

February 29, 2024

Mr. Tim Crockett, P.E.
Crockett Engineering
1000 West Nifong Boulevard, Building 1
Columbia, MO 65203

RE: Traffic Impact Study - Proposed Mixed Use Development
Vandiver Drive – East of Rangeline Street
Columbia, Missouri
CBB Job No. 008-24

Dear Mr. Crockett:

As requested, CBB has completed a traffic impact study pertaining to a proposed mixed-use development in Columbia, Missouri. The development site is generally located on the north side of Vandiver Drive, approximately 900 feet east of Rangeline Street. The location of the site relative to the surrounding area is depicted in **Figure 1**.

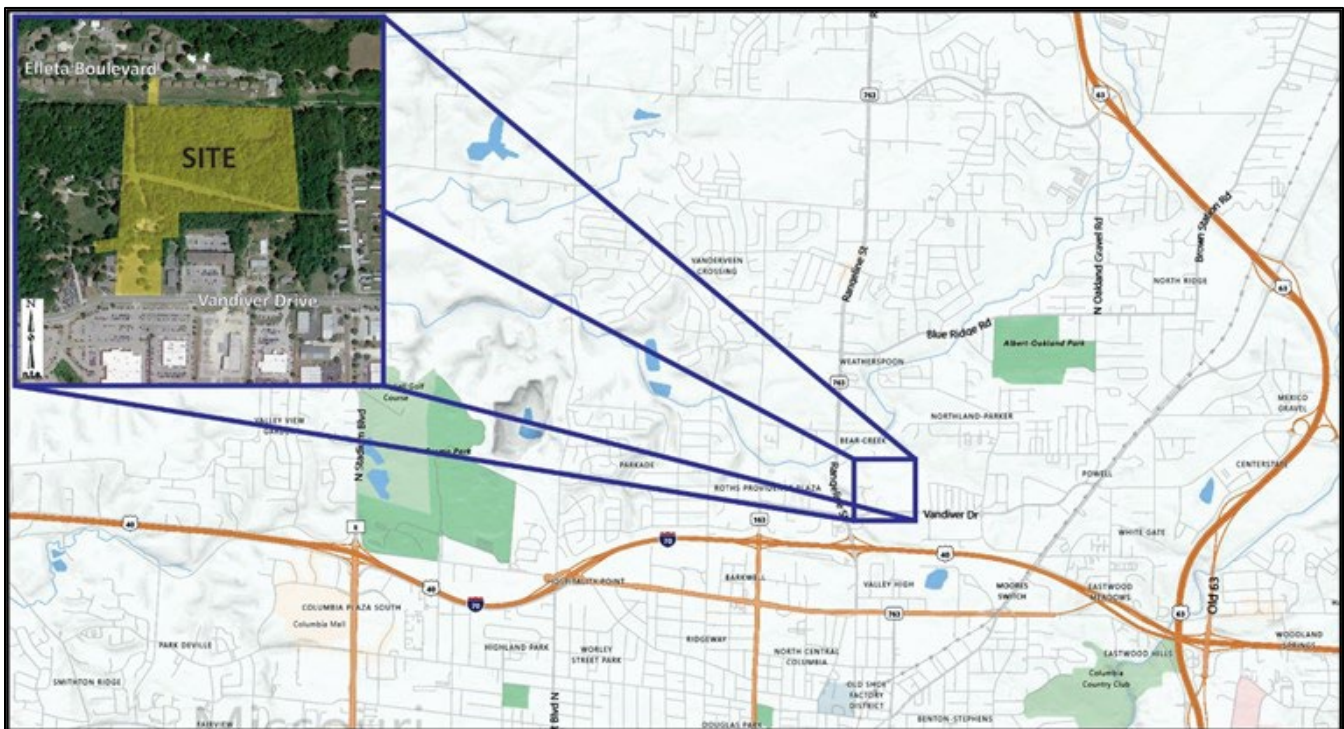


Figure 1: Project Location Map



Based on the concept plan provided by Crockett Engineering, it is anticipated that the proposed development will consist of two commercial lots closer to Vandiver Drive with multi-family on the balance of the site. Access for the development is proposed via a new roadway, Jolene Drive, on Vandiver Drive that would extend north through the site to connect to Elleta Boulevard. A schematic of the concept plan provided is shown in **Exhibit 1**.

The purpose of this study was to determine the number of additional trips that would be generated by the proposed development, assign the trips to the adjoining roadways, evaluate the impact of the additional trips on the operating conditions for the adjacent roadways, and determine the ability of motorists to safely enter and exit the site. If necessary, roadway improvements (lane additions and/or traffic control modifications) were recommended to mitigate the impact of the development and to accommodate the additional traffic. The focus of this study was the AM and PM peak hours of a typical weekday.

CBB discussed the scope of work for this traffic study with the City of Columbia at the commencement of the traffic study process. CBB also provided the City a Technical Memo summarizing the existing traffic volumes, the proposed site trip generation and directional distribution estimates, and the analysis scenarios and gained their consensus on the assumptions prior to completing the traffic analyses

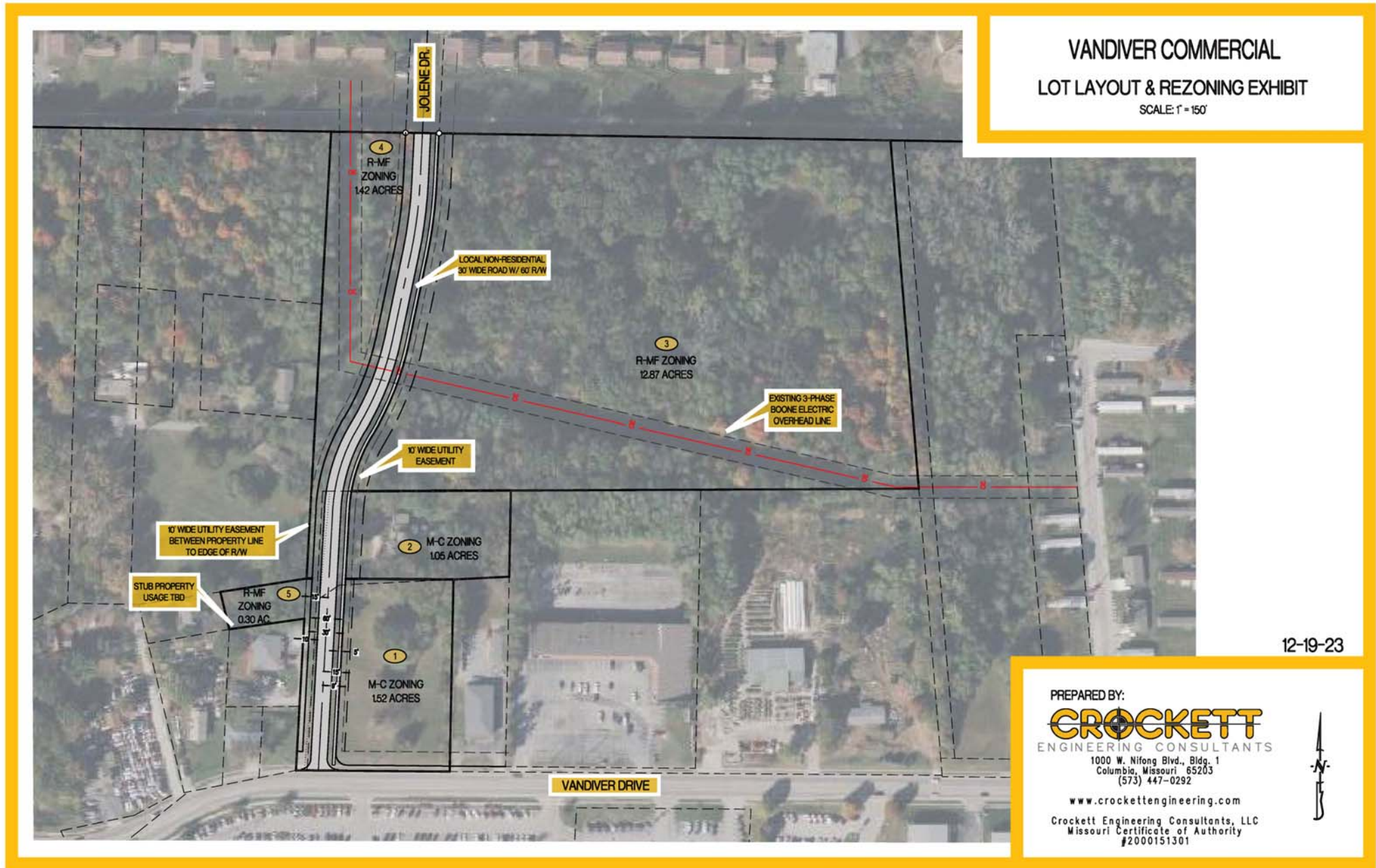
As requested, the traffic impact study evaluated the following analysis scenarios for the weekday AM and PM peak hours:

- 2024 Existing Conditions (current traffic counts); and
- 2024 Build Conditions (existing plus site trips).

As requested, the study evaluated the following study intersections:

- Vandiver Drive and Rangeline Street; and
- Vandiver Drive and Proposed Site Drive/Toyota Dealership Drive

The following report presents the methodology and findings relative to the Existing and 2024 Build conditions.



12-19-23

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Exhibit 1: Preliminary Site Plan (provided by others)

Job# 008-24
02/28/2024





EXISTING CONDITIONS

Area Roadway System: Rangeline Street is a north-south Principal Arterial through the City of Columbia maintained by MoDOT as Missouri Route 763. The posted speed limit is 45 miles per hour (mph) within the study area. Rangeline Street is a four-lane roadway with auxiliary turn lanes provided at most cross streets. Sidewalks are provided on both sides of Rangeline Street along developed parcels. Marked bicycle lanes are also provided for both northbound and southbound Rangeline Street.

Vandiver Drive is an east-west Minor Arterial maintained by the City of Columbia. Vandiver Drive is a three-lane roadway with one 12-foot lane in each direction and a center two-way-left-turn-lane (TWLTL). The posted speed limit is 35 mph within the study area. Sidewalks are provided on both sides of Vandiver Drive east of Rangeline Street and on the north side of Vandiver Drive west of Rangeline Street. Paved six-foot shoulders are also provided on both sides of Vandiver Drive.

The intersection of Rangeline Street and Vandiver Drive is controlled by a traffic signal. The signal operates under free operations with set minimum and maximum green times. The eastbound Vandiver Drive approach consists of a left-turn lane and a shared through/right-turn lane. The westbound Vandiver Drive approach consists of dual left-turn lanes and a shared through/right-turn lane. The northbound and southbound Rangeline Street approaches consist of a left-turn lane, two through lanes and a right-turn lane. The eastbound left-turn movement operates under protected plus permissive flashing yellow arrow phasing. The westbound left-turn movement operates under protected only phasing. The northbound and southbound approaches also operate under protected only phasing. Pedestrian push button and crosswalks are provided across the north and east legs of the intersection. **Figure 2** provides an aerial view of the Rangeline Street and Vandiver Drive intersection.

The Vandiver Drive and the Toyota Dealership driveway intersection is side-street STOP controlled with the Toyota Dealership driveway required to stop. All approaches consist of a single shared lane, with a two-way left-turn lane along Vandiver Drive to facilitate left-turn maneuvers. **Figure 3** provides an aerial view of the Vandiver Drive and Toyota Dealership Drive intersection.



Figure 2: Rangeline Street and Vandiver Drive Intersection

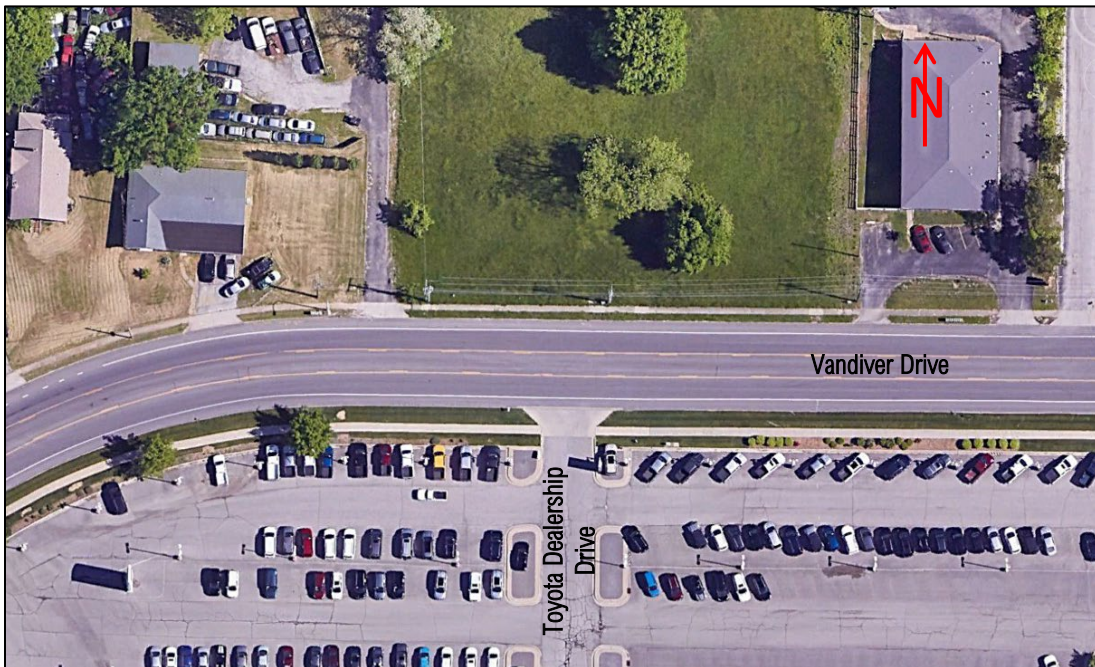


Figure 3: Vandiver Drive and Toyota Dealership Drive Intersection



Existing Traffic Volumes: Video, turning movement traffic counts were conducted at the following intersections during the weekday morning (7:00 - 9:00 a.m.) and weekday afternoon (3:00- 6:00 p.m.) peak periods on Thursday, February 1, 2024:

- Vandiver Drive and Rangeline Street; and
- Vandiver Drive and Toyota Dealership Drive

The area school academic calendars were reviewed to ensure that the data was collected during normal school operations. The traffic count data was also collected during dry weather conditions. Based on the traffic data collected, the morning peak hour occurred between 7:30 and 8:30 a.m. and the afternoon peak hour occurred between 4:15 and 5:15 p.m. The existing peak hour volumes are summarized in **Exhibit 2**.

Given the traffic characteristics in the area and the anticipated trip generation for the proposed development, the peak periods identified would represent a “worst-case scenario” with regards to the traffic impact. If traffic operations are acceptable during these weekday peak hours, it can be reasoned that conditions would be acceptable throughout the remainder of the day.



Exhibit 2: Existing Traffic Volumes



PROPOSED SITE

Proposed Land Use: Based on the concept plan provided by Crockett Engineering, shown in Exhibit 1, the proposed development will likely consist of a mix of commercial uses with a multi-family residential component. For the purposes of this study, it was assumed the proposed development would develop with the following uses:

- Lot 1 – bank (3 drive-thru lanes);
- Lot 2 - general retail (8,000 SF); and
- Lots 3/4 - 131 units of multi-family.

Site Access: As shown on the concept plan, access for the development is proposed via a new roadway, Jolene Drive, on Vandiver Drive that would extend north through the site to connect to Elleta Boulevard.

Careful consideration should be given to sight distance obstructions when planning future aesthetics enhancements, such as signs, berms, fencing and landscaping, to ensure that these improvements do not obstruct the view of entering and exiting traffic at the intersection of all drives with the public roadways. It is generally recommended that all improvements higher than 3 ½ feet above the elevation of the nearest pavement edge be held back at least 20 feet from the traveled roadway.

Trip Generation: Forecasts were prepared to estimate the amount of traffic that the proposed mixed-use development would generate during the weekday AM and PM peak periods. These forecasts were based upon information provided in the *Trip Generation Manual*, 11th Edition, published by the Institute of Transportation Engineers (ITE). This manual, which is a standard resource for transportation engineers, is based on a compilation of nationwide studies documenting the characteristics of various land uses. Estimates for proposed mixed-use development were based upon the following land uses:

- Land Use 220 – Multi-family Housing Low-Rise
- Land Use 822 – Strip Retail Plaza (<40,000k)
- Land Use 912 – Drive-In Bank

Based upon the recommended procedures for estimating trip generation outlined in the “Trip Generation Handbook, A Recommended Practice”, published by ITE (March 2001), the average trip rate was utilized for:

- Land Use 912 – Drive-In Bank

and the regression equation was utilized for:

- Land Use 822 – Strip Retail Plaza (<40,000k); and



- Land Use 912 – Drive-In Bank.

The peak hour of adjacent street traffic (one hour between 7 and 9 a.m.) was utilized for the AM peak hour and the peak hour of adjacent street traffic (one hour between 4 and 6 p.m.) was utilized for the PM peak hour trip generation.

It should be noted that not all of these trips would represent *new* traffic on the adjacent roadways. Nationwide studies have found that a percentage of convenience-oriented trips, such as banks and retail plazas would already be present on the adjacent roads and would be attracted to the development on their way to or from home, work or another destination (i.e., pass-by trips). The actual percentage of traffic attributable to pass-by depends upon the nature of the use, the time of day and the traffic volume on the adjacent street. The statistical information provided in the ITE Trip Generation Appendices *Pass-By Data and Rate Tables/2021*, was utilized to estimate pass-by percentages for the proposed commercial uses. The pass-by percentages applied are summarized in **Table 1**.

Table 1: Pass-by Trip Assumptions

Land Use	Pass-By Trip Assumptions	
	Weekday AM Peak Hour	Weekday PM Peak Hour
Strip Retail Plaza (<40k)		40%
Drive-In Bank	29%	35%

The resulting trip generation estimate, including both new trips and pass-by trips, for the proposed Vandiver Mixed-Use development are summarized in **Table 2**. As shown in the table, the proposed Vandiver Mixed-Use development is estimated to generate 105 new trips during the weekday AM peak hour and 170 new trips during the weekday PM peak hour with another 10 and 50 pass-by trips respectively during the AM and PM peak hours.



Table 2: Trip Generation Estimate – Vandiver Mixed-Use

Land Use	Size	Weekday AM Peak Hour			Weekday PM Peak Hour		
		In	Out	Total	In	Out	Total
Bank	3 lanes	15	10	25	40	40	80
Strip Retail Plaza	8,000 ft ²	15	10	25	30	35	65
Multi-Family	131 units	15	50	65	50	25	75
Total Trips		45	70	115	120	100	220
Pass-by Trips		5	5	10	25	25	50
New Trips		40	65	105	95	75	170

Trips Rounded to Nearest 5 vph

Trip Distribution: The site-generated trips for the proposed Vandiver Mixed-Use development were then assigned into and out of the site based upon an assumed estimated directional distribution. Based upon the existing travel patterns and the surrounding area and roadway network, the distribution of new site-generated trips are summarized in **Table 3**.

Table 3: Trip Distribution Assumptions

DIRECTION OF TRAVEL	RESIDENTIAL TRIPS	COMMERCIAL TRIPS
To/from the north on Rangeline Street	10%	30%
To/from the south on Rangeline Street (I-70)	60%	20%
To/from the east on Vandiver Drive	18%	25%
To/from the west on Vandiver Drive	12%	25%

It should be noted that the pass-by trips were assigned in accordance with the adjacent street traffic along Vandiver Drive. The resulting assignment of site-generated trips for the weekday AM and PM peak hours is summarized in **Exhibit 3**.

2024 Build Traffic Volumes (Existing plus Site): The assigned traffic volumes resulting from the trip distribution for the proposed mixed-use development (Exhibit 3) were added to the Existing traffic volumes (Exhibit 2) to determine the total volumes in the forecasted scenario. The forecasted, or 2024 Build, traffic volumes for the weekday AM and PM peak hours are shown in **Exhibit 4**.



Exhibit 3: Site-Generated Trips



Exhibit 4: 2024 Build Traffic Volumes



TRAFFIC ANALYSIS

Study Procedures: The Existing and 2024 Build operating conditions were analyzed using SYNCHRO 11, a macro-level analytical traffic flow model. SYNCHRO is based on study procedures outlined in the *Highway Capacity Manual*, published by the Transportation Research Board. This manual, which is used universally by traffic engineers to measure roadway capacity, establishes six levels of traffic service: Level A ("Free Flow"), to Level F ("Fully Saturated"). Levels of service (LOS) are measures of traffic flow, which consider such factors as speed, delay, traffic interruptions, safety, driver comfort, and convenience. Level C, which is normally used for highway design, represents a roadway with volumes ranging from 70% to 80% of its capacity. However, Level D is often considered acceptable for peak period conditions in urban and suburban areas.

The thresholds that define level of service at an intersection are based upon the type of control used (i.e., whether it is signalized or unsignalized) and the calculated delay. For signalized and all-way stop intersections, the average control delay per vehicle is estimated for each movement and aggregated for each approach and then the intersection as a whole. At intersections with partial (side-street) stop control, delay is calculated for the minor movements only since motorists on the main road are not required to stop.

Level of service is directly related to control delay. At signalized intersections, the level of service criteria differ from that at unsignalized intersections primarily because varying transportation facilities create different driver expectations. The expectation is that a signalized intersection is designed to carry higher traffic volumes, and consequently may experience greater delay than an unsignalized intersection. **Table 3** summarizes the thresholds used in the analysis for signalized and unsignalized intersections.

Table 4: Level of Service Thresholds

LEVEL OF SERVICE (LOS)	CONTROL DELAY PER VEHICLE (SEC/VEH)	
	SIGNALIZED INTERSECTIONS	UNSIGNALIZED INTERSECTIONS
A	≤ 10	0-10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-50
F	> 80	> 50



2024 Build Auxiliary Turn Lane Needs: The need for a right-turn lane on Vandiver Drive was evaluated using MoDOT’s Engineering Policy Guidelines (EPG), as typically used by the City. The MoDOT EPG considers auxiliary lanes an asset in promoting safety and improved traffic flow at relatively high conflict locations. Separate turn lanes are intended to remove turning vehicles from the through lanes to reduce the potential number of rear-end collisions at intersections.

The MoDOT EPG provides guidelines for separate right-turn lanes on the through roadway by comparing the total advancing volume to the number of mainline right-turns. The operating speed of the major roadway is used to determine if a right-turn lane is warranted.

Utilizing MoDOT’s *Right-Turn Lane Guideline for Two-lane Roadway* nomograph, a separate westbound right-turn lane is borderline warranted on Vandiver Drive at the proposed site drive. However, there are currently no right-turn lanes provided along Vandiver Drive at any of the many private drives. As such, a separate right-turn lane, while considered an asset, is not necessary to provide acceptable operations. **Figure 3** graphically illustrates the right-turn evaluation utilizing the 2024 Build traffic volumes on Vandiver Drive at the proposed site drive.

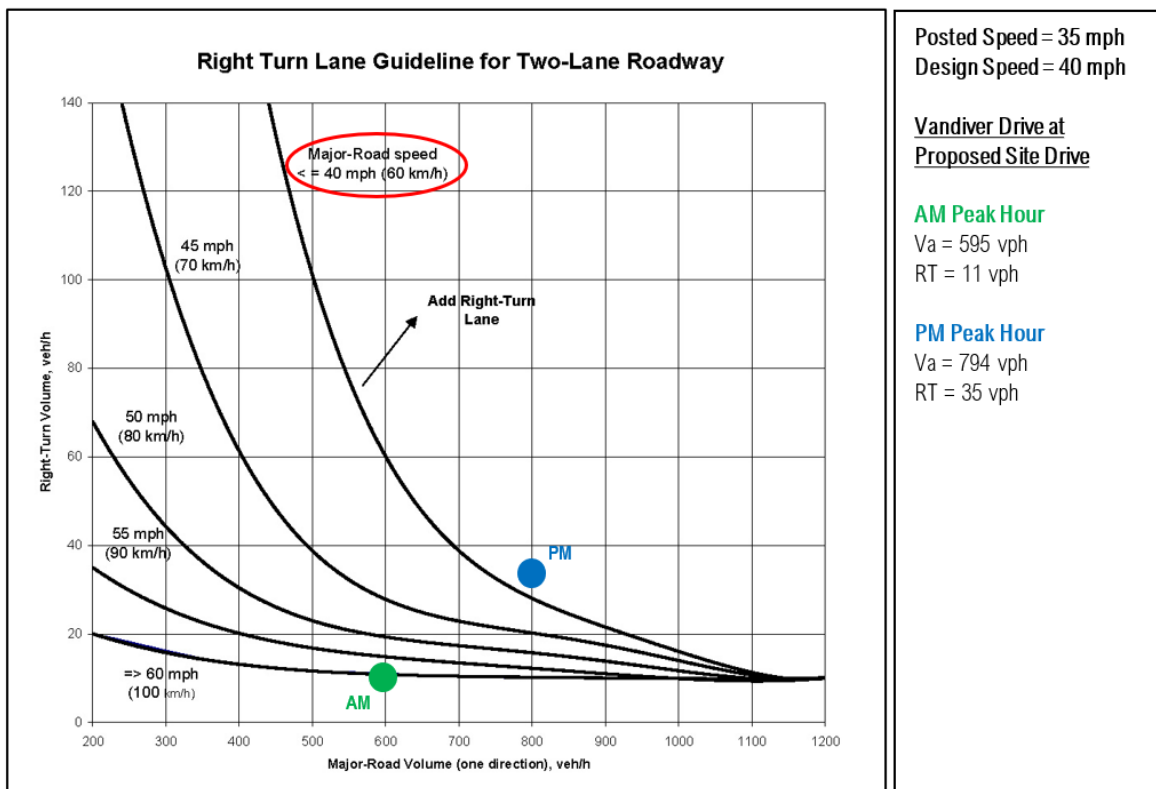


Figure 3: Right-Turn Lane Warrant – Westbound Vandiver Drive at Site Drive (2024 Build)



Operating Conditions: The study intersections were evaluated using the methodologies described above. **Table 4** summarizes the results of these analyses, which reflect the Existing and 2024 Build operating conditions and average delay for each of the study intersections during the weekday AM and PM peak hours. Also shown in **Table 4** is the 95th percentile queue for the critical movement for each approach at the Vandiver Drive and Rangeline Street intersection.

Table 5: Capacity Analysis Summary

INTERSECTION/MOVEMENT	AM PEAK HOUR		PM PEAK HOUR	
	EXISTING CONDITIONS	2024 BUILD CONDITIONS	EXISTING CONDITIONS	2024 BUILD CONDITIONS
Rangeline Street and Vandiver Drive (Traffic Signal Control)				
Eastbound Vandiver Drive Approach	D (47.9) 95 th Queue: 295' TR	D (49.1) 95 th Queue: 310' TR	D (54.4) 95 th Queue: 600' TR	E (61.7) 95 th Queue: 640' TR
Westbound Vandiver Drive Approach	D (50.2) 95 th Queue: 350' TR	D (50.7) 95 th Queue: 370' TR	D (53.4) 95 th Queue: 485' TR	E (56.8) 95 th Queue: 535' TR
Northbound Rangeline Street Approach	C (24.7) 95 th Queue: 245' TH	C (25.8) 95 th Queue: 255' TH	D (41.1) 95 th Queue: 500' TH	D (45.0) 95 th Queue: 515' TH
Southbound Rangeline Street Approach	D (35.9) 95 th Queue: 405' TH	D (37.6) 95 th Queue: 420' TH	D (44.2) 95 th Queue: 365' TH	D (44.7) 95 th Queue: 365' TH
Overall	D (36.6)	D (38.0)	D (46.8)	D (50.3)
Vandiver Drive and Toyota Dealership Drive (Side-Street Stop Control)				
Eastbound Vandiver Drive Approach	Free Flow	Free Flow	Free Flow	Free Flow
Westbound Vandiver Drive Left-Turn	A (9.3)	A (9.3)	A (8.9)	A (9.0)
Northbound Toyota Dealership Drive Approach	B (14.6)	B (14.8)	C (15.4)	C (15.7)
Vandiver Drive and Site Drive (Side-Street Stop Control)				
Eastbound Vandiver Drive Left-Turn		A (9.0)		B (10.3)
Westbound Vandiver Drive Approach		Free Flow		Free Flow
Southbound Site Drive Approach		B (14.9)		C (20.8)

X (XX.X) - Level of Service (Vehicular delay in seconds per vehicle)
 95th percentile queue for the critical movement of the approach and lane (L-Left, TH-Thru, TR-Shared Thru/Right, R-Right)

As shown in the table, the signalized intersection of Rangeline Street and Vandiver Drive currently operates at overall LOS D in the peak hours and is forecasted to continue to operate at overall LOS D in the 2025 Build conditions. Note that the eastbound and westbound Vandiver approaches are forecasted to operate at LOS E in the PM peak hour Build conditions, with a minor increase in the average delay of approximately seven seconds for the eastbound approach and three seconds for the westbound approach. All approaches at the unsignalized study intersections are forecasted to operate at favorable levels of service (i.e., LOS C or better) during the peak periods.



SUMMARY

CBB completed the preceding study to address the traffic impacts associated with the proposed mixed-use commercial development generally located on the north side of Vandiver Drive, approximately 900 feet east of Rangeline Street, in Columbia, Missouri.

In summary, the following findings should be considered in conjunction with the proposed Vandiver Mixed-Use development:

- The proposed development is estimated to add about 105 new trips in the AM peak hour and 170 new trips in the PM peak hour to the adjacent roadways.
- The signalized intersection of Rangeline Street and Vandiver Drive currently operates at overall LOS D in the peak hours and is forecasted to continue to operate at overall LOS D in the 2025 Build conditions.
- All approaches at the unsignalized study intersections, including the proposed site access, are forecasted to operate at favorable levels of service during the peak periods.
- Based on MoDOT's EPG, a separate westbound right-turn lane is borderline warranted on Vandiver Drive at the proposed site drive. However, there are currently no right-turn lanes provided along the City owned Vandiver Drive at any of the many private drives. As such, a separate right-turn lane, while considered an asset, is not necessary to provide acceptable operations.
- Careful consideration should be given to sight distance obstructions when planning any future aesthetic enhancements, such as berms, fencing and landscaping, at the development drive to ensure that these improvements do not obstruct the view of entering and exiting traffic at the site intersection with Vandiver Drive. It is generally recommended that all improvements wider than two inches (posts, tree trunks, etc.) and higher than 3 1/2 feet above the elevation of the nearest pavement edge be held back at least 20 feet from the traveled roadway.

We trust that this traffic impact study adequately describes the forecasted traffic conditions that should be expected as a result of the proposed Vandiver mixed-use development. If additional information is desired, please feel free to contact me at 314-449-9572 or swhite@cbbtraffic.com.

Sincerely,

Shawn Lerai White, P.E., PTOE
Associate - Senior Traffic Engineer