

## ***Appendix 2***

U.S. 69 Expansion Project Highway Capacity Software Analysis Technical  
Memorandum



**DRAFT**

US 69 EXPANSION PROJECT

Technical Memorandum

# Highway Capacity Software Analysis

June 4, 2021

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## EXECUTIVE SUMMARY

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As part of the conceptual analysis completed for the U.S. 69 Modernization and Expansion project, traffic analyses were completed for the AM and PM peak hours using the Freeway Facilities module within Highway Capacity Software (HCS) Version 7.9. Traffic capacity analysis results generated in the HCS Freeway Facilities analysis software application for the U.S. 69 study area corridor are summarized for the Existing and two proposed Build alternatives. The executive summary focuses on the future build results.





Two future build alternatives were analyzed and compared to each other.

- **General Purpose Lane (GP) plus Auxiliary Lane Widening Alternative (GP+aux.)** – This alternative would add one additional general-purpose lane in each direction for a total of 3 GP lanes in each direction on U.S. 69 plus an auxiliary lane between interchanges at high congestion locations.
- **Express Toll Lane (ETL) plus Auxiliary Lane Widening Alternative (ETL+aux.)** - This alternative would add one additional ETL in each direction and maintain the two existing general purpose (GP) lanes on U.S. 69 plus an auxiliary lane between interchanges at high congestion locations.










































































































AM and PM peak hour results of 2050 Build conditions are presented in Tables ES-1 and ES-2. The results demonstrate that during the peak 15 minute periods of the AM peak hour the GP+aux. alternative shows minor to moderate congestion in all lanes of the northbound direction from 151<sup>st</sup> to Blue Valley Pkwy and College to 119<sup>th</sup>, while the ETL+aux. shows similar congestion in the general-purpose lanes, but provides the option to use the ETL for a more reliable, higher speed trip. Similarly, during the PM peak hour, the GP+aux. alternative has minor to moderate congestion between 119<sup>th</sup> St and 151<sup>st</sup> St for all motorists, whereas the ETL+aux. alternative provides motorists a congestion free, higher speed travel lane option through that part of the corridor.

In conclusion, the results illustrate that





- the ETL+aux lanes alternative provides sufficient future traffic operations and travel reliability; and
- the GP+aux lanes alternative does not provide sufficient future operations and travel reliability and therefore needs additional improvements such as additional lanes, collector distributor roads or other improvements to address traffic congestion.

Level of Congestion	
No Congestion	
Minor Congestion	
Moderate Congestion	
Severe Congestion	













































































































**Table ES-1: 2050 Build, AM Peak Congestion**

ROADWAY SEGMENT	Express Lanes						Traditional Widening					
	Southbound			Northbound			Southbound			Northbound		
	GP ↓	GP ↓	ETL ↓	ETL ↑	GP ↑	GP ↑	GP ↓	GP ↓	GP ↓	GP ↑	GP ↑	GP ↑
103rd St to I-435												
I-435 to College Blvd												
College Blvd to 119th St												
119th St to Blue Valley Pkwy												
Blue Valley Pkwy to 135th St												
135th St to 151st St												
151st St to 159th St												
159th St to 167th St												
167th St to 179th St												

Source: Highway Capacity Software

Level of Congestion	
No Congestion	
Minor Congestion	
Moderate Congestion	
Severe Congestion	

**Table ES-2: 2050 Build, PM Peak Congestion**

ROADWAY SEGMENT	Express Lanes						Traditional Widening					
	Southbound			Northbound			Southbound			Northbound		
	GP ↓	GP ↓	ETL ↓	ETL ↑	GP ↑	GP ↑	GP ↓	GP ↓	GP ↓	GP ↑	GP ↑	GP ↑
103rd St to I-435												
I-435 to College Blvd												
College Blvd to 119th St												
119th St to Blue Valley Pkwy												
Blue Valley Pkwy to 135th St												
135th St to 151st St												
151st St to 159th St												
159th St to 167th St												
167th St to 179th St												

Source: Highway Capacity Software

# 1. INTRODUCTION

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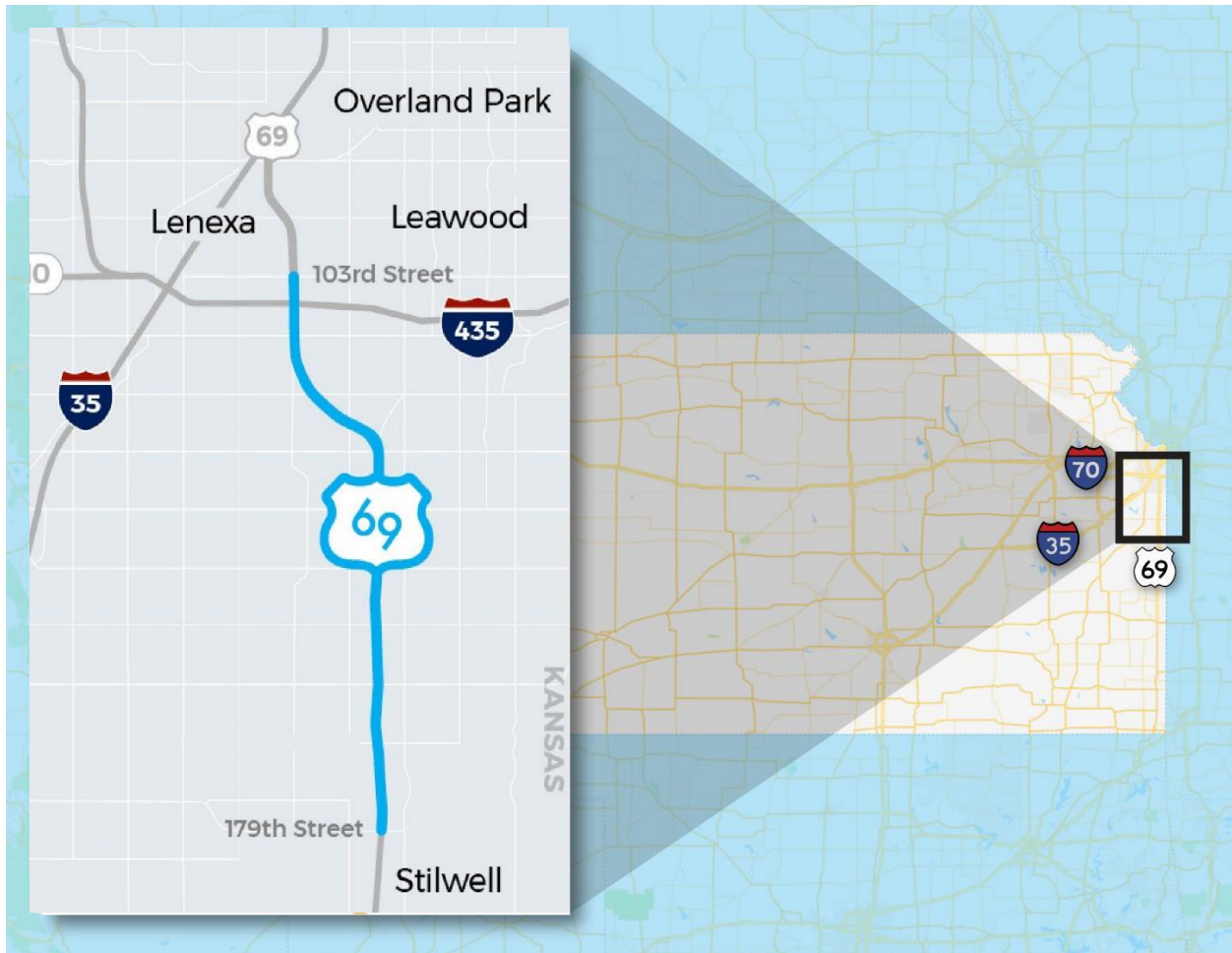
United States Highway 69 (U.S. 69) is a vital corridor to the transportation network in the State of Kansas, the Kansas City metropolitan area and the City of Overland Park, Kansas. Often referred to as the backbone of Overland Park, U.S. 69 runs north-south through the city with the northern limit merging with Interstate 35 (I-35) and the southern limit extending to the Overland Park city boundary and south through the State of Kansas. U.S. 69 links many of the primary east-west arterial corridors in the City providing connectivity to major employment centers and residential developments.

The project limits of the U.S. 69 Modernization and Expansion project extend along U.S. 69 between the 179<sup>th</sup> Street Interchange and the 103<sup>rd</sup> Street Interchange, approximately 12 miles. The Project evaluates two alternatives for adding capacity to U.S. 69. One alternative evaluates the feasibility of expanding U.S. 69 to include one express toll lane in both the northbound and southbound directions plus an auxiliary lane where congestion occurs, along with interchange improvements and arterial turn-lane and ramp improvements throughout the study corridor. A toll-free alternative is also evaluated which includes an additional general purpose through lane in each direction with auxiliary lane where congestion occurs, along with interchange improvements and arterial turn-lane and ramp improvements throughout the corridor.

Figure 1 shows the location of the U.S. 69 study area within the State of Kansas.



*Figure 1: U.S. 69 Project Location*



Note: The U.S. 69 Modernization and Expansion project limits are 103<sup>rd</sup> Street on the north and 179<sup>th</sup> Street on the south.

To provide a comparative analysis of the Express Toll Lane (ETL) and General-Purpose (GP) Lane alternatives, the Highway Capacity Software Version 7.9 (HCS7) was used as the analysis software. HCS7 is a deterministic software that provides a high-level comparison of levels of congestion. As part of the BIA Study, a more complex VISSIM model, which uses microsimulation, will be developed for a more detailed analysis. Although VISSIM will provide a more detailed analysis of the corridor, HCS provides a general comparison between the two build alternatives.

## 2. HCS FREEWAY FACILITIES ANALYSIS

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### Alternatives

As part of the conceptual analysis, traffic analyses were completed for the project study area for the AM and PM peak hours using the Freeway Facilities module within Highway Capacity Software Version 7.9 (HCS7) for the following alternatives:

**Table 1: Alternatives Evaluated**

Existing 2019	2019 Existing No-Build – Existing network with 2019 traffic volumes.
Design Year 2050 (Projects 1 & 2)	2050 Design Year Build – General Purpose Lane Widening plus Auxiliary Lanes where warranted (GP+aux.) – One additional general-purpose lane in each direction to the existing network with 2050 traffic volumes.
	2050 Design Year Build – Express Toll Lane Widening plus Auxiliary Lanes where warranted (ETL+aux.) – One additional express toll lane in each direction to the existing network with 2050 traffic volumes.

The U.S. 69 Modernization and Expansion Project is anticipated to be constructed in two major phases.

- **Project 1** could be completed as early as 2026 and includes general purpose lane or express toll lane widening on U.S. 69 from 103<sup>rd</sup> Street to 151<sup>st</sup> Street plus auxiliary lanes where warranted and interchange improvements within these limits. Project 1 does not include any improvements south of 151<sup>st</sup> Street or the modification of the U.S. 69 and I-435 interchange.
- **Project 2**, expected to be needed by 2040, will extend the U.S. 69 general purpose lane or express toll lane widening south from 151<sup>st</sup> Street to 179<sup>th</sup> Street plus auxiliary lanes where warranted and interchange improvements within these limits. Project 2 will also provide updates to the College Boulevard interchange and U.S. 69 and I-435 interchange, including a collector-distributor (CD) system from College Boulevard to I-435 and 103<sup>rd</sup> Street, as well as removing the northbound loop ramp to I-435 westbound and replacing it with a direct flyover.



## Methodology

Basic freeway segments and ramp merges, diverges, and weaves were analyzed on U.S. 69 using the HCS Freeway Facilities system module. HCS Freeway Facilities allows the integration of individual segment analyses into a singular corridor analysis to study potential multi-segment operational issues.

The first step in the freeway analysis involved the segmentation of U.S. 69 in each travel direction. The segments fall into the following categories: basic freeway, merge areas, diverge areas, and weave areas. After categorizing the segments, geometric and traffic volume inputs were entered into HCS Freeway Facilities for each segment. These inputs include:

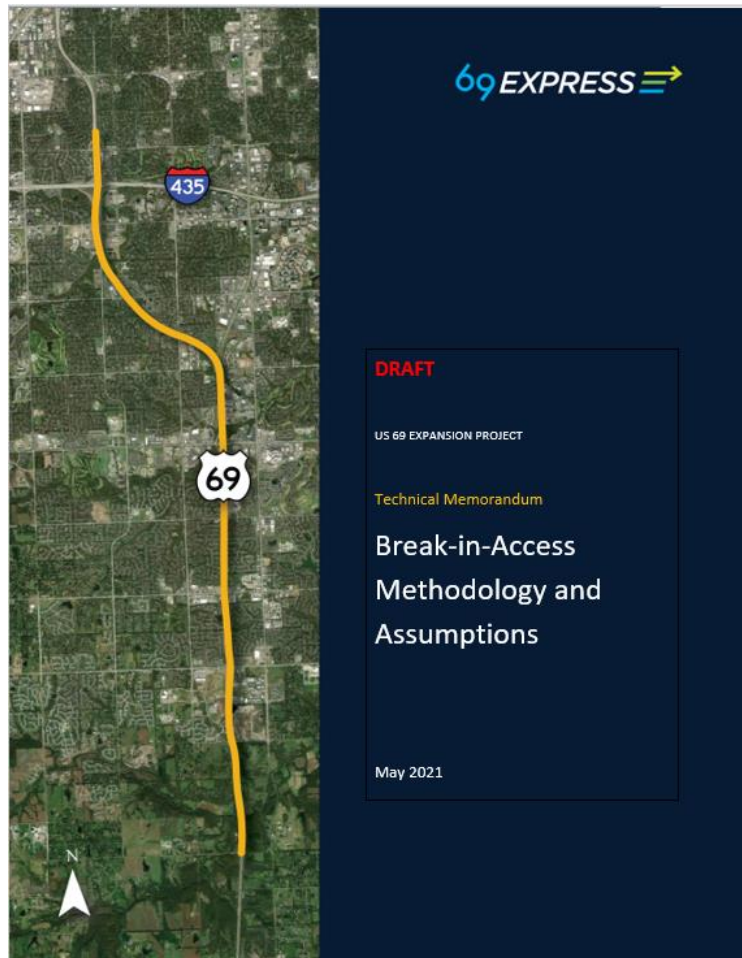
- Peak Hour Traffic Volumes – see Section 3.0
- Number of Lanes – assumed mainline through lanes plus auxiliary lanes in congested areas
- Terrain Type – Grades were coded in where As-Built information was available and is assumed to be “Level” for all other locations.
- Base Free Flow Speed – 75 mph for US 69 south of 167<sup>th</sup> Street and 70 mph north of 167<sup>th</sup> Street
- Free Flow Speeds on Ramps – assumed 30 mph for build alternative loop ramps and 35 mph for all other build alternative ramps
- Truck Percentage (range 1% to 14%)
- Lane Width – 12 feet
- Right Shoulder Lateral Clearance – 10 feet
- Segment and Acceleration/Deceleration Lane Lengths – Based on measured field or design information, measured from the beginning of taper to gore point

After inputs were entered into HCS Freeway Facilities software, output data for each segment was collected for the segment density and corresponding LOS, traffic volume, and average speed. Level of service and congestion results represent the worst 15-minute period of the peak hour.

### 3. TRAFFIC DEMAND

Traffic volumes were developed along the US 69 mainline, ramps, and cross streets in the AM and PM peak hours for both northbound and southbound directions. Volumes for the Existing year 2019 and Future No-Build year 2050 were developed. The methodology and assumptions details of the traffic volume development can be found in the *Break-in-Access Methodology and Assumptions, May 2021* report as well as the *U.S. 69 Existing and Future No-Build Balanced Traffic, April 2021*.

Initial preliminary future build year volumes were developed for both Express Toll Lane and General-Purpose alternatives. For the Express Toll Lane alternative, volumes were initially estimated for the express toll lane by shifting volume from the general-purpose lane based on an initial capacity analysis when the two general purpose lanes were expected to operate at LOS E or worse. Once volumes were input into HCS, volumes were further adjusted to maintain maximum LOS C in the express toll lane.



## 4. HCS CAPACITY ANALYSIS RESULTS

### Existing Conditions

Existing 2019 traffic capacity analysis results generated in the HCS Freeway Facilities analysis software application for the U.S. 69 study area corridor are summarized in Tables 2 and 3 below for the Existing AM and PM peak hours. Future No-Build traffic levels of congestion get considerably worse with no improvements.

**Table 2: 2019 Existing, AM Peak Congestion**

ROADWAY SEGMENT	Existing			
	Southbound		Northbound	
	GP ↓	GP ↓	GP ↑	GP ↑
103rd St to I-435	■	■	■	■
I-435 to College Blvd	■	■	■	■
College Blvd to 119th St	■	■	■	■
119th St to Blue Valley Pkwy	■	■	■	■
Blue Valley Pkwy to 135th St	■	■	■	■
135th St to 151st St	■	■	■	■
151st St to 159th St	■	■	■	■
159th St to 167th St	■	■	■	■
167th St to 179th St	■	■	■	■

Level of Congestion	
No Congestion	■
Minor Congestion	■
Moderate Congestion	■
Severe Congestion	■

Source: Highway Capacity Software

**Table 3: 2019 Existing, PM Peak Congestion**

ROADWAY SEGMENT	Existing			
	Southbound		Northbound	
	GP ↓	GP ↓	GP ↑	GP ↑
103rd St to I-435	■	■	■	■
I-435 to College Blvd	■	■	■	■
College Blvd to 119th St	■	■	■	■
119th St to Blue Valley Pkwy	■	■	■	■
Blue Valley Pkwy to 135th St	■	■	■	■
135th St to 151st St	■	■	■	■
151st St to 159th St	■	■	■	■
159th St to 167th St	■	■	■	■
167th St to 179th St	■	■	■	■

Level of Congestion	
No Congestion	■
Minor Congestion	■
Moderate Congestion	■
Severe Congestion	■





Source: Highway Capacity Software

## Build Alternatives













































































































Two future build alternatives were analyzed and compared to each other.

- **General Purpose (GP) Lane Widening Alternative Plus Auxiliary Lanes (GP+aux.)** – This alternative would add one additional general-purpose lane in each direction for a total of 3 GP lanes in each direction on U.S. 69.
- **Express Toll Lane (ETL) Widening Alternative Plus Auxiliary Lanes (ETL+aux.)** – This alternative would add one additional ETL in each direction and maintain the two existing general-purpose lanes on U.S. 69.





The HCS Freeway Facilities analysis results for the 2050 Design Year Build alternatives are shown in **Tables 4 and 5**. This alternative modeled each Build alternatives using 2050 peak hour traffic volumes.

Level of Congestion	
No Congestion	
Minor Congestion	
Moderate Congestion	
Severe Congestion	













































































































**Table 4: 2050 Build, AM Peak Congestion**

ROADWAY SEGMENT	Express Lanes						Traditional Widening					
	Southbound			Northbound			Southbound			Northbound		
	GP ↓	GP ↓	ETL ↓	ETL ↑	GP ↑	GP ↑	GP ↓	GP ↓	GP ↓	GP ↑	GP ↑	GP ↑
103rd St to I-435												
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135th St to 151st St												
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159th St to 167th St												
167th St to 179th St												

Source: Highway Capacity Software

Level of Congestion	
No Congestion	
Minor Congestion	
Moderate Congestion	
Severe Congestion	

**Table 5: 2050 Build, PM Peak Congestion**

ROADWAY SEGMENT	Express Lanes						Traditional Widening					
	Southbound			Northbound			Southbound			Northbound		
	GP ↓	GP ↓	ETL ↓	ETL ↑	GP ↑	GP ↑	GP ↓	GP ↓	GP ↓	GP ↑	GP ↑	GP ↑
103rd St to I-435												
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Blue Valley Pkwy to 135th St												
135th St to 151st St												
151st St to 159th St												
159th St to 167th St												
167th St to 179th St												

Source: Highway Capacity Software

2050 AM peak operational results indicate that the ETL+aux. alternative provides an option to use a congestion free travel lane for the entire corridor, while the GP+aux. alternative in the northbound direction has locations where all lanes have minor to moderate congestion. Similarly, in the PM peak hour, the GP+aux. and ETL+aux. both show segments slow down with minor to moderate congestion in the southbound and northbound direction. However, the ETL+aux. alternative provides motorists a high-speed, no congestion option to use the express lane that the GP+aux. does not.

## 5. CONCLUSION

As part of the planning process to determine a future build preferred alternative for the design year 2050, a comparative analysis between a tolled and toll-free alternative was completed for the US 69 Express Project using HCS version 7.9. HCS was used to provide a high-level comparison between the two alternatives. Once a U.S. 69 Build alternative is selected, a more detailed VISSIM microsimulation model will be developed for the FHWA required Break-in-Access.

The HCS analysis shows that by the year 2050 both the ETL+aux. and GP+aux. alternative will have segments that operate with minor to moderate congestion in the peak direction during the worst 15 minutes of both AM and PM peaks. The difference is, in these congested areas, the GP+aux. alternative has this congestion in all three travel lanes thus providing a slower and less reliable trip through the corridor. While these areas of congestion are still present in the general-purpose lanes of the ETL+aux. alternative, there is an option for travelers to use the express lane which will provide a faster and more reliable trip through the corridor.