

July 16, 2019

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

RE: Traffic Impact Study – Rock Climbing Facility and Storage Facility  
Highway WW  
Boone County, Missouri  
CBB Job No. 51-19

Dear Mr. Crockett:

As requested, CBB has completed a traffic impact study pertaining to the proposed Rock Climbing Facility and Storage Facility in Boone County, Missouri. The proposed development is located on the south side of Highway WW approximately 500 feet west of El Chaparral Avenue. The site would consist of a recreational rock climbing facility with a complementary retail use and a storage facility. The location of the site in relation to the surrounding road system is depicted in **Figure 1**.



Figure 1: Project Location Map



Based on the site plan provided at the commencement of the study, the proposed development would consist of a 15,000-square-foot rock climbing gym, a 4,500-square-foot retail space, and a 212-unit self-storage facility. Access is proposed via the existing access drive on Highway WW approximately 500 feet west of El Chaparral Avenue. The existing drive would be widened and improved to accommodate the new development site. A schematic of the concept plan provided is shown in **Figure 2**.



Figure 2: Proposed Site Plan (Provided by Crockett Engineering)

The purpose of this study was to determine the number of additional trips that would be generated by the proposed development, evaluate the impact 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) are 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 Missouri Department of Transportation (MoDOT) and Boone County at the commencement of the traffic study process.

As requested by MoDOT and the County, the study included the intersection of Highway WW at the proposed site driveway for the 2019 conditions. The following report presents the methodology and findings relative to the 2019 Build conditions.





## EXISTING CONDITIONS

**Area Roadway System:** Highway WW (East Broadway) is a minor arterial roadway that runs primarily east-west through the study area. Highway WW is owned and maintained by MoDOT. Within the study area, Highway WW provides two travel lanes, one in each direction. The posted speed limit adjacent to the site is 45 miles per hour (mph). No sidewalks are provided along Highway WW through the study area.

**Baseline Traffic Volumes:** Baseline traffic volumes at the intersection of Highway WW and El Chaparral Avenue were obtained from the Traffic Impact Study for The Brooks Phase 2 completed by CBB in January of 2017. As that development has not yet been fully completed, the 2016 Build traffic volumes from The Brooks Phase 2 study are expected to represent the most accurate baseline for this study. Based on the prior counts, the weekday AM peak hour occurred from 7:15 to 8:15 a.m. while the weekday PM peak hour occurred from 4:45 to 5:45 p.m. The baseline weekday AM and PM peak hour traffic volumes are summarized in **Figure 3**.

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



Figure 3: Baseline Traffic Volumes



**PROPOSED SITE**

With the base traffic volumes within the study area established, we then considered the traffic associated with the proposed development.

**Proposed Land Use:** Based upon the concept plan provided by Crockett Engineering Consultants, previously shown in Figure 2, a development is proposed on the south side of Highway WW to the west of El Chaparral Drive. The site would consist of a 15,000-square-foot rock climbing gym, a 4,500-square-foot retail space, and a 212-unit self-storage facility.

**Site Access:** As shown on the concept plan, access to the proposed site would be provided via the existing full-access driveway on Highway WW, which would be widened and improved to accommodate the new development site.

**Trip Generation:** Forecasts were prepared to estimate the amount of traffic that the proposed development would generate during the weekday AM and PM peak periods. These forecasts were based upon information provided in the latest edition of the *Trip Generation Manual*. Estimates for the proposed development were based upon Land Use: 434 – Rock Climbing Gym, 820 – Shopping Center, and 151 – Mini-Warehouse.

The data provided for Peak Hour of Generator was used for the traditional weekday AM and PM peak hour forecasts. Based on this data, the trip generation forecast for the proposed development is shown in **Table 1**. As shown, the proposed development would generate a total of 40 trips during the weekday AM peak hour and 66 trips during the weekday PM peak hour.

**Table 1: Trip Estimate – Rock Climbing Gym and Storage Facility**

ITE Code	Land Use	Unit	Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
434	Rock Climbing Gym	15,000 sf	10	10	20	20	20	40
820	Shopping Center	4,500 sf	10	5	15	10	10	20
151	Mini-Warehouse (Self-Storage)	212 units	3	2	5	3	3	6
Total Trips			23	17	40	33	33	66





**Trip Distribution:** The site-generated trips for the proposed development were then assigned into and out of the site based upon an estimated directional distribution. Based upon the existing travel patterns in the area, it is anticipated that the distribution of site-generated trips for the proposed development would be as follows:

- To/from the east on Highway WW ..... 25%
- To/from the west on Highway WW ..... 75%

The site-generated traffic volumes for the weekday AM and PM peak hour are shown in **Figure 4**.

**2019 Build Traffic Volumes (Baseline plus Site-Generated Volumes):** The assigned traffic volumes resulting from the trip distribution for the proposed development were added to the Baseline traffic volumes to determine the total volumes in the forecasted scenario. The 2019 Build traffic volumes for the AM and PM peak hours are shown in **Figure 5**.



Figure 4: Site-Generated Traffic Volumes



Figure 5: 2019 Build Volumes





## 2019 TRAFFIC ANALYSIS

**Study Procedures:** The 2019 Build operating conditions were analyzed using SYNCHRO 10, 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 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 different 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 2** summarizes the thresholds used in the analysis for signalized and unsignalized intersections.

**Table 2: 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



**2019 Build Auxiliary Turn Lane Needs:** The need for a separate eastbound right-turn lane and westbound left-turn lane on Highway WW at the site drive were evaluated using MoDOT's Access Management Guidelines (AMG). These guidelines consider 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 method provides volume guidelines for the consideration of separate turn lanes by comparing the total advancing volume (which includes all turning traffic) to the number of right and left-turns during the design hour with respect to a given major road speed.

Utilizing MoDOT's AMG *Right-Turn Lane Guideline for Two-lane Roadway* nomograph, shown in **Figure 6**, a separate right-turn lane is warranted on Highway WW at the site drive.

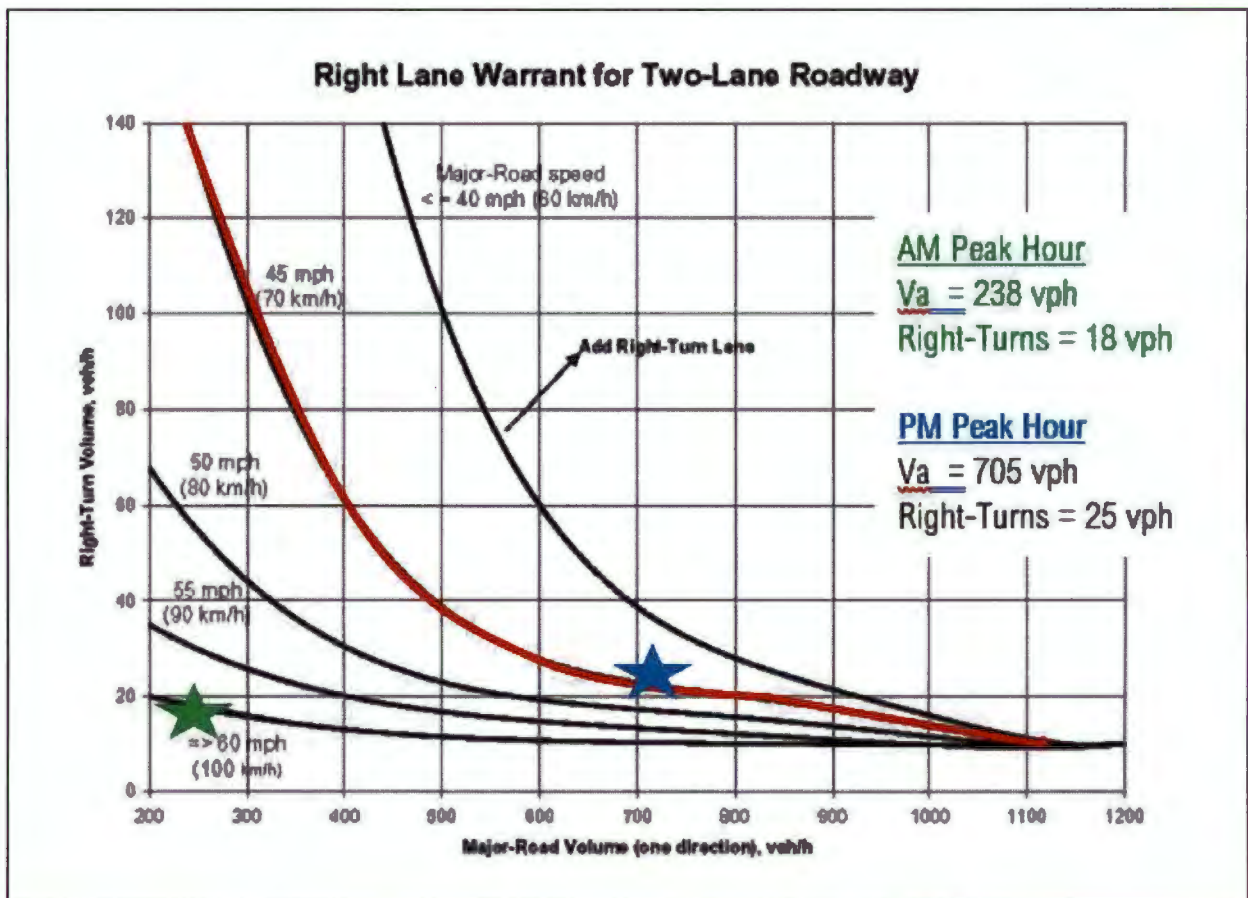


Figure 6: Eastbound Highway WW Right-Turn Warrant – 2019 Build Conditions





Utilizing MoDOT's AMG *Left-Turn Lane Guideline for Two-lane Roadway (45 mph)* nomograph, shown in **Figure 7**, a separate left-turn lane is technically warranted on Highway WW at the site drive. However, the Access Management Guidelines state that "a left-turn lane is not needed for a left turn volume less than 10 vph unless criteria other than volume, such as crash experience, justify the need". Thus given the forecasted left-turn volume of 5 vph in the AM peak hour and 8 vph in the PM peak hour, a left-turn lane is not justified.

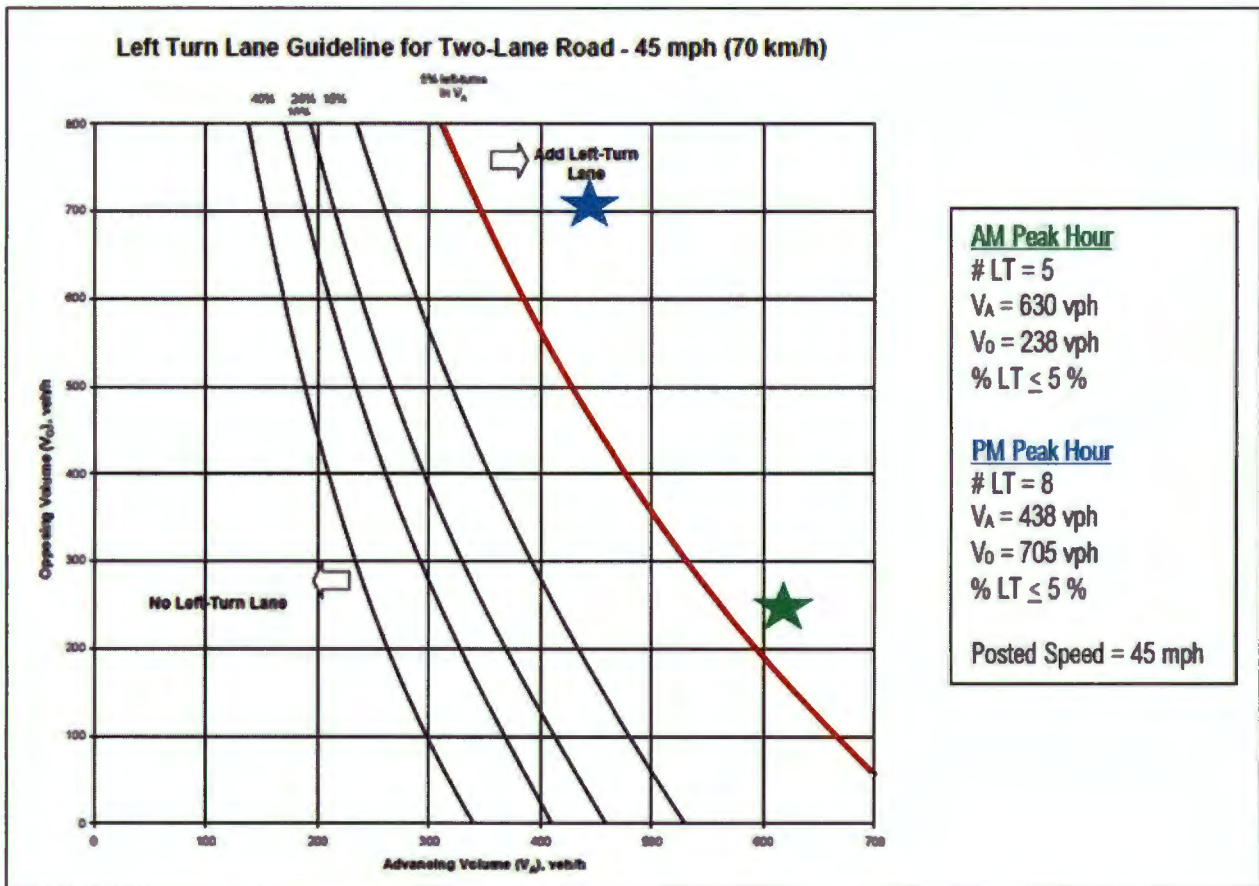


Figure 7: Westbound Highway WW Left-Turn Warrant – 2019 Build Conditions

**2019 Operating Conditions:** The study intersection was evaluated using the methodologies described above. **Table 3** summarizes the results of this analysis, which reflects the 2019 Build operating conditions and average delays with and without the warranted right-turn lane during the AM and PM peak hours. Although a separate eastbound right-turn lane is warranted, the addition of the right-turn lane will not have a notable impact on the operations of the intersection as the eastbound and westbound approaches of Highway WW would still operate at LOS A.



Table 3: Capacity Analysis Summary – 2019 Build Conditions

Intersection / Approach	Weekday AM Peak Hour		Weekday PM Peak Hour	
	No Improvements	With Right-Turn Lane	No Improvements	With Right-Turn Lane
<i>Highway WW and Proposed Site Driveway (Side-Street STOP)</i>				
Eastbound Highway WW Approach	Free Flow	Free Flow	Free Flow	Free Flow
Westbound Highway WW Approach	A (<1.0)	A (<1.0)	A (<1.0)	A (<1.0)
Northbound Site Drive Approach	C (16.2)	C (16.0)	C (24.4)	C (24.0)

X (XX.X) - Level of Service (Vehicular delay in seconds per vehicle)

As shown in **Table 3**, all approaches at the study intersection operate at desirable levels of service (i.e., LOS C or better) during the peak hours in the 2019 Build conditions with and without the eastbound right-turn lane.

**Driveway Queueing:** CBB was also asked to consider any queuing at the storage facility gates and its impact on the site driveway at Highway WW. With only three vehicles expected to access the storage facility during each peak hour, we do not expect queueing at the gate to be an issue. Approximately 280 feet of driveway is provided on the site plan between the gate and the proposed entrance, meaning approximately eleven vehicles could be queued at the gate before blocking the ability to turn off Highway WW into the site.

**SUMMARY**

In summary, the following findings and improvements should be considered in conjunction with the proposed rock climbing and self-storage facility in Boone County, Missouri:

- Based on MoDOT’s AMG, an eastbound right-turn lane is warranted on Highway WW at the proposed site drive.

We trust that this traffic study adequately describes the forecasted traffic conditions that should be expected in the vicinity of the proposed development. If additional information is desired, please feel free to contact me at 314-449-9572 or [swhite@cbbtraffic.com](mailto:swhite@cbbtraffic.com).

Sincerely,

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