This effort included collecting field data as well as available existing data from various state and local agencies. Agencies that were contacted included the Kansas Department of Transportation (KDOT), Mid-America Regional Council (MARC), Johnson County, Miami County, City of Gardner, City of Edgerton, and the City of Olathe. The data collected for the study included:

1. Weekday a.m. and p.m. peak period intersection turning movement counts at all study intersections and ramps. The counts were conducted from 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m. in June and July of 2006;
2. KDOT daily traffic counts for I-35 and US-56, including truck classification counts where available;
3. Average daily traffic counts for other area highways (KDOT count map);
4. Crash data for I-35;
5. Recent traffic studies related to new developments and transportation improvements;
6. Traffic signal timing;
7. Intersection and Interstate geometry and traffic control data (field observations);
8. Peak period I-35 travel time runs (to support calibration of the simulation model); and
9. Other field observations (e.g. queue and delay observations to support the simulation modeling).

2.2. Traffic Volumes and Forecasting

2.2.1. Existing Volumes

Existing traffic volumes were developed based on recent daily and peak-period count data. The count data was smoothed to provide a consistent base for the analysis. Truck volumes were also estimated based on the available truck counts in the Traffic Study Corridor. (The existing daily and peak hour volumes are presented in Figures 3.1 and 3.2 in Section 3.)

2.2.2. Future Volumes (Travel Demand Model Assumptions)

Forecast Year and Study Scenarios

The forecast year selected for the analysis was 2030, as directed by the review agencies to meet a typical minimum 20-year planning horizon. To establish a basis for considering the need for a new I-35 interchange, a 2030 No-Build Scenario was created that assumes no new interchange is constructed in the Traffic Study Corridor by the year 2030. In addition to the 2030 No-Build Scenario, two Build scenarios were evaluated. One Build scenario considers a new interchange at 199th Street and Waverly Road. This is the location currently shown in local planning documents, including the Johnson County *Comprehensive Arterial Road Network Plan* (CARNP) adopted in December 1998 and Johnson County's *Rural Comprehensive Plan* adopted in June 2004. This location was proposed in the CARNP in conjunction with a proposed upgrade of 199th Street to a two- to four-lane rural parkway from I-35 east to Mission Road. West of I-35, 199th Street was proposed as a two-lane rural major arterial. The second Build

scenario considers a new interchange at the Homestead Lane overpass. This second option was developed to meet KDOT's preferred minimum two-mile separation between interchanges in urban areas. Therefore, the future study scenarios included:

- 2030 No-Build (no new I-35 interchange)
- 2030 Build Waverly Road Interchange
- 2030 Build Homestead Lane Interchange

Forecasting Model

The City of Olathe's computerized travel demand forecasting model (Model) was selected as the most appropriate platform for developing the 2030 No-Build and Build traffic forecasts. The Model, using the TransCAD software, provides both daily and p.m. peak hour forecasts for a typical weekday. The Olathe Model does not currently provide a.m. peak hour forecasts as model output. The Model covers an area about 14 miles long (north-south) and 15 miles wide (east-west). The approximate Model limits are 87th Street/83rd Street to the north, Quivira Road to the east, 199th Street to the south, and Sunflower Road to the west. The model boundary is illustrated in Figure 1.1. The Model divides the region into 782 internal Traffic Analysis Zones (TAZs), which allow existing and future land-use/socioeconomic information to be grouped into reasonably sized areas. These TAZs are joined to the transportation network by links known as centroid connectors, and the Model - through an iterative process - generates, distributes, and assigns traffic to the transportation network. In addition to the 782 internal TAZs, the Model includes 72 external zones that represent traffic heading in and out of the Model (such as I-35 south of 191st Street).

Model Land Use

The Traffic Study Corridor is at the southwestern edge of the Olathe model; in fact, the Sunflower Interchange is outside the Model. Much of the area within and near the Traffic Study Corridor is in a state of flux regarding future land-use and transportation planning; therefore, to prepare the Model for the needed analysis, the 2030 land-use and network assumptions were reviewed and refined. Refining these assumptions involved extensive input from multiple agencies (Agencies), including the Kansas Department of Transportation (KDOT), the Federal Highway Administration (FHWA), the City of Gardner, the City of Edgerton, the City of Olathe, Johnson County, Miami County, and the Mid-America Regional Council (MARC). Through an ongoing collaborative process, these agencies reached consensus regarding the land-use and network assumptions to be included in the Model.

As originally received at the outset of the traffic studies, the Model included four horizon years: 2004 (existing), 2010, 2015, and 2050. Since 2030 was identified by the Agencies as the desirable year for traffic forecasting and impact analysis, a new model horizon year had to be developed. The process for creating the approved 2030 land-use inputs included (1) Linear interpolation between the Model's 2015 and 2050 land-use scenarios, (2) Specific inputs by the City of Gardner related to future growth within and near the City, and (3) extensive review and input from the remaining Agencies, especially Johnson County and the City of Edgerton. The process also included manipulation of the Model's external link volumes to represent relevant expected growth beyond the Model edges (such as redevelopment of the Sunflower Army Ammunition Plant site).

In addition to the agency coordination described above, several comprehensive planning, land use, and zoning documents were obtained and reviewed to identify future land-use and transportation plans/assumptions within or near the Traffic Study Corridor that might affect the 2030 No-Build Scenario. The following documents and studies were considered:

- Miami County - *Comprehensive Plan*, September 2004
- Johnson County – *Comprehensive Arterial Road Network Plan (CARNP)*, January 1998
- Johnson County – *The Rural Comprehensive Plan*, June 2004
- Johnson County - *Sunflower Army Ammunition Plan Conceptual Land Use Plan*, June 1998

- Johnson County Planning Commission - *New Century AirCenter Comprehensive Compatibility Plan*, February 1996
- Johnson County & Tetra Tech EM, Inc. - *Sunflower Army Ammunition Plant Supplemental Environmental Assessment*, January 2004
- City of Olathe - *2005 Transportation Study*
- Gould Evans Goodman Associates - *Lone Elm Vicinity Plan* and Draft Update, June 2000 and February 2007
- City of Edgerton - *Comprehensive Land Use Plan*, 2000
- City of Gardner - *Comprehensive Plan*, 2003
- KDOT - *K-10 Transportation Study*, May 2005
- KDOT & Johnson County – *K-10 Corridor Study Update*, January 2004
- KDOT (HNTB & HDR)- *K-7 Corridor Management Plan*, February 2006
- City of Olathe (HNTB) - *I-35 & Lone Elm Road Interchange Environmental Assessment*
- MARC - *South Metro Connector Study* (ongoing)

The finalized land-use scenario included adjustments to account for known major developments and plans in the area including: Sunflower Army Ammunition Plant, Lone Elm Plan, development at New Century AirCenter, proposed BNSF Intermodal Facility, The Allen Group's proposed Logistics Park, and other expected growth in Gardner. Further details regarding the approved land uses in the 2030 model are available in the *Land-Use and Traffic Forecasting Assumptions Memorandum* (HDR, 2/2/07) and in the September 2007 addendum to this document, both of which are provided in Appendix A.

Model Roadway Network

The model network was also updated to an anticipated 2030 condition. The process for creating the 2030 No-Build model network was similar to the land-use update process, involving starting from the 2050 network as a base and working with the agencies to gain consensus regarding appropriate modifications. Some of these No-Build scenario improvements were inside and some outside of the study corridor. Major improvements in the vicinity of the Traffic Study Corridor are illustrated in **Figure 2.1**. Key assumptions that affect the Traffic Study Corridor are listed below:

I-35 mainline – It is assumed that I-35 will be widened to six lanes from 151st Street to Gardner Road.

I-35/Gardner Road interchange and vicinity – The assumptions at this interchange include signalization of both ramp terminals, and the addition of right-turn lanes at the southbound ramp intersection (westbound and southbound approaches). It is further assumed that both 191st Street intersections with Gardner Road will be moved several hundred additional feet away from the interchange to provide adequate separation to facilitate traffic flow. On the north side, this would tie into the current 188th Street alignment west of Gardner Road (including added turn lanes and signalization at the intersection).

K-7 – In keeping with the recommendations of the *K-7 Corridor Management Plan*, the 2030 No-Build scenario assumes that K-7 will be converted to a continuous freeway from Olathe to Spring Hill. This includes a new freeway-to-freeway interchange with I-35 in Olathe. K-7 does not fall within the Traffic Study Corridor, but it is in the Model and heavily influences regional traffic volume distributions.

151st Street – It is assumed in the 2030 Model that 151st Street will be a four lane roadway from New Century Road east to I-35, continuing over the railroad tracks east of Old US 56 where it currently is discontinuous.

167th Street – It is assumed that 167th Street will be widened from two to four lanes between Waverly Road and Moonlight Road.

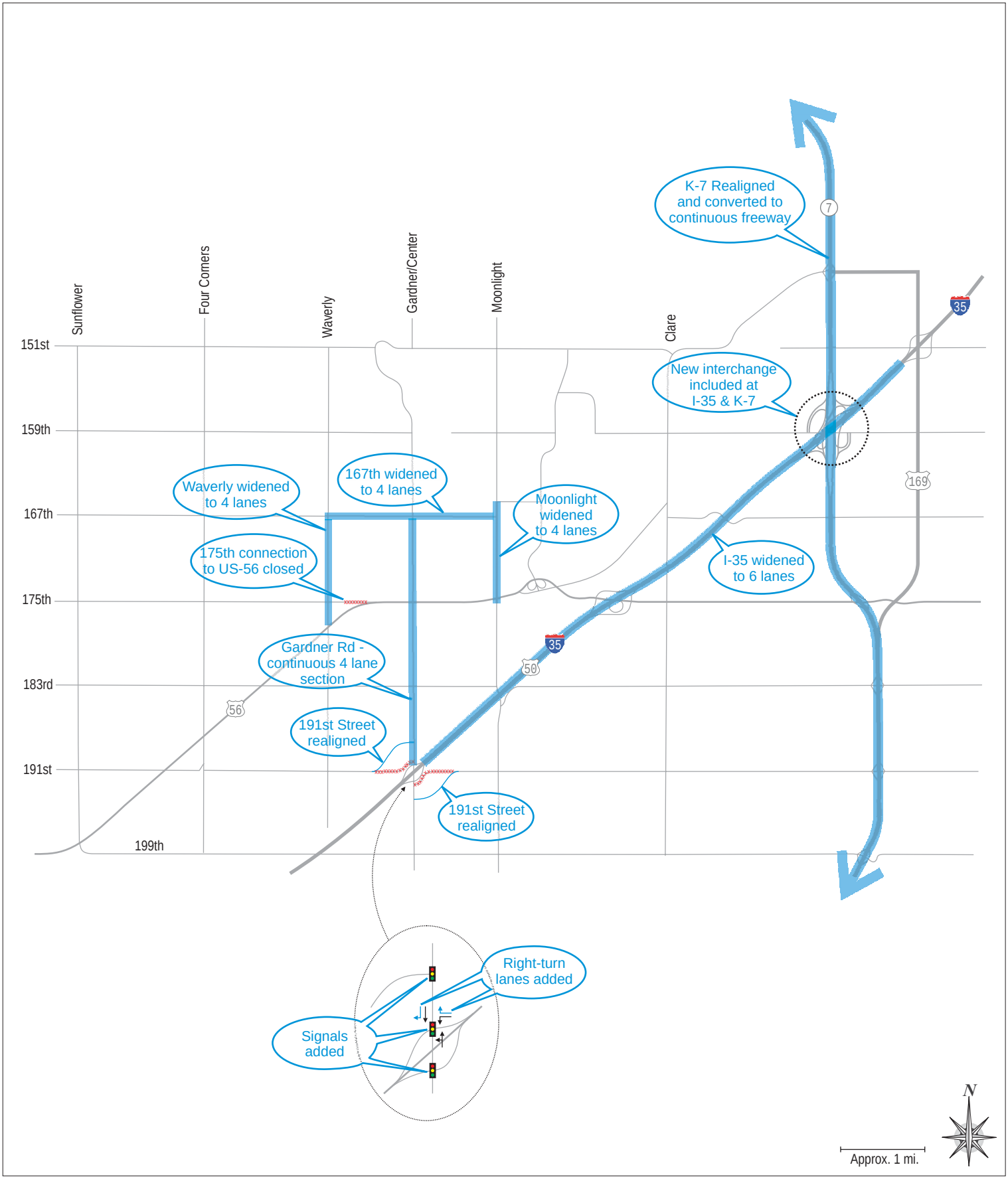


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Figure 2.1: Anticipated Major Transportation Network Improvements by 2030

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175th Street – The "triangle" created by 175th Street, US-56, and Waverly Road is operationally challenging and will continue to be so as traffic volumes increase. The 2030 No-Build scenario assumes that the 175th Street connection to US-56 will be closed so that motorists traveling between 175th Street and US-56 will need to use Waverly Road.

Gardner Road – Much of Gardner Road between US-56 and I-35 already consists of a four-lane cross-section, but there are several areas with only two lanes. The 2030 No-Build scenario assumes a complete four-lane facility for this entire segment, including the widening of the bridge over the BNSF tracks.

Waverly Road – It is assumed that Waverly Road will be widened to four lanes between US-56 and 167th Street.

Moonlight Road - It is assumed that Moonlight Road will be widened to four lanes between Santa Fe Street and 167th Street, and that the Moonlight Road/Santa Fe Street intersection will be relocated approximately 600 feet south to provide better separation from the BNSF tracks and US-56.

Local Streets – Some of the existing roads between US-56 and I-35 are currently low-volume gravel roadways, including Waverly Road, 191st Street, and 183rd Street. Johnson County's CARNP shows these roads as future paved facilities. The 2030 No-Build model increases the capacities of these roadways to reflect the CARNP recommendations.

Intersection Upgrades - Many of the study intersections, especially those along US-56, are assumed to be upgraded under the No-Build scenario. (Figure 3.5 illustrates assumed 2030 lane geometries and traffic control for each intersection.)

The Model includes many other assumptions regarding future improvements for the entire area covered by the Model. These underlying Model assumptions were not changed as part of this project.

Model Results and Final Volumes

The p.m. peak hour and daily models were run using the approved 2030 No-Build land use scenario and the approved 2030 No-Build network. The resulting "raw" model output was then adjusted based on a comparison of the calibrated base year model "forecasts" to the existing traffic volumes. This helped ensure that localized traffic patterns were taken into account and that under- or over-representation of volumes in the base year were corrected. Existing truck traffic was also examined to develop balanced estimates of future truck volumes. This included separate distributions and assignments of the truck traffic related to the planned BNSF Intermodal facility and proposed Allen Development of Kansas (ADK) Logistics Park development, which were then combined with the general truck flow (which was based on percentages of the total volumes).

Because the Model does not directly produce a.m. forecasts, a separate set of post-processing techniques were employed to estimate a.m. peak period flows based on the reversed p.m. Model results. This process included comparing the reversed (2004) base year flows with the existing a.m. traffic volumes. Based on that comparison, the reversed 2030 p.m. volumes were adjusted to a.m. values. Truck traffic for the a.m. peak hour was again estimated by calculating the general truck flows using percentages and then adding the truck forecasts for the planned BNSF Intermodal Facility and proposed ADK Logistics Park.

The I-35/Sunflower Road interchange is outside the model boundaries, and was therefore addressed independently. Spreadsheet methods were used to derive future volumes at this location based on existing

counts, projected land use growth, Model external zone data, and consideration of the plans and data highlighted previously.

The final volumes were determined to be appropriately representative of the anticipated 2030 No-Build peak hour and daily traffic flows, based on the approved land use and network assumptions. The same Model process was followed for the two Build scenarios, the only change being the addition of the appropriate interchange to the Model runs. The final volume forecasts are provided in figures in Section 3.

2.2.3. Traffic Operations Analyses

The traffic operations analysis evaluated the ten study intersections and the freeway (mainline and ramp) system for all study scenarios. The analysis focused on the critical weekday a.m. and p.m. peak hours, though daily traffic volume data is discussed in this document where appropriate. The traffic analysis approach was based upon several methodology sources, including:

- *Highway Capacity Manual* – Transportation Research Board (TRB), 2000
- *Manual of Uniform Traffic Control Devices (MUTCD)* – FHWA, 2003 Edition
- *A Policy on Geometric Design of Highways and Streets* - AASHTO, 2004

Based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, operations within a rural area should target a Level of Service (LOS) C or better for future conditions; for urban areas, the guidelines suggest a target LOS of D or better. For this study, since the surrounding land use is rapidly developing, a minimum standard of LOS D was chosen, along with a LOS C as a desirable goal.

The BIA uses two primary technical traffic analysis methods: Highway Capacity Manual and micro-simulation. Both of these methods were used for all study intersections and freeway facilities. This provided two separate assessments (and points of comparison) for the critical roadway facilities.

Highway Capacity Manual

The Highway Capacity Manual (HCM) 2000, published by the Transportation Research Board, provides standard traffic operational analysis methods for intersections, freeways, and ramps (merge and diverge).

LOS is the fundamental HCM parameter describing operational conditions within a traffic stream. LOS is an A-through-F letter ranking scale with LOS A indicating free-flow, low density, or nearly negligible delay conditions and LOS F indicating facility breakdown with low speeds, high densities, and high delay. For intersections, LOS is based on the average control delay per entering vehicle measured in seconds. Control delay includes not only stops at intersections, but also slower speeds as vehicles advance in queue or decelerate upstream of an intersection. For signalized and all-way stop-controlled intersections, individual approach delays as well as an overall average delay are calculated for each intersection. For one and two-way stop-controlled intersections, the delay is only reported by approach. For freeway elements (including both segments and ramps), LOS is based on density, defined as the number of vehicles per mile per lane. **Table 2.1** shows the LOS criteria used in this study. The HCM methods were implemented using the Highway Capacity Software (HCS+) for freeways and ramps, and the Synchro Version 7 software for intersections.

Microscopic Traffic Simulation Model

In addition to the HCM methods, the study team also employed the computer program VISSIM (version 4.2) to evaluate traffic operations. VISSIM is a microscopic simulation model used for analyzing urban networks. The VISSIM model was calibrated to replicate existing conditions using field-measured travel speeds and queue observations.

Table 2.1: Level of Service

Level of Service	Intersections			Freeways		
	Description	Control Delay (sec/veh)		Description	Maximum Density (veh/mi/ln)	
		Signalized	Unsignalized		Mainline	Ramps
A	Most vehicles do not stop	≤ 10	≤ 10	Free flow	11	10
B	Some vehicles stop	> 10 and ≤ 20	> 10 and ≤ 15	Slight restriction to free flow	18	20
C	Significant number of stops	> 20 and ≤ 35	> 15 and ≤ 25	Restrictions to free flow	26	28
D	Many stop, individual cycle failure	> 35 and ≤ 55	> 25 and ≤ 35	Noticeable restriction, declining speeds	35	35
E	Frequent individual cycle failure, at capacity	> 55 and ≤ 80	> 25 and ≤ 50	No gaps in traffic, volatile speeds	45	>35
F	Arrival rate exceeds capacity	> 80	Demand > capacity	Breakdown, large queues, recurring congestion	>45	demand > capacity

Source: *Highway Capacity Manual (HCM), 2000*

For freeways, VISSIM reports densities (and speeds) on a per-link basis, and does not typically distinguish between "mainline", "ramp junction", and "weave section" (as HCM does) in calculating Measures of Effectiveness (MOEs). VISSIM segmentation is typically based on the characteristics of the link (speed, number of lanes) or locations where interruptions/changes occur (ramp junction, lane drop, etc.). For the purposes of this study, density was extracted for each segment in the VISSIM model, and the HCM freeway mainline density-LOS correlation (see Table 2.1) was used to evaluate all segments.

For intersections, VISSIM reports average delay per vehicle (as well as queues) for links on each intersection approach (as defined by the user). This allows the individual delays to be averaged into an intersection-wide delay-per-vehicle measure, analogous to the HCM procedures. Table 2.1 also shows the LOS ranges used to evaluate signalized and unsignalized intersections.

3. Interstate System Break-In-Access Requirements

The following eight sections directly address the eight requirements of FHWA's policy statement for adding interchanges to the interstate system. The eight requirements are considered in order.

3.1. Existing System Evaluation

> **FHWA Policy:** *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 evaluation of the existing system addresses the following: Existing Conditions, Future No-Build Traffic Volumes, Future No-Build Traffic Operational Analysis, and Improvements Considered to Address 2030 No-Build Operational Issues.

3.1.1. Existing Conditions

The existing traffic conditions in the Traffic Study Corridor were assessed based on the current highway volumes, geometrics, and traffic control. The analysis presented below addresses traffic volumes, traffic operations, and other key traffic issues.

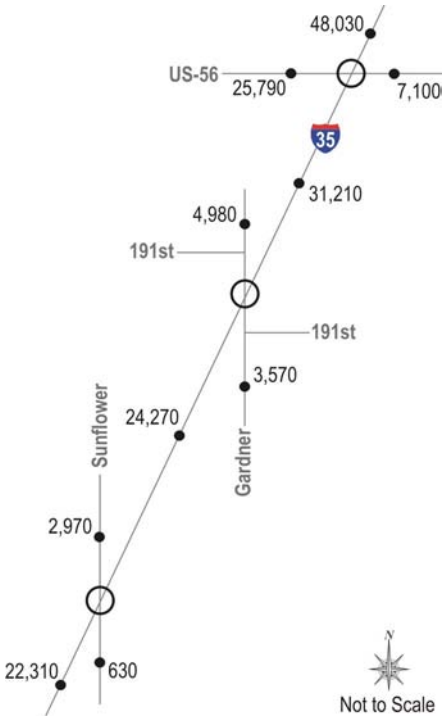
Existing Traffic Volumes

Current average daily traffic count data (from 2004 to 2006) was collected for the major roadways in the Traffic Study Corridor. These counts were adjusted to a consistent base year of 2007. The adjusted daily traffic flows are presented in **Figure 3.1**.

I-35 carries 22,300 vehicles per day (vpd) at the south end of the corridor and approximately 48,000 vpd at the north end of the corridor. The volumes on Sunflower Road and Gardner Road in the vicinity of I-35 are below 5,000 vpd. Volumes on US-56 are substantially higher, especially to the west of I-35 where it carries nearly 26,000 vpd. These traffic flows translate to heavy traffic demand at the US-56/I-35 interchange, which will be demonstrated further in the operational analysis section. Daily vehicle classification count data was available for most of I-35 in the corridor. According to this data, daily truck percentages on I-35 (including both single-unit trucks and trailer trucks) decrease from south to north with 25 percent trucks south of Sunflower Road and approximately 12 percent trucks north of US-56.

Peak hour traffic volume data is also illustrated in **Figure 3.2**. Current directional peak hour traffic volumes on I-35 range from nearly 3,000 vph north of US-56 (a.m. peak hour northbound and p.m. peak hour southbound) to less than 500 vph south of Sunflower Road (a.m. peak hour southbound). The highest ramp volumes are found at the US-56 interchange where approximately 1,240 vehicles use the loop ramp from eastbound US-56 to northbound I-35 during the a.m. peak hour and over 1,100 vph use the southbound I-35 exit ramp during the p.m. peak hour.

Figure 3.1: Existing Average Daily Traffic (ADT) Volumes



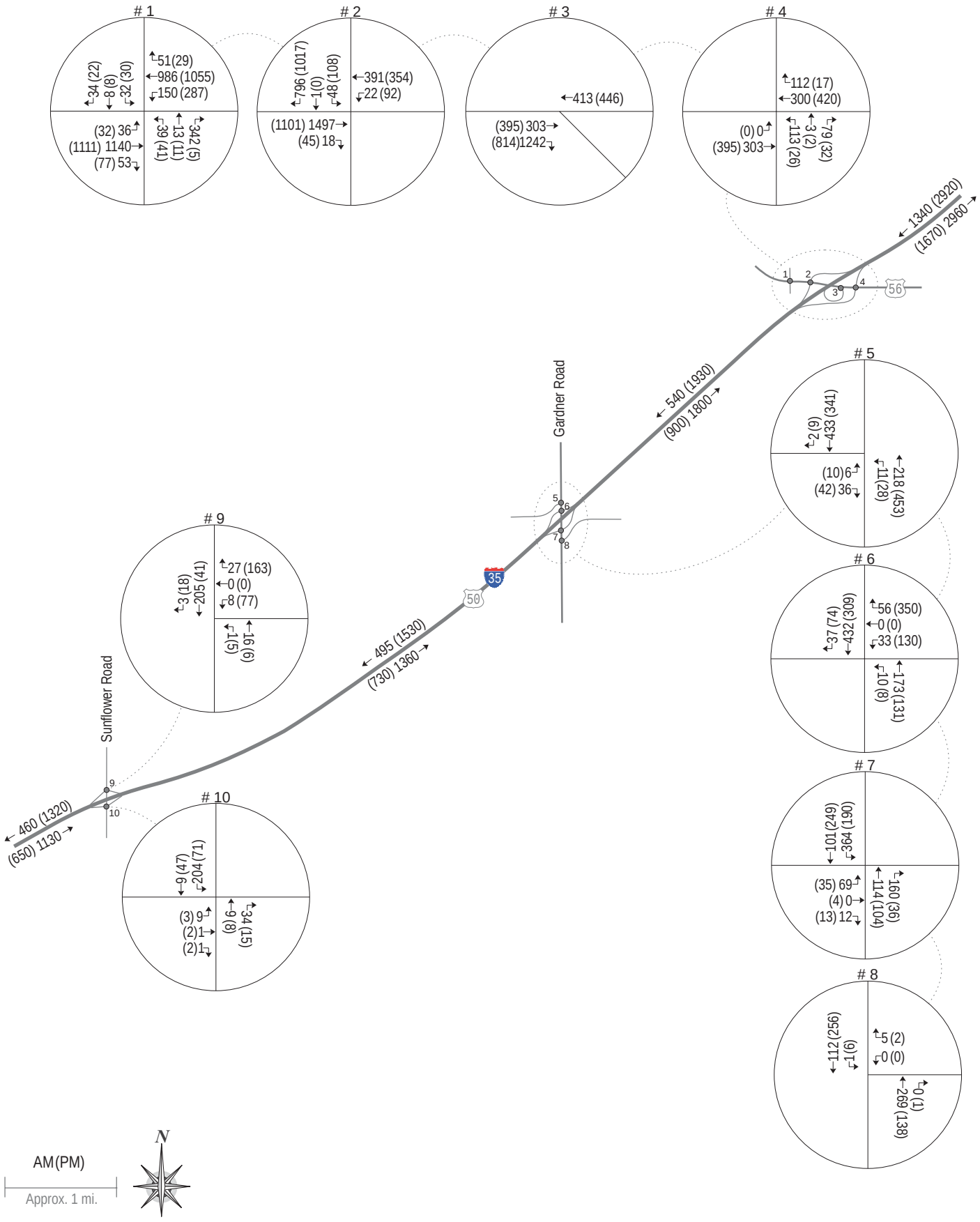


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Figure 3.2: Existing Peak Hour Traffic Volumes

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Current volumes at the Gardner Road interchange are substantially lower with peak ramp volumes of closer to 500 vph. Volumes at the Sunflower interchange are lower still with few volumes exceeding 200 vph.

Existing Operational Analysis

The existing conditions analysis was conducted for the weekday a.m. and p.m. peak hours using the existing traffic volumes, traffic control, and geometry for the study intersections, freeway sections, and freeway ramps. Each of these transportation facilities were examined for operational concerns. Figure 3.2 illustrates the existing a.m. and p.m. peak-hour volumes used in the analysis, and **Figure 3.3** presents the current geometric and traffic control data.

Intersection Operations

Table 3.1 summarizes the results of the existing intersection operational analysis using the HCM method. The detailed analysis sheets are provided in Appendix B. As indicated in the table, the majority of the study intersections operate acceptably (LOS D or better) during both peak hours. The following two intersections, however, operate below this level:

- *Intersection #2: I-35 Southbound Ramps and US-56.* The one-lane I-35 southbound exit ramp flares to two lanes as it approaches US-56. The heavy southbound right-turn movement has a free-flow lane onto US-56 westbound. The southbound left-turn movement is stop-controlled. This southbound left-turn movement operates at LOS E during the p.m. peak hour. During this time period the left-turn volume is just over 100 vehicles, while the conflicting through and left-turn volumes on US 56 are heavy with over 1,500 vehicles (total) in both directions.

- *Intersection #7: Gardner Road and I-35 NB Ramps.* The one-lane eastbound (off-ramp) approach to this unsignalized intersection operates at LOS F during the a.m. peak hour (average delay of 58 seconds per vehicle). This is due in part to the conflicting southbound left-turn and northbound right-turn movements, which are heaviest during the a.m. peak. The eastbound a.m. peak hour approach volume affected by this delay is approximately 80 vehicles. This current poor operating condition is also an indicator of potential future problems at this location as traffic volumes to and from I-35 increase.

Table 3.1: Existing Intersection Operations Analysis

Study Intersection # and Name	Traffic Control	AM Peak Hour Delay (sec/veh)	AM Peak Hour LOS	PM Peak Hour Delay (sec/veh)	PM Peak Hour LOS
1 Cedar Niles/ US 56	Signalized	28.0	C	25.2	C
2 US 56/ I-35 SB Ramps	OWSC	33.0 (SB)	D	41.3 (SB)	E
3 US 56/ I-35 NB On-Loop Ramp*	Uncontrolled	v/c~.62	OK	v/c~.41	OK
4 US 56/ I-35 NB Ramps	OWSC	18.0 (NB)	C	17.4 (NB)	C
5 Gardner Rd/ W 191st St	OWSC	12.0 (EB)	B	12.7 (EB)	B
6 I-35 SB Ramps/ Gardner Rd	OWSC	12.9 (WB)	B	23.0 (WB)	C
7 I-35 NB Ramps/ Gardner Rd	OWSC	53.6 (EB)	F	20.7 (EB)	C
8 Gardner Rd/ E 191st St	OWSC	9.8 (WB)	A	9.0 (WB)	A
9 I-35 SB Ramps/Sunflower Rd	OWSC	9.2 (WB)	A	9.8 (WB)	A
10 I-35 NB Ramps/Sunflower Rd	OWSC	14.2 (EB)	B	9.9 (EB)	A

Notes: OWSC - One way stop controlled intersection
For one and two-way stop-controlled intersections the delay and LOS for the worst approach is shown.
*For the ramp diverge at Intersection 3, an approximate ramp volume-to-capacity ratio was calculated.

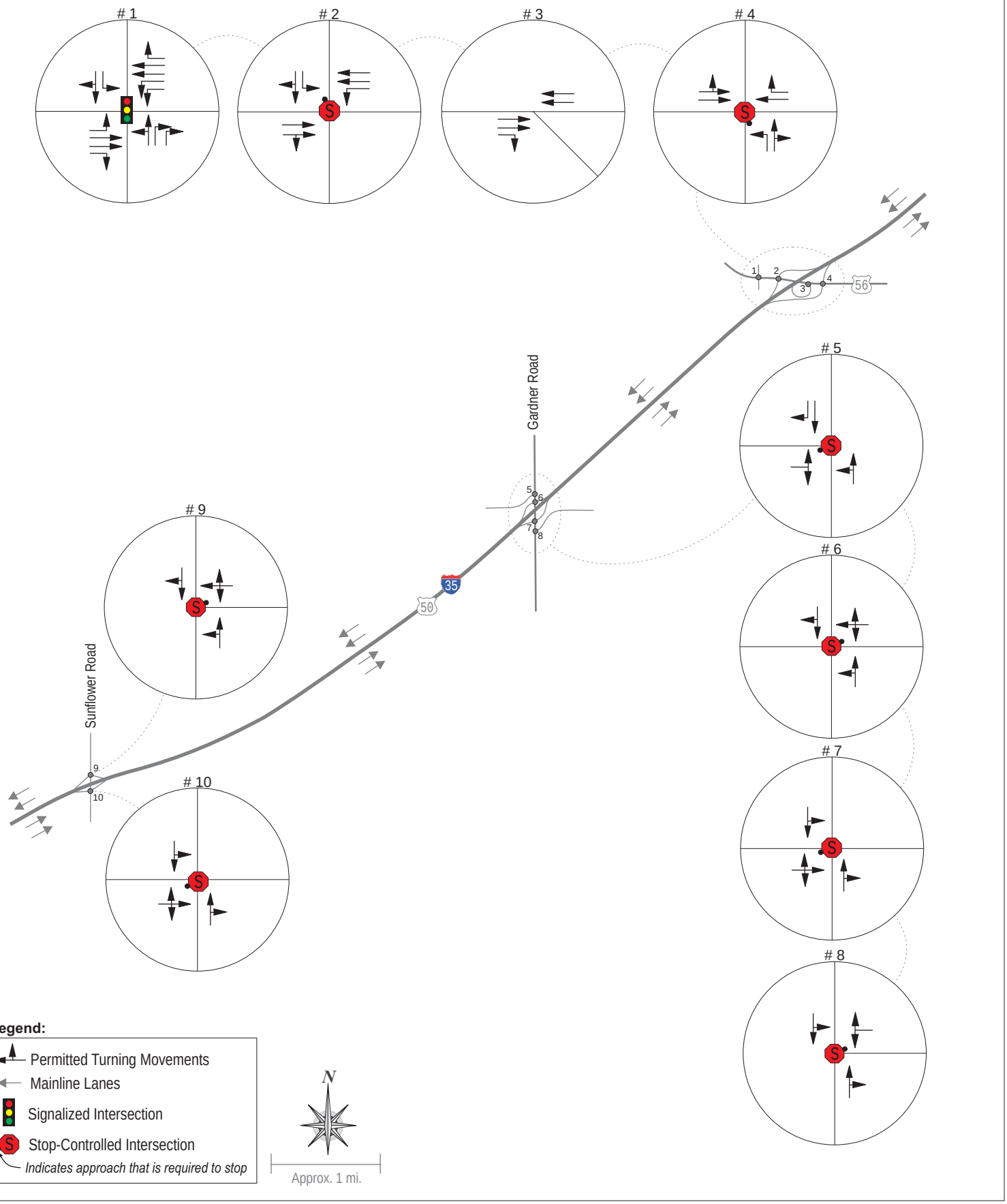

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Figure 3.3: Existing Geometry and Traffic Control

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Freeway Operations

The existing I-35 freeway operational analysis using the HCM method (for both mainline and ramp junctions) is summarized in **Table 3.2**. The detailed analysis sheets are provided in Appendix C. Currently, all freeway segments and ramps in the Traffic Study Corridor operate acceptably. Only one freeway segment operates at LOS C (US-56 to 151st Street), while all of the others operate at LOS B or better during both peak periods. Similarly, all of the ramps at the three interchanges in the Traffic Study Corridor operate at LOS B or better, with the exception of both of the US-56 on-ramps to I-35 northbound in the a.m. peak, and the US-56 southbound off-ramp in the p.m. peak (which operate at LOS C).

Table 3.2: Existing Freeway Operational Analyses

Basic Freeway Segments		**AM Peak Hour**			**PM Peak Hour**		
Location	**Lanes**	**Peak Hour Volumes**	**Density (pc/mi/ln)**	**LOS**	**Peak Hour Volumes**	**Density (pc/mi/ln)**	**LOS**
I-35 NB							
Edgerton to Sunflower	2	1130	9.4	A	650	5.7	A
Sunflower to Gardner	2	1360	11.2	B	730	6.3	A
Gardner to US 56	2	1800	14.8	B	900	7.7	A
US 56 to 151st Street	2	2960	24.3	C	1670	13.9	B
I-35 SB							
151st St to US 56	2	1340	11.1	B	2920	24.3	C
US 56 to Gardner	2	540	4.7	A	1930	16.0	B
Gardner to Sunflower	2	495	4.3	A	1530	12.8	B
Sunflower to Edgerton	2	460	4.0	A	1320	11.1	B

Ramp Merge/Diverge		**AM Peak Hour**			**PM Peak Hour**		
Ramp Description		**Ramp Volume (vph)**	**Density (pc/mi/ln)**	**LOS**	**Ramp Volume (vph)**	**Density (pc/mi/ln)**	**LOS**
I-35 NB							
Sunflower Road Off	na	11	8.3	A	7	3.9	A
Sunflower Road On	na	239	12.7	B	88	7.4	A
Gardner Road Off	na	81	10.6	B	52	4.7	A
Gardner Road On	na	524	16.4	B	230	8.9	A
US 56 Off	na	195	14.9	B	60	6.3	A
US 56 EB on-loop	na	1242	25.3	C	814	15.3	B
US 56 WB on	na	112	25.6	C	19	16.1	B
I-35 SB							
US 56 Off	na	845	10.4	B	1125	25.9	C
US 56 On	na	40	5.4	A	137	17.8	B
Gardner Road Off	na	89	2.7	A	480	16.3	B
Gardner Road On	na	47	5.1	A	82	14.3	B
Sunflower Road Off	na	35	2.2	A	240	12.4	B
Sunflower Road On	na	4	4.8	A	23	12.5	B

VISSIM Results

The VISSIM model of the existing conditions supported the conclusion that the current facilities generally operate at LOS C or better. This applies to both the intersection and freeway/ramp analysis. Additional VISSIM information is included in Appendix D.

3.1.2. 2030 No-Build Traffic Volumes

To assess the future design-year traffic operating conditions, 2030 No-Build traffic volume forecasts were developed. The No-Build scenario assumes that no new interchange will be constructed in the Traffic Study Corridor by 2030. The forecasts were developed using the methodology presented in Section 2.2. The land-use and highway (network) assumptions used to generate the 2030 No-Build forecasts were discussed with and agreed upon by the Federal, state, and local agencies involved in the BIA study process as documented in the land-use memo (Appendix A). As presented in Section 2, the 2030 highway network assumes some key improvements within the Traffic Study Corridor, including:

- Upgrading I-35 to six lanes between 151st Street and Gardner Road;
- Widening Gardner Road to four lanes between the I-35 Southbound Ramp and the current four-lane section;
- Signalizing three of the four intersections at and near the Gardner Road interchange; and
- Adding a southbound right-turn lane and a westbound right-turn lane to the Gardner Road / I-35 Southbound Ramp intersection.

The resulting 2030 No-Build Average Daily Traffic (ADT) volumes are illustrated in **Figure 3.4**. A comparison with existing ADTs (Figure 3.1) indicates that, as expected, the large amount of anticipated future development translates to sizeable forecasted traffic volume increases throughout the Traffic Study Corridor. Examples include:

- Daily volumes on I-35 are forecasted to roughly double, from a range of 22,000-48,000 vpd in 2007 to a range of 48,000-100,000 vpd in 2030.
- Daily volumes on US-56 west of the interchange are also forecasted to nearly double, while volumes east of the interchange are forecasted to increase more than five times.
- Daily volumes on Gardner Road north and south of the interchange are forecasted to increase approximately fivefold, with 2030 No-Build volumes of 27,400 north of 188th Street and 17,200 south of 191st Street.
- Daily volumes at the Sunflower interchange are forecasted to increase by approximately three to four times.

Similar sizeable increases are forecasted for the a.m. and p.m. peak hours, as can be seen by comparing **Figure 3.5** to Figure 3.2. During the peak hours, however, there is the added issue of directionality, with one direction carrying more traffic than the other direction. For example, north of US-56, the 2030 No-Build p.m. peak hour flows are 5,560 vph southbound and 4,390 vph northbound. Notable locations and movements in the 2030 No-Build Scenario include:

- The peak directional flows on I-35 (north of US-56) are forecasted to nearly double to 5,750 vph northbound in the a.m. peak and 5,560 vph southbound in the p.m. peak.
- The I-35 southbound exit ramp to US-56 is predicted to increase to 1,920 vph during the p.m. peak, while the loop ramp from eastbound US-56 to northbound I-35 is expected to have an a.m. peak volume of 1,670 vph.
- The I-35 / Gardner Road interchange ramp volumes are forecasted to grow substantially, with an a.m. peak volume of 2,220 vph (northbound ramp to I-35) and a p.m. peak volume of 1,920 vph (southbound ramp from I-35). The projected increase in traffic at the I-35 / Gardner Road interchange is more than at the I-35 / US-56 interchange given the lower current volumes at Gardner Road.
- The study intersections are forecasted to experience similar high volumes, with heavy turn movements exceeding 500 vph at nearly every intersection. Additionally, four of the five I-35 ramp intersections at US-56 and Gardner are forecasted to experience turn volumes that exceed 1,000 during at least one peak hour.

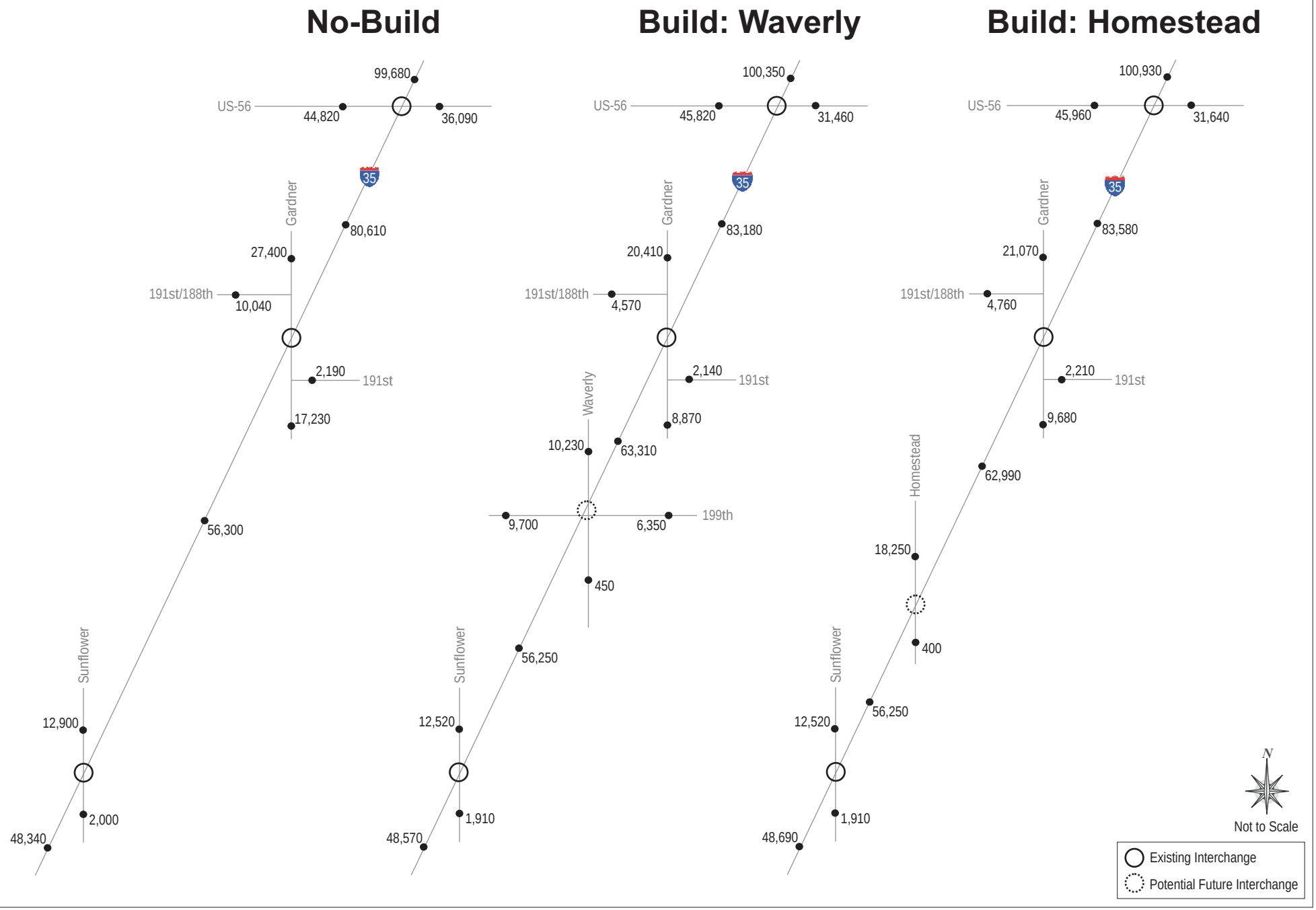

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Figure 3.4: Average Daily Traffic (ADT) Volumes - 2030 Scenarios

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No Build Scenario

Waverly Scenario

Homestead Scenario

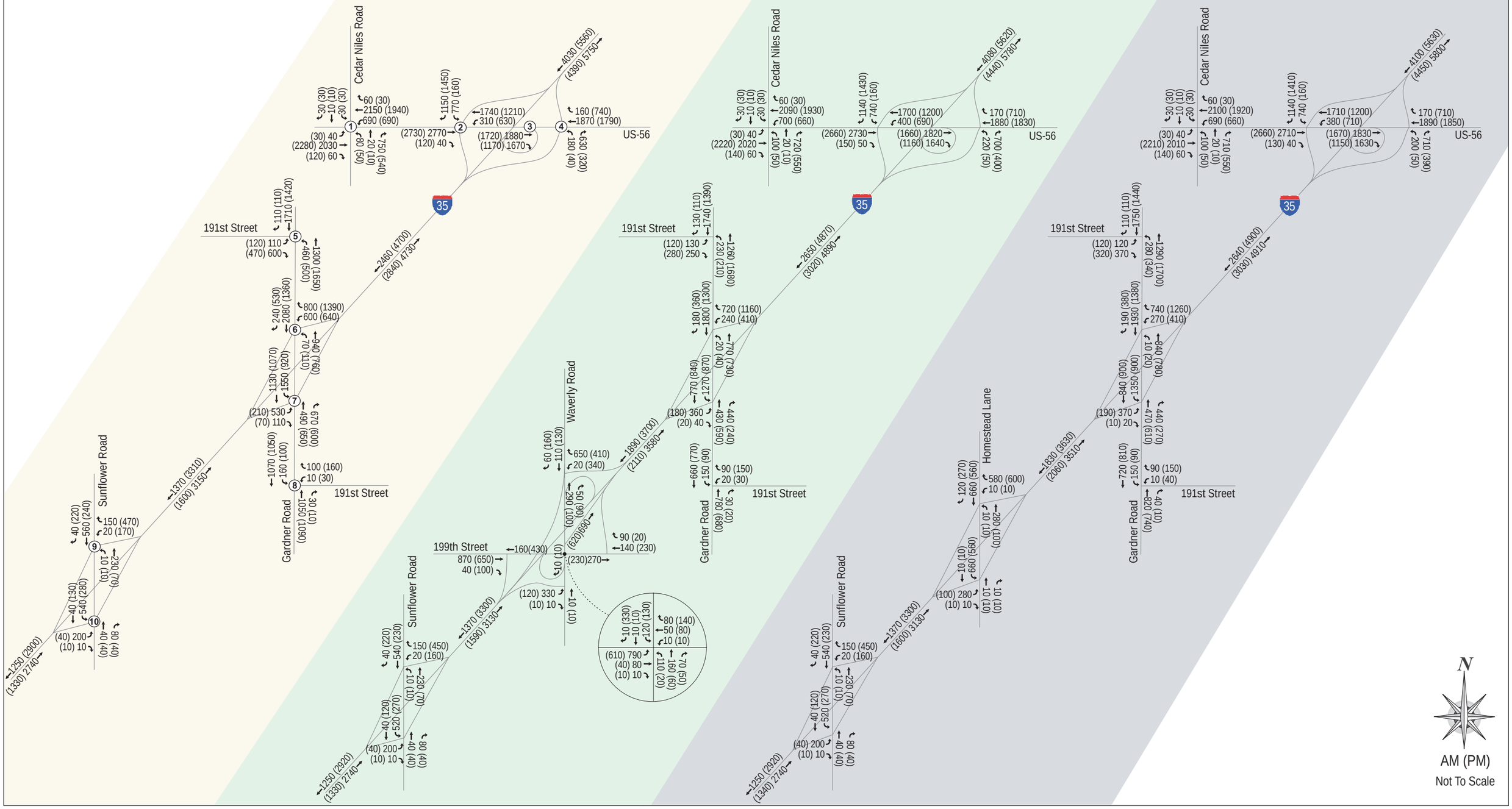

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Figure 3.5: 2030 Peak Hour Turning Movements - All Scenarios

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3.1.3. 2030 No-Build Operational Analysis

Based on the 2030 No-Build traffic forecasts and geometrics, the operating conditions were assessed for the study intersections and interstate facilities.

Intersection Operations

The 10 Study Intersections were evaluated using the projected 2030 No-Build traffic volumes (Figure 3.5) and the 2030 No-Build intersection geometries illustrated in **Figure 3.6**. The results of this analysis using the HCM method are shown in **Table 3.3** and the detailed analysis sheets are provided in Appendix B. As the table indicates, many of the study intersections are forecasted to operate at LOS E or worse under this scenario during one or both peak hours. These intersections are addressed below. Additional improvements that could be considered to address the 2030 No-Build operational issues are discussed in Section 3.1.4.

Table 3.3: 2030 No-Build Intersection Operations Analysis

Study Intersection # and Name	Traffic Control	AM Peak Hour Delay (sec/veh)	AM Peak Hour LOS	PM Peak Hour Delay (sec/veh)	PM Peak Hour LOS
1 US 56 / Cedar Niles Rd	Signalized	82.0	F	103.4	F
2 US 56 / I-35 SB Ramps	Signalized	193.8	F	163.8	F
3 US 56 / I-35 NB On-Loop Ramp*	Uncontrolled	v/c~.84	OK	v/c~.59	OK
4 US 56 / I-35 NB Ramps	Signalized	18.1	B	7.4	A
5 Gardner Rd / W 188th St	Signalized	56.7	E	25.1	C
6 I-35 SB Ramps / Gardner Rd	Signalized	200+	F	200+	F
7 I-35 NB Ramps / Gardner Rd	Signalized	200+	F	200+	F
8 Gardner Rd / E 191st St	OWSC	200+ (WB)	F	200+ (WB)	F
9 I-35 SB Ramps / Sunflower Rd	Signalized	5.9	A	18.0	B
10 I-35 NB Ramps / Sunflower Rd	Signalized	13.5	B	4.5	A

Notes: OWSC - One way stop controlled intersection
For one and two-way STOP controlled intersections the delay and LOS for the worst approach is shown.
*For the ramp diverge at Intersection 3, an approximate ramp volume-to-capacity (v/c) ratio was calculated.

- *Intersection #1 (US-56/Cedar Niles Road):* This intersection is projected to operate at LOS F during both peak hours. The primary factor affecting operations at this intersection is heavy forecasted "mainline" traffic on US-56 (peaking in the eastbound direction in the morning and the westbound direction during the evening). Additional through capacity would likely be required to improve this intersection to an acceptable level of service in the No-Build scenario. It is useful to note that intersections west of Cedar Niles Road (i.e. Old US-56 and Moonlight Road) are also expected to experience poor operating conditions in 2030 due to the projected high traffic demand in the US-56 corridor.

- *Intersection #2 (US-56/I-35 Southbound Ramps):* This intersection is forecasted to experience heavy southbound left-turn movements, conflicting with the through traffic on US-56 and resulting in LOS F operations during both peak hours. The intersection would require additional turn and through capacity to operate acceptably during both peak hours.

- *Intersection #5 (Gardner Road/188th Street):* This intersection is forecasted to operate poorly during the a.m. peak hour due in part to heavy northbound left-turn and eastbound right-turn volumes. Additional turn-lane capacity would be required to bring this intersection to an acceptable level of service.

- *Intersections #6 and 7 (I-35/Gardner Road Interchange):* Both of the ramp intersections are forecasted to operate at LOS F during both peak hours, with volumes far exceeding the No-Build Scenario capacities.

- *Intersection #8 (Gardner Road/191st Street south):* The stop-controlled westbound (191st Street) approach to this unsignalized intersection is forecasted to operate at LOS F during both peak hours. Forecasted commercial, residential, and industrial growth on Gardner Road south of the intersection results in heavy projected north-south through volumes, delaying side-street motorists. This level of traffic indicates that Gardner Road might eventually need to be widened to four lanes south of I-35 to serve future development. At this particular intersection, signalization or turn prohibitions might eventually be necessary to improve side-street operations.

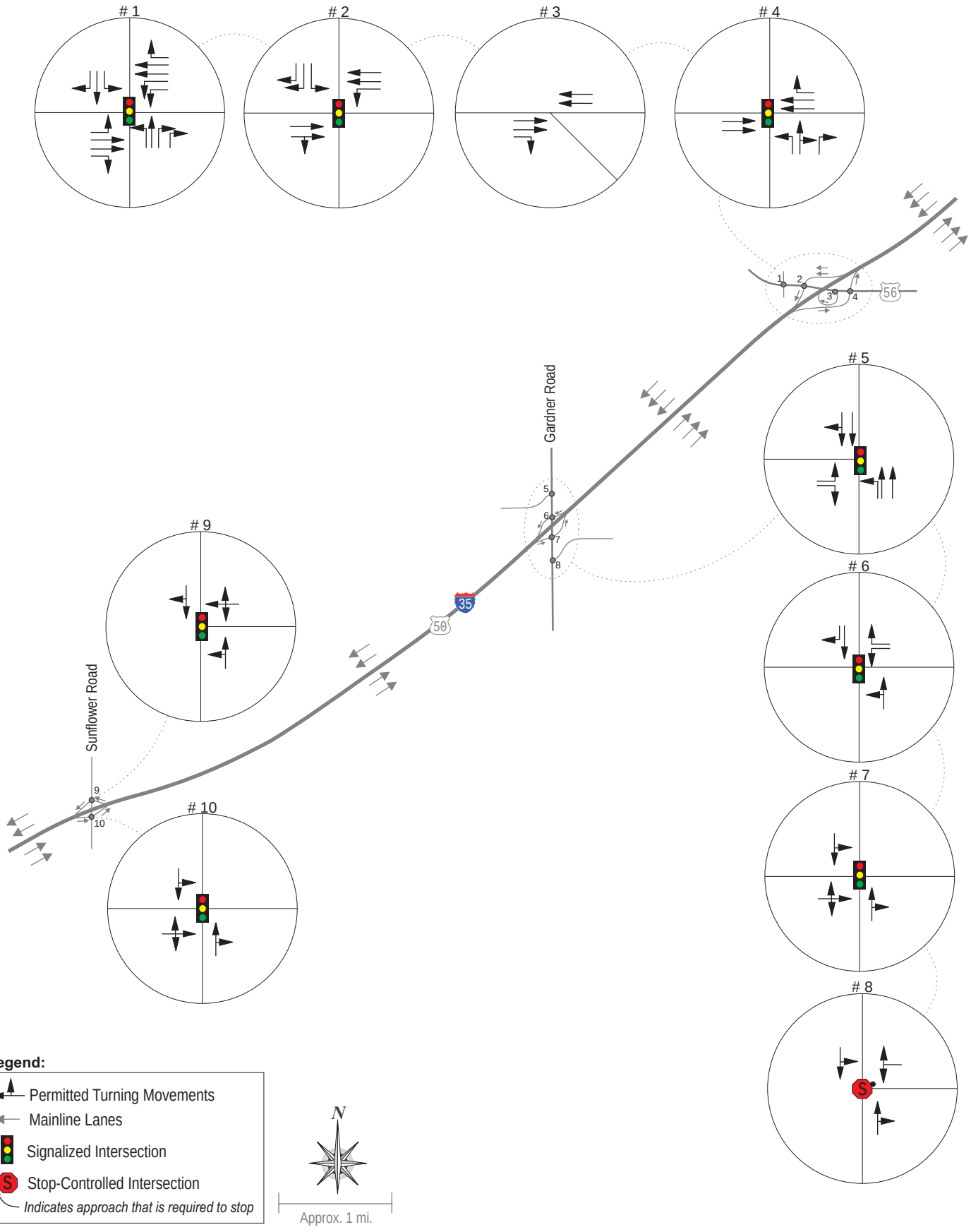

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Figure 3.6: 2030 No-Build Geometry

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Freeway Operations

Table 3.4 summarizes the freeway operational analysis using the HCM method (for both mainline and ramp junctions) for the 2030 No-Build Scenario. The detailed analysis sheets are provided in Appendix C. The analysis is based on the peak hour volumes presented in Figure 3.4 and the 2030 No-Build geometrics presented in Figure 3.5. With the large forecasted traffic increases described in the previous section, LOS on these facilities is forecasted to decrease from the existing primarily LOS A and B levels, to LOS C and D in many cases. The I-35 mainline between US-56 and 151st Street is forecasted to operate at LOS E northbound during the a.m. peak and LOS E southbound during the p.m. peak.

The US-56 southbound off-ramp is projected to operate at LOS F during the a.m. peak hour, with a diverge volume exceeding the available capacity. This indicates that a second exit lane may be needed to achieve an acceptable level of service. The Gardner Road on-ramp to I-35 northbound is predicted to operate at LOS E in the a.m. peak with a ramp volume of 2200 vph. The corresponding southbound exit ramp to Gardner Road is predicted to operate at LOS F in the p.m. peak with 2,030 vph. Again, two-lane ramps may be required to serve these volumes.

Table 3.4: 2030 Freeway Operational Analyses

Basic Freeway Segments		**AM Peak Hour**			**PM Peak Hour**		
Location	**Lanes**	**Peak Hour Volumes**	**Density (pc/mi/ln)**	**LOS**	**Peak Hour Volumes**	**Density (pc/mi/ln)**	**LOS**
I-35 NB							
Edgerton to Sunflower	2	2740	22.9	C	1330	11.7	B
Sunflower to Gardner	2	3150	26.9	D	1600	14.0	B
Gardner to US-56	3	4730	27.3	D	2840	16.3	B
US-56 to 151st Street	3	5750	37.1	E	4390	25.0	C
I-35 SB							
151st St to US 56	3	4030	22.8	C	5560	35.4	E
US-56 to Gardner	3	2460	14.2	B	4700	27.2	D
Gardner to Sunflower	2	1370	11.9	B	3310	29.4	D
Sunflower to Edgerton	2	1250	10.9	A	2900	24.8	C

Ramp Merge/Diverge		**AM Peak Hour**			**PM Peak Hour**		
Ramp Description		**Ramp Volume (vph)**	**Density (pc/mi/ln)**	**LOS**	**Ramp Volume (vph)**	**Density (pc/mi/ln)**	**LOS**
I-35 NB							
Sunflower Road Off	na	210	24.4	C	50	11.2	B
Sunflower Road On	na	620	28.7	D	320	15.7	B
Gardner Road Off	na	640	28.4	D	280	13.9	B
Gardner Road On	na	2220	*	F	1520	27.4	C
US-56 Off	na	810	28.0	C	360	17.7	B
US-56 EB on-loop	na	1670	*	F	1170	18.8	B
US-56 WB on	na	160	**	E	740	26.3	C
I-35 SB							
US-56 Off	na	1920	*	F	1610	**	E
US-56 On	na	350	15.5	B	750	28.8	D
Gardner Road Off	na	1400	**	E	2030	*	F
Gardner Road On	na	310	13.3	B	640	30.4	D
Sunflower Road Off	na	170	11.4	B	640	30.4	D
Sunflower Road On	na	50	12.4	B	230	26.9	C

*Notes: * indicates one or more ramp area traffic flows exceed facility capacity recommended in HCM*
*** indicates one or more ramp area traffic flows exceed 90% of facility capacity recommended in HCM*
(The second capacity check above (**) is not standard HCM practice, but is used here to show where capacity constraints may begin to dictate operational characteristics.)

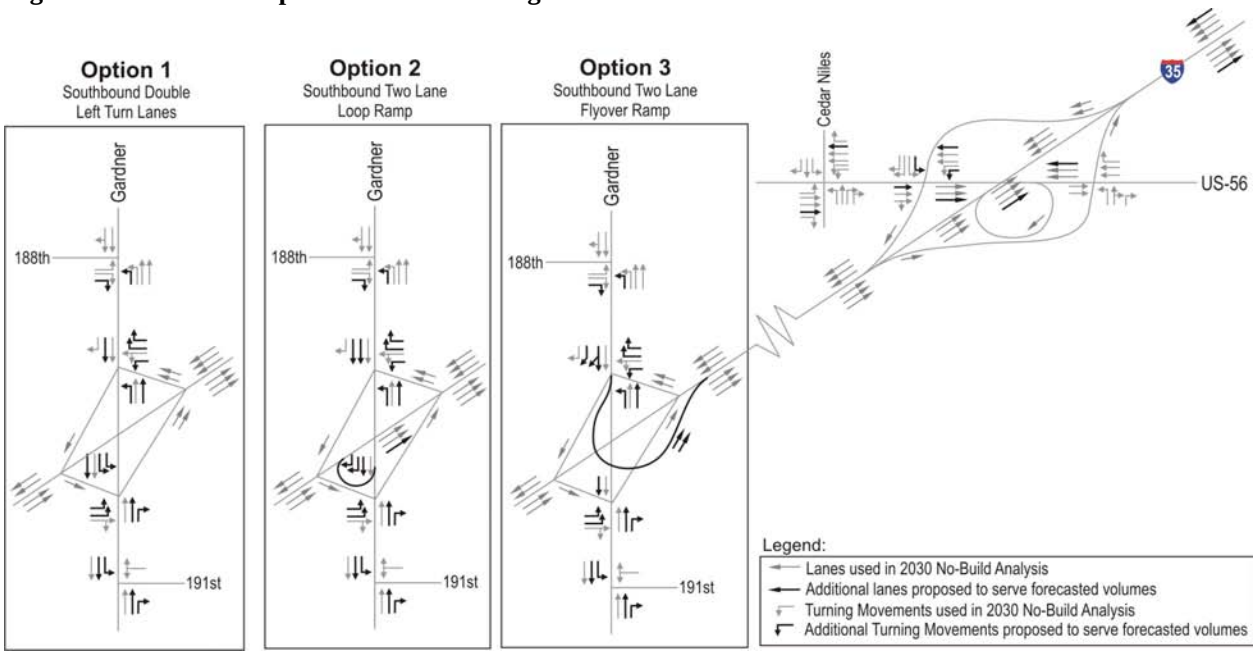
VISSIM Results

The VISSIM analysis of the 2030 No-Build Scenario confirmed that many intersection and ramp locations will operate at LOS E and F. Because VISSIM simulates the actual effects of congestion, a portion of the traffic assigned to the network could not get through the congested model system during the one-hour analysis period. This means that traffic either could not enter the system or was left in long queues trying to navigate through congested locations (such as the Gardner Road interchange). The VISSIM analysis therefore led to the same conclusion as the HCM analysis – additional improvements would be needed to make the 2030 No-Build Scenario operate at acceptable levels of service. Additional VISSIM information is included in Appendix D.

3.1.4. Improvements Considered to Address 2030 No-Build Operational Issues

Overall, the 2030 No-Build traffic operational analysis demonstrates that many key intersections and freeway facilities throughout the Traffic Study Corridor are expected to reach or exceed capacity even with the assumed 2030 transportation network improvements. This section outlines the improvements that could be considered to improve some of the key facilities (especially at Gardner Road) to acceptable levels of service. The improvements discussed below are illustrated in **Figure 3.7**.

Figure 3.7: Potential Improvements to Existing Facilities to Accommodate 2030 Peak Hour Flows



Improvements Related to Intersection Operations

US-56 Intersection Improvements

As outlined previously, additional turn capacity and more significantly, additional east-west through lane capacity, is required to bring the forecasted deficient US-56 intersections (1 and 2) up to an acceptable level of service. Specific improvements include the addition of a second southbound left-turn lane and a second westbound left-turn lane at the US-56 / I-35 Southbound Ramps intersection and third through lanes in both directions at both intersections. These improvements may necessitate the widening of the existing bridge over I-35.

Gardner Road Intersection Improvements

The Gardner Road / 188th Street intersection could be improved to an acceptable level of service through the addition of a northbound left-turn lane and a westbound right-turn lane. South of the interchange, at

Gardner Road / 191st Street (South), signalization as well as a second northbound through lane and a second southbound through lane would be required. The north-south through lanes are necessary to provide lane continuity with the southern ramp intersection. A northbound right-turn lane and a southbound left-turn lane would also be recommended at this intersection.

The large through and turning volumes at the two Gardner Road interchange intersections suggest that the interchange would need to be substantially reconstructed to provide acceptable operating conditions. (For example, the forecasted southbound left-turn volume at the Gardner Road / I-35 northbound Ramps intersection is 1,550 and 920 vehicles during the a.m. and p.m. peak hours respectively.) A range of options was explored for improving the interchange to acceptable conditions.

Option 1 – Upgrade Diamond Interchange Intersections

First, upgrades to the existing diamond interchange configuration were considered. The upgrades included widening the bridge to a seven lane cross-section (two through lanes in each direction, two southbound left-turn lanes, and one northbound left-turn lane) and widening both off-ramps (four lanes on the I-35 southbound off-ramp approach and three lanes on the I-35 northbound off-ramp approach). These improvements (illustrated in Figure 3.6) could possibly provide LOS D operations in the critical a.m. peak period and LOS C in the p.m. peak period. However, the adequacy of these improvements rests on a number of key assumptions. One of these is that the southbound left-turn lane use would be balanced. This in turn is tied to the concept of either a two-lane northbound on-ramp and/or an extensive northbound I-35 auxiliary lane (fourth northbound lane for some distance). If one or possibly both of these are not provided, then the level of service would possibly degrade back to unacceptable conditions. Two other key assumptions are that the signal timing will yield good southbound flow progression during the a.m. peak period and that "surges" within the peak hour will be minimal. In addition to these factors, there is considerable concern that the queue lengths could be problematic. The southbound left-turn movement is predicted to be over capacity (v/c =1.07) and a queue analysis using random arrivals indicates that if the southbound left-turn movement does not clear every cycle, then it is possible that the queue could exceed the allocated 800-foot storage length during the next cycle. Overall, with the very high left-turn volume, the sensitivity to lane balance and signal timing, and the potential queuing problems, an upgraded diamond is not considered adequate to accommodate the forecasted 2030 No-Build design volumes (in the absence of a new I-35 access point).

Option 2 – Loop Ramp

A loop ramp configuration was examined second. At the I-35 southbound ramp intersection, the previously described improvements would be retained, but a loop ramp would replace the double left-turn lanes serving southbound Gardner Road traffic headed for northbound I-35. However, the a.m. peak volume of 1,550 vph (13% trucks) is near the capacity of a single-lane loop ramp. In fact, assuming rolling terrain and a peak hour factor of 0.90, the passenger car equivalent volume is 2,058 which exceeds the 1,900-vph capacity recommended by the HCM for a single-lane ramp with a design speed between 20 and 30 mph.[3] A single-lane ramp could also cause upstream lane-use imbalances. Therefore, a two-lane loop ramp could be considered, but these are not widely used and the selection of this option may not be suitable for this application given the high truck percentages. In general, loop ramp options do not appear sufficient for the volume and traffic stream characteristics.

Option 3 – Flyover Ramp

A third option would be to construct a flyover from southbound Gardner Road to northbound I-35. As with the loop ramp, a single-lane flyover would operate near capacity in the a.m. peak hour, though a higher design speed could be used to increase the capacity to approximately 2,100 vph. However, given the potential concern that a single-lane flyover may be inadequate (and expensive to upgrade),

[3] It also exceeds the 2,000 vph capacity recommended for a ramp with a design speed of 30-40mph.

consideration of a two-lane flyover would be recommended. Regardless of whether it was a one- or two-lane flyover, this would likely be the most costly of the three options. It would also be an unusual option for a local service interchange on the urban boundary. Therefore, while it would be the most effective operational solution to accommodating the forecasted 2030 design flows without initiating a new access point, it would also be the most expensive and the least practical and is therefore not considered a realistic alternative.

Improvements Related to Freeway Operations

I-35 Mainline Improvements
In addition to the intersection improvements, an eight-lane cross section would be required on I-35 north of US-56 to accommodate the mainline freeway volumes at an acceptable level of service.

US-56 Ramp Improvements
The fourth northbound lane on I-35 is assumed to begin at the loop ramp from US-56 eastbound. This fourth lane would yield acceptable levels of service for both northbound US-56 on-ramps. However, to adequately meet the projected a.m. peak hour demand on the I-35 southbound exit ramp to US-56 (1,920 vph), a two-lane exit ramp would be required in a "lane balance" configuration (one exit-only lane and one optional exit lane). With these improvements, the US-56 interchange would operate acceptably during both peak periods.

Gardner Road Freeway-Ramp Options
The projected 2030 Gardner Interchange ramp volumes for the northbound on-ramp and the southbound off-ramp are both forecasted to exceed the capacity of a single-lane ramp during the a.m. and p.m. peak hours, respectively. This results in forecasted LOS F operations at both locations during these peak times as shown in Table 3.4. Both ramps would need two lanes to address these capacity issues. In the northbound direction, one ramp lane would be an "add" lane to I-35, while the other ramp lane would merge to the north. Similarly, in the southbound direction, one lane would be designed as an exit only, while the other could be an optional exit lane from the rightmost through lane (providing "lane balance").

Conclusions

As outlined above, the existing interchanges in the Traffic Study Corridor would not have sufficient capacity even with the assumed 2030 No-Build improvements to handle the projected 2030 traffic volumes. The additional improvements required to make the interchanges operate acceptably would be very substantial, both for I-35 and the major cross streets of Gardner Road and US-56. Most notably, the improvements needed at the Gardner Road interchange would be unreasonably out-of-scale for a local service interchange. Only the Sunflower Road interchange is forecasted to operate acceptably in the 2030 No-Build Scenario, but this location is too far from the other interchanges to relieve the over-capacity conditions.

In addition to the capacity, queue, and level of service issues with the existing interchanges, the current locations also offer limited access to the planned future development areas south and west of Gardner Road (between Gardner Road and Sunflower Road). Conversely, a new interchange to the south and west could potentially relieve future traffic demands on the Gardner Road Interchange, while providing improved access in the vicinity of 199th Street near Four Corners Road and Waverly Road.

It is therefore appropriate to consider the construction of a new interchange to both relieve traffic demands and improve access.

3.2. Transportation System Management Options

> **FHWA Policy:** *All reasonable alternatives for design options, location and transportation system management type improvements (such as ramp metering, mass transit, and HOV facilities) have been assessed and provided for if currently justified, or provisions are included for accommodating such facilities if a future need is identified.*

The goal of this section is to assess the wide range of improvement options available for addressing the locations identified as having operational issues in Section 3.1. This assessment will focus on three main categories: design improvements to the current facilities, improvements to nearby and/or parallel facilities, and transportation system management options.

Design Improvements to the Current Facilities
The previous section outlined the projected 2030 operational issues related to the existing Traffic Study Corridor interchanges and intersections in the No-Build Scenario. It also outlined potential design options for improving locations operating below the acceptable thresholds. The design improvements required to meet the design-year traffic flows are extensive. They would require completely reconstructing the existing I-35 / Gardner Road interchange, adding lanes to existing I-35 ramps at both Gardner Road and US-56, and adding lanes on the mainline north of US-56. In addition, the only reconfiguration option that appears to directly address future needs at the Gardner Road interchange would include the construction of a two-lane flyover from southbound Gardner Road to northbound I-35. Given the extent of these improvements, it was concluded that it is not practical to upgrade the existing interchange to meet the forecasted 2030 demand volumes. Therefore, other alternatives should be considered for addressing the needs in the corridor, including a new access point on I-35.

Improvements to Nearby and/or Parallel Facilities
Consideration has been given to the ability of non-interstate facilities to help relieve the demand on the interstate and the demand for access to and from the interstate. **Figure 3.8** illustrates the roadway network in and around the Traffic Study Corridor. The predominant street pattern is a grid, with clusters of local roads in the more heavily developed areas. In contrast, I-35 is overlaid on this grid as a northeast-southwest highway. There are no substantial parallel facilities close to I-35 with the exception of US-56 which runs roughly parallel to I-35 between Edgerton and the US-56 / I-35 Interchange. This facility, however, is predicted to be over capacity in the vicinity of I-35 and cannot offer traffic relief for other over-capacity facilities (such as the I-35 / Gardner Road interchange). One other roadway that was considered for its potential to relieve some of the Gardner area traffic demands was 151st Street. This east-west roadway

Figure 3.8 Roadway Network

could serve some of the future development in northern Gardner; however, it was determined to be too far north to significantly benefit the I-35 corridor. In general, the two existing I-35 access points serving the Gardner area are forecasted to operate over capacity in 2030 and there are no other facilities suitable for relieving these traffic demands.

Transportation System Management
Transportation System Management (TSM) is often used to refer to a broad range of non-capital-intensive operational improvements, non-single occupant capacity enhancements, and demand-side initiatives. These can include signal systems, transit service improvements, employer based flex-time programs, and many other strategies.

Regarding operational improvements, the current analysis assumes well-coordinated signal systems would be in place throughout the corridor by 2030, timed to maximize progression for the major flows. However, as presented in Section 3.1, such systems would not be sufficient to accommodate the substantial traffic growth by 2030. The analysis also assumes capacity enhancements, such as right-turn overlap phases and right-turn lanes, would be added where needed. Again, these efforts to gain more from the current system would be important, but alone they would not be adequate to address 2030 capacity needs.

The current analysis does not assume ramp-metering or other flow-leveling techniques. Ramp metering could potentially help resolve the mainline capacity issues on I-35 by smoothing and spreading the peak-hour flows. However, such an option would need to be part of a regional strategy for managing flow on the larger I-35 corridor, as metering a short segment could shift travel patterns without addressing the flow and capacity issues in a systematic manner. In addition, ramp metering would not address the interchange capacity / freeway mainline access issues, and in fact, could exacerbate them. Therefore, while ramp metering may be an improvement that should be considered by KDOT and others, it was not assumed to be practical for addressing the areas of concern identified in this study.

Transit service in the corridor is provided by Johnson County Transit (The JO). The main route serving the area is Route L. This is a weekday peak period express route running from downtown Gardner and the Moonlight Road area north on I-35 to Downtown Kansas City. It accesses I-35 via the US-56 interchange. In the Gardner area it stops at a park-and-ride lot near the intersection of E. Santa Fe Street and Energy Center Drive (Tradenet Publishing lot). It also stops at two mall park-and-ride lots along I-35 to the north. Route L provides three inbound runs to Kansas City in the a.m. peak and three outbound runs from Kansas City in the p.m. peak. The L/N Route also serves the same area with a single late afternoon outbound run from Kansas City each weekday.

According to the current Regional Transit Plan (Smart Moves), service expansion options are being considered for the area. This includes extending the peak period bus service south on US-56 to Edgerton and the addition of a new park-and-ride facility in Edgerton. The bus service would exit I-35 at US-56 (as it does today) and then continue on US-56 south to Edgerton (through Gardner). A local circulator in the Gardner area is also proposed in the Smart Moves plan. The circulator would provide local only service on weekdays (peak and midday) and weekends. A peak period Freeway Flyer Route from Edgerton to a central Johnson County transit hub is also under consideration (30-minute headways).

These improvements would enhance transportation options in the corridor and could increase transit use, especially during peak travel periods. However, a critical question is the extent to which these improvements could ameliorate the considerable traffic congestion highlighted in Section 3.1. Recent research indicates that enhanced transit service in urbanizing areas can provide modest decreases in peak-hour traffic flows. While this would help decrease delay and improve operations at key locations, it would not be sufficient to address locations where the traffic demand is substantially greater than the

available capacity (such as at the Gardner Road / I-35 Ramp intersections). It could however, be part of a more extensive effort to minimize future congestion before it becomes a problem. Therefore, it is recommended that the current express bus system be extended south to Gardner and both transit and park-and-ride facilities be considered for the existing Gardner Road interchange as well as any new interchange that might be constructed in the vicinity. Inclusion of these facilities is particularly important given the changing nature of the Gardner area from a bedroom community to one with a more balanced jobs-housing ratio. The increase in employment in Gardner will draw reverse commute traffic south on I-35 that could be served by increased transit availability. The new transit service would also serve the more traditional suburb-to-city-center as well as the growing suburb-to-suburb commute.

Enhanced transit service could be paired with demand management methods to further reduce peak-hour passenger car demands. Demand-management approaches could take the form of carpool/vanpool initiatives, employer-based flex-time programs, telecommute options, preferential parking for high-occupancy vehicles (HOV), transit subsidy programs and shower facilities for bike riders. Through research, all of these methods have been shown to have various levels of effectiveness in reducing traffic demand. However, again, this would not be enough to overcome the projected 2030 capacity shortfall at the I-35 / Gardner Road and I-35 / US-56 interchanges, but it could help extend the life of the current facilities and/or reduce the extent of improvements that are required to achieve acceptable conditions. As additional employers locate in Gardner, it will be useful to explore demand management strategies that encourage off-peak commute patterns. Typically larger employers, including government agencies, are targeted as potential candidates for offering these programs.

The addition of HOV lanes to I-35 is another option that could be considered in response to the issues identified in the Study Corridor. This would improve the peak-hour mainline capacity and would also provide incentive for increased auto occupancy and therefore lower peak-period traffic volumes. However, similar to transit service improvements, the expected benefits would not be sufficient to compensate for the substantial capacity shortfall at the interchanges and similar to ramp metering, it would need to be part of a larger I-35 corridor plan.

In summary, system management, transit, demand management, and operational improvement strategies alone or in combination, are not expected to be able to completely address the capacity shortfall. These approaches often provide single-digit to possibly low double-digit traffic reductions or capacity enhancements, while some of the critical movements in the system are expected to be more than 50 percent over capacity in 2030. However, considering these various options as part of the local and regional transportation planning process can help lead to successful and cost-effective strategies with benefits for the corridor and the region.

3.3. Operational and Safety Impacts

> **FHWA Policy:** *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. The operational analysis for existing conditions shall, particularly in urbanized areas, include an analysis of sections of Interstate to and including at least the first adjacent existing or proposed interchange on either side. Crossroads and other roads and streets shall be included in the analysis to the extent necessary to assure their ability to collect and distribute traffic to and from the interchange with new or revised access points.*

In keeping with the above FHWA policy guidance, the study addressed the entire I-35 corridor from north of US-56 south past the Sunflower Interchange. Traffic operations on all of the interchange cross streets

were also assessed, including traffic conditions at intersections adjacent to the interchange that might have an impact on interchange capacity and operations.

3.3.1. Proposed Interchange Locations and Concepts

As part of the study, two locations were selected for concept development and analysis:

1. Waverly Road (199th Street near Waverly Road)
2. Homestead Lane

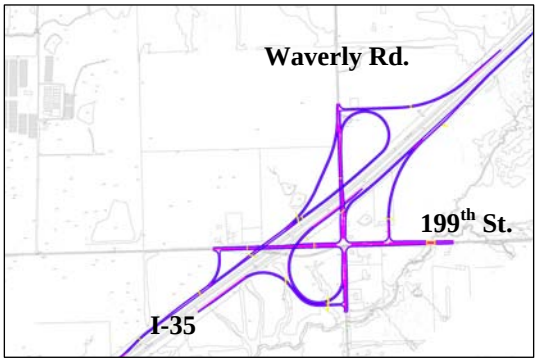
Figure 3.9: Potential Interchange Locations

These locations are illustrated in **Figure 3.9**. The Waverly Road (199th Street) location is recommended in local planning documents, most notably the Johnson County Comprehensive Arterial Road Network Plan (CARNP). The Homestead location was suggested during discussions with state and local agencies involved in the study because it provides approximately two miles between adjacent interchanges. KDOT prefers a minimum two-mile separation between Interstate interchanges in urban areas. Both locations have existing overpasses.

Waverly Interchange Concepts

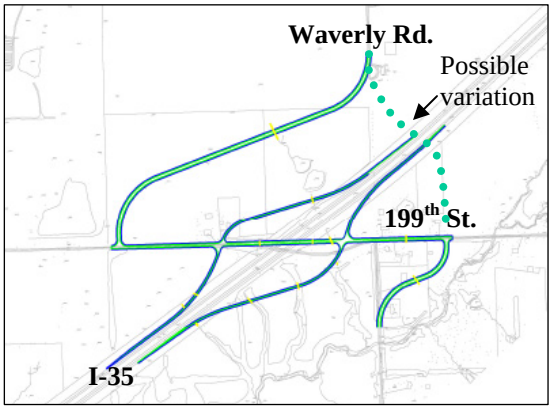
A number of concepts were explored for constructing an efficient, operationally feasible, and cost-effective interchange at Waverly Road that would maximize driver understanding. Some of the concepts were simple, while others were more complex. It was decided that it would be useful to develop concepts that put bounds on the possible design solutions; an extensive (and potentially expensive) high-end design as well as a simple, lower capacity design.

Figure 3.10: Waverly Interchange Option 1



Option 1 (**Figure 3.10**) illustrates the most extensive design that would be reasonable to consider at this location. While it may appear complex, it is in fact designed so that vehicles can access I-35 from 199th Street or Waverly Road from any direction, without having to turn onto another street (to facilitate driver expectation). In all cases but one (Westbound 199th Street to Southbound I-35), these moves are made by right turns, which is a benefit for trucks and for overall capacity. It has loop on-ramps serving both directions and it includes two bridges over I-35 (Waverly Road and 199th Street). In the northbound direction there are two on-ramp merge locations (on the mainline), but in the southbound direction all three on-ramps merge prior to merging with the mainline. Overall, it would be very "user-friendly", but also potentially costly to construct.

Figure 3.11: Waverly Interchange Option 2



Option 2 (**Figure 3.11**) is similar in many ways to the existing Gardner Road interchange, with the notable exception that the Waverly Road intersections would be located sufficiently far from the ramp termini to facilitate acceptable traffic operations and to prevent queue spillback problems. It only includes one bridge over I-35

(199th Street). Therefore, north-south traffic on Waverly Road would have to pass through the interchange.

A possible variation on Option 2 would be to make Waverly Road continuous on either the east or west side, by constructing a second I-35 overpass as shown by the dotted line in Figure 3.11.

There are many options that would fall in between Options 1 and 2 in terms of complexity and expense. These two options are illustrated here to bracket the range of alternatives.

Homestead Interchange Concepts
At the Homestead Lane interchange location, a diamond configuration was determined to be the most cost-effective design solution. **Figure 3.12** shows Homestead Lane Option 1, a standard diamond interchange with single lane ramps. A minor modification of this design would be to employ roundabouts at each ramp termini as shown in **Figure 3.13** (a "dumbbell" design). This could potentially provide enhanced capacity without the installation of signals.

Figure 3.12: Homestead Interchange Option 1

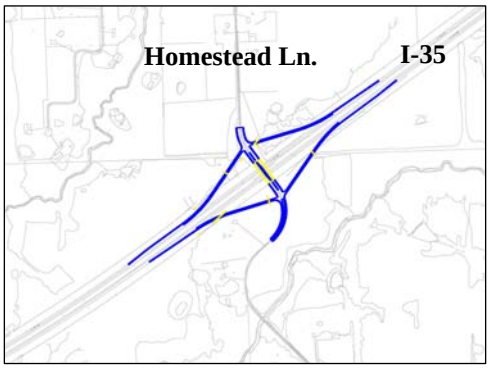
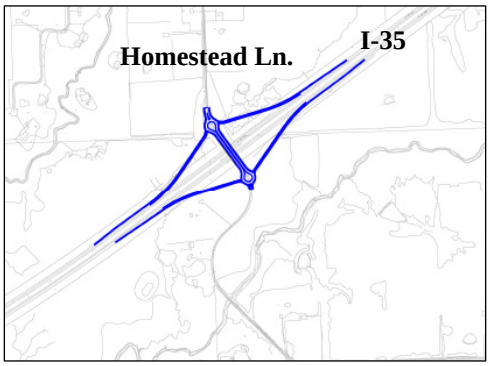


Figure 3.13: Homestead Interchange Option 2



3.3.2. 2030 Build Traffic Volumes

The 2030 Build traffic volumes were based on the same land-use scenario that was used for the 2030 No-Build Scenario. The roadway network was also the same, with the exception of the new interchange being evaluated. The forecasted 2030 average daily traffic volumes for both the Waverly and Homestead interchange alternatives are illustrated in Figure 3.3. The projected a.m. and p.m. peak hour volumes are illustrated in Figure 3.4.

Waverly Volumes
Daily 2030 traffic projections on 199th Street and Waverly Road in the vicinity of the new interchange range from below 500 to just over 10,000 vpd. Compared to the 2030 No-Build Scenario, the volume on I-35 between Gardner Road and Waverly Road is projected to increase by approximately 7,000 vpd (from 56,300 to 63,310 vpd) due to traffic traveling further to and from the south using this new access point. The projected traffic on I-35 between Gardner Road and US-56 is forecasted to increase by 2,500 vpd, but the forecasted difference is less than 700 vpd north of US-56. Traffic on Gardner Road north of I-35 is forecasted to decrease by 7,000 vpd (from 27,400 to 20,410 vpd) compared to the No-Build Scenario, while traffic south of I-35 is forecasted to decrease by approximately 8,400 vpd (from 17,230 to 8,870 vpd). These changes highlight the effect of the new interchange on the volumes at the existing Gardner interchange.

The Waverly Road interchange area is projected to have total ramp volumes of 1,950 and 1,880 in the a.m. and p.m. peak hours, respectively. The total ramp volume at the Gardner Road interchange is expected to decrease by approximately 1,300 vph (28%) in the a.m. peak and 1,190 vph (27%) in the p.m.

peak hour. This includes a reduction of the critical a.m. southbound left-turn volume at the Gardner Road / I-35 Northbound ramps intersection from 1,550 vph to 1,270 vph. The ramp volumes at the Sunflower Road and US-56 interchanges are not expected to change substantially with the addition of the new interchange – plus or minus approximately two or three percent. In addition to the shift in traffic from the Gardner interchange to the Waverly interchange, the peak-hour volumes on I-35 are forecasted to increase slightly, reflecting the improved access in the area.

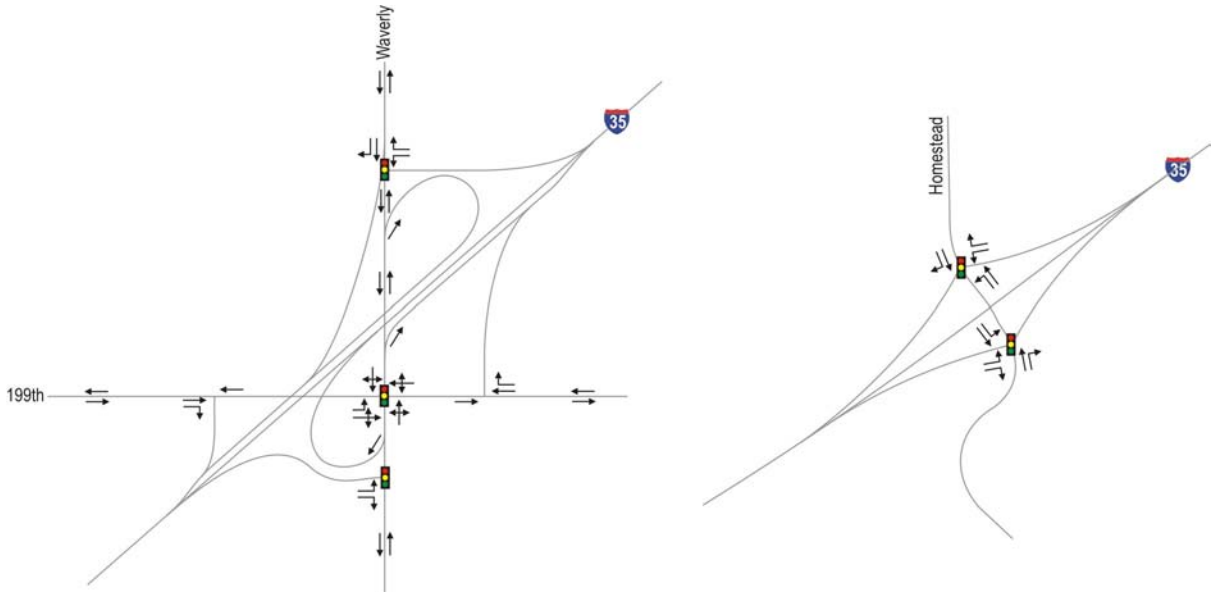
Homestead Volumes
With the Homestead Lane interchange alternative, the daily traffic projections show over 18,000 vpd on Homestead Lane north of the interchange and less than 500 south of the interchange. This is consistent with current land use and development planning which shows considerable development to the north and very little development to the south. Compared to the No-Build Scenario, the Homestead interchange is forecasted to draw 6,700 vehicles further south on I-35. It is also forecasted to increase volumes on I-35 by approximately 3,000 vpd north of Gardner Road and 1,250 vpd north of US-56. The forecasted volume drop on Gardner Road is 6,300 vpd north of I-35 (27,400 to 21,070 vpd) and 7,550 vpd south of I-35 (17,230 to 9,680 vpd). The forecasted changes on US-56 and Sunflower Road are similar to those described for the Waverly Road alternative.

An examination of the 2030 Homestead Lane alternative peak-hour forecasts indicates peak-hour ramp volumes of 1,680 in the a.m. peak hour and 1,570 in the p.m. peak hour. Ramp traffic at the I-35 / Gardner Road interchange is forecasted to decrease by 26 percent in the a.m. and 23 percent in the p.m. Peak hour ramp volumes at US-56 and Sunflower Road are not predicted to change substantially (plus or minus two or three percent) with the addition of the new interchange.

3.3.3. 2030 Build Operational Analyses

The 2030 Build operational analyses employed the 2030 Build Scenario traffic volume forecasts illustrated in Figure 3.4. The 2030 Build highway geometric assumptions were the same as those for the No-Build Scenario (Figure 3.5) with the exception of the new interchange concept being studied. The highway geometry assumed for the new interchanges is provided in **Figure 3.14**. These two concepts were selected for analysis purposes to evaluate the feasibility of an interchange at each location. The partial cloverleaf design selected for Waverly Road provided an upper bound to the type of interchange

Figure 3.14: New Interchange Geometry Assumptions



that might be considered in this area, while the Homestead Lane concept is representative of a typical diamond interchange. As these two conceptual options were evaluated and shown to be generally operationally feasible, no further options were considered as part of this current study.

Intersection Level of Service

Table 3.5 presents a summary of the 2030 intersection level of service analysis for the two Build Scenarios. The detailed analysis sheets are provided in Appendix B. With a new interchange in place, few intersection LOS results are forecasted to change substantially compared to the No-Build Scenario. Two exceptions to this are the Cedar Niles Road / US-56 and Gardner Road / W. 191st Street intersections. The first of these is forecasted to improve from LOS F to LOS E in the a.m. and p.m. peaks. The second is projected to improve from LOS E in the a.m. peak to LOS C or better, reflecting improved access to the area west of Gardner Road.

This analysis demonstrates the extent to which the 2030 No-Build Scenario is over capacity through the Traffic Study Corridor, especially at the I-35 / Gardner Road interchange. Even with considerable traffic reductions at this location, the level of service results remain unchanged. Similar to the No-Build Scenario analysis, a discussion is provided later in this section regarding what would be required to improve these intersections to acceptable operating conditions.

Table 3.5: 2030 Intersection Operations Analysis

Study Intersection # and Name	Traffic Control	Peak Period	No Build Delay (sec/veh)	No Build LOS	Build Waverly Delay (sec/veh)	Build Waverly LOS	Build Homestead Delay (sec/veh)	Build Homestead LOS
1 Cedar Niles/ US-56	Signalized	AM	82.0	F	72.7	E	68.9	E
		PM	103.4	F	80.0	E	79.0	E
2 US-56/ I-35 SB Ramps	Signalized	AM	193.8	F	200+	F	197.0	F
		PM	168.8	F	164.1	F	165.4	F
3 US-56/ I-35 NB On-Loop Ramp*	Uncontrolled	AM	v/c~.88	OK	v/c~.86	OK	v/c~.86	OK
		PM	v/c~.62	OK	v/c~.61	OK	v/c~.61	OK
4 US-56/ I-35 NB Ramps	Signalized	AM	18.1	B	15.5	B	18.9	B
		PM	7.4	A	9.5	A	9.5	A
5 Gardner Rd/ W 191st St	Signalized	AM	56.7	E	15.8	B	21.6	C
		PM	25.1	C	11.3	B	14.7	B
6 I-35 SB Ramps/ Gardner Rd	Signalized	AM	200+	F	194.2	F	200+	F
		PM	200+	F	200+	F	200+	F
7 I-35 NB Ramps/ Gardner Rd	Signalized	AM	200+	F	200+	F	200+	F
		PM	200+	F	200+	F	200+	F
8 Gardner Rd/ E 191st St	OWSC	AM	200+ (WB)	F	200+ (WB)	F	200+ (WB)	F
		PM	200+ (WB)	F	200+ (WB)	F	200+ (WB)	F
9 I-35 SB Ramps/ Sunflower Rd	Signalized	AM	5.9	A	5.9	A	5.3	A
		PM	18.0	B	10.7	B	17.5	B
10 I-35 NB Ramps/ Sunflower Rd	Signalized	AM	13.5	B	13.0	B	10.8	B
		PM	4.5	A	3.2	A	4.4	A
11 I-35 SB Ramp/ Waverly Rd	Signalized	AM	Intersections Not Included in Scenario		10.4	B	Intersections Not Included in Scenario	
		PM			9.4	A		
12 Waverly Rd/ 199th St	Signalized	AM			22.1	C		
		PM			30.8	C		
13 I-35 NB Ramp/ Waverly Rd	Signalized	AM			4.8	A		
		PM			13.4	B		
14 I-35 SB Ramps/ Homestead Ln	Signalized	AM					11.8	B
		PM					11.3	B
15 I-35 NB Ramps/ Homestead Ln	Signalized	AM					14.6	B
		PM					8.4	A

Notes: OWSC - One way stop controlled intersection
For one and two-way STOP controlled intersections the delay and LOS for the worst approach is shown.
*For the ramp diverge at Intersection 3, an approximate ramp volume to capacity ratio was calculated.

Freeway System Level of Service Results

The freeway analysis levels of service are summarized in **Table 3.6** and the detailed analysis sheets are provided in Appendix C. With construction of either the Waverly Road or Homestead Lane interchange, it is predicted that most of the levels of service will remain similar to those without the interchange. The

Table 3.6: 2030 Freeway Operational Analyses

	No-Build				Build – Waverly Alternative				Build – Homestead Alternative			
	AM		PM		AM		PM		AM		PM	
	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)	LOS
Basic Freeway Segments												
I-35 NB												
Edgerton to Sunflower	22.9	C	11.7	B	22.9	C	11.8	B	22.9	C	11.9	B
Sunflower to new intchg	--	--	--	--	26.7	D	13.9	B	26.7	D	14.0	B
New intchg to Gardner	26.9	D	14.0	B	32.9	D	18.4	C	31.3	D	18.0	B
Gardner to US-56	27.3	D	16.3	B	28.4	D	17.3	B	28.5	D	17.4	B
US-56 to 151st	37.1	E	25.0	C	37.5	E	25.3	C	37.8	E	25.4	C
I-35 SB												
151st to US-56	22.8	C	35.4	E	23.1	C	35.8	E	23.2	C	36.2	E
US-56 to Gardner	14.2	B	27.2	D	15.2	B	28.6	D	15.2	B	28.9	D
Gardner to new intchg	11.9	B	29.4	D	16.4	B	36.2	E	15.9	B	34.0	D
New intchg to Sunflower	--	--	--	--	12.0	B	29.3	D	12.0	B	29.3	D
Sunflower to Edgerton	10.9	A	24.8	C	11.0	A	25.1	C	11.0	A	25.1	C
Ramp Junctions												
I-35 NB												
Sunflower Exit	24.4	C	11.2	B	24.4	C	11.2	B	24.4	C	11.3	B
Sunflower Entr	28.7	D	15.7	B	28.5	D	15.6	B	28.5	D	15.7	B
Homestead Exit	--	--	--	--	--	--	--	--	28.2	D	13.9	B
Homestead Entr	--	--	--	--	--	--	--	--	31.8	D	20.6	C
Waverly Exit	--	--	--	--	28.2	D	13.8	B	--	--	--	--
Waverly Loop Entr	--	--	--	--	25.7	C	14.5	B	--	--	--	--
Waverly Entr	--	--	--	--	**	E	21.0	C	--	--	--	--
Gardner Exit	28.4	D	13.9	B	**	E	19.2	B	**	E	18.7	B
Gardner Entr	*	F	27.4	C	*	F	26.3	C	*	F	26.4	C
US-56 Exit	28.0	C	17.7	B	28.9	D	19.0	B	28.9	D	19.0	B
US-56 Loop Entr	*	F	26.3	C	*	F	26.5	C	*	F	26.5	C
US-56 Entr	**	E	18.8	B	**	E	19.2	B	**	E	19.3	B
I-35 SB												
US-56 Exit	*	F	**	E	*	F	**	E	*	F	**	E
US-56 Entr	15.5	B	28.8	D	16.9	B	29.9	D	16.7	B	30.2	D
Gardner Exit	**	E	*	F	25.4	C	37.9**	E	25.7	C	*	F
Gardner Entr	13.3	B	30.4	D	18.1	B	**	E	17.6	B	**	E
Waverly Exit	--	--	--	--	16.8	B	**	E	--	--	--	--
Waverly Entr	--	--	--	--	13.5	B	30.7	D	--	--	--	--
Homestead Exit	--	--	--	--	--	--	--	--	16.2	B	**	E
Homestead Entr	--	--	--	--	--	--	--	--	13.5	B	30.4	D
Sunflower Exit	11.4	B	30.4	D	11.4	B	30.3	D	11.4	B	30.3	D
Sunflower Entr	12.4	B	26.9	C	12.4	B	27.1	C	12.4	B	27.1	C

Notes: ** indicates one or more ramp area traffic flows exceed facility capacity recommended in HCM*
*** indicates one or more ramp area traffic flows exceed 90% of facility capacity recommended in HCM*
(The second capacity check above (**) is not standard HCM practice, but is used here to show where capacity constraints may begin to dictate operational characteristics.)

few locations that improve or worsen are addressed below along with new ramps that operate below the acceptable threshold (see highlighted locations).

Waverly Analysis

The forecasted increase in traffic on the I-35 mainline between Gardner Road and Waverly Road would cause this two-lane section to drop to from LOS D in the No-Build Scenario to LOS E in the Build Waverly Scenario in the southbound direction during the p.m. peak hour. This in turn would contribute to forecasted LOS E operations at the Gardner Road Southbound On-Ramp and Waverly Road Southbound

Off-Ramp during the p.m. peak hour. Conversely, the Gardner Road Southbound Off-Ramp is expected to improve from LOS E in the No-Build Scenario to LOS C during the a.m. peak, and from LOS F to LOS E during the p.m. peak due to the shift in traffic to the south.

The Waverly Road Northbound On-Ramp and Gardner Road Northbound Off-Ramp are both predicted to operate at LOS E in the a.m. peak hour due to capacity constraints at the merge / diverge locations.

Homestead Analysis
Similar to the Waverly Road alternative, the Gardner Road Northbound Off-Ramp is again predicted to drop to LOS E compared to the No-Build Scenario during the a.m. peak hour. The Southbound Gardner Off-Ramp is expected to improve to LOS C in the a.m. peak due to the shift in traffic to the south.

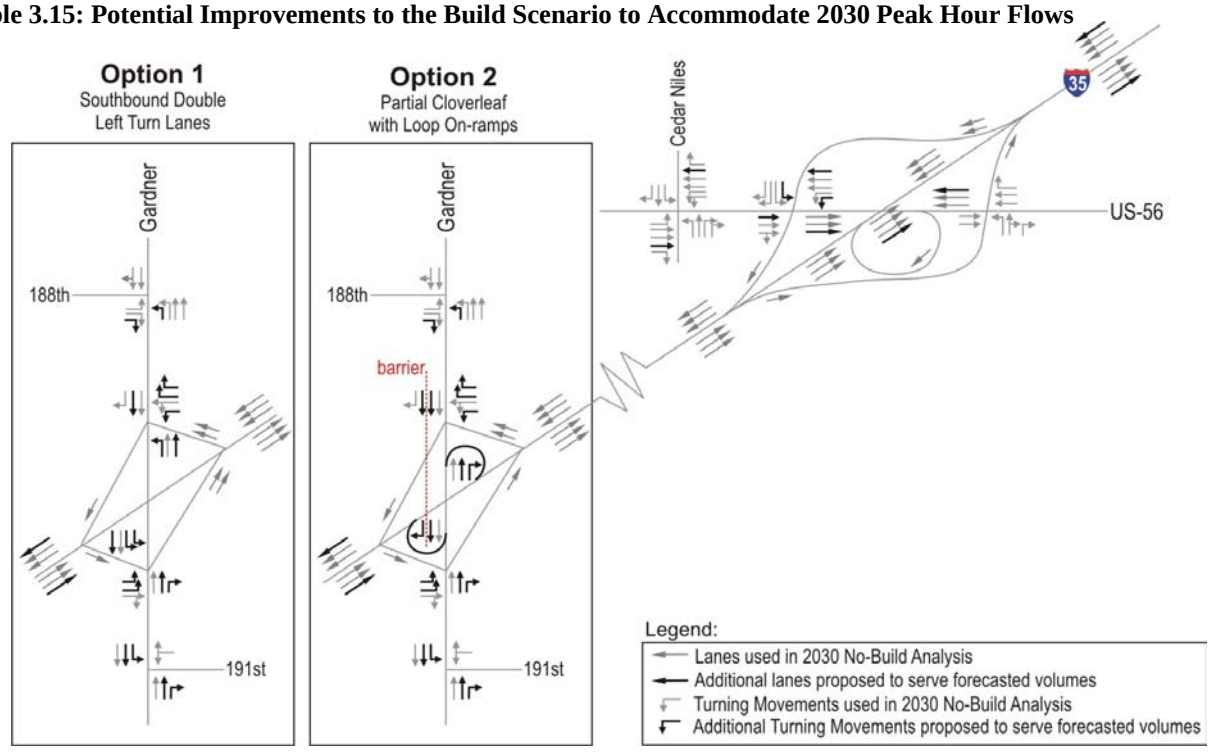
During the p.m. peak hour both the Gardner Road Southbound On-Ramp and the Homestead Lane Southbound Off-Ramp are projected to operate at LOS E due to merge / diverge congestion.

VISSIM Results
The VISSIM analysis of the Build Scenarios yielded results that were generally consistent with the HCM analysis in that the system was still forecasted to experience demand above its capacity. The VISSIM model (similar to the No-Build results) was not able to accommodate the forecasted demand without additional roadway improvements. Again, many vehicles were either unable to enter the system or were left in queues at congested locations such as the Gardner Road interchange ramp intersections.

3.3.4. Improvements Considered to Address 2030 Build Operational Issues

Overall, the 2030 Build traffic operational analysis indicates that while the Build Scenario would shift traffic compared to the No-Build Scenario, it would not improve many of the locations that were forecasted to operate below acceptable levels in the No-Build Scenario. Therefore, additional improvements would still be needed at many of the critical locations in the Traffic Study Corridor. Some of the major improvements that could be considered to bring the interchange-freeway system up to acceptable operating conditions are outlined in **Figure 3.15**. They are similar to the possible

Table 3.15: Potential Improvements to the Build Scenario to Accommodate 2030 Peak Hour Flows



improvements discussed for the 2030 No-Build Scenario, however the extent of improvements considered for the Gardner Interchange is reduced.

Improvements Related to Intersection Operations

US-56 Intersection Improvements

Because the Build Scenarios do not substantially decrease (or increase) traffic at the I-35 / US-56 interchange compared to the No-Build Scenario, the improvements outlined for the No-Build scenario apply to the Build scenario as well.

Gardner Road Intersection Improvements

Similar to the No-Build Scenario, south of the interchange, at Gardner Road / 191st Street (South), signalization as well as a second northbound through lane and a second southbound through lane would be required. The north-south through lanes are necessary to provide lane continuity with the southern ramp intersection. A northbound right-turn lane and a southbound left-turn lane would also be recommended at this intersection.

Even with a new interchange providing partial relief, large through and turning volumes are projected at the two Gardner Road interchange intersections, requiring that the interchange be substantially reconstructed to provide acceptable operating conditions. In considering the range of options explored for the No-Build Scenario, it appears that a more standard service interchange design alternative (such as a single lane loop ramp) may be feasible. A new bridge over I-35 would still be required, but additional structures such as flyover ramps are not expected to be necessary.

Improvements Related to Freeway Operations

I-35 Mainline Improvements

As with the No-Build Scenario, an eight-lane cross section would be required on I-35 north of US-56 to accommodate the mainline freeway volumes at an acceptable level of service.

In addition, due to the increased traffic projected to proceed south on I-35 to the new interchange, there are a number of ramp locations that are predicted to operate at LOS E as outlined in Table 3.6 above (they exceed 90 percent of some operational capacity parameters). This results in the need to extend the proposed I-35 six-lane section south to the new interchange location. It also would require a change in the design of the two-lane on- and off-ramps at the I-35 / Gardner Road interchange, as the exit-only lane would move one interchange to the south.

US-56 Ramp Improvements

The required US-56 Ramp improvements are the same as for the No-Build Scenario.

Gardner Road Freeway-Ramp Options

Two-lane ramps are still expected to be necessary to and from the north at the I-35 / Gardner Road interchange. However, the design of these ramps would need to be adjusted because the exit-only lanes would shift to the new interchange. Therefore, auxiliary lanes would need to be added to provide the appropriate two-lane ramp lane balance and capacity.

Conclusions

Construction of either of the proposed new interchanges is projected to serve a considerable volume of traffic, improve access, and shift traffic from the I-35 / Gardner Road interchange. However, based on the projected operational analysis, there are a number of congested locations that will remain from the No-Build Scenario. There are also locations that would need to be further upgraded with construction of the new interchange. With the improvements outlined above, the system would operate acceptably. The

I-35 / Gardner Road interchange would also be able to be reconstructed in a more typical local service interchange configuration.

3.3.5. Crash Analysis

As part of the BIA Study, a crash analysis was prepared for I-35 in the Traffic Study Corridor. This analysis was intended to highlight any areas that may be of interest or concern in considering the break-in-access request. Crash data was obtained from KDOT's Geometric and Accident Unit in May of 2007. The data included all crashes reported on I-35 within the Traffic Study Corridor occurring during the five-year period from 2002 through 2006.

Freeway/Roadway Section Crash Analysis
For the initial analysis, the I-35 corridor was divided into two sections as shown in **Table 3.7**. Using the crash data obtained from KDOT, the two sections were examined in detail to highlight any trends or high crash rate locations. As part of the analysis, crash totals were summarized and stratified by severity, crash type, time of day, and roadway conditions to determine if any crash patterns were present. Crash rates were also calculated and compared to statewide averages.

Total Crashes
According to the KDOT data, a total of 245 crashes occurred on I-35 within the Traffic Study Corridor during the five-year analysis period. Approximately 64 percent of these crashes occurred between the Sunflower Road and Gardner Road interchanges. There were also five fatal crashes during the five year period on I-35, four of which occurred between Sunflower Road and Gardner Road.

Crash Rates
The Institute of Transportation Engineers (ITE) Rate Quality Control Method was employed to conduct a crash rate analysis. This analysis method compares the five-year average crash rate for a highway section to the statewide average for a similar type highway. Statistical methods are then used to determine if the crash rate exceeds the statewide average (at a 99% confidence level) through the use of a critical crash rate threshold.

Table 3.7 shows the crash rates per million vehicle miles (MVM) for the two sections of I-35. As demonstrated in the table, the section between Sunflower Road and Gardner Road exceeds the critical crash rate threshold; therefore it can be considered a high crash section (at the 99th percentile confidence interval). The other section is below both the critical rate as well as the base statewide average for similar facilities. Section 1 of I-35 also had a high fatal crash rate, exceeding the statewide average for fatal crashes. It is not certain why this section of I-35 has a higher crash rate, though the analysis presented below offers some differences in crash type, time, and the roadway conditions.

Table 3.7 Crash Summary and Crash Rates along I-35

Roadway Section	Length (mi)	Avg. ADT (2002-06)	Crashes		Crash Rate (per MVMT)			
			Total	Fatal	Section Crash Rate	Statewide Average	KDOT Critical Rate (99% conf)	Exceeds Critical Rate
I-35								
1. Sunflower to Gardner	4.714	22,256	156	4	0.815	0.640	0.792	YES
2. e/o Gardner to US-56	3.125	28,502	89	1	0.548	0.640	0.805	NO

ADT= Average Daily Traffic | MVMT= Million Vehicle Miles Traveled | KDOT= Kansas Department of Transportation

Crash Severity
The reported crashes were examined with respect to the severity of the crashes. Each crash is classified as either fatal, injury, or property damage only (PDO). Overall, the majority of reported crashes were classified as PDO crashes (77%) with about one-fifth (21%) recorded as injury crashes. Of the total crashes that occurred along I-35, five were fatal crashes (one involved two fatalities). Four of these crashes occurred between Sunflower Road and Gardner Road and one between Gardner Road and US-56.

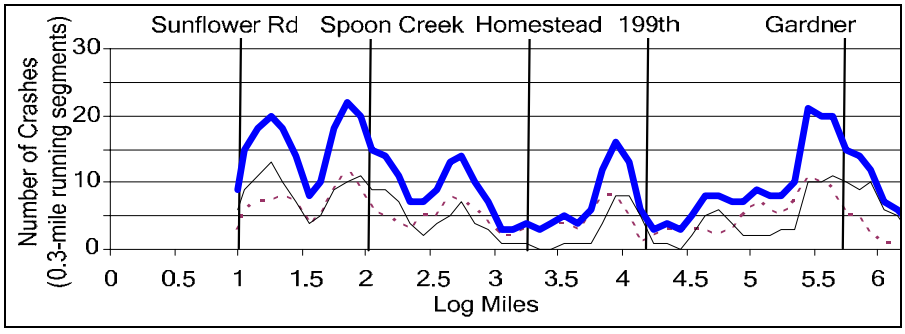
Crash Type
An examination of the crash type data for I-35 reveals that the most common crash type was collision with an animal (29%). In the high-crash-rate section south of Gardner Road, animal crashes accounted for 31 percent of all crashes. The next most common crash type was collision with a fixed object (26%). Overall, crashes with animals and various object types accounted for 59 percent of all crashes on these two sections of I-35. The third most common crash type was an overturned vehicle (12%). The various categories of collisions with other vehicles (rear-end, sideswipe, angle, etc.) accounted for approximately 23 percent of all I-35 crashes.

Time of Day
To examine time-of-day patterns, five time periods were established: am off peak (midnight to 7am), am peak (7 to 9am), mid-day off-peak (9am to 4pm) pm peak (4 to 6pm), and pm off-peak (6pm to midnight). The pm off-peak period (6pm to midnight) was the most commonly reported time period for crashes on I-35 (28%), with 31 percent of all crashes on Section 1 occurring during that time period.

Road Surface Conditions
Dry roads constituted the most common condition by far at approximately 70 percent of total crashes along I-35. Wet roadway conditions were present for 9 percent of I-35 crashes, while snow, ice, and slush were present during 20 percent of the I-35 crashes.

Focused Study on High Crash Section
A more detailed examination was conducted for the section of I-35 between Sunflower Road and Gardner Road because it was identified as a potential high crash location. The crash data for this section was examined by direction in three-tenth mile long segments to determine if there were any crash clusters. The results of that analysis are shown in **Figure 3.16.**

Figure 3.16: Number of Crashes by Three-Tenth Sections on I-35



As illustrated in the figure, there appear to be approximately five crash clusters in the section, three with 20 or more crashes and two with between 10 and 19 crashes. The crashes are fairly evenly distributed between the northbound and southbound directions. The types of crashes in these locations are predominantly fixed object and animal strike crashes. A closer examination of the crash locations indicates that:

- Near Sunflower Road – 40 to 45 percent of the crashes were fixed object crashes.

- Near Spoon Creek – Crash types were more evenly divided between other vehicle, fixed-object, overturned, and animal.
- South of Homestead – The peak involves mainly fixed object crashes, followed by other vehicle and animal crashes.
- Near 199th Street – The majority of crashes (60 – 70%) were animal strike crashes.
- Near Gardner Road – Animal crashes were predominant, followed by other vehicle crashes.

It is important to note that there were very few crashes recorded in the immediate vicinity of the Homestead Lane overpass. There was also a low number of crashes reported in the vicinity of 199th Street (near Waverly Road) with the exception of the spike just to the south which was mainly animal crashes.

More detailed crash statistics can be found in Appendix E.

Conclusions
Overall, the crash analysis appears to indicate that while safety is a concern on the larger I-35 mainline segment where the break-in-access is proposed, it is not as critical an issue in the immediate vicinity of the two proposed interchange locations. Animal crashes are also a major issue on this Sunflower Road to Gardner Road segment, including a cluster of animal crashes south of the current 199th Street overpass. Therefore, it may be appropriate to consider methods for reducing the potential for these types of crashes.

3.3.6. 2030 Build Scenario Conclusions

A new interchange on I-35 between Gardner Road and Sunflower Road would provide access to anticipated future growth areas south of the City of Gardner. The interchange would be expected to relieve the existing I-35/Gardner Road interchange to the extent that a reasonable (although extensive) level of 2030 improvements could be developed to allow I-35/Gardner Road to operate at acceptable levels of service. It was found that interchange locations at either 199th Street/Waverly Road or Homestead Lane could be designed to provide desired access and performance. A new interchange would not be anticipated to exacerbate any existing crash patterns on I-35, although if designed to reduce animal encroachments, it could help address the most common crash type in the vicinity.

3.4. Public Use and Full Access

FHWA Policy: *The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" for special purpose access for transit vehicles, for HOV's, or into park and ride lots may be considered on a case-by-case basis. The proposed access will be designed to meet or exceed current standards for Federal-aid projects on the Interstate System.*

Figure 3.17: Road Upgrade Required for Homestead Interchange Location

The break-in-access proposed in this report is proposed as a public facility, providing access to other public roadways in the interchange vicinity. Conceptual interchange designs being considered at both locations are proposed as public full-access interchanges. Ramps are provided to and from northbound and southbound I-

35. For the Homestead Lane alternative, it would be necessary to upgrade Homestead Lane from a gravel roadway to a full width, four-lane paved roadway between I-35 and 199th Street to provide an appropriate connection to other public roadways (See **Figure 3.17**).

It is anticipated that an interchange at either location would be designed to meet current Federal Interstate System design standards. There are no currently known limitations that would require exceptions to these standards.

3.5. Local and Regional Planning

> **FHWA Policy:** *The proposal considers and is consistent with local and regional land use and transportation plans. Prior to final approval, all requests for new or revised access must be consistent with the metropolitan and/or statewide transportation plan, as appropriate, the applicable provisions of 23 CFR part 450 and the transportation conformity requirements of 40 CFR parts 51 and 93.*

The proposed interchange is not currently in the Mid-America Regional Council (MARC) long-range transportation plan (Transportation Outlook 2030) or in the MARC 2006-2010 Transportation Improvement Program (TIP). It is therefore not on the KDOT State TIP, which includes the MARC TIP by reference. It is understood that before a new interchange can be constructed, it will need to be added to these planning documents.

Figure 3.18: Johnson County CARNP

The proposed access to I-35 is, however, on the Johnson County Comprehensive Arterial Road Network Plan (CARNP). The CARNP is the County's principal transportation planning document and was adopted by the County Commissioners in 1999. The CARNP shows a new grade-separated access point on I-35 at 199th Street near Waverly Road as illustrated in **Figure 3.18**. It also shows upgrades to 199th Street to provide improved east-west connectivity in the vicinity of the interchange. Specifically, 199th Street is shown as a two- to four-lane rural parkway (Type III-High Roadway) from I-35 east to Mission Road. West of I-35, 199th Street was proposed as a two-lane rural major arterial (Type II-Medium Roadway). Waverly Road is shown as a two-lane minor arterial (Type I-Low Roadway), though given its location and orientation it could experience considerable traffic demands with a new interchange in the location shown in the CARNP. As the CARNP is a broad planning document, it is consistent with the plan to also consider the Homestead Lane location just south of 199th Street for a new interchange. Homestead Lane itself is shown as a two-lane minor arterial (Type I-Low Roadway) in the CARNP.

The more recent Johnson County Rural Comprehensive Plan Update incorporates the CARNP recommendations. Therefore, the transportation section of this document also shows a potential interchange in the vicinity of I-35 and 199th Street/Waverly Road.

The land use policy area map in the County's comprehensive plan characterizes the area surrounding the potential interchange locations as a Rural Traditional area. However, the 199th Street location is very near the Urban Fringe area around Gardner. In general, the addition of a new I-35 access point in the vicinity of 199th Street/Waverly Road is consistent with the County's current comprehensive plan.

The City of Gardner's future land-use plan (approved in 2003) shows the area around the potential interchange locations as rural, with commercial development to the northeast (south of I-35) and

residential development to the northeast (north of I-35). Discussions were held with City staff regarding the City's current planning direction related to land use in the area and whether it differs from the official 2003 plan. City staff indicated that additional commercial development was being considered north of I-35 due in part to utility availability. Additionally, during the discussions regarding the land use forecasts for the model, the City and others indicated that development not currently shown on the land-use plan is anticipated in the area north of the potential interchange locations. Specifically, commercial development (non-retail) is anticipated north of 199th Street on both sides of I-35 and residential development is anticipated north of 199th Street west of I-35. An interchange in this area would serve these potential future (2030) development areas.

Overall, the proposed break-in-access appears to be consistent with local transportation and land-use planning, but it is not yet included in the regional and state-level transportation plans.

3.6. Potential for Multiple Interchanges

> **FHWA Policy:** *In areas where the potential exists for future multiple interchange additions, all requests for new or revised access are supported by a comprehensive Interstate network study with recommendations that address all proposed and desired access within the context of a long-term plan.*

The proposed I-35 break-in-access outlined in this report is part of a larger system. This is reflected in the selection of the Traffic Study Corridor and study intersections. As outlined previously, the construction of a new interchange is expected to reduce the level of improvement required at the existing I-35 / Gardner Road interchange. In fact, it may permit the use of reasonable capacity upgrades to improve the critical Gardner Road / I-35 Northbound Ramps intersection. The effects on the other nearby interchanges, however, appear to be minimal.

Only one new interchange is being considered as part of this request; however, there are local plans for a possible new interchange on I-35 at Edgerton Road approximately four miles south of the 199th Street overpass and about one mile south of the existing Sunflower Road interchange. This separate proposal for an interchange at Edgerton Road is part of a plan to improve access north from I-35 to the Sunflower Army Ammunition Plant redevelopment area. That interchange would be connected with upgrades to Edgerton Road and/or a new north-south highway generally within or near the Edgerton Road corridor. It is not anticipated that the current proposal for a new access point in the vicinity of 199th Street or Homestead Lane would substantially affect (or be affected by) an interchange at Edgerton Road. The Edgerton Road proposal would more likely decrease the traffic volumes at the existing Sunflower Road Interchange, by spreading some of the local (Edgerton) interstate access demand over two interchanges.

3.7. Coordination with Development and Other Transportation Improvements

> **FHWA Policy:** *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.*

As outlined at the beginning of this document, there has been considerable development in the Gardner area over the last 10-15 years and that growth is expected to continue. The need for new and/or improved access to I-35 in the vicinity of Gardner is tied to this development. Extensive efforts were made as part

of this study to coordinate with local, regional, and state agencies regarding planned and anticipated long-term development in the area. This included numerous meetings and an interim land-use memo (Appendix A) directly addressing area land-use and development assumptions. As outlined in the methodology section, the traffic forecasting approach took into account numerous plans and potential developments including the Sunflower Army Ammunition Plant, Lone Elm Plan, development at New Century AirCenter, proposed BNSF Intermodal Facility, and proposed ADK Logistics Park.

In addition, the inputs to this analysis have been coordinated with available studies related to the known development proposals to make sure that the land-use, trip generation, and roadway network improvement assumptions are consistent. For example, this included accounting for road closures (associated with railroad grade-crossing closures) in the vicinity of the planned BNSF Intermodal Facility. It is important to mention at this point that the 2030 traffic volumes are expected to exceed capacity at the US-56 and Gardner Road interchanges regardless of any single development project proposal (including the BNSF and ADK proposals mentioned above). Therefore, the need for improved I-35 access (of some type) is not specifically tied to any one development, but it is definitely connected with the projected overall development intensity in the area.

3.8. Planning Requirements and Environmental Processing Status

> **FHWA Policy:** *The request for new or revised access contains information relative to the planning requirements and the status of the environmental processing of the proposal.*

This report addresses the need for and operational feasibility of the proposed I-35 break-in-access. Subsequent to this study, KDOT will conduct a location, design and environmental study. That study will select the specific location for the proposed break-in-access. It will also define the preliminary design of the new interchange and provide the documentation necessary for environmental approval. The follow-up study will also include appropriate public and agency involvement.

4. Conclusions

The analysis presented in this document leads to the following conclusions:

1. Existing traffic operations within the Traffic Study Corridor (I-35, its interchanges, and nearby study intersections) are generally acceptable. At two currently unsignalized ramp terminals (I-35 Southbound Ramps/US-56 and I-35 Northbound Ramps/Gardner Road), certain stop-controlled movements are operating at a poor LOS, indicating symptoms of potential future capacity needs.

2. By the year 2030, planned and anticipated local land-use growth, coupled with regional growth, are forecasted to cause large traffic-volume increases throughout the Traffic Study Corridor. These volumes are anticipated to result in unacceptable (LOS E) operations on the segment of I-35 north of US-56, even with the assumption that I-35 will be widened to six lanes. In addition, the growth is anticipated to result in unacceptable operations at I-35's interchanges with US-56 and Gardner Road, resulting in the potential need for substantial improvements at both interchanges. At I-35/Gardner Road, the interchange configuration dictated by the forecasted volumes would be unreasonably out-of-scale for a local service interchange.

3. In addition to operational issues at the I-35/Gardner Road interchange, anticipated growth patterns and development types south of the City of Gardner (and associated access needs) point toward the need for a new interchange on I-35 between Gardner Road and Sunflower Road.

4. Two potential locations appear to be viable for a new I-35 interchange: Waverly Road/199th Street, and Homestead Lane. Each could be designed to provide public access and full movements, and could serve anticipated traffic demand.

5. With a new interchange in place, 2030 volumes at the I-35/Gardner Road interchange could be reduced to the point that a potentially reasonable interchange configuration could be developed, although complete reconstruction of the interchange would still be necessary.

6. Regardless of the presence of a new interchange, it is anticipated that the I-35/US-56 interchange may need substantial improvements by 2030.

7. Additional options to help reduce congestion, such as expanded transit service (in keeping with MARC's Smart Moves plan), employer-based Transportation Demand Management (TDM) initiatives (such as flex-time, preferential car/van-pool treatments, and telecommuting), and Transportation Systems Management (TSM) techniques (such as ramp metering and signal coordination), should be coupled with the capacity improvements identified for the Transportation Study Corridor to achieve the overall system goals of mobility and access.

5. Next Steps

As described in Section 3.8, KDOT is planning to conduct a location, design and environmental study for the proposed break-in-access. That study is expected to select the specific location for the interchange, to develop a preliminary design, and to provide the documentation necessary for environmental approval. The study will also include appropriate public and agency involvement. These items, plus incorporation of the interchange into the MARC TIP (and, by reference, the STIP), will complete the requirements for FHWA and KDOT approval of a break-in-access on I-35 between Gardner Road and Sunflower Road.