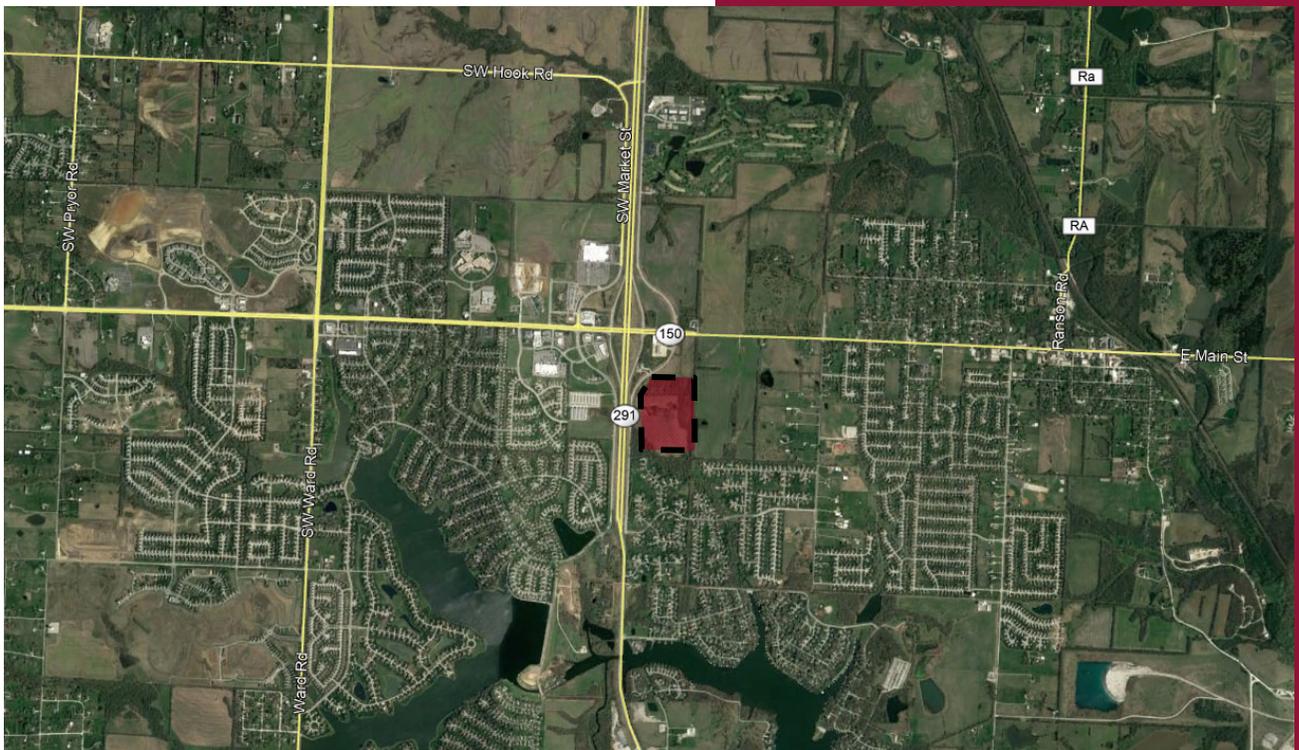


M-291 & M-150 Traffic Impact Study

M-291 Outer Road and M-150
Lee's Summit, Missouri



Prepared for:
Engineering Solutions

Prepared by TranSystems
February 2020



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February 21, 2020

Mr. Matt Schlicht
Engineering Solutions
50 SE 30th Street
Kansas City, Missouri 64106

**RE: M-291 and M-150 Traffic Study
Lee's Summit, Missouri**

Dear Mr. Schlicht:

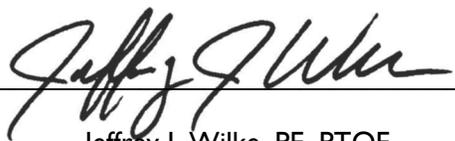
In response to your request and authorization, TranSystems has completed a traffic impact study for a proposed residential development to be located generally along the east side of East Outer Road, south of M-150 Highway in Lee's Summit, Missouri. The purpose of this study was to assess the impact of the proposed development on the surrounding transportation system.

Included in this study is a discussion of the anticipated impact of the proposed development on the adjacent street network and identified improvements to mitigate deficiencies for the following scenarios:

- ▶ Existing Conditions
- ▶ Existing plus Development Conditions

We trust that the enclosed information proves beneficial to you, the Missouri Department of Transportation (MoDOT), and the City of Lee's Summit in this phase of the development process. We appreciate the opportunity to be of service to you and will be available to review this study at your convenience.

Sincerely,
TRANSYSTEMS

By: 
Jeffrey J. Wilke, PE, PTOE

By: 
Emma H Martin, EIT

JJW:EHM/ehm/PI01200025
Enclosure

Introduction

TranSystems has completed a traffic impact study for a proposed residential development to be located generally along the east side of East Outer Road, south of M-150 Highway in Lee's Summit, Missouri. The purpose of this study was to assess the impact of the proposed development on the surrounding transportation system. The location of the development site relative to the major streets in the area is shown on **Figure A-1** in **Appendix A**.

This study also contains a description of the proposed development and the surrounding transportation infrastructure along with trip generation estimates, trip distribution estimates, capacity analyses, and a summary of the findings. The scope of this study was developed in conjunction with the Missouri Department of Transportation (MoDOT) permitting staff.

Proposed Development Plan

The proposed development is a multi-family residential subdivision. The development includes 98 duplex units and 88 four-plex townhome units. This total includes the three four-plex townhomes that are planned to be located on the east side of the stream.

Access for the development will be provided from two proposed site driveways on East Outer Road. Site Drive A will be located roughly 1,150 feet south of M-150. The second site drive (Site Drive B) will be located approximately 2,005 feet south M-150. The development's roadway network includes a future connection to the east of the site from Site Drive B. A copy of the proposed site plan showing the access points is included on **Figure A-2** in **Appendix A** for reference.

Study Area

To assess the impacts of the proposed development, the intersections listed below were identified for study during the A.M. and P.M. peak periods of a typical weekday.

- ▶ M-150 Highway and East Outer Road
- ▶ Site Driveways

Traffic Counts

The turning-movement traffic volume counts were collected on Monday, February 3 and Tuesday, February 4, 2020. The turning movement counts were collected from 7:00 to 9:00 A.M. and from 4:00 to 6:00 P.M. The A.M. peak hour occurred between 7:00 and 8:00 A.M. The P.M. peak hour occurred between 4:30 and 5:30 P.M. The existing lane configurations, traffic control devices, and peak hour traffic volumes have been illustrated on **Figure A-3**.

Surrounding Land Uses and Street Network

The proposed development site exists within an open agricultural area. The development site is bounded on the east by East Outer Road. There is a residential neighborhood south of the development site. The property to the west is also undeveloped with some agricultural land uses. There is a small commercial area across the west side of East Outer Road.

M-291 Highway is classified as a principal arterial road by the MoDOT's Functional Classification Maps. It is a four-lane divided highway that runs north/south in the southern portion of Lee's Summit. There is a diamond interchange on M-291 at M-150.

East Outer Road is a two-lane commercial collector, per Lee's Summit Thoroughfare Master Plan, that runs adjacent to M-291. It intersects M-150 roughly 700 feet east of the northbound M-291 ramps. The roadway has a 28 foot paved surface, with turf slopes to ditches along both sides. The speed limit is 45 mph. East Outer Road on the north side of M-150 has similar characteristics. The intersection of M-150 and East Outer Road is signalized.

The segment of M-150 near the development site is classified by MoDOT as a minor arterial road. M-150 is a four-lane divided highway when it intersects East Outer Road. The speed limit of the segment adjacent to the site is 45 mph.

Analysis

The scope of analysis for the assessment of the proposed development's impact on the surrounding transportation system is largely based on the recommended practices of the Institute of Transportation Engineers (ITE), as outlined in their [Traffic Engineering Handbook](#). ITE is a nationally-recognized organization of transportation professionals with members from both private and public sectors. The analysis of the proposed development's impact included development of trip generation and trip distribution estimates as well as a traffic operations assessment for each study scenario. Each of the analysis methodologies and findings are described in the subsequent sections.

Trip Generation

Trip generation estimates were prepared using the Institute of Transportation Engineer's [Trip Generation](#), 10th Edition. **Table 1** shows the expected trips to be generated by each phase of the proposed development.

Table 1
Trip Generation

Land Use	Intensity	ITE Code	Average Weekday	A.M. Peak Hour			P.M. Peak Hour		
				Total	In	Out	Total	In	Out
Single-Family Housing	98 units	210	701	47	11	36	59	38	21
Low-Rise Multi-Family Housing	88 units	220	925	68	17	51	90	57	33
Total Full Development Trips			1,626	115	28	87	149	95	54

The most recent edition of Trip Generation does not include a land use category specifically for duplexes and fourplex townhomes. The Low-Rise Multifamily Housing land use includes apartments, townhomes, and condominiums located within the same building with at least three other dwelling units; therefore, the townhomes were include within this land use. However, Low-Rise Multifamily Housing

does not include duplexes with only two units in the same building, so the duplexes were included within the Single-Family Housing land use.

Trip Distribution

The estimated trips generated by the proposed development were distributed onto the street system based on the trip distributions summarized in **Table 2**. These distributions are based on existing traffic patterns and engineering judgment. The detailed distribution patterns through the study intersections are shown in **Appendix B**.

Table 2 Trip Distribution	
Direction To/From	Percentage
North on East Outer Road	5%
South on East Outer Road	5%
East on M-150 Highway	15%
West on M-150 Highway	75%
Total	100%

Sight Distances

Sight distances and sight distance measurement methods are provided in A Policy on Geometric Design of Highways and Streets (7th Edition), also referred to as the AASHTO Green Book published by the American Association of State Highway and Transportation Officials (AASHTO). Intersection sight distance is provided at intersections to allow the drivers of stopped vehicles to depart from their approach and enter or cross the uncontrolled street. These distances are generous, allowing enough distance for the stopped driver to complete their turning or crossing maneuver without requiring through traffic on the uncontrolled street to reduce their speed. Stopping sight distance is the minimum distance required to allow for a vehicle to stop before reaching a stationary object in its path.

Sight distances were measured in the field at each proposed site driveway intersection. The measurements and AASHTO recommended sight distances for each direction are shown on the following page in **Table 3**.

The sight distance measurements indicate that sight lines are adequate at the intersection of East Outer Road and proposed Site Drive B, but not at the intersection with Site Drive A. Although Site Drive B does meet the AASHTO recommendations for sight distance, sight lines are limited by foliage along the road. Clearing vegetation would improve visibility. Sight distance is restricted by vegetation and embankment on the inside of a horizontal curve at the proposed intersection of East Outer Road and Site Drive A. Grading improvements and clearing is needed to achieve adequate sight distance. Regular maintenance will also be needed to ensure sight lines are clear at all times.

Table 3
Intersection Sight Distances

Location	Direction Looking	Measured Sight Distance, feet	Recommended Intersection Sight Distance, feet	Recommended Stopping Sight Distance, feet
East Outer Road at Site Drive A	North	600	500	360
	South	295	500	360
East Outer Road at Site Drive B	North	500	500	360
	South	>1000	500	360

Traffic Operation Assessment

An assessment of traffic operations was made for the scenarios listed below. These scenarios allowed for comparison of the before and after impacts of the proposed development on the street network.

- ▶ Existing Conditions
- ▶ Existing plus Development Conditions

The study intersections were evaluated using the Synchro traffic analysis software package. Calculations were performed based on the methodologies outlined in the Highway Capacity Manual (HCM), 6th Edition, which is published by the Transportation Research Board. The operating conditions at an intersection are graded by the “level of service” experienced by drivers. Level of service (LOS) describes the quality of traffic operating conditions and is rated from “A” to “F”. LOS A represents the least congested condition with free-flow movement of traffic and minimal delays. LOS F generally indicates severely congested conditions with excessive delays to motorists. Intermediate grades of B, C, D, and E reflect incremental increases in the average delay per stopped vehicle. Control delay is measured in seconds per vehicle. **Table 4** shows the upper limit of delay associated with each level of service for signalized and unsignalized intersections.

Table 4
Intersection Level of Service Delay Thresholds

Level of Service (LOS)	Signalized	Unsignalized
A	≤ 10 Seconds	≤ 10 Seconds
B	≤ 20 Seconds	≤ 15 Seconds
C	≤ 35 Seconds	≤ 25 Seconds
D	≤ 55 Seconds	≤ 35 Seconds
E	≤ 80 Seconds	≤ 50 Seconds
F	> 80 Seconds	> 50 Seconds

While LOS measurements apply to both signalized and unsignalized intersections, there are significant differences between how these intersections operate and how they are evaluated. LOS for signalized intersections reflects the operation of the intersection as a whole.

Unsignalized intersections, in contrast, are evaluated based on the movement groupings which are required to yield to other traffic. Typically, these are the left turns off of the major street and the side-street approaches for two-way stop-controlled intersections. At unsignalized intersections lower LOS ratings (D, E and F) do not, in themselves, indicate the need for additional improvements. Many times there are convenient alternative routes to avoid the longer delays. Other times the volumes on the unsignalized approaches are relatively minor when compared to the major street traffic, and improvements such as traffic signal installation may increase the average delay to all users of the intersection.

The LOS rating deemed acceptable varies by community, facility type and traffic control device. Most communities in the region have identified LOS D as the minimum desirable goal for signalized intersections. However, at unsignalized intersections LOS D, E, or even F are often considered acceptable for low to moderate traffic volumes where the installation of a traffic signal is not warranted by the conditions at the intersection, or the location has been deemed undesirable for signalization.

The decision to install a traffic signal, which is often considered when lower LOS ratings are projected, should be based on engineering studies and the warrants for traffic signal installation as outlined in the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD). Signals are typically not recommended in locations where there are convenient alternative paths, or if the installation of a traffic signal would have negative impacts on the surrounding transportation system.

Traffic queues were also evaluated as part of the analyses. Long traffic queues which extend beyond the amount of storage available, either between intersections or within turn lanes, can have significant impacts on operations. The projected vehicular queues were analyzed to ensure the analyses are reflective of the physical constraints of the study intersections and to identify if additional storage is needed for turn lanes.

Existing Conditions

The results of the Existing Conditions intersection analyses are summarized below in **Table 5**. The study intersection was evaluated with the lane configurations, traffic volumes, and traffic control devices shown on **Figure A-3**. The Synchro output files are included in **Appendix C**.

Table 5 Intersection Operational Analysis Existing Conditions					
Intersection	Movement	A.M. Peak Hour		P.M. Peak Hour	
		LOS ¹	Delay ²	LOS ¹	Delay ²
M-150 Highway and East Outer Road	Traffic Signal	B	13.6	A	9.6

1 – Level of Service
 2 – Delay in seconds per vehicle

The results in **Table 5** indicate that the study intersection currently operates at an acceptable level of service during both peak hours. The northbound left-turn 95th percentile queue is 190 feet during the A.M. peak hour and 98 feet in the P.M. peak hour. The queue length does not exceed the left-turn lane storage length.

Existing plus Development Conditions

The results of the Existing plus Development Conditions intersection analyses are summarized in **Table 6**. The study intersections were evaluated with the lane configurations, traffic volumes, and traffic control devices shown on **Figures A-4** through **A-6**. The Synchro output files are included in **Appendix C**.

Table 6 Intersection Operational Analysis Existing plus Development Conditions					
Intersection	Movement	A.M. Peak Hour		P.M. Peak Hour	
		LOS¹	Delay²	LOS¹	Delay²
M-150 Highway and East Outer Road	<i>Traffic Signal</i>	B	16.1	B	12.4
Site Drive A and East Outer Road	<i>Westbound</i>	A	9.9	A	9.1
	<i>Southbound Left-Turn</i>	A	7.8	A	7.5
Site Drive B and East Outer Road	<i>Westbound</i>	A	9.7	A	9.0
	<i>Southbound Left-Turn</i>	A	7.7	A	7.5

1 – Level of Service
 2 – Delay in seconds per vehicle

The results in the table above indicate that all of the study intersections are projected to operate at acceptable levels of service with the addition of the proposed development traffic. The projected northbound left-turn 95th percentile queue at M-150 and East Outer Road increases to 217 feet during the A.M. peak hour and 141 feet in the P.M. peak hour. These queue lengths are not projected to exceed the left-turn lane storage length, however the A.M. queue will be close to the end of the turn lane.

The existing plus development traffic volumes were compared to the turn lane warrant diagrams in the Missouri Department of Transportation's Engineering Policy Guide (EPG). The volumes at both site driveway intersections with the East Outer Road are well below the minimum warranting thresholds for turn lanes.

Summary

TranSystems has completed a traffic impact study for a proposed residential development to be located generally along the east side of East Outer Road, south of M-150 Highway in Lee's Summit, Missouri. The purpose of this study was to assess the impact of the proposed development on the surrounding transportation system.

The sight distance measurements indicate that sight lines are adequate at the intersection of East Outer Road at Site Drive B, but not at the intersection with Site Drive A. The design of Site Drive A should

include providing adequate sight distances. This will require grading improvements, foliage removal, and regular maintenance. Site Drive B would also benefit from foliage removal and maintenance.

The proposed development is projected to generate 115 vehicular trips in the A.M. peak hour and 149 vehicular trips in the P.M. peak hour. All study intersections are projected to operate at acceptable levels of service with the addition of the development traffic volumes. All queues are projected to be contained within their respective turn lanes. As such, no capacity improvements are identified to mitigate the additional traffic from the proposed development.