November 25, 2024

D & D Investments of Columbia LLC
C/O Dan Burks
1200 I-70 DR SW
Columbia, Missouri 65203

RE: Traffic Impact Study – Willow Creek East
St. Charles Road and Route Z
Columbia, Missouri
CBB Job No. 085-23

Dear Mr. Burks:

As requested, CBB has completed a traffic impact study pertaining to the proposed Willow Creek East development generally located in the northwest quadrant of St. Charles Road and Route Z intersection in Columbia, Missouri. 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 by Crockett Engineering, the proposed Willow Creek East development will include approximately 196 single-family detached homes and 12 single-family attached homes on six lots. There is also a commercial outlot shown in the northwest quadrant of the roundabout.

In conjunction with the proposed development, a new collector roadway (Mosby Drive) would be constructed along the north side of the development that would tie into Route Z to the east and eventually Battle Avenue to the west, though the timing of the west connection is unknown. Access for the residential portion of the development is proposed via two new drives on St. Charles Road (Tribeca Drive and Ascent Drive) and via the new collector road (Mosby Drive) on Route Z. In addition, stub streets are shown to connect to further development to the west and north. Access for the commercial outlot is proposed via a new drive on Route Z and via the eastern subdivision street (Ascent Drive). The conceptual site plan (provided by others) is shown in **Figure 2**.

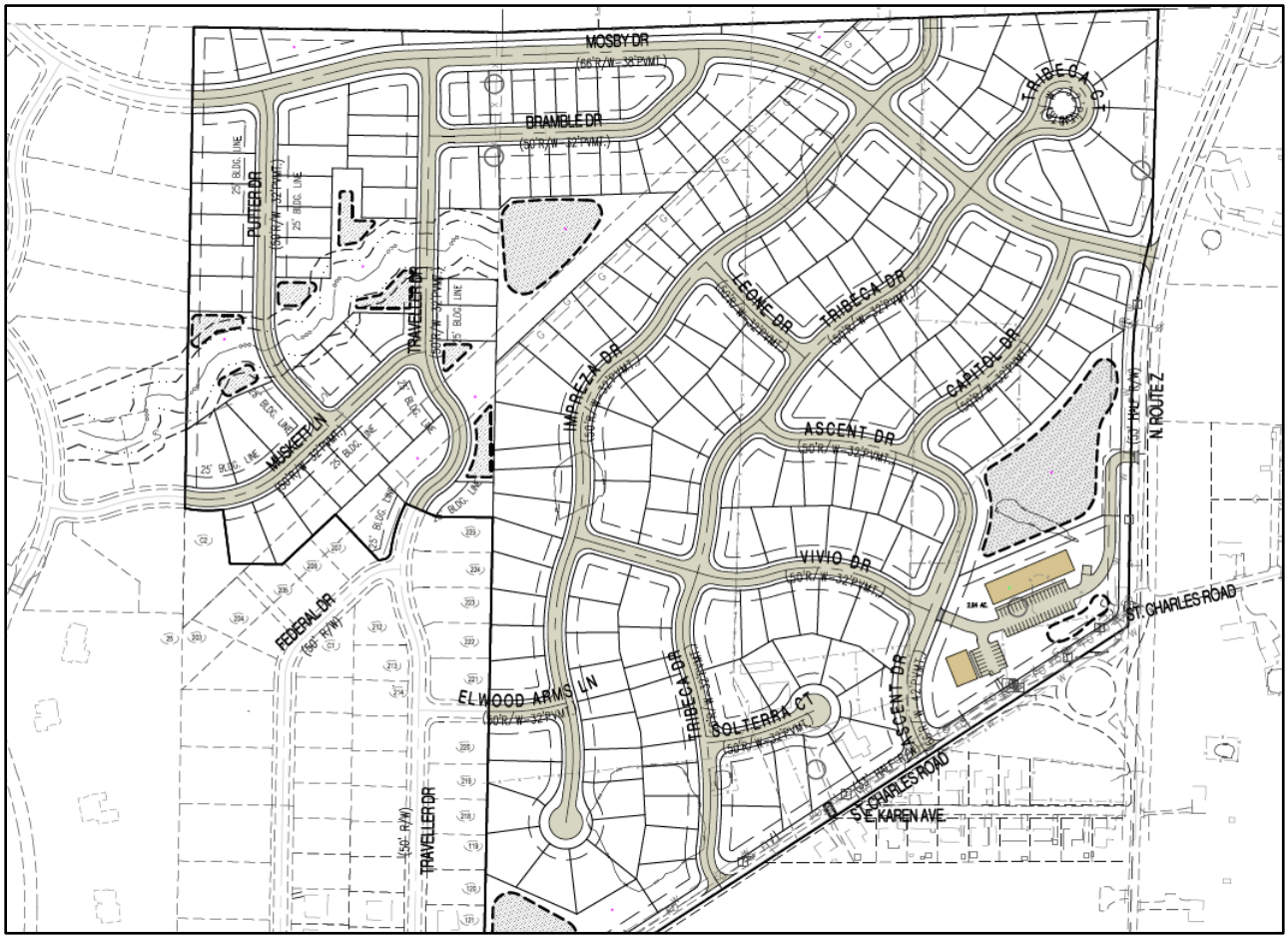

Figure 2: Concept Plan Excerpt (provided by others)

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 weekday AM, school dismissal and PM peak hours.

The following intersections were included in the study:

- Route Z and St. Charles Road;
- Route Z and East St. Charles Road;
- Route Z and proposed commercial drive;
- Route Z and proposed Mosby Drive;
- St. Charles Road and proposed Ascent Drive; and
- St. Charles Road and proposed Tribeca Drive.

The following analysis scenarios for the weekday peak hours were analyzed:

- 2024 Conditions
  - ✓ 2024 Base Conditions (Existing plus Willow Creek Plat 1 and 2 Trips)
  - ✓ 2024 Build (2024 Base plus Willow Creek East Trips plus Outlot Trips)

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

EXISTING CONDITIONS

Area Roadway System: St. Charles Road is a Major Collector roadway owned and maintained by Boone County near the subject site. St. Charles Road is a two-lane roadway that runs generally east-west through northeast Columbia. Battle High School and Battle Elementary School are located approximately one mile west of Route Z on St. Charles Road. The posted speed limit is 45 miles per hour (mph) adjacent to the proposed site. Neither sidewalks, nor bicycle facilities, are provided along the roadway. **Figure 3** depicts the typical cross section on St. Charles Road adjacent to the site.

Figure 3: St. Charles Road Cross Section Adjacent to Site

Route Z is a two-lane Major Arterial owned and maintained by the Missouri Department of Transportation (MoDOT) that runs north-south through the study area. Route Z consists of two 11-foot lanes with one and a half to two-foot shoulders. The posted speed limit is 55 mph. Sidewalks are not provided along the roadway. Route Z provides access to northern Boone County, terminating in Centralia; to the south, Route Z terminates at its interchange with I-70.

The intersection of St. Charles Road and Route Z is controlled by a single-lane roundabout, as depicted in **Figure 4.**

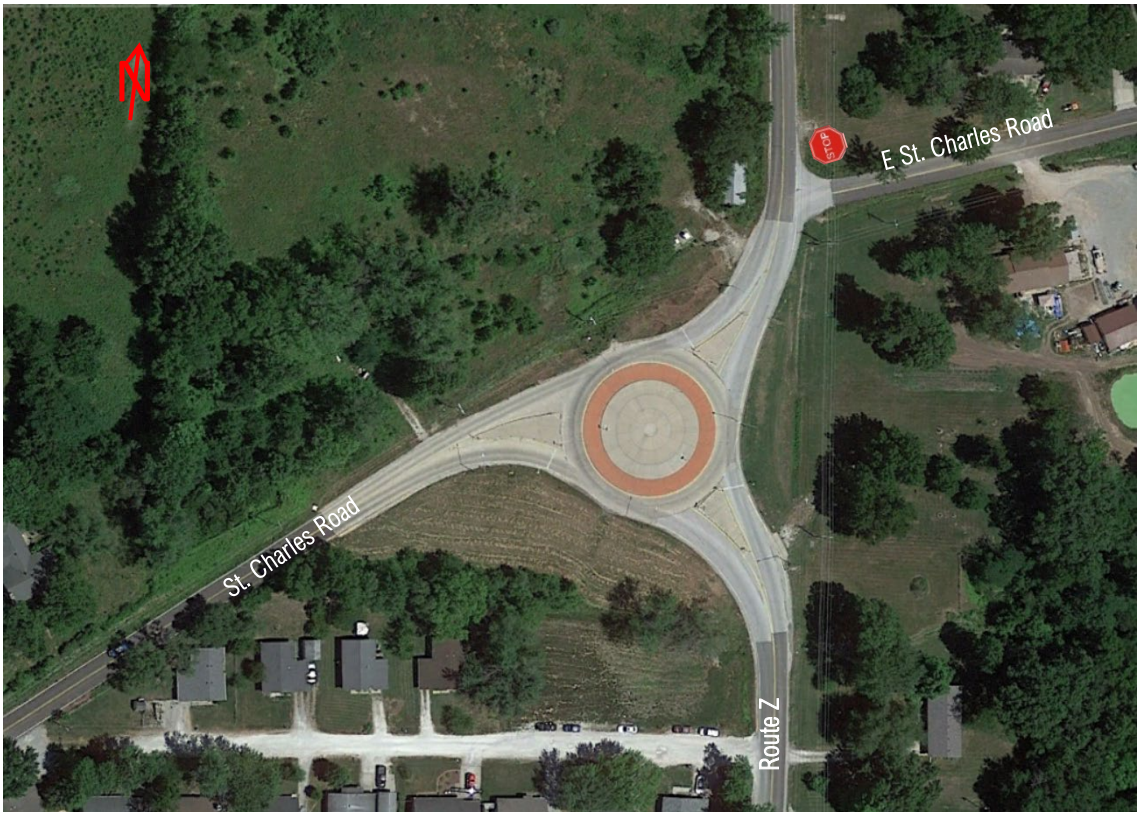

Figure 4: Route Z and St. Charles Road Intersection

Existing Traffic Volumes: Video, turning movement traffic counts were conducted at the following intersections during the weekday morning (6:00 - 9:00 a.m.) and weekday afternoon (2:00 - 6:00 p.m.) peak periods on Thursday, August 24, 2023:

- Route Z and St. Charles Road (roundabout); and
- Route Z and East St. Charles Road.

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. The existing peak hour traffic volumes are summarized in **Exhibit 1**. Based on the traffic data collected, the weekday morning peak hour occurred between 7:00 and 8:00 a.m. Since Battle High School has a later start/dismissal (8:55 a.m. to 4:05 p.m.), the school dismissal and PM peak hour occurred at the same time between 3:45 and 4:45 p.m.

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

Exhibit 1: Existing Traffic Volumes

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APPROVED DEVELOPMENT - WILLOW CREEK PLAT 1 AND 2

Approved Developments in Area: Based on information provided by the site engineer, there are approximately 25 homes still to be built within the Willow Creek Plat 1 and 2 subdivision, located just west of the proposed development site. As such, the site-generated trips for the additional 25 single-family homes were reflected in the 2024 Base scenario.

Traffic forecasts for the additional homes were developed using the *Trip Generation Manual*, 11th Edition, published by the Institute of Transportation Engineers (ITE) to determine the anticipated number of trips for the Willow Creek Plat 1 and 2 subdivision. The ITE manual, which is a standard resource for transportation engineers, is based on a compilation of nationwide studies documenting the trip generation characteristics of various land uses. Specifically, ITE Code 210 (Single Family Detached Housing) was utilized to determine trip generation estimates.

Forecasts were prepared to estimate the amount of traffic that the approved Willow Creek Plat 1 and 2 subdivision would generate during the weekday AM and PM peak hours based on the ITE data, see **Table 1**.

Table 1: Trip Estimate – Willow Creek Plat 1 and 2 Subdivision

Land Use (ITE Code)	Unit	ADT (VPD)	Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
Single Family Detached Housing (210)	25	282	5	16	21	17	10	27

The new trips for the Willow Creek Plat 1 and 2 subdivision were assigned in accordance with the existing travel patterns in the area as shown in **Exhibit 2**.

The trips associated with the Willow Creek Plat 1 and 2 subdivision (Exhibit 2) were added to the Existing Traffic Volumes (Exhibit 1) to develop the 2024 Base Traffic Volumes. **Exhibit 3** summarizes the 2024 Base Traffic Volumes which include the Willow Creek Plat 1 and 2 subdivision.

Exhibit 2: Willow Creek Plat 1 & 2 Trips (Build Out Approximately 25 Homes)

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Exhibit 3: Base Traffic Volumes

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PROPOSED SITE – WILLOW CREEK EAST

Proposed Land Use: Based on the concept plan provided by Crockett Engineering, the proposed Willow Creek East development will include approximately 196 single-family detached homes and 12 single-family attached homes on 6 lots. There is also a future commercial outlot shown in the northwest quadrant of the roundabout.

Site Access: In conjunction with the proposed development, a new collector roadway (Mosby Drive) would be constructed along the north side of the development that would tie into Route Z to the east and eventually Battle Avenue to the west though the timing of the west connection is unknown. Access for the residential portion of the development is proposed via two new drives on St. Charles Road (Tribeca Drive and Ascent Drive) and via the new collector road (Mosby Drive) on Route Z. In addition, stub streets are shown to connect to further development to the west and north. Access for the commercial outlot is proposed via a new drive on Route Z and via the eastern subdivision street (Ascent Drive).

Note that the sight distance was not measured in the field to evaluate the available sight distance at the proposed new roadways on St. Charles Road and on Route Z. It is recommended that the site civil engineer illustrate the necessary intersection sight distance triangles on the site plan for the proposed driveways. These areas should be kept clear of all obstructions to provide adequate visibility for safe operations.

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.

Willow Creek East Trip Generation: Forecasts were prepared to estimate the amount of traffic that the proposed residential 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 ITE. Although the proposed development would consist of a small number of attached single-family homes (i.e., 12 homes), estimates for the entire residential development were based on ITE Land Use 210 – Single Family Detached Housing which is a more conservative approach when considering trip generation. The peak hour of adjacent street traffic data (one hour between 7 and 9 a.m. and one hour between 4 and 6 p.m.) was utilized for the AM and PM peak hours, respectively.

The resulting trip generation estimate for the proposed Willow Creek East residential development is summarized in **Table 2**. As shown in the table, the proposed development is estimated to generate 145 trips during the weekday AM peak hour and 198 trips during the weekday PM peak hour.

Table 2: Trip Estimate – Proposed Willow Creek East Residential Development

Land Use (ITE Code)	Unit	ADT (VPD)	Weekday AM Peak Hour			Weekday PM Peak Hour		
			In	Out	Total	In	Out	Total
Single Family Detached Housing (210)	208	1,979	36	109	145	125	73	198

Willow Creek East Trip Distribution*:* The site-generated trips for the proposed Willow Creek East residential development were assigned into and out of the site based upon an assumed directional distribution. Based upon the existing travel patterns in the area, it is anticipated the distribution of site-generated trips would be as summarized in **Table 3.**

Table 3: Directional Distribution Assumptions – Willow Creek East Residential Development

Direction of Travel	Directional Distribution
To/from the north on Route Z	10%
To/from the south on Route Z	40%
To/from the west on St. Charels Road	50%

The site-generated trips for the proposed Willow Creek East residential development weekday AM and PM peak hours are shown in **Exhibit 4.**

Future Commercial Outlot Trip Generation: As mentioned previously, a portion of the overall development area, in the northwest quadrant of the roundabout at St. Charles Road and Route Z, is noted as future commercial. Forecasts were prepared to estimate the amount of traffic that the future commercial outlot might generate during the weekday AM and PM peak periods. These forecasts were based upon information provided in the *Trip Generation Manual*, 11th Edition.

Since a user has not been identified for the future commercial outlot, several possible uses suggested by the developer were considered including neighborhood retail, medical office and a daycare. Estimates for future commercial outlot were based upon the following possible land uses:

- Land Use 565 - Daycare
- Land Use 720 – Medical Office
- Land Use 822 – Retail Plaza

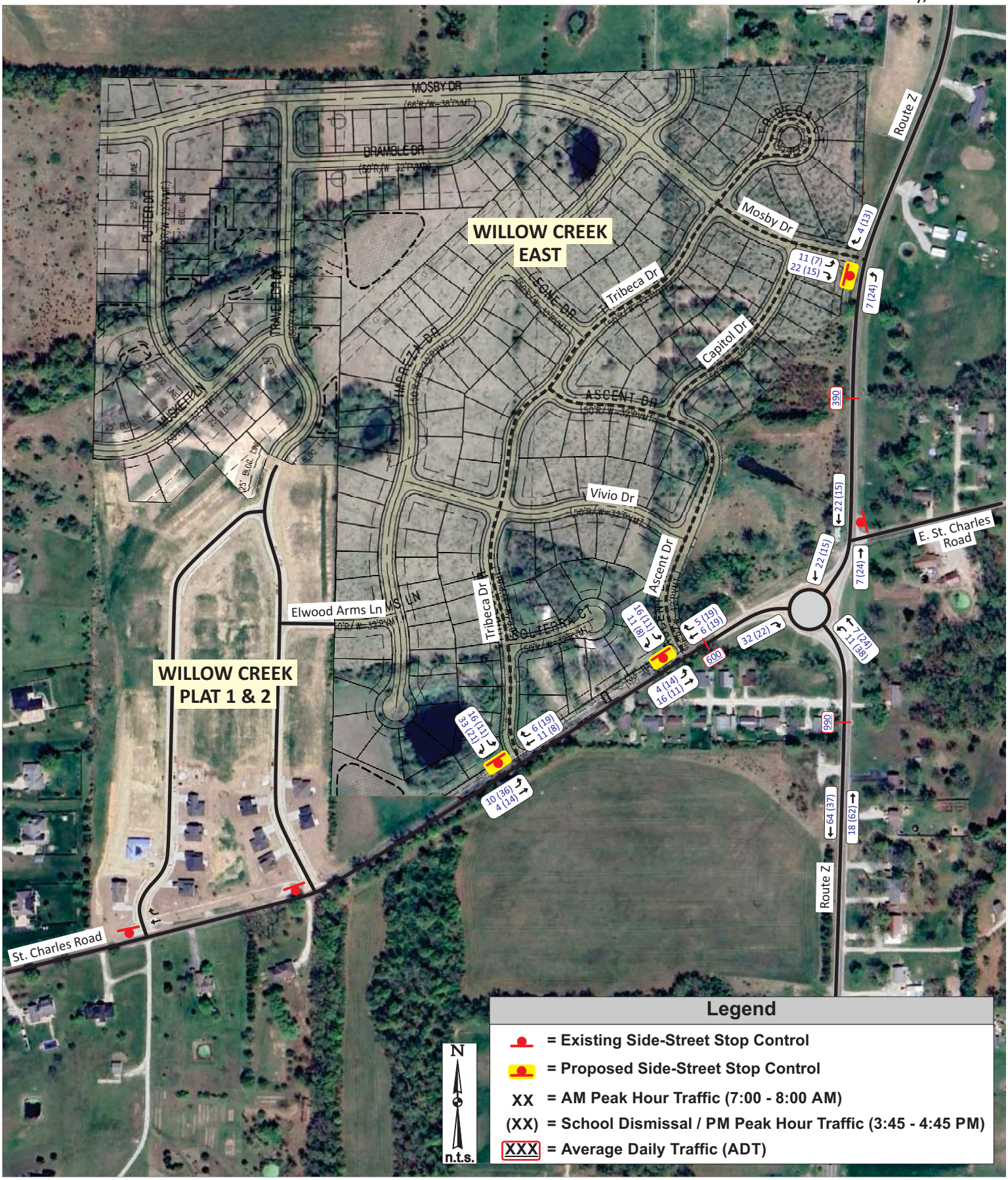

Exhibit 4: Site Generated Trips - Residential

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It should also be noted that not all of these trips would represent *new* traffic on the adjacent roadways. A portion of the traffic attracted to the commercial site would already be traveling on Route Z or St. Charles Road as part of another trip (i.e., "pass-by" trip). The pass-by trips would not increase traffic on the adjacent roadways, but they would increase the turning movements at the entrances. The actual percentage of traffic attributable to pass-by trips 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 development. Based on this data, a pass-by rate of 40% during the PM peak hour was used for the retail plaza, while a pass-by rate of 40% during the AM and PM peak hours was used for the daycare.

The resulting trip generation estimate for the potential future commercial outlot is summarized in **Table 4**.

Table 4: Trip Generation Estimate – Potential Future Commercial Outlot

ITE CODE	LAND USE	FLOOR AREA (SF)	MISC. Qty	MISC. Unit	ADT (VPD)	AM PEAK HOUR (VPH) IN	AM PEAK HOUR (VPH) OUT	AM PEAK HOUR (VPH) TOTAL	PM PEAK HOUR (VPH) IN	PM PEAK HOUR (VPH) OUT	PM PEAK HOUR (VPH) TOTAL
Potential User - Retail											
822	Strip Retail Plaza <40k	13,500			799	21	14	35	48	48	96
				Pass-By Trips (PM 40%)					19	19	38
				New Trips		21	14	35	29	29	58
Potential User - Office											
720	Medical / Dental Office	13,500			472	31	8	39	16	36	52
				New Trips		31	8	39	16	36	52
Potential User - Day Care											
565	Day Care Center		160	students	617	60	54	114	52	59	111
				Pass-By Trips (AM & PM 40%)		23	23	46	22	22	44
				New Trips		37	31	68	30	37	67

As shown, an assumed retail plaza would generate approximately 35 trips in the AM peak hour and 96 trips in the PM peak hour; an assumed medical office would generate approximately 39 trips in the AM peak hour and 52 trips in the PM peak hour; and an assumed daycare would generate approximately 114 trips in the AM peak hour and 111 trips in the PM peak hour. Given a daycare would generate the highest number of trips of the assumed uses, to be conservative, it was assumed that the outlot would be a daycare.

Future Commercial Outlot Trip Distribution*:* The site-generated trips for the future commercial outlot were assigned into and out of the site based upon an assumed directional distribution. Based upon the existing travel patterns in the area and proximity to area neighborhoods, it is anticipated the distribution of the new site-generated trips would be as summarized in **Table 5.**

Table 5: Directional Distribution Assumptions – Future Commercial Outlot

Direction of Travel	Directional Distribution
To/from the north on Route Z	30%
To/from the south on Route Z	20%
To/from the west on St. Charels Road	50%

The site-generated trips for the potential future commercial oulot for the weekday AM and PM peak hours are shown in **Exhibit 5.** Pass-by trips were assigned according to the existing traffic volumes on the adjacent roadways.

2024 Build Traffic Volumes: The proposed Willow Creek East residential site-generated trips (Exhibit 4) and potential future commercial oulot trips (Exhibit 5) were added to the Base Traffic Volumes (Exhibit 3) to determine the total volumes in the forecasted scenario. The forecasted, or 2024 Build, traffic volumes for the AM and PM peak hours are shown in **Exhibit 6.**

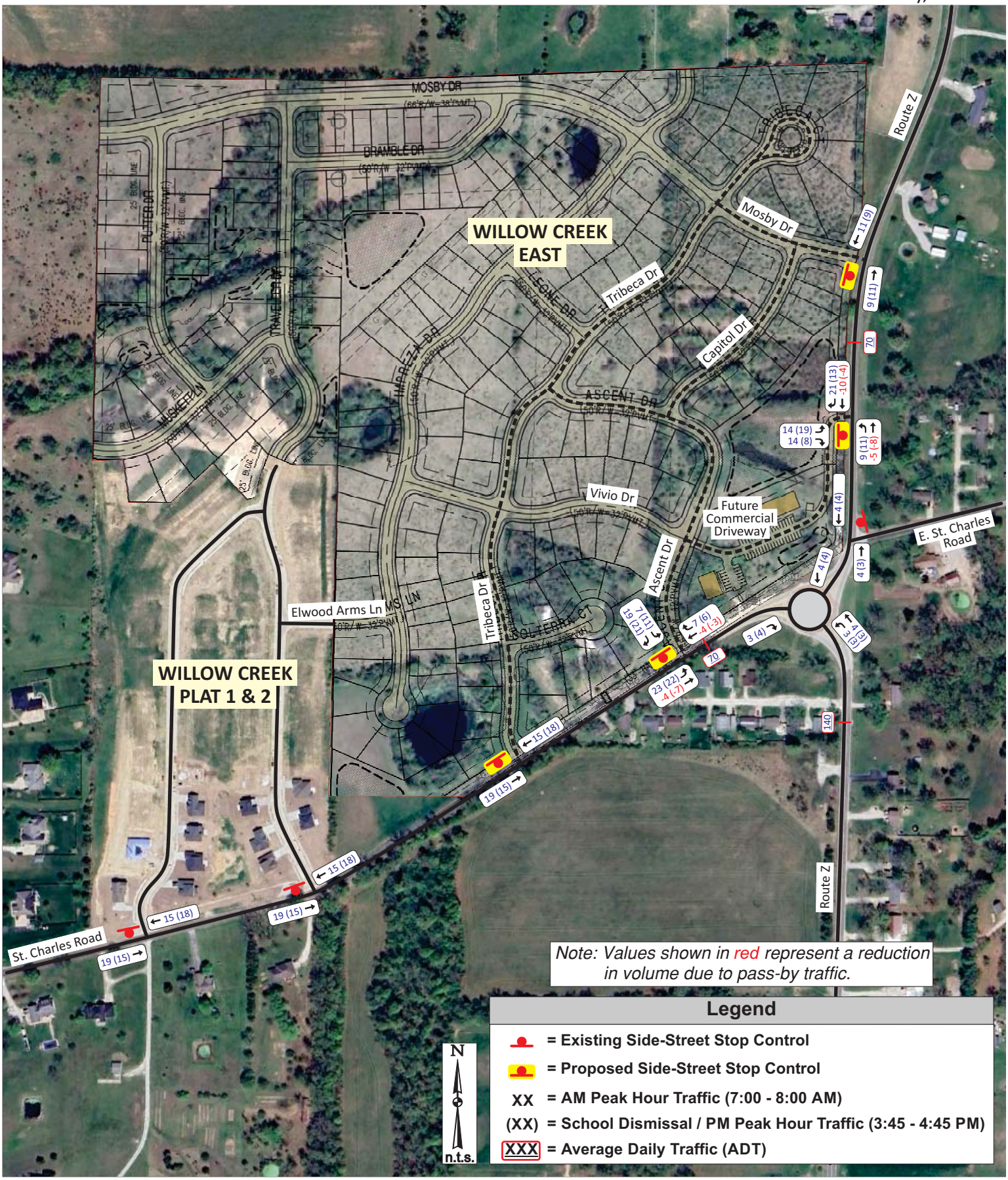

Exhibit 5: Site-Generated Trips - Future Commercial

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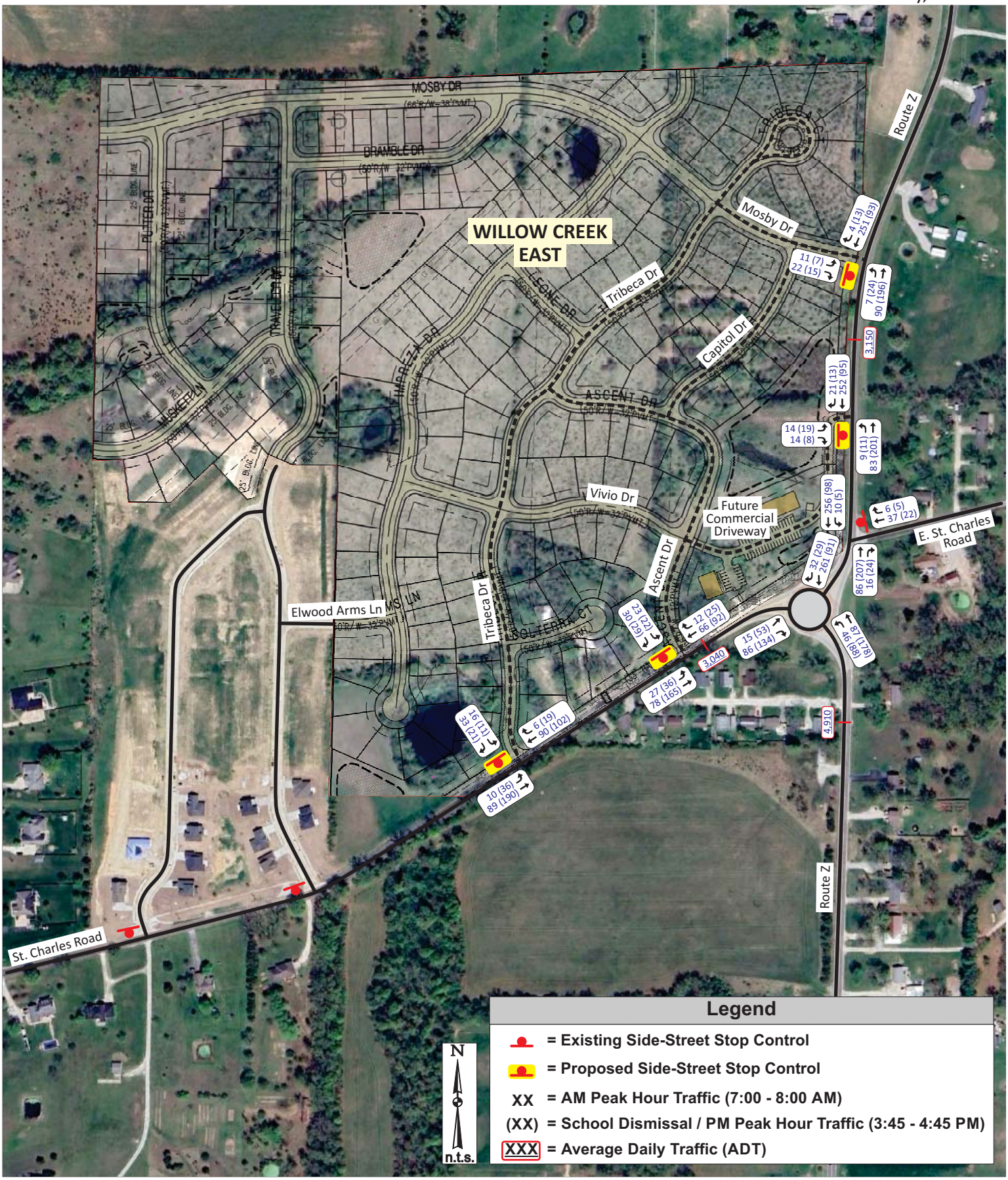

Exhibit 6: 2024 Build Traffic Volumes

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TRAFFIC ANALYSIS

2024 Build Auxiliary Left-Turn Lane Warrants: The need for eastbound left-turn lanes on St. Charles Road at the proposed Tribeca Drive and Ascent Drive site drives were evaluated using the Left-Turn Guidelines for Two-lane Roadway nomograph which is based on criteria using MoDOT's Engineering Policy Guide (EPG). The MoDOT EPG criteria provides guidelines for separate left-turn lanes on the through roadway by comparing the total advancing volume (which includes all turning traffic) to the total opposing volume (which includes opposing through and right-turn movements) during the design hour with respect to the number of mainline left-turns. Then, the percentage of left-turns is determined by dividing the number of left-turns by the total advancing volume. If the point lies to the right of the percentage line, then a left-turn lane should be considered. If the point is to the left of the line, then a left-turn lane is not necessary. Since the posted speed on St. Charles Road is 45 mph, the 50-mph graph was used.

Figures 5 and 6 graphically illustrate the eastbound left-turn evaluations at the proposed Tribeca Drive and Ascent Drive site drives, respectively, assuming the 2024 Build traffic volumes during the weekday AM and PM peak hours. As can be seen in the figures, given the low traffic volumes on St. Charles Road and the light turning movements, <u>separate eastbound left-turn lanes are not warranted on St. Charles Road at the proposed site drives.</u>

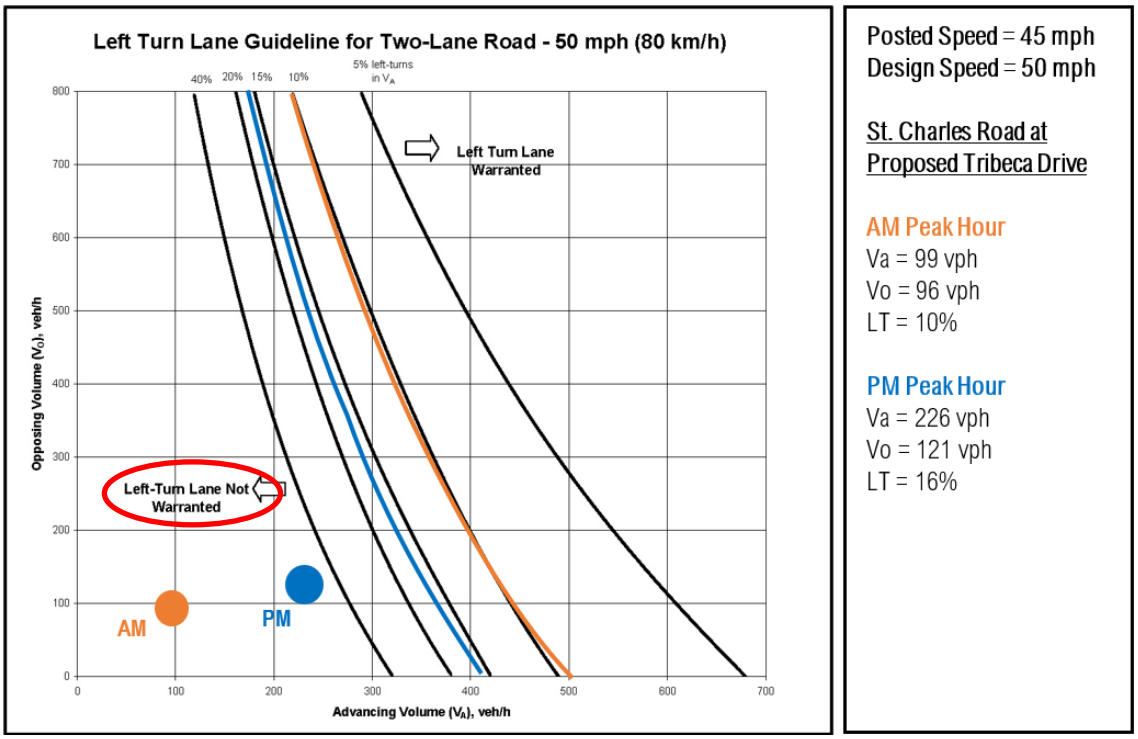


Figure 5: Eastbound St. Charles Road at Proposed Tribeca Drive Left-Turn Warrant – 2024 Build Conditions

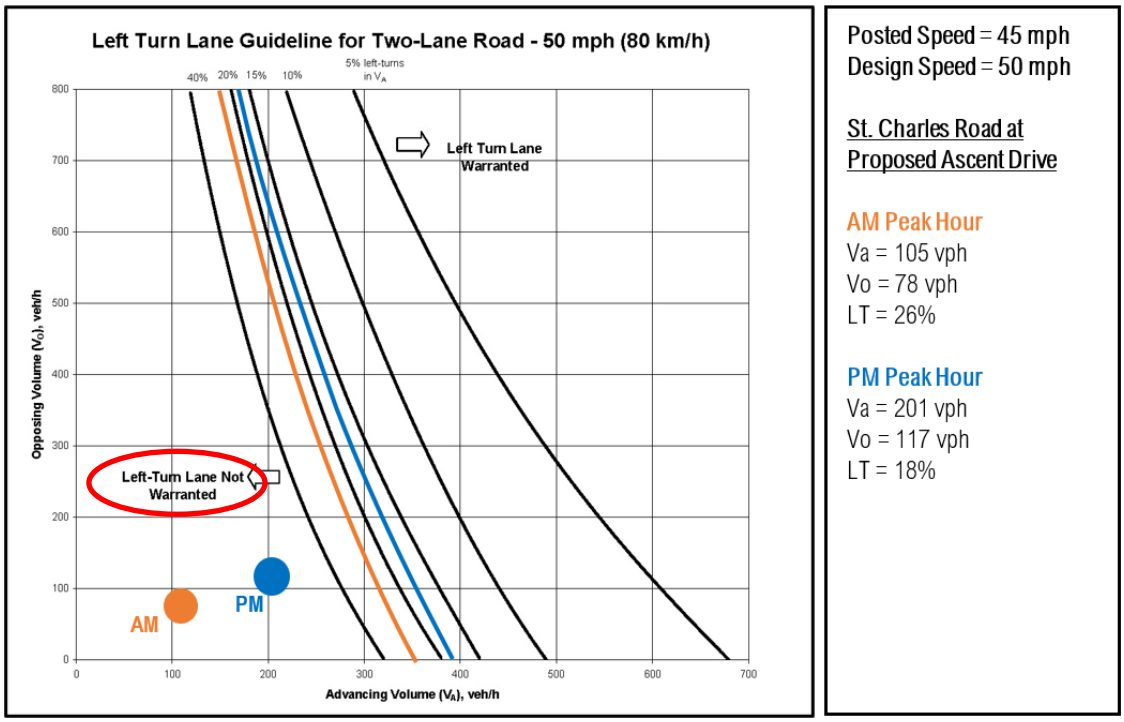
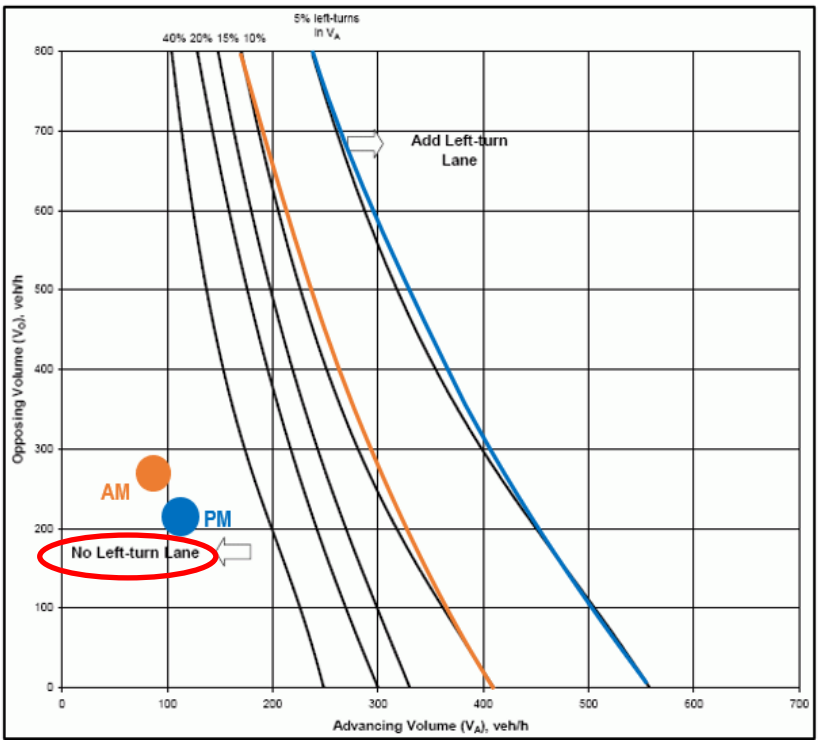


Figure 6: Eastbound St. Charles Road at Proposed Ascent Drive Left-Turn Warrant – 2024 Build Conditions

The same criteria from MoDOT's EPG was used to analyze the need for northbound left-turn lanes on Route Z at the future commercial drive and proposed Mosby Drive. However, since the posted speed limit on Route Z is 55 mph, the 60-mph graph was used for the left-turn lane analysis at these intersections.

Figures 7 and 8 graphically illustrate the northbound left-turn evaluations at the future commercial drive and Mosby Drive, respectively, assuming the 2024 Build traffic volumes during the weekday AM and PM peak hours. As can be seen in the figures, given the relatively low traffic volumes on Route Z and the light turning movements, separate northbound left-turn lanes are not warranted on Route Z at the proposed site drives.



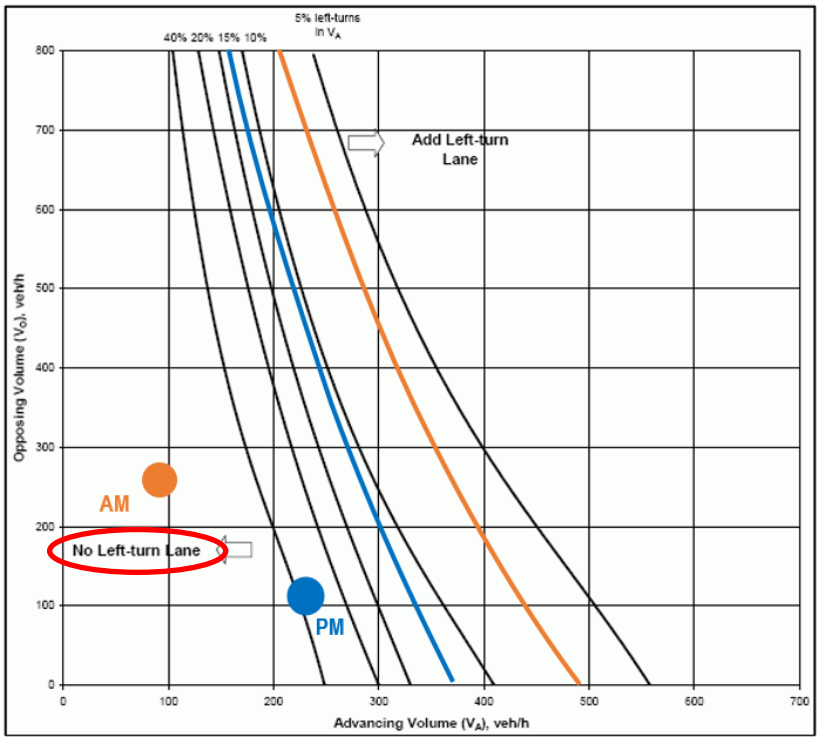
Posted Speed = 55 mph
Design Speed = 60 mph

Route Z at Proposed Commercial Drive

AM Peak Hour
Va = 92 vph
Vo = 273 vph
LT = 10%

PM Peak Hour
Va = 212 vph
Vo = 108 vph
LT = 5%

Figure 7. Northbound Route Z at Future Commercial Drive Left-Turn Warrant – 2024 Build Conditions



Posted Speed = 55 mph
Design Speed = 60 mph

Route Z at Proposed Mosby Drive

AM Peak Hour
Va = 97 vph
Vo = 255 vph
LT = 7%

PM Peak Hour
Va = 220 vph
Vo = 106 vph
LT = 11%

Figure 8. Northbound Route Z at Proposed Mosby Drive Left-Turn Warrant – 2024 Build Conditions

Auxiliary Right-Turn Lane Warrants: The need for westbound right-turn lanes on St. Charles Road at the proposed Tribeca Drive and Ascent Drive intersections were evaluated using the *Right-Turn Guidelines for Two-Lane Roadway* nomograph which is based on criteria from MoDOT's EPG criteria. The MoDOT EPG provides guidelines for separate right-turn lanes on the through roadway by comparing the total advancing volume (which includes all turning traffic) to the number of mainline right-turns. The operating speed (posted speed limit) of the major roadway is used to determine if a right-turn lane is warranted. If the point lies to the right of the operating speed line, then a right-turn lane should be considered. If the plotted point is to the left of the line, then a left-turn lane is not necessary. St. Charles Road has a posted speed of 45 mph, so the 50-mph graph line was used.

Figures 9 and 10 graphically illustrate the westbound right-turn evaluations at the proposed Tribeca Drive and Ascent Drive intersections, respectively, assuming the 2024 Build traffic volumes during the weekday AM and PM peak hours. As can be seen in the figures, given the low traffic volumes on St. Charles Road and the light turning movements, separate westbound right-turn lanes are not warranted on St. Charles Road at the proposed site drives.

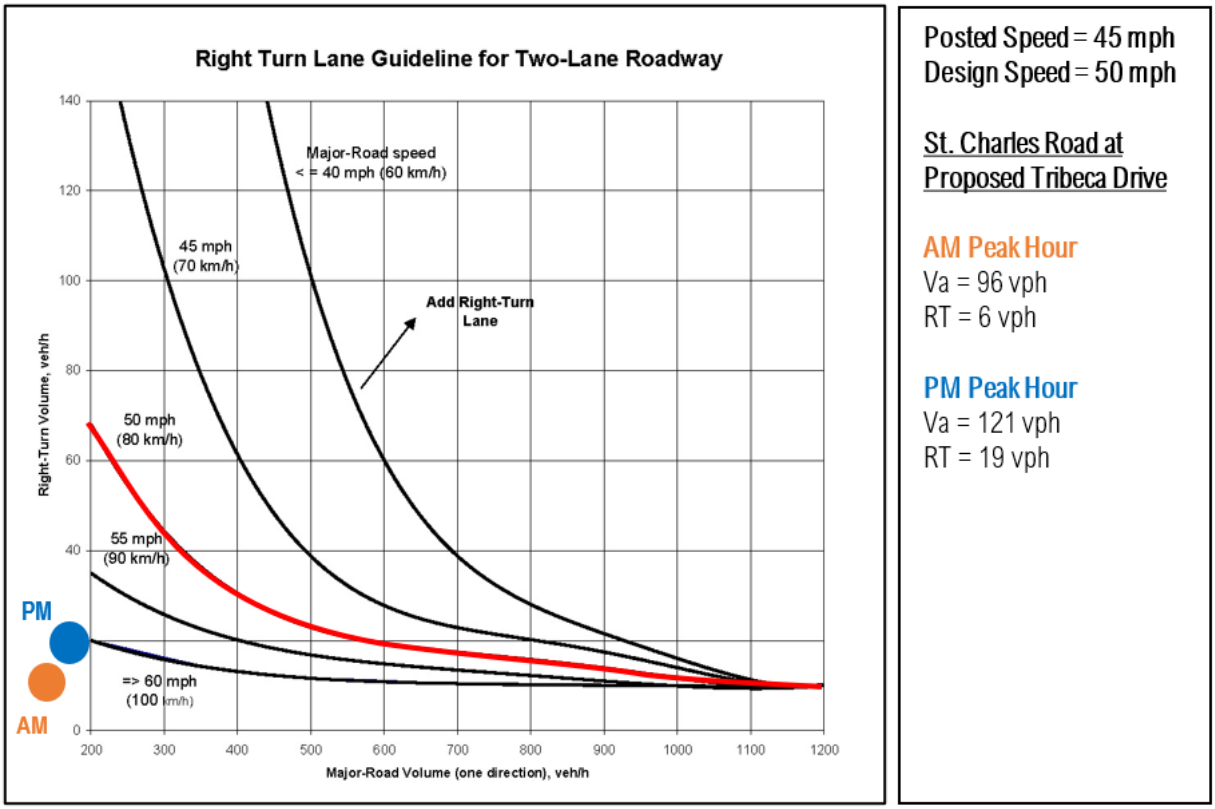
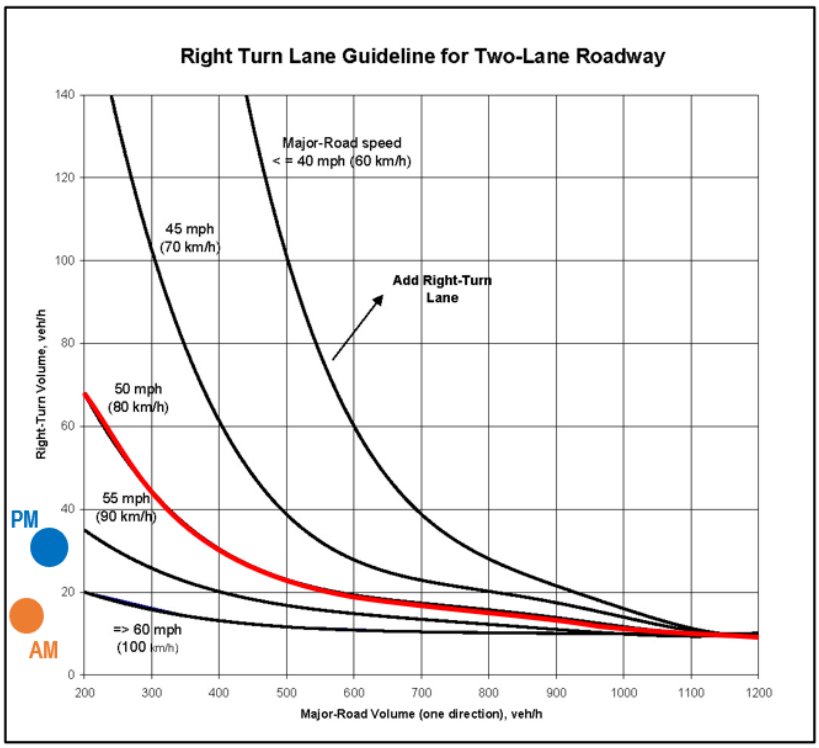


Figure 9: Westbound St. Charles Road at Tribeca Drive Right-Turn Warrant – 2024 Build Conditions



Posted Speed = 45 mph
Design Speed = 50 mph

St. Charles Road at
Proposed Ascent Drive

AM Peak Hour
Va = 78 vph
RT = 12 vph

PM Peak Hour
Va = 117 vph
RT = 25 vph

Figure 10: Westbound St. Charles Road at Ascent Drive Right-Turn Warrant – 2024 Build Conditions

The same criteria from MoDOT's EPG was used to analyze the need for southbound right-turn lanes on Route Z at the future commercial drive and proposed Mosby Drive. However, since the posted speed limit on Route Z is 55 mph, the 60 mph plot line was used for the right-turn lane analysis at these intersections.

Figures 11 and 12 graphically illustrate the southbound right-turn evaluations at the future commercial drive and Mosby Drive intersections, respectively, assuming the 2024 Build traffic volumes during the weekday AM and PM peak hours.

As shown, the southbound Route Z approach at Mosby Drive does not warrant consideration of a separate right-turn lane; however, the southbound Route Z approach at the proposed commercial drive is just above the threshold for consideration of a separate right-turn lane. However, the land use used to assign trips to this commercial development was an assumption using the higher trip generation of the potential uses, and is not necessarily what would be constructed. Given that the turn-lane warrant threshold was only met by about two (2) right turn movements from the commercial development, the need for this right turn lane should be re-evaluated once the actual land use for the commercial development is known considering that if the use is general retail or office the trip generation would be lower and a right-turn lane would not be warranted. In our opinion, a separate right-turn lane at the future commercial drive should not be a requirement at this time.

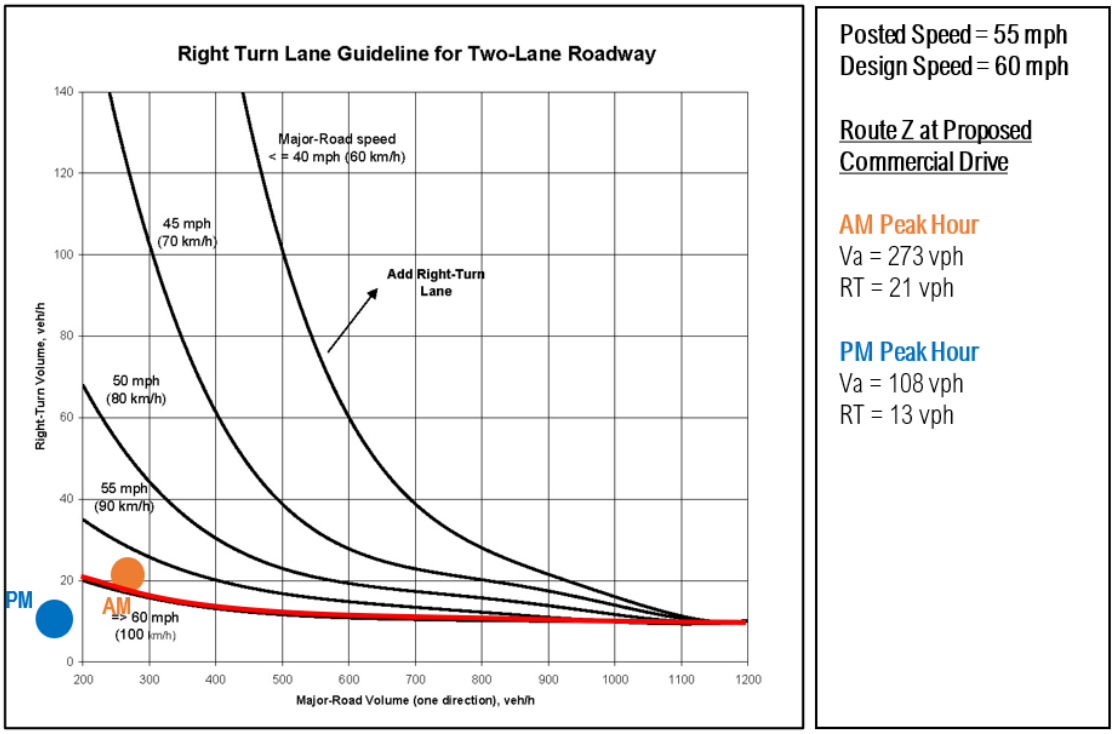


Figure 11: Southbound Route Z at Future Commercial Drive Right-Turn Warrant – 2024 Build Conditions

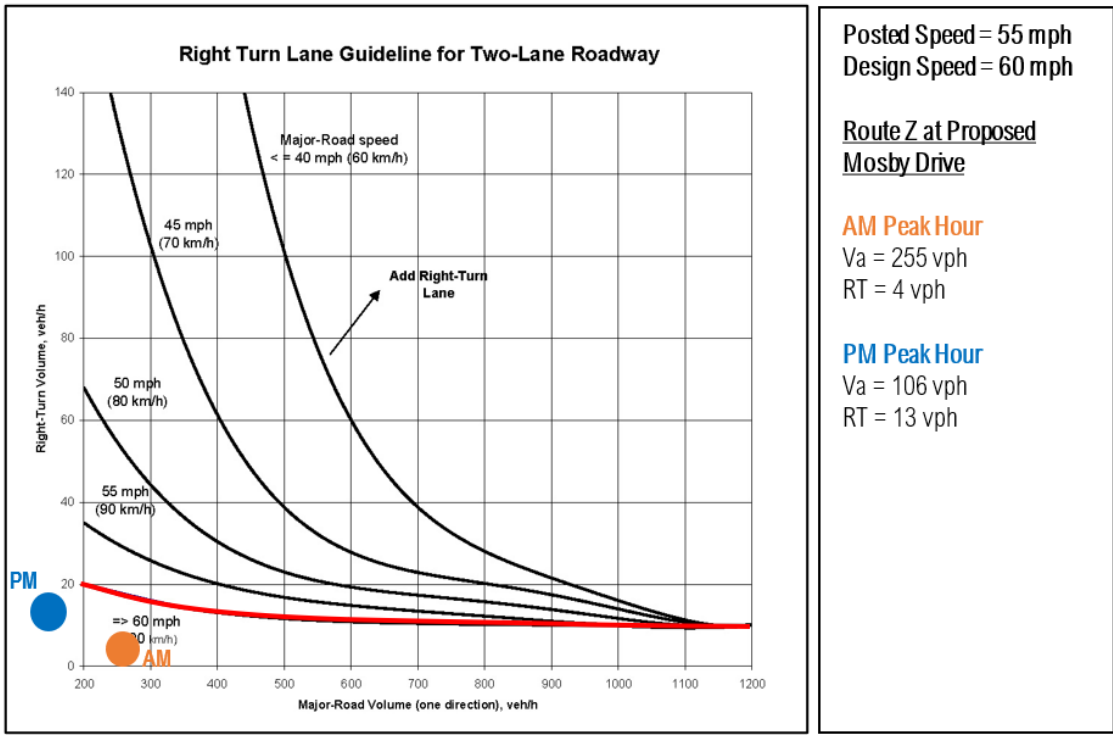


Figure 12: Southbound Route Z at Proposed Mosby Drive Right-Turn Warrant – 2024 Build Conditions

Study Procedures: The 2024 Base and Build operating conditions were analyzed using SYNCHRO 11, a macro-level analytical traffic flow model and SIDRA 9 for the roundabout. SYNCHRO and SIDRA are 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 typically 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 6** summarizes the thresholds used in the analysis for signalized and unsignalized intersections.

Table 6: 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 Operating Conditions: The intersections were evaluated using the methodologies described previously. **Table 7** summarizes the results of this analysis, which reflects the 2024 Base and Build operating conditions and average delay at the study intersection during the weekday AM and PM peak hours. The Synchro/Sidra estimated 95th percentile queue length for each approach is also shown in the table. The free-flow movements are not shown in the table.

Table 7: 2024 Capacity Analysis Summary

Intersection / Approach	Weekday AM Peak Hour		Weekday PM Peak Hour	
	2024 Base	2024 Build	2024 Base	2024 Build
Route Z and St. Charles Road (Roundabout)				
Eastbound St. Charles Road Approach	A (7.2) 95th Q: <25' v/c ratio: 0.101	A (7.1) 95th Q: <25' v/c ratio: 0.163	A (6.8) 95th Q: 35' v/c ratio: 0.244	A (6.8) 95th Q: 50' v/c ratio: 0.294
Northbound Route Z Approach	A (8.5) 95th Q: <25' v/c ratio: 0.102	A (8.8) 95th Q: <25' v/c ratio: 0.125	A (8.4) 95th Q: 30' v/c ratio: 0.204	A (9.1) 95th Q: 45' v/c ratio: 0.275
Southbound Route Z Approach	A (6.6) 95th Q: 35' v/c ratio: 0.245	A (6.7) 95th Q: 40' v/c ratio: 0.274	A (6.6) 95th Q: <25' v/c ratio: 0.101	A (6.9) 95th Q: <25' v/c ratio: 0.127
Overall	**A (7.1)**	**A (7.3)**	**A (7.4)**	**A (7.7)**
Route Z and East St. Charles Road (Side-Street Stop)				
Westbound East St. Charles Rd Approach	B (11.2) 95th Q: <25'	B (11.6) 95th Q: <25'	B (10.6) 95th Q: <25'	B (11.0) 95th Q: <25'
Southbound Route Z Left-Turn/Approach	A (<1.0) 95th Q: <25'	A (<1.0) 95th Q: <25'	A (<1.0) 95th Q: <25'	A (<1.0) 95th Q: <25'
Route Z and Future Commercial Outlot Drive (Side-Street Stop)				
Eastbound Commercial Drive Approach		B (11.0) 95th Q: <25'		B (10.6) 95th Q: <25'
Northbound Route Z Left-Turn/Approach		A (<1.0) 95th Q: <25'		A (<1.0) 95th Q: <25'
Route Z and Proposed Mosby Drive (Side-Street Stop)				
Eastbound Mosby Drive Approach		B (10.7) 95th Q: <25'		A (9.7) 95th Q: <25'
Northbound Route Z Left-Turn/Approach		A (<1.0) 95th Q: <25'		A (<1.0) 95th Q: <25'
St. Charles Road and Proposed Ascent Drive (Side-Street Stop)				
Eastbound St. Charles Rd Left-Turn/Approach		A (2.1) 95th Q: <25'		A (1.6) 95th Q: <25'
Southbound Ascent Drive Approach		A (9.9) 95th Q: <25'		B (10.5) 95th Q: <25'
St. Charles Road and Proposed Tribeca Drive (Side-Street Stop)				
Eastbound St. Charles Rd Left-Turn/Approach		A (<1.0) 95th Q: <25'		A (1.5) 95th Q: <25'
Southbound Tribeca Drive Approach		A (9.9) 95th Q: <25'		B (10.2) 95th Q: <25'

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, T-Thru, R-Right, TR-Thru/Right)

As shown in the table, all approaches at the study intersections operate at favorable levels of service (i.e., LOS B or better) during both peak hours for the 2024 Base conditions. All approaches to the study intersections would continue to operate at favorable levels of service

for the 2024 Build condition during peak hours with negligible differences in the forecasted delay as compared to the 2024 Base conditions.

Adequacy of Two-Lane Cross Section on St. Charles Road: As mentioned previously, St. Charles Road is classified as a Major Collector Roadway. The concept of functional classification defines the role that a particular roadway segment plays in serving the flow of traffic through a network. Roadways are assigned to one of several possible functional classifications within a hierarchy according to the character of travel service each roadway provides. As defined by the Federal Highway Administration (FHWA), the characteristics of an Urban Major Collector are as follows:

- Serve both land access and traffic circulation in higher density residential and commercial areas;
- Penetrate residential neighborhoods, often for significant distances;
- Distribute and channel trips between Local Roads and Arterials, usually over a distance greater then ¾ of a mile; and
- Operating characteristics often include higher speeds and more signalized intersections.

St. Charles Road, as a Major Collector, is designed to carry the traffic from the residential subdivisions along the roadway to the nearest arterial roadways.

The maximum Annual Average Daily (AAD) traffic volume was based upon information provided in the latest edition of the *Quality Level of Service Handbook.* The *Quality Level of Service Handbook* (QLOS) determines the capacity of a roadway based upon different variables such as the posted speed, urban versus rural roadway, and state versus local roadway using the *Highway Capacity Manual*. LOS is a measure of traffic flow which considers 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 generally considered acceptable for peak period conditions.

Based on the QLOS handbook, St. Charles Road has an AAD (Average Annual Daily) maximum capacity of 14,740 vehicles for non-state routes. In order to achieve LOS D, the AAD maximum is 13,990 vehicles for non-state routes.

Based on 2024 Build traffic volumes, St. Charles Road has an estimated daily traffic volume of just over 3,000 vehicles per day (vpd) east of Route Z which is much less than the estimated capacity of the roadway discussed above (i.e., 13,990 vpd). As such, the two-lane cross-section on St. Charles Road is appropriate.

Proposed Access on St. Charles Road for Potential Hardy Construction: As requested by the County, CBB reviewed the potential development of a contractor's office and storage yard for Hardy Construction on the south side of St. Charles Road near the subject site. In a Traffic Generation Report prepared by ESS, dated October 21, 2024, the construction company is estimated to generate 15 vehicles or less in the AM and PM peak hours. Specifically, at the site drive on St. Charles Road, the report estimates three or less turning vehicles for any given movement at the St. Charles Road site drive.

The construction company drive is located about 375 feet west of the proposed Willow Creek East residential access (Tribeca Drive). Given the low turning movements at the proposed construction company drive, the proposed spacing is adequate.

SUMMARY

CBB completed the preceding traffic impact study pertaining to a proposed development, referred to as Willow Creek East, generally located in the northwest quadrant of St. Charles Road and Route Z in Columbia, Missouri. The proposed Willow Creek East development will include approximately 196 single-family detached homes and 12 single-family attached homes on six lots. There is also a future commercial outlot shown in the northwest quadrant of the roundabout.

In conjunction with the proposed development, a new collector roadway (Mosby Drive) would be constructed along the north side of the development that would tie into Route Z to the east and eventually Battle Avenue to the west, though the timing of the west connection is unknown. Access for the residential portion of the development is proposed via two new drives on St. Charles Road (Tribeca Drive and Ascent Drive) and via the new collector road (Mosby Drive) on Route Z. Access for the future commercial outlot is proposed via a new drive on Route Z and via the eastern subdivision street (Ascent Drive)

In summary, the following findings should be considered in conjunction with the proposed Willow Creek East development:

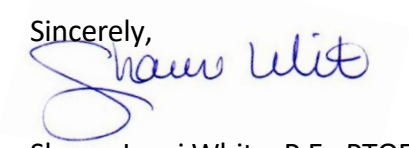
- The proposed residential development is estimated to generate 145 trips during the weekday AM peak hour and 198 trips during the weekday PM peak hour.
- Based on 2024 Build peak hour volumes, separate turn lanes are not warranted on either St. Charles Road or Route Z at the proposed residential site driveways.
- Based on 2024 Build peak hour volumes, the southbound Route Z approach at the proposed commercial drive is just above the threshold for consideration of a separate right-turn lane.
    - Note that the land use used to assign trips for this future commercial development was an assumption using the higher trip generation of the potential uses and is not necessarily what would be constructed. Given that the right-turn lane warrant threshold was only met by about two (2) right turn vehicles, the need for this right-turn lane should be re-evaluated once the actual land use for the commercial development is known considering that if the use is general retail or office the trip generation would be lower and a right-turn lane would not be warranted. *In our opinion, a separate right-turn lane at the future commercial drive should not be a requirement at this time*.
- All approaches at the study intersections operate at favorable levels of service (i.e., LOS B or better) during both peak hours for the 2024 Base conditions.
- All approaches to the study intersection would continue to operate at favorable levels of service for the 2024 Build conditions during peak hours with negligible differences in the forecasted delay as compared to the 2024 Base.

- It is recommended that the site civil engineer illustrate the necessary intersection sight distance triangles on the site plan for the proposed new roadways on St. Charles Road and on Route Z. These areas should be kept clear of all obstructions to provide adequate visibility for safe 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 drives to ensure that these improvements do not obstruct the view of entering and exiting traffic at the site drives on St. Charles Road and Route Z. 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 this traffic study adequately describes the forecasted traffic conditions that should be expected in the vicinity of the proposed Willow Creek East development in Boone County, Missouri. 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
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