

# TRAFFIC IMPACT STUDY

For

**Rhetoric Site  
El Paso County, Colorado**

June 2022

Prepared for:

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**Table of Contents**

**I. Introduction ..... 1**

    Project Overview..... 1

    Study Area Boundaries ..... 1

    Site Description..... 1

    Existing and Committed Surface Transportation Network.....5

**II. Existing Traffic Conditions ..... 7**

    Peak Hour Intersection Levels of Service – Existing Traffic.....9

    Existing Traffic Analysis Results .....9

**III. Future Traffic Conditions Without Proposed Development..... 10**

    Peak Hour Intersection Levels of Service – Background Traffic ..... 14

    Background Traffic Analysis Results – Year 2027 ..... 14

    Background Traffic Analysis Results – Year 2040 ..... 15

**IV. Proposed Project Traffic ..... 16**

    Trip Generation..... 16

    Adjustments to Trip Generation Rates ..... 17

    Trip Distribution..... 19

    Trip Assignment..... 19

**V. Future Traffic Conditions With Proposed Developments ..... 22**

**VI. Project Impacts ..... 25**

    Peak Hour Intersection Levels of Service – Total Traffic ..... 25

    Total Traffic Analysis Results Upon Development Build-Out ..... 26

**VII. Conclusion ..... 27**

**List of Figures**

Figure 1 – Location.....3  
Figure 2 – Conceptual Site Plan.....4  
Figure 3 – Existing Traffic Volumes & Intersection Geometry .....8  
Figure 4 – Background Traffic Volumes & Intersection Geometry – Year 2027.....12  
Figure 5 – Background Traffic Volumes & Intersection Geometry – Year 2040.....13  
Figure 6A – Distribution and Site-Generated Assignment – Year 2027 .....20  
Figure 6B – Distribution and Site-Generated Assignment – Year 2040.....21  
Figure 7 – Total Traffic Volumes & Intersection Geometry – Year 2027.....23  
Figure 8 – Total Traffic Volumes & Intersection Geometry – Year 2040.....24

**List of Tables**

Table 1 – Intersection Capacity Analysis Summary – Existing Traffic .....9  
Table 2 – Intersection Capacity Analysis Summary – Background Traffic – Year 2027 .....14  
Table 3 – Intersection Capacity Analysis Summary – Background Traffic – Year 2040 .....15  
Table 4 – Trip Generation Rates .....16  
Table 5 – Trip Generation Summary .....17  
Table 6 – Trip Generation Summary with Reductions .....18  
Table 7 – Intersection Capacity Analysis Summary – Total Traffic – Year 2027 .....25  
Table 8 – Intersection Capacity Analysis Summary – Total Traffic – Year 2040 .....26

**Appendices**

APPENDIX A           TRAFFIC COUNT DATA  
APPENDIX B           LEVEL OF SERVICE DEFINITIONS  
APPENDIX C           CAPACITY WORKSHEETS  
APPENDIX D           INTERNAL CAPTURE WORKSHEETS

## I. Introduction

### Project Overview

This traffic impact study is provided as a planning document and addresses the capacity, geometric, and control requirements associated with the development entitled Rhetoric Site.

This proposed mixed-use development consists of various conceptual land uses including multifamily residential, and commercial businesses. The development is located near the southeast corner of the intersection of Vollmer Road with Tahiti Drive in El Paso County, Colorado.

### Study Area Boundaries

The study area to be examined in this analysis encompasses Vollmer Road near the existing intersection with Tahiti Drive and future Marksheffel Road as well as proposed site accesses.

Figure 1 illustrates location of the site and study intersections.

### Site Description

Land for the development is currently vacant and surrounded by a mix of commercial, residential, and open space land uses.

The proposed development is conceptual and specific land uses are subject to change. However, for purposes of this analysis, there is assumed to be construction for approximately 504 multifamily dwelling units, an approximate 55,800 square foot self-storage facility, 23,500 square feet of retail plaza, a gas station supporting 14 vehicle fueling positions, an approximate 2,000 square foot coffee/donut shop with drive-through window, and an automated car wash with one car wash tunnel. It is to be noted that land use densities indicated are estimated based on a typical Floor Area Ratio (FAR) of 0.2 in relation to the known acreage allocated to each land use at this time.

Proposed primary access to the development is provided at the following locations: one full-movement access onto Vollmer Road (referred to as Business Drive), one right-in/right-out access onto future Marksheffel Road (referred to as Business Drive), and one full-movement access onto future Marksheffel Road serving as the southern leg of the intersection of Marksheffel Road with future Sterling Ranch Road.

Additional access to specific development areas may be provided, however given the conceptual nature of the site, these access locations are subject to change and therefore were not considered within this analysis. This provides for a conservative analysis.

Development construction is likely to be phased; however, specific phasing details are undefined at this time. For purposes of this study, it is anticipated that development build-out would be completed by end of Year 2027.

General site and access locations are shown on Figure 1.

A conceptual site plan, as prepared by NES Inc., is shown on Figure 2. This plan is provided for illustrative purposes only.





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**RHETORIC SITE**  
Traffic Impact Study

**Figure 1**  
SITE LOCATION

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Page 3







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Include exhibit showing distances between accesses.

Traffic calming may be necessary on Business Drive. Can be examined during Preliminary Plan submittal

Are these accesses Full or R In/R Out? It not likely full movements will be allowed at both.

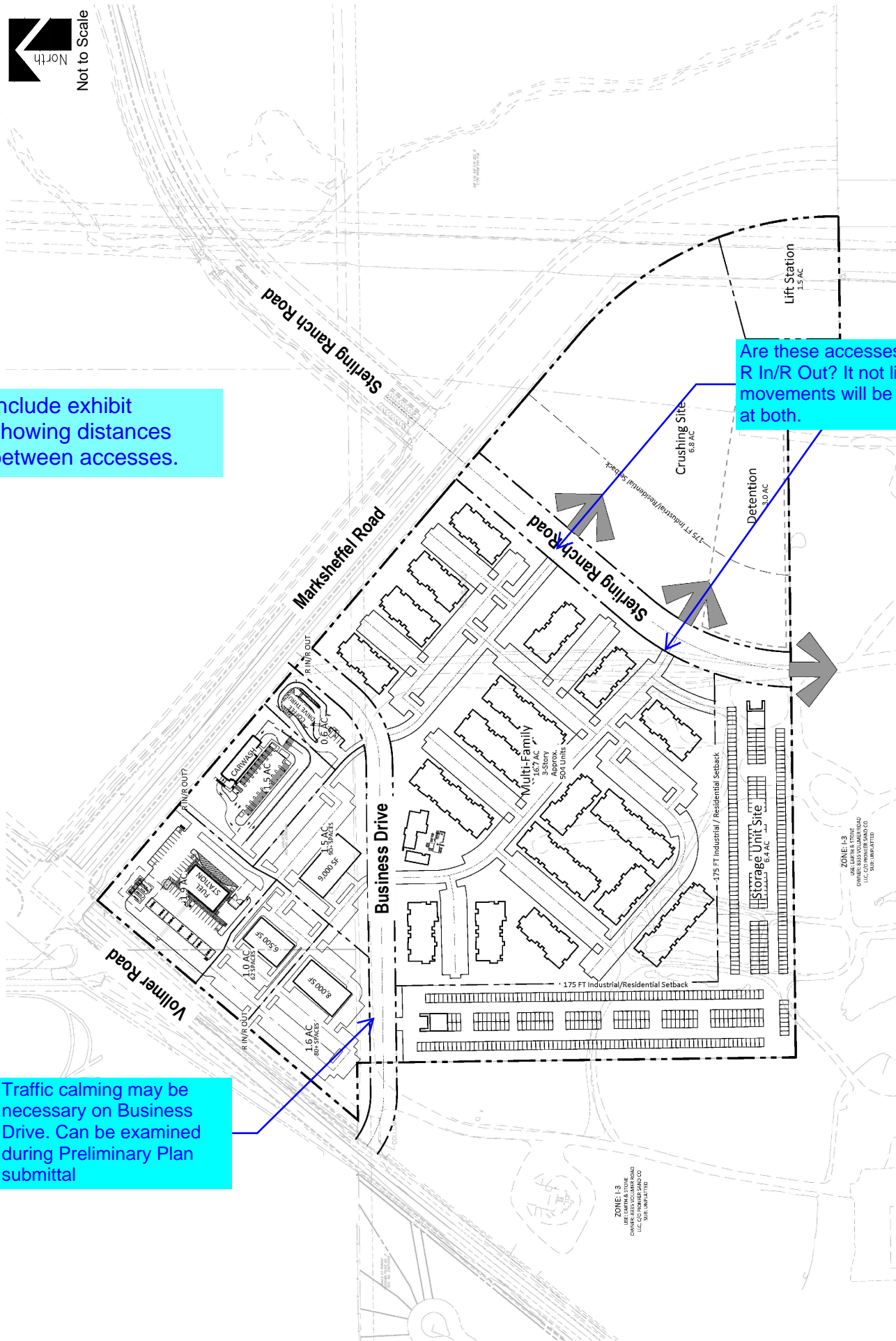


Figure 2  
CONCEPTUAL SITE PLAN



## Existing and Committed Surface Transportation Network

Within the study area, Vollmer Road is the primary roadway that will accommodate traffic to and from the proposed development. The secondary roadways include Tahiti Drive, Marksheffel Road, and Sterling Ranch Road. A brief description of each roadway, based on the County's 2040 Major Transportation Corridors Plan (MTCP)<sup>1</sup> and Engineering Criteria Manual (ECM)<sup>2</sup>, is provided below:

Vollmer Road is a north-south rural roadway having two through lanes (one lane in each direction) with shared turn lanes at the intersection within the study area. Vollmer Road provides a posted speed limit of 45 MPH. Pursuant to the County's MTCP it is understood that Vollmer Road is envisioned to be a minor arterial roadway with four through lanes upon build-out.

Tahiti Drive is a north-south rural unpaved roadway having two through lanes (one lane in each direction) with shared turn lanes at the intersection within the study area. Tahiti Drive is unclassified in County's MTCP. However, per Standard Drawing 2-10 of the County ECM and the roadway's estimated ROW width, Tahiti Drive is assumed to be classified as a local roadway with a posted speed limit of 45 MPH. It is anticipated that Tahiti Drive will be closed as development build-out occurs within the surrounding area to allow for construction of Marksheffel Road to the east and west of Vollmer Road.

Marksheffel Road is a future east-west principal arterial roadway having a build-out cross-section of six through lanes (three lanes in each direction) with exclusive turn lanes at intersections within the study area pursuant to the County's MTCP. Marksheffel Road is anticipated to provide a posted speed limit of 45 MPH based on the County ECM. It is understood that ownership and maintenance of Marksheffel Road will be assumed by the City of Colorado Springs and specific design requirements are therefore to be pursuant to the City's engineering standards and specifications. For analysis purposes, and in order to remain consistent with assumptions made in previously approved traffic reports within the area, it is assumed that Marksheffel Road will be constructed as a four-lane roadway ending at Vollmer Road by Year 2027. It is uncertain as to when build-out for Marksheffel Road to six through lanes may occur depending on continued area development. Therefore, Year 2040 analysis conditions assume Marksheffel to remain a four-lane roadway and will be extended west of Vollmer Road. This assumption provides for a conservative analysis.

Sterling Ranch Road is a future north-south collector roadway having two through lanes (one lane in each direction) with exclusive turn lanes at the intersection within the study area. Sterling Ranch Road is anticipated to provide a posted speed limit of 35 MPH based on the County ECM. Year 2027 and Year 2040 background analysis conditions assume that Sterling Ranch Road will be constructed upon adjacent development build-out and will end at Marksheffel Road. Extension of Sterling Ranch Road south of Marksheffel Road is anticipated to occur upon proposed development site build-out.

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<sup>1</sup> El Paso County 2016 Major Transportation Corridors Plan Update, Felsburg Holt & Ullevig, December 2016.

<sup>2</sup> El Paso County Engineering Criteria Manual, El Paso County, December 2016.



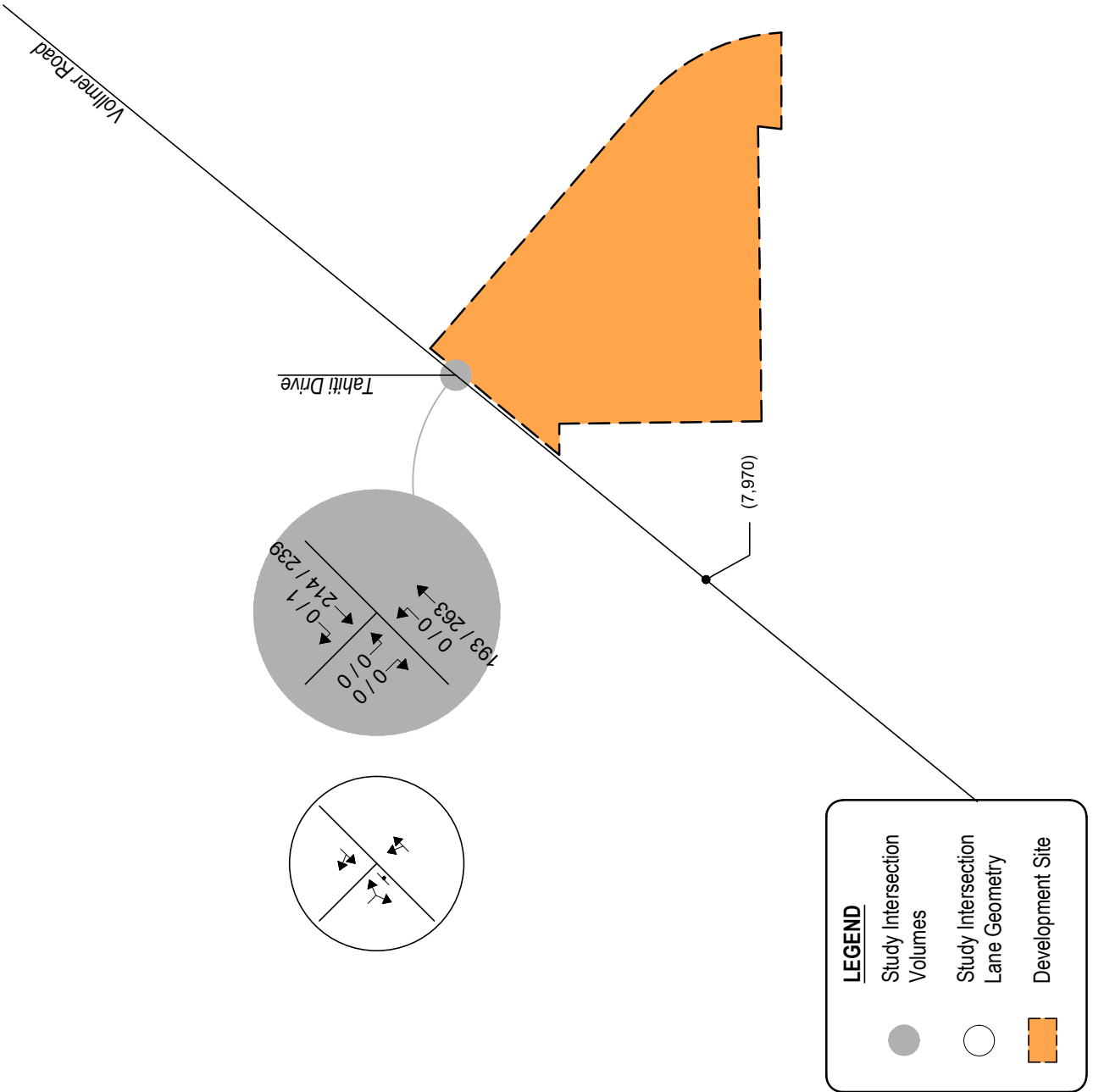
Existing study intersections operate under a stop-controlled condition. A stop-controlled intersection is defined as a roadway intersection where vehicle rights-of-way are controlled by one or more “STOP” signs. It is however understood that the future intersections of Marksheffel Road with Vollmer Road and Sterling Ranch Road will be signalized upon surrounding area build-out or when signal warrants are met. For analysis purposes signalization is assumed to occur by Year 2040.

## II. Existing Traffic Conditions

Morning (AM) and afternoon (PM) peak hour traffic counts were collected at the intersection of Vollmer Road with Tahiti Drive. Counts were collected on March 24, 2022, with AM peak hour counts being collected during the period of 7:00 a.m. to 9:00 a.m. and PM peak hour counts being collected during the period of 4:00 p.m. to 6:00 p.m.

Average daily traffic (ADT) 24-hour traffic volumes shown for Vollmer Road were obtained from the City of Colorado Springs Web Mapping Application Traffic Counts data map.

Collected and referenced counts representing existing traffic volumes and existing intersection geometry are shown on Figure 3. Traffic count data is included for reference in Appendix A.



**Figure 3**  
**EXISTING TRAFFIC**  
Volumes & Intersection Geometry  
AM / PM Peak Hour  
(ADT) : Average Daily Traffic

### Peak Hour Intersection Levels of Service – Existing Traffic

The Signalized and Unsignalized Intersection Analysis techniques, as published in the Highway Capacity Manual (HCM), 6<sup>th</sup> Edition, by the Transportation Research Board and as incorporated into the SYNCHRO computer program, were used to analyze the study intersections for existing and future traffic conditions. These nationally accepted techniques allow for the determination of intersection level of service (LOS) based on the congestion and delay of each traffic movement.

Level of service is a method of measurement used by transportation professionals to quantify a driver's perception of travel conditions that include travel time, number of stops, and total amount of stopped delay experienced on a roadway network. The HCM categorizes level of service into a range from "A" which indicates little, if any, vehicle delay, to "F" which indicates a level of operation considered unacceptable to most drivers. These levels of service grades with brief descriptions of the operating condition, for unsignalized and signalized intersections, are included for reference in Appendix B and have been used throughout this study.

The level of service analyses results for existing conditions are summarized in Table 1.

Intersection capacity worksheets developed for this study are provided in Appendix C.

**Table 1 – Intersection Capacity Analysis Summary – Existing Traffic**

INTERSECTION LANE GROUPS	LEVEL OF SERVICE	
	AM PEAK HOUR	PM PEAK HOUR
Vollmer Road / Tahiti Drive (Stop-Controlled)		
Northeastbound Left and Through	A	A
Southbound Left and Right	A	A

Key: Stop-Controlled Intersection: Level of Service

### Existing Traffic Analysis Results

Under existing conditions, operational analysis shows that the unsignalized intersection of Vollmer Road with Tahiti Drive has turning movement operations at LOS A during both the morning and afternoon peak traffic hours.

### III. Future Traffic Conditions Without Proposed Development

Background traffic is the traffic projected to be on area roadways without consideration of the proposed development. Background traffic includes traffic generated by development of vacant parcels in the area.

To account for projected traffic from adjacent developments not yet built, Year 2027 and Year 2040 background traffic conditions utilize estimated peak hour and 24-hour daily traffic volumes from the approved traffic study prepared for Sterling Ranch Filing No. 2 and Sterling Ranch Phase 2<sup>3</sup>, as provided by the County's Electronic Development Application Review Program (EDARP). This referenced traffic study includes traffic generation for the surrounding development area as analyzed by LSC Transportation Consultants, Inc. including, but not limited to, the following previously prepared traffic analyses:

- Sterling Ranch Traffic Impact Study, June 2008.
- Sterling Ranch Phase 1, March 2015.
- Branding Iron at Sterling Ranch Filing No. 1 and Homestead at Sterling Ranch Filing No. 1, December 2017.
- Sterling Ranch Phase 2 Preliminary Plan, December 2018.
- Sterling Ranch Filing No. 2, April 2018.
- Sterling Ranch Phase 2, December 2018.
- Copper Chase at Sterling Ranch, December 2018.
- Homestead at Sterling Ranch Filing No. 2, March 2020
- Branding Iron at Sterling Ranch Filing No. 2, May 2020.
- Homestead North Phase 1, August 2020.

Include reference to report for Sterling Ranch East Minor Plan Amend (SKP224) & Preliminary Plan (SP224)

Total traffic volumes as defined in Figures 20 and 21 of the 2021 Sterling Ranch traffic report were used to define background traffic conditions for purposes of this analysis. It is noted that Figure 20 presents total traffic volumes for Year 2025, and therefore in order to represent Year 2027 background traffic conditions, a compounded annual growth rate was applied to these volumes in order to account for additional increases in traffic volumes due to ongoing development within the area. Using population growth estimates provided by the Pikes Peak Area Council of Governments' (PPACG) 2045 Long Range Transportation Plan<sup>4</sup>, an assumed annual growth rate of two percent was applied to the Year 2025 traffic volumes which were then grown to Year 2027.

<sup>3</sup> Sterling Ranch Filing No. 2 and Sterling Ranch Phase 2 Traffic Impact Study, LSC Transportation Consultations, Inc. June 2021.

<sup>4</sup> Moving Forward 2045: Pikes Peak Area Regional Transportation Plan, PPACG, January 2020.



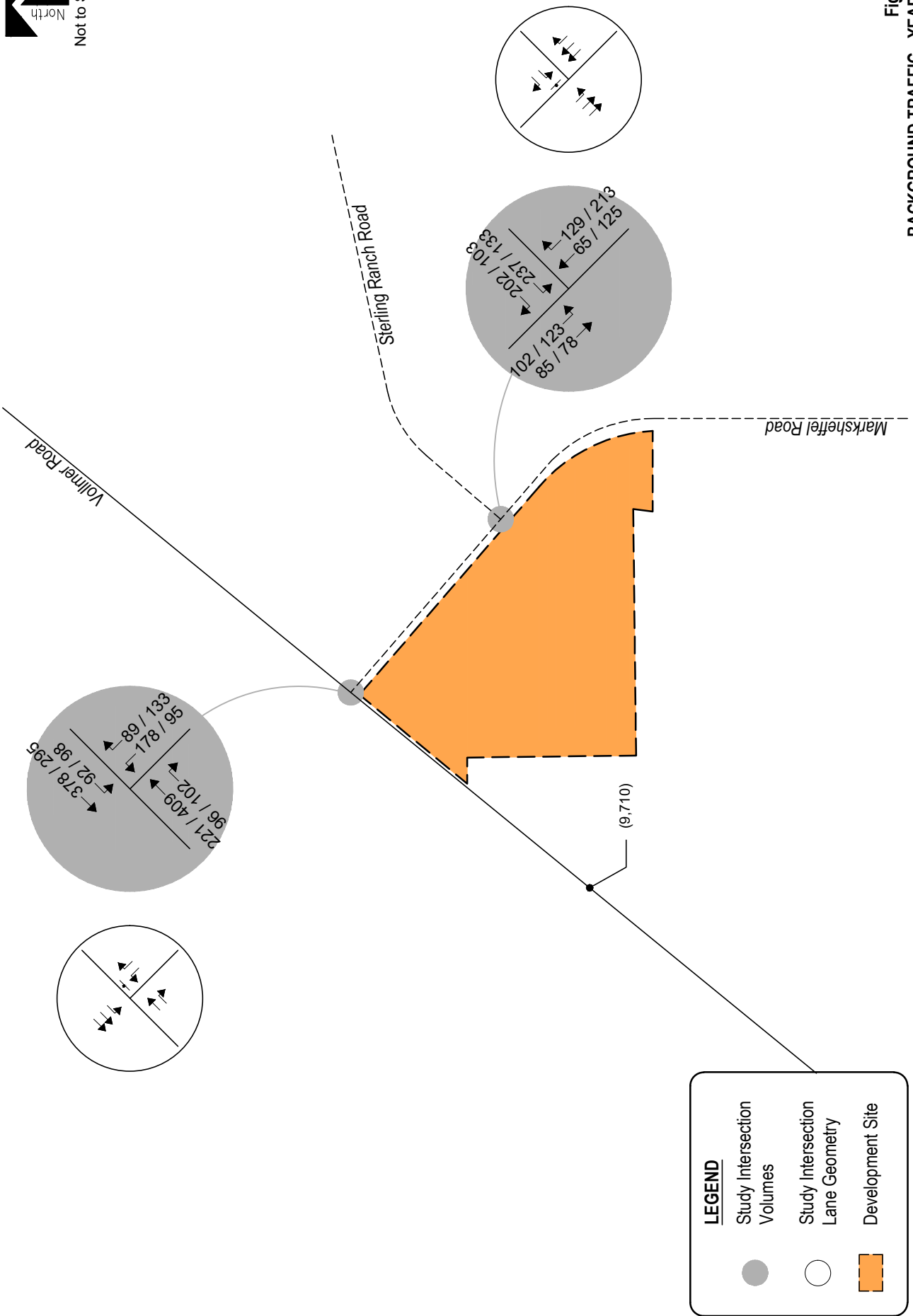
Pursuant to the proposed and committed area roadway improvements discussed in Section I, Year 2027 background traffic conditions assume the completion of Marksheffel Road east of Vollmer Road and Sterling Ranch Road north of Marksheffel Road. For analysis purposes, and to remain consistent with intersection geometry assumptions utilized in previous traffic reports, study intersections were analyzed as stop-controlled conditions. Vollmer Road is assumed to be widened in the southbound direction to provide two through lanes and the Tahiti Drive intersection is anticipated to be closed with existing traffic volumes utilizing alternative routes to the north.

Year 2040 background traffic conditions assume the completion of Marksheffel Road to the west of Vollmer Road, and the intersection of Marksheffel Road with Vollmer Road and Sterling Ranch Road are assumed to be signalized. Widening of Vollmer Road to provide four through lanes (two lanes in each direction) is also assumed.

State whether S.R.R. south of Marksheffel is constructed or not.

Future Year 2040 signal timing parameters for the intersections of Marksheffel Road with Vollmer Road and Sterling Ranch Road were assumed based on the possible signal head configuration and allowable movements, and pursuant to typical signal timing data described within the County's ECM. Timings were used throughout this study to the best extent possible in order to remain consistent with typical County signal coordination plans.

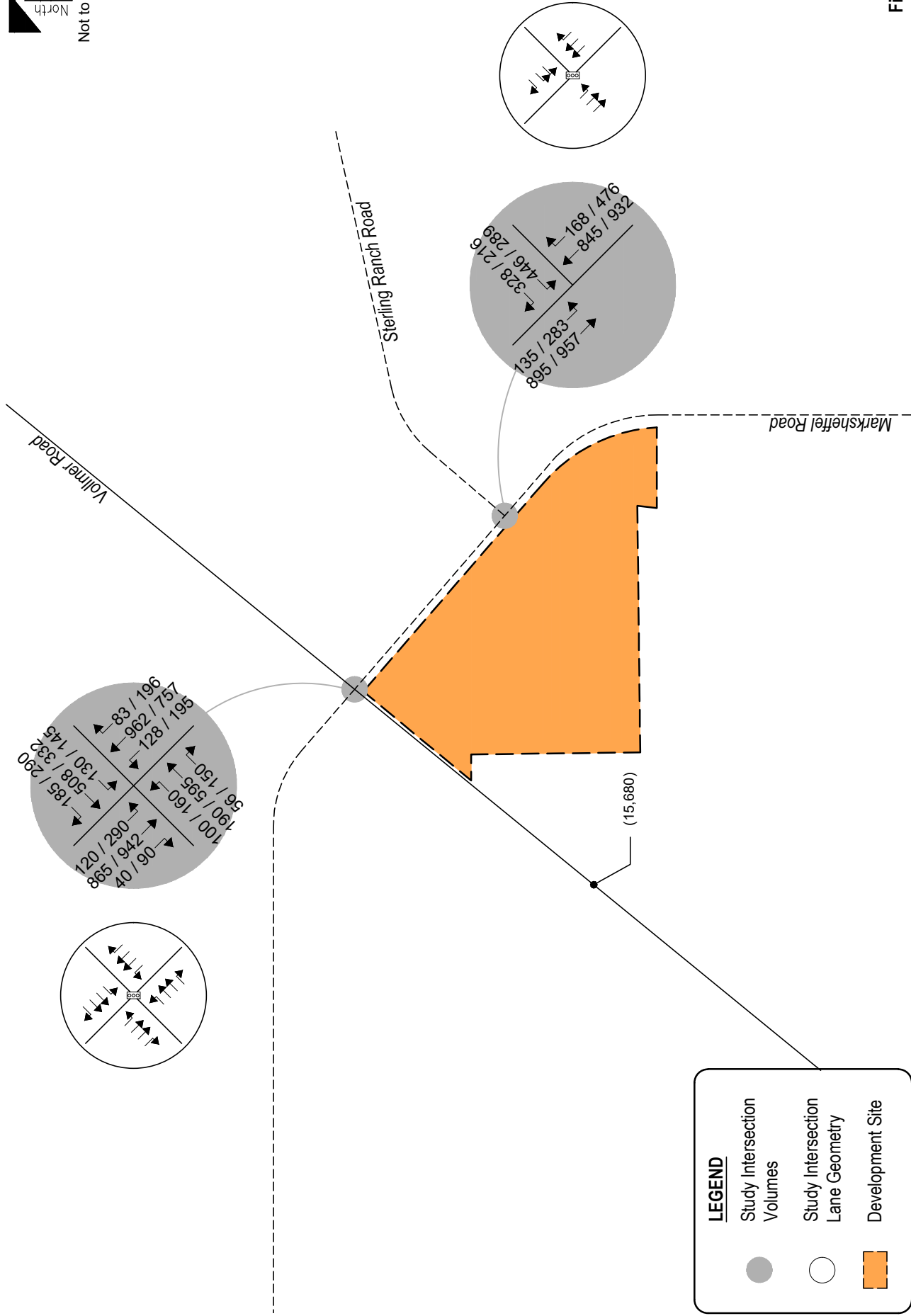
Projected background traffic volumes and intersection geometry for Years 2027 and 2040 are shown on Figure 4 and Figure 5, respectively.



**Figure 4**  
**BACKGROUND TRAFFIC - YEAR 2027**  
Volumes & Intersection Geometry  
AM / PM Peak Hour  
(ADT) : Average Daily Traffic



Not to Scale



**LEGEND**

-  Study Intersection
-  Volumes
-  Study Intersection
-  Lane Geometry
-  Development Site

**Figure 5**  
**BACKGROUND TRAFFIC - YEAR 2040**  
 Volumes & Intersection Geometry  
 AM / PM Peak Hour  
 (ADT) : Average Daily Traffic

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### Peak Hour Intersection Levels of Service – Background Traffic

As with existing traffic conditions, the operations of study intersections were analyzed under background conditions, without the proposed development, using the SYNCHRO computer program.

Background traffic level of service analysis results for Year 2027 are listed in Table 2. Year 2040 operational results are summarized in Table 3.

Definitions of levels of service are given in Appendix B. Intersection capacity worksheets are provided in Appendix C.

**Table 2 – Intersection Capacity Analysis Summary – Background Traffic – Year 2027**

INTERSECTION LANE GROUPS	LEVEL OF SERVICE	
	AM PEAK HOUR	PM PEAK HOUR
Vollmer Road / Marksheffel Road (Stop-Controlled)		
Westbound Left	C	C
Westbound Right	B	B
Southbound Left	A	A
Marksheffel Road / Sterling Ranch Road (Stop-Controlled)		
Eastbound Left	A	A
Southbound Left	C	C
Southbound Right	A	A

Key: Stop-Controlled Intersection: Level of Service

### Background Traffic Analysis Results – Year 2027

Year 2027 background traffic analysis indicates that the unsignalized intersection of Vollmer Road with Marksheffel Road has turning movement operations at or better than LOS C during both the AM and PM peak traffic hours.

The unsignalized intersection of Marksheffel Road with Sterling Ranch Road has turning movement operations at or better than LOS C during both the AM and PM peak traffic hours.

**Table 3 – Intersection Capacity Analysis Summary – Background Traffic – Year 2040**

INTERSECTION LANE GROUPS	LEVEL OF SERVICE	
	AM PEAK HOUR	PM PEAK HOUR
Vollmer Road / Marksheffel Road (Signalized)	C (28.1)	C (34.4)
Marksheffel Road / Sterling Ranch Road (Signalized)	B (15.3)	B (14.6)

Key: Signalized Intersection: Level of Service (Control Delay in sec/veh)

### Background Traffic Analysis Results – Year 2040

By Year 2040 and without the proposed development, the study intersection of Vollmer Road with Marksheffel Road experiences LOS C operations during both the AM and PM peak traffic hours.

The study intersection of Marksheffel Road with Sterling Ranch Road experiences LOS B operations during both the AM and PM peak traffic hours.



## IV. Proposed Project Traffic

### Trip Generation

Standard traffic generation characteristics compiled by the Institute of Transportation Engineers (ITE) in their report entitled Trip Generation Manual, 11<sup>th</sup> Edition, were applied to the proposed land use in order to estimate average daily traffic (ADT), AM Peak Hour, and PM Peak Hour vehicle trips. A vehicle trip is defined as a one-way vehicle movement from a point of origin to a point of destination.

The ITE land use codes 151 (Mini-Warehouse), 220 (Multifamily Housing (Low-Rise)), 822 (Strip Retail Plaza), 937 (Coffee/Donut Shop with Drive-Through Window), 945 (Convenience Store/Gas Station), and 948 (Automated Car Wash) were used for estimating trip generation because of their conservative rates and best fit to the anticipated land use descriptions.

As actual land uses, densities or site plans within the Rhetoric Site become defined over time, it is expected that traffic generation characteristics considered within this study will need to be updated by more specific traffic analyses or studies to help assess if transportation improvements are needed to mitigate potential traffic impacts.

Trip generation rates used in this study are presented in Table 4.

**Table 4 – Trip Generation Rates**

ITE CODE	LAND USE	UNIT	TRIP GENERATION RATES						
			24 HOUR	AM PEAK HOUR			PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
151	Mini-Warehouse	KSF	1.45	0.05	0.04	0.09	0.07	0.08	0.15
220	Multifamily Housing (Low-Rise)	DU	6.74	0.10	0.30	0.40	0.32	0.19	0.51
822	Strip Retail Plaza	KSF	54.45	1.42	0.94	2.36	3.30	3.30	6.59
937	Coffee/Donut Shop w/DTW	KSF	533.57	43.80	42.08	85.88	19.50	19.50	38.99
945	Convenience Store/Gas Station	VFP	265.12	8.03	8.03	16.06	9.21	9.21	18.42
948	Automated Car Wash	CWT	775.00	*	*	*	38.75	38.75	77.50

Key: KSF = Thousand Square Feet Gross Floor Area. DU = Dwelling Units. VFP = Vehicle Fueling Positions. CWT = Car Wash Tunnels.

Table 5 illustrates projected ADT, AM Peak Hour, and PM Peak Hour traffic volumes likely generated by the proposed development upon build-out.

**Table 5 – Trip Generation Summary**

ITE CODE	LAND USE	SIZE	TOTAL TRIPS GENERATED								
			24 HOUR	AM PEAK HOUR			PM PEAK HOUR				
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL		
151	Mini-Warehouse	55.8 KSF	81	3	2	5	4	4	8		
220	Multifamily Housing (Low-Rise)	504 DU	3,397	48	153	202	162	95	257		
822	Strip Retail Plaza	23.5 KSF	1,280	33	22	55	77	77	155		
937	Coffee/Donut Shop w/DTW	2.0 KSF	1,067	88	84	172	39	39	78		
945	Convenience Store/Gas Station	14 VFP	3,712	112	112	225	129	129	258		
948	Automated Car Wash	1 CWT	775	*	*	*	39	39	78		
<i>Total:</i>			<i>10,311</i>	<i>285</i>	<i>374</i>	<i>659</i>	<i>450</i>	<i>384</i>	<i>834</i>		

Key: KSF = Thousand Square Feet Gross Floor Area. DU = Dwelling Units. VFP = Vehicle Fueling Positions. CWT = Car Wash Tunnels.  
 Note: All data and calculations above are subject to being rounded to nearest value.

Not all numbers in this table match spreadsheets in appendix. Please update

Upon build-out, Table 5 illustrates that the proposed development has the potential to generate approximately 10,311 daily vehicle trips with 659 of those occurring during the morning peak hour and 834 during the afternoon peak hour.

### Adjustments to Trip Generation Rates

It is considered likely that a mixed-use development of this type will attract trips from within area land uses. Utilizing research obtained by the National Cooperative Highway Research Program (NCHRP), ITE created an estimation tool<sup>5</sup> for determining internal capture for mixed-use developments. Using NCHRP Report 684 methodology, it is determined that the proposed land uses have various internal capture percentages ranging from 7 to 59 percent. Applying vehicle occupancy estimates from ITE's Trip Generation Handbook, 3<sup>rd</sup> Edition, it is determined that overall averages of approximately 9% of total AM peak hour trips and approximately 18% of total PM peak hour trips will be captured internally.

It is important to note that the mini-warehouse, convenience store/gas station, and automated car wash ITE land uses, are not subject to internal capture computations within the estimation tool. This is due to the nature of such businesses which generally operate as destinations for a specific demographic serving a wide area and/or are more likely to generate pass-by or diverted link trips. While some portion of trips to these land uses may originate within the development area, it is assumed that this portion is minor and may be accounted for in the average internal capture for the overall development site.

ITE's internal capture spreadsheets are provided for reference in Appendix D.

Table 6 illustrates projected ADT, AM Peak Hour, and PM Peak Hour traffic volumes likely generated by the proposed development upon build-out with reductions applied due to internal capture.

<sup>5</sup> NCHRP Report 684: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments, National Cooperative Highway Research Program, October 2010.

**Table 6 – Trip Generation Summary with Reductions**

ITE CODE	LAND USE	SIZE	24 HOUR	TOTAL TRIPS GENERATED					
				AM PEAK HOUR			PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
151	Mini-Warehouse	55.8 KSF	70	3	2	5	3	4	7
220	Multifamily Housing (Low-Rise)	504.0 DU	2,938	44	139	183	133	78	211
822	Strip Retail Plaza	23.5 KSF	1,107	30	20	50	63	63	127
937	Coffee/Donut Shop w/DTW	2.0 KSF	923	80	77	156	32	32	64
945	Convenience Store/Gas Station	14.0 VFP	3,211	102	102	205	106	106	211
948	Automated Car Wash	1.0 CWT	670	*	*	*	32	32	64
<i>Trip Reduction:</i>			<i>14%</i>	<i>9%</i>	<i>9%</i>	<i>9%</i>	<i>18%</i>	<i>18%</i>	<i>18%</i>
<i>Total:</i>			<i>8,919</i>	<i>259</i>	<i>340</i>	<i>599</i>	<i>369</i>	<i>315</i>	<i>684</i>

Key: KSF = Thousand Square Feet Gross Floor Area. DU = Dwelling Units. VFP = Vehicle Fueling Positions. CWT = Car Wash Tunnels.  
 Note: All data and calculations above are subject to being rounded to nearest value.

paragraph, do not have any is one ?

Include description on how this % was obtained.

Upon build-out and with consideration for internal capture trip reductions, Table 6 illustrates that the proposed development has the potential to generate approximately 8,919 daily trips with 599 of those occurring during the morning peak hour and 684 during the afternoon peak hour.

As noted previously, specific land uses within the development site are also likely to attract pass-by trips from the adjacent roadway system. ITE defines a pass-by trip as an intermediate stop on the way from an origin to a primary trip destination without a route diversion. Due to this behavior, pass-by trips are not considered as “new” traffic generated by the development since the trips are already present on the roadway network enroute to their primary destination.

Pass-by trips are especially common to convenience store/gas station and coffee/donut shop land uses given the convenience provided by these businesses on the way to another primary destination such as a place of work or home. As example, published ITE pass-by and diverted link trip data indicates an average trip generation reduction rate of 62 percent during the AM peak traffic hour and 56 percent during the PM peak traffic hour as typical to convenience store/gas station land uses.

Given the conceptual nature of the proposed land uses, and the ongoing adjacent development within the surrounding area, specific pass-by percentages can only be assumed and may be subject to change. Therefore, in order to provide for a conservative analysis, no reductions were applied due to pass-by trips.

### **Trip Distribution**

The overall directional distribution of site-generated traffic was determined based on the location of development site within the County, proposed and existing area land uses, allowed turning movements, and available roadway network, and in reference to previously approved traffic studies for the adjacent ongoing development areas.

Overall trip distribution patterns for the development for Years 2027 and 2040 are shown on Figures 6A and 6B, respectively. These distribution patterns mirror those presented in the referenced traffic studies prepared for Sterling Ranch Filing 2 and Sterling Ranch Phase 2.

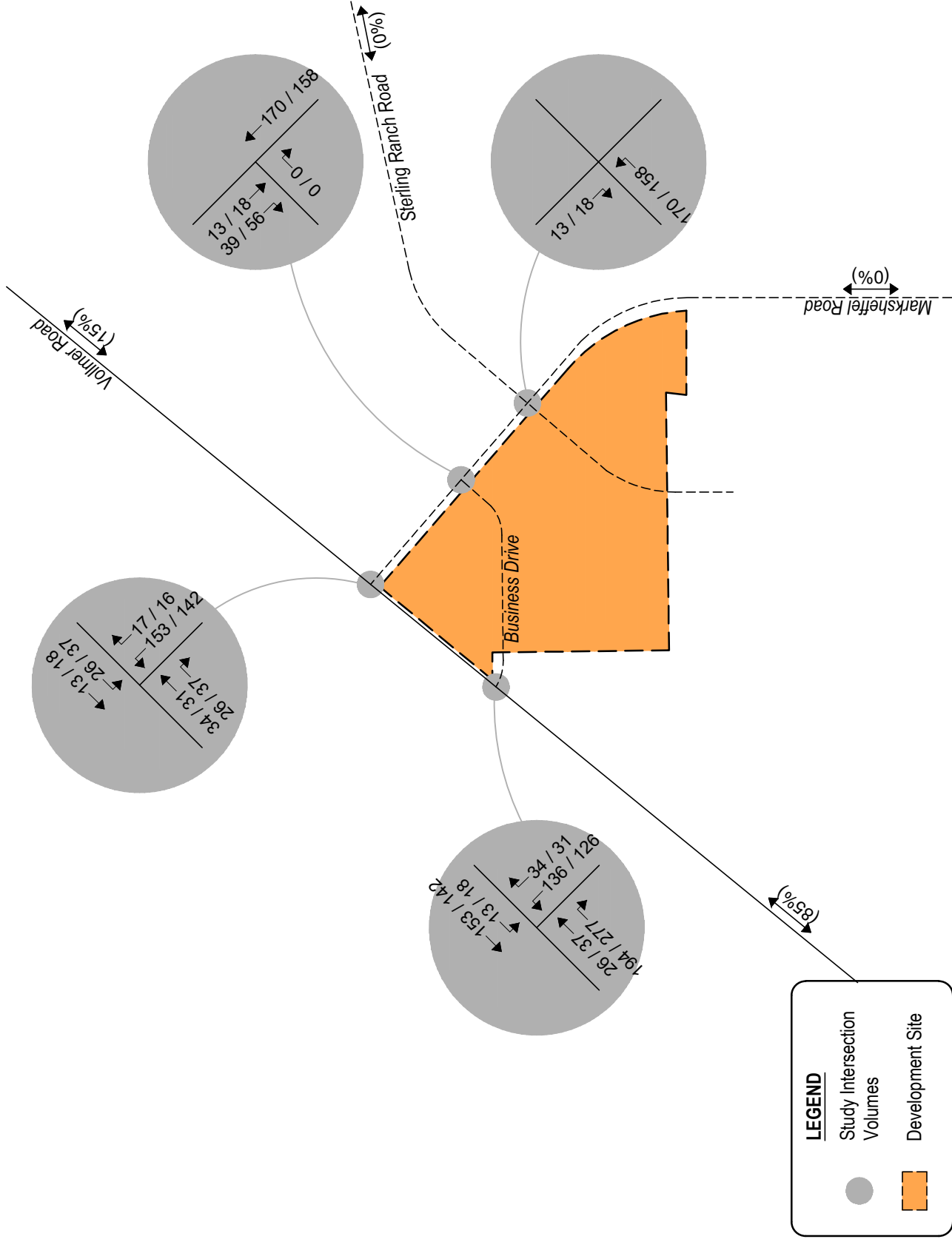
### **Trip Assignment**

Trip assignment is how generated and distributed vehicle trips are expected to be loaded onto the available roadway network.

Applying trip distribution patterns to site-generated traffic provides the overall site-generated trip assignments for Year 2027 shown on Figure 6A, and Year 2040 shown on Figure 6B.



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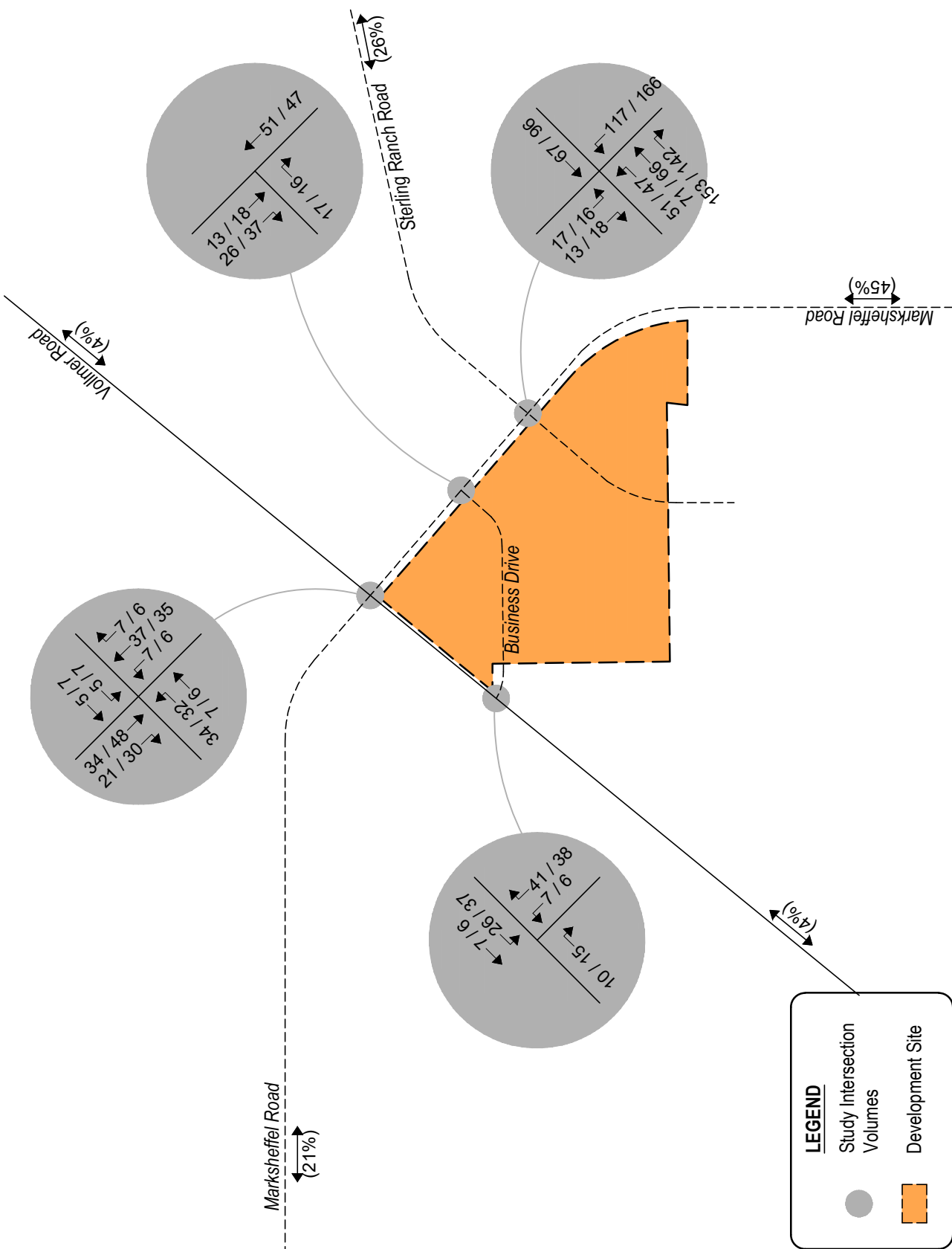


**Figure 6A**  
**SITE DEVELOPMENT DISTRIBUTION - YEAR 2027**  
 (%): Overall

**SITE-GENERATED**  
 AM / PM Peak Hour







**LEGEND**

- Study Intersection
- Development Site

**Figure 6B**  
**SITE DEVELOPMENT DISTRIBUTION - YEAR 2040**  
 (%): Overall  
**SITE-GENERATED**  
 AM / PM Peak Hour

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## **V. Future Traffic Conditions With Proposed Developments**

Total traffic is the traffic projected to be on area roadways with consideration of the proposed development. Total traffic includes background traffic projections for Years 2027 and 2040 with consideration of site-generated traffic. For analysis purposes, it was assumed that development construction would be completed by end of Year 2027.

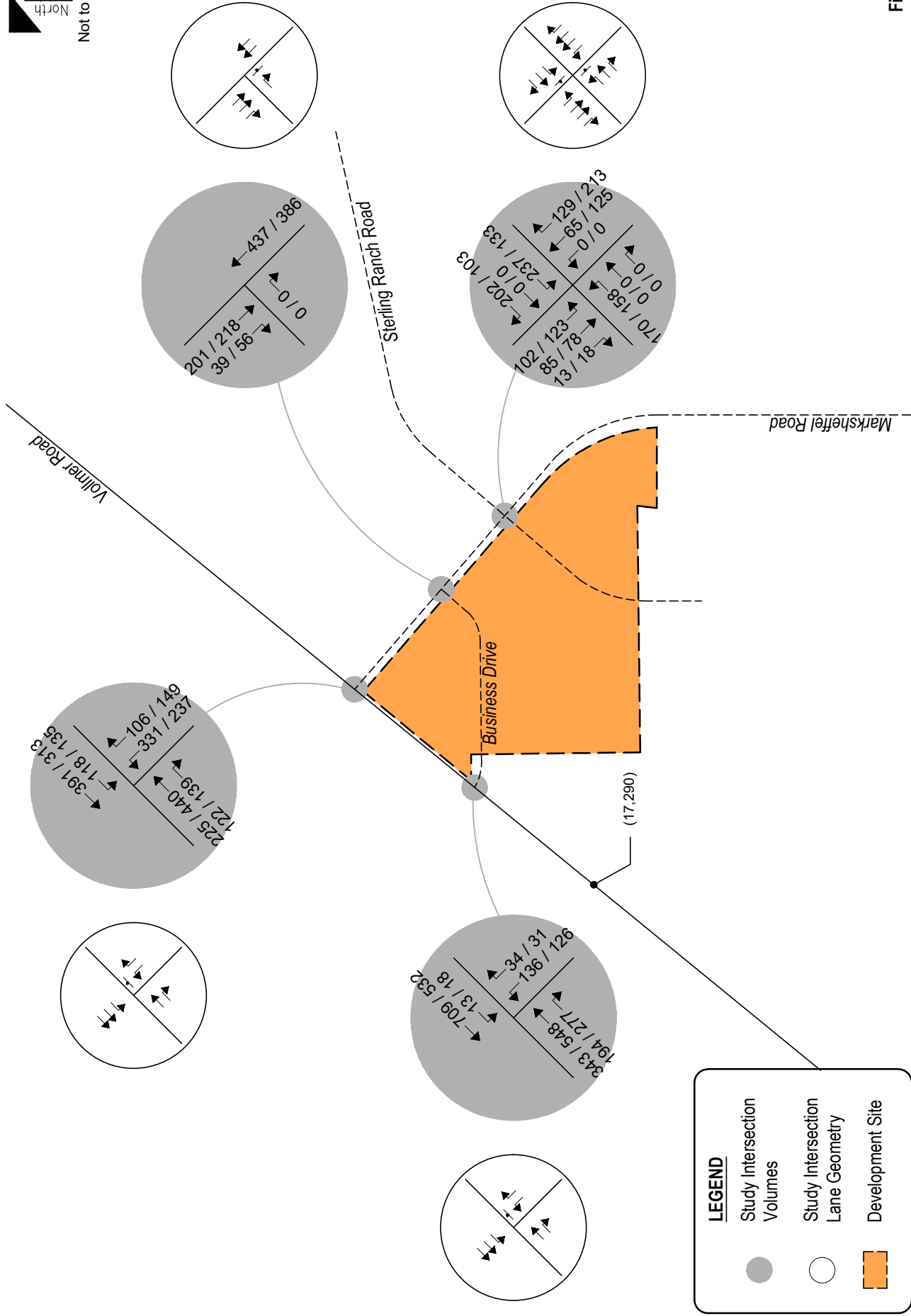
Pursuant to area roadway improvement discussions provided in Section III, Year 2027 and Year 2040 total traffic conditions assume no additional roadway improvements to accommodate regional transportation demands. Roadway improvements associated with site development are expected to be limited to site access and frontage as required by the governing agency.

Projected Year 2027 total traffic volumes and intersection geometry are shown in Figure 7.

Figure 8 shows projected total traffic volumes and intersection geometry for Year 2040.



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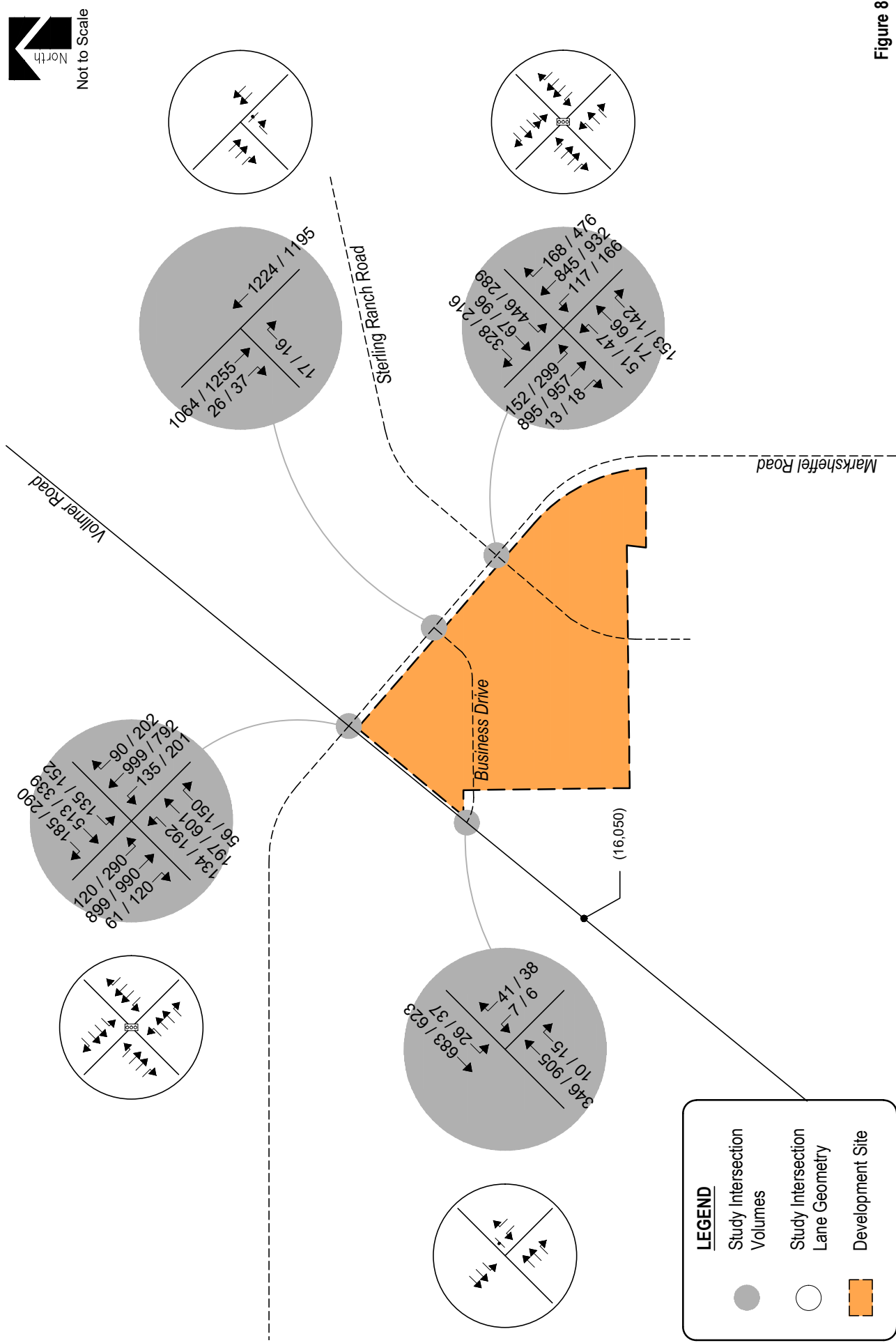


**Figure 7**  
**TOTAL TRAFFIC - YEAR 2027**  
 Volumes & Intersection Geometry  
 AM / PM Peak Hour  
 (ADT) : Average Daily Traffic





Not to Scale



**Figure 8**  
**TOTAL TRAFFIC - YEAR 2040**  
 Volumes & Intersection Geometry  
 AM / PM Peak Hour  
 (ADT) : Average Daily Traffic

**RHETORIC SITE**  
 Traffic Impact Study



**SM ROCHA, LLC**  
 Traffic and Transportation Consultants

## VI. Project Impacts

The analyses and procedures described in this study were performed in accordance with the latest HCM and are based upon the worst-case conditions that occur during a typical weekday upon build-out of site development and analyzed land uses. Therefore, study intersections are likely to operate with traffic conditions better than those described within this study, which represent the peak hours of weekday operations only.

### Peak Hour Intersection Levels of Service – Total Traffic

As with background traffic, the operations of the study intersections were analyzed under projected total traffic conditions using the SYNCHRO computer program. Total traffic level of service analysis results for Years 2027 and 2040 are summarized in Table 7 and Table 8, respectively.

Definitions of levels of service are given in Appendix B. Intersection capacity worksheets are provided in Appendix C.

**Table 7 – Intersection Capacity Analysis Summary – Total Traffic – Year 2027**

INTERSECTION LANE GROUPS	LEVEL OF SERVICE	
	AM PEAK HOUR	PM PEAK HOUR
Vollmer Road / Marksheffel Road (Stop-Controlled)		
Westbound Left	F	F
Westbound Right	B	B
Southbound Left	A	A
Marksheffel Road / Sterling Ranch Road (Stop-Controlled)		
Eastbound Left	A	A
Westbound Left	A	A
Northbound Left	C	C
Northbound Through	A	A
Northbound Right	A	A
Southbound Left	C	C
Southbound Through	A	A
Southbound Right	A	A
Vollmer Road / Business Drive (Stop-Controlled)		
Westbound Left	C	D
Westbound Right	B	B
Southbound Left	A	A
Marksheffel Road / Business Drive (Stop-Controlled)		
Northbound Right	A	A

Key: Stop-Controlled Intersection: Level of Service

**Table 8 – Intersection Capacity Analysis Summary – Total Traffic – Year 2040**

INTERSECTION LANE GROUPS	LEVEL OF SERVICE	
	AM PEAK HOUR	PM PEAK HOUR
Vollmer Road / Marksheffel Road (Signalized)	C (27.9)	C (34.7)
Marksheffel Road / Sterling Ranch Road (Signalized)	C (27.5)	C (28.4)
Vollmer Road / Business Drive (Stop-Controlled)		
Westbound Left	B	C
Westbound Right	A	B
Southbound Left	A	B
Marksheffel Road / Business Drive (Stop-Controlled)		
Northbound Right	B	B

Key: Signalized Intersection: Level of Service (Control Delay in sec/veh)  
 Stop-Controlled Intersection: Level of Service

### Total Traffic Analysis Results Upon Development Build-Out

Table 8 illustrates how, by Year 2040 and upon assumed development build-out, the signalized intersection of Vollmer Road with Marksheffel Road shows an overall LOS C operation during both the morning and afternoon peak traffic hours. Compared to the background traffic analysis, the traffic generated by the proposed development is not expected to significantly change the operations of the study intersection.

The signalized intersection of Marksheffel Road with Sterling Ranch Road is projected to have morning and afternoon peak traffic hour operations at LOS C.

The stop-controlled intersection of Vollmer Road with Business Drive is projected to have turning movement operations at LOS B or better for the morning peak traffic hour and LOS C or better for the afternoon peak traffic hour.

The stop-controlled intersection of Marksheffel Road with Business Drive is projected to have turning movement operations at LOS B for both the morning and afternoon peak traffic hours.

## VII. Conclusion

This traffic impact study is provided as a planning document and addresses the capacity, geometric, and control requirements associated with the development entitled Rhetoric Site. This proposed mixed-use development consists of various conceptual land uses including multifamily residential, and commercial businesses. The development is located near the southeast corner of the intersection of Vollmer Road with Tahiti Drive in El Paso County, Colorado.

The study area to be examined in this analysis encompasses Vollmer Road near the existing intersection with Tahiti Drive and future Marksheffel Road as well as proposed site accesses.

Analysis was conducted for critical AM Peak Hour and PM Peak Hour traffic operations for existing traffic conditions, Year 2027 and Year 2040 background traffic conditions, and Year 2027 and Year 2040 total traffic conditions.

Under existing conditions, operational analysis shows that the unsignalized intersection of Vollmer Road with Tahiti Drive has turning movement operations at LOS A during both the morning and afternoon peak traffic hours.

Year 2027 background traffic analysis indicates that the unsignalized intersection of Vollmer Road with Marksheffel Road has turning movement operations at or better than LOS C during both the AM and PM peak traffic hours. The unsignalized intersection of Marksheffel Road with Sterling Ranch Road has turning movement operations at or better than LOS C during both the AM and PM peak traffic hours.

By Year 2040 and without the proposed development, the study intersection of Vollmer Road with Marksheffel Road experiences LOS C operations during both the AM and PM peak traffic hours. The study intersection of Marksheffel Road with Sterling Ranch Road experiences LOS B operations during both the AM and PM peak traffic hours.

Analysis of future traffic conditions indicates that the addition of site-generated traffic is expected to create no negative impact to traffic operations for the existing and surrounding roadway system upon consideration of the various roadway and intersection control improvements assumed within this analysis. With all conservative assumptions defined in this analysis, the study intersections are projected to operate at future levels of service comparable to Year 2040 background traffic conditions. Proposed site accesses have long-term operations at LOS C or better during peak traffic periods and upon build-out.

Include discussions on Pedestrian Routing, Sight Distance & access spacing.

Include discussion on accel/decel lanes per City comments for Vollmer & Marksheffel, as well as for Sterling Ranch Road. Ensure these lanes work with access spacing.

Sterling Ranch Road intersections will need to be included in analysis and discussions.

## **APPENDIX A**

### **Traffic Count Data**





ALL TRAFFIC DATA SERVICES

(303) 216-2439

www.alltrafficdata.net

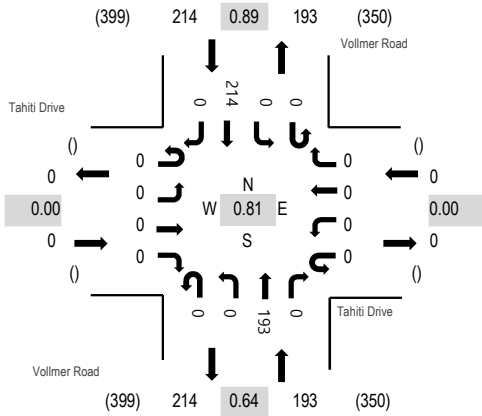
Location: 3 Vollmer Road & Tahiti Drive AM

Date: Thursday, March 24, 2022

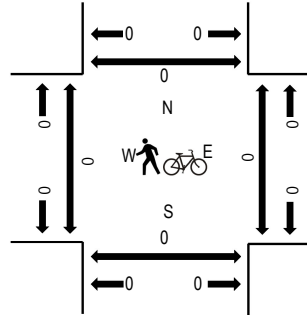
Peak Hour: 07:45 AM - 08:45 AM

Peak 15-Minutes: 07:45 AM - 08:00 AM

Peak Hour - All Vehicles



Peak Hour - Pedestrians/Bicycles on Crosswalk



Note: Total study counts contained in parentheses.

Traffic Counts

Interval Start Time	Tahiti Drive Eastbound				Tahiti Drive Westbound				Vollmer Road Northbound			Vollmer Road Southbound				Total	Rolling Hour	Pedestrian Crossings					
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru			Right	West	East	South	North	
7:00 AM	0	0	0	0	0	0	0	0	0	0	42	0	0	0	0	30	0	72	374	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	33	0	0	0	0	47	0	80	400	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	41	0	0	0	0	55	0	96	400	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	75	0	0	0	0	51	0	126	407	0	0	0	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	37	0	0	0	0	61	0	98	375	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	34	0	0	0	0	46	0	80		0	0	0	0
8:30 AM	0	0	0	0	0	0	0	0	0	0	47	0	0	0	0	56	0	103		0	0	0	0
8:45 AM	0	0	0	0	0	0	0	0	0	0	41	0	0	0	0	53	0	94		0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	350	0	0	0	0	399	0	749		0	0	0	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	193	0	0	0	0	214	0	407		0	0	0	0

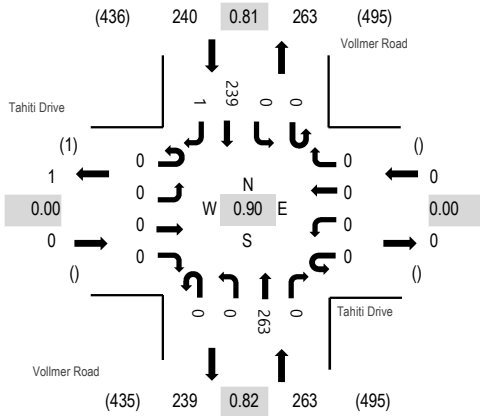
**Location:** 3 Vollmer Road & Tahiti Drive PM

**Date:** Thursday, March 24, 2022

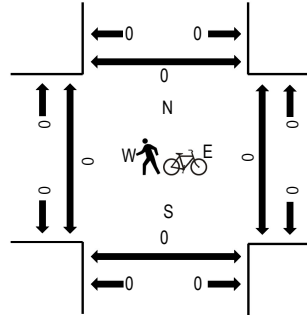
**Peak Hour:** 04:00 PM - 05:00 PM

**Peak 15-Minutes:** 04:00 PM - 04:15 PM

**Peak Hour - All Vehicles**



**Peak Hour - Pedestrians/Bicycles on Crosswalk**



Note: Total study counts contained in parentheses.

**Traffic Counts**

Interval Start Time	Tahiti Drive Eastbound				Tahiti Drive Westbound				Vollmer Road Northbound			Vollmer Road Southbound				Total	Rolling Hour	Pedestrian Crossings					
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru			Right	West	East	South	North	
4:00 PM	0	0	0	0	0	0	0	0	0	0	66	0	0	0	0	73	1	140	503	0	0	0	0
4:15 PM	0	0	0	0	0	0	0	0	0	0	68	0	0	0	0	52	0	120	467	0	0	0	0
4:30 PM	0	0	0	0	0	0	0	0	0	0	49	0	0	0	0	63	0	112	463	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0	0	0	80	0	0	0	0	51	0	131	453	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	55	0	0	0	0	49	0	104	428	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	62	0	0	0	0	54	0	116		0	0	0	0
5:30 PM	0	0	0	0	0	0	0	0	0	0	54	0	0	0	0	48	0	102		0	0	0	0
5:45 PM	0	0	0	0	0	0	0	0	0	0	61	0	0	0	0	45	0	106		0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	495	0	0	0	0	435	1	931		0	0	0	0
Peak Hour	0	0	0	0	0	0	0	0	0	0	263	0	0	0	0	239	1	503		0	0	0	0

## **APPENDIX B**

### **Level of Service Definitions**

The following information can be found in the Highway Capacity Manual, Transportation Research Board, 2016: Chapter 19 – Signalized Intersections and Chapter 20 – Two-Way Stop Controlled Intersections.

### **Automobile Level of Service (LOS) for Signalized Intersections**

Levels of service are defined to represent reasonable ranges in control delay.

#### **LOS A**

Describes operations with a control delay of 10 s/veh or less and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is low and either progression is exceptionally favorable or the cycle length is very short. If it is due to favorable progression, most vehicles arrive during the green indication and travel through the intersection without stopping.

#### **LOS B**

Describes operations with control delay between 10 and 20 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is low and either progression is highly favorable or the cycle length is short. More vehicles stop than with LOS A.

#### **LOS C**

Describes operations with control delay between 20 and 35 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when progression is favorable or the cycle length is moderate. Individual *cycle failures* (i.e., one or more queued vehicles are not able to depart as a result of insufficient capacity during the cycle) may begin to appear at this level. The number of vehicles stopping is significant, although many vehicles still pass through the intersection without stopping.

#### **LOS D**

Describes operations with control delay between 35 and 55 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is high and either progression is ineffective or the cycle length is long. Many vehicles stop and individual cycle failures are noticeable.

#### **LOS E**

Describes operations with control delay between 55 and 80 s/veh and a volume-to-capacity ratio no greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is high, progression is unfavorable, and the cycle length is long. Individual cycle failures are frequent.

#### **LOS F**

Describes operations with control delay exceeding 80 s/veh or a volume-to-capacity ratio greater than 1.0. This level is typically assigned when the volume-to-capacity ratio is very high, progression is very poor, and the cycle length is long. Most cycles fail to clear the queue.

### **Level of Service (LOS) for Unsignalized TWSC Intersections**

Level of Service (v/c ≤ 1.0)	Average Control Delay (s/veh)
A	0 - 10
B	> 10 - 15
C	> 15 - 25
D	> 25 - 35
E	> 35 - 50
F	> 50

## **APPENDIX C**

### **Capacity Worksheets**

HCM 6th TWSC  
1: Vollmer Road & Tahiti Drive

Existing Traffic Volumes  
AM Peak Hour

Intersection						
Int Delay, s/veh	0					
Movement	SBL	SBR	NEL	NET	SWT	SWR
Lane Configurations	T			T		
Traffic Vol, veh/h	0	0	0	193	214	0
Future Vol, veh/h	0	0	0	193	214	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	0	210	233	0

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	443	233	233	0	-	0
Stage 1	233	-	-	-	-	-
Stage 2	210	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	572	806	1335	-	-	-
Stage 1	806	-	-	-	-	-
Stage 2	825	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	572	806	1335	-	-	-
Mov Cap-2 Maneuver	572	-	-	-	-	-
Stage 1	806	-	-	-	-	-
Stage 2	825	-	-	-	-	-

Approach	SB	NE	SW
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NEL	NET	SBLn1	SWT	SWR
Capacity (veh/h)	1335	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	0	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-

HCM 6th TWSC  
1: Vollmer Road & Tahiti Drive

Existing Traffic Volumes  
PM Peak Hour

Intersection						
Int Delay, s/veh	0					
Movement	SBL	SBR	NEL	NET	SWT	SWR
Lane Configurations	T			T		
Traffic Vol, veh/h	0	0	0	263	239	1
Future Vol, veh/h	0	0	0	263	239	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	0	286	260	1

Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	547	261	261	0	0
Stage 1	261	-	-	-	-
Stage 2	286	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	498	778	1303	-	-
Stage 1	783	-	-	-	-
Stage 2	763	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	498	778	1303	-	-
Mov Cap-2 Maneuver	498	-	-	-	-
Stage 1	783	-	-	-	-
Stage 2	763	-	-	-	-

Approach	SB	NE	SW
HCM Control Delay, s	0	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NEL	NET	SBLn1	SWT	SWR
Capacity (veh/h)	1303	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	0	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	-	-	-

HCM 6th TWSC  
1: Vollmer Road & Marksheffel Road

Background Traffic Volumes  
AM Peak Hour - Year 2027

Intersection						
Int Delay, s/veh	5.5					
Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↙	↗	↑	↗	↙	↗↗
Traffic Vol, veh/h	178	89	221	96	92	378
Future Vol, veh/h	178	89	221	96	92	378
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	150	150	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	193	97	240	104	100	411

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	646	240	0	0	344
Stage 1	240	-	-	-	-
Stage 2	406	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13
Critical Hdwy Stg 1	5.43	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219
Pot Cap-1 Maneuver	420	798	-	-	1213
Stage 1	799	-	-	-	-
Stage 2	642	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	386	798	-	-	1213
Mov Cap-2 Maneuver	386	-	-	-	-
Stage 1	799	-	-	-	-
Stage 2	589	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	18.9	0	1.6
HCM LOS	C		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	386	798	1213	-
HCM Lane V/C Ratio	-	-	0.501	0.121	0.082	-
HCM Control Delay (s)	-	-	23.3	10.1	8.2	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	2.7	0.4	0.3	-



HCM 6th TWSC  
 2: Marksheffel Road & Sterling Ranch Road

Background Traffic Volumes  
 AM Peak Hour - Year 2027

Intersection						
Int Delay, s/veh	7.9					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↑↑	↑↑	↗	↘	↗
Traffic Vol, veh/h	102	85	65	129	237	202
Future Vol, veh/h	102	85	65	129	237	202
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	150	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	111	92	71	140	258	220

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	211	0	0	339	36
Stage 1	-	-	-	71	-
Stage 2	-	-	-	268	-
Critical Hdwy	4.14	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	5.84	-
Follow-up Hdwy	2.22	-	-	3.52	3.32
Pot Cap-1 Maneuver	1357	-	-	631	1029
Stage 1	-	-	-	943	-
Stage 2	-	-	-	753	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	1357	-	-	579	1029
Mov Cap-2 Maneuver	-	-	-	579	-
Stage 1	-	-	-	866	-
Stage 2	-	-	-	753	-

Approach	SE	NW	SW
HCM Control Delay, s	4.3	0	13
HCM LOS			B

Minor Lane/Major Mvmt	NWT	NWR	SEL	SETSWLn1SWLn2		
Capacity (veh/h)	-	-	1357	-	579	1029
HCM Lane V/C Ratio	-	-	0.082	-	0.445	0.213
HCM Control Delay (s)	-	-	7.9	-	16.1	9.4
HCM Lane LOS	-	-	A	-	C	A
HCM 95th %tile Q(veh)	-	-	0.3	-	2.3	0.8

HCM 6th TWSC  
1: Vollmer Road & Marksheffel Road

Background Traffic Volumes  
PM Peak Hour - Year 2027

Intersection						
Int Delay, s/veh	4.2					
Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↙	↗	↑	↗	↙	↗↗
Traffic Vol, veh/h	95	133	409	102	98	295
Future Vol, veh/h	95	133	409	102	98	295
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	150	150	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	103	145	445	111	107	321

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	820	445	0	0	556
Stage 1	445	-	-	-	-
Stage 2	375	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13
Critical Hdwy Stg 1	5.43	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219
Pot Cap-1 Maneuver	328	612	-	-	1013
Stage 1	645	-	-	-	-
Stage 2	666	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	293	612	-	-	1013
Mov Cap-2 Maneuver	293	-	-	-	-
Stage 1	645	-	-	-	-
Stage 2	595	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	17.3	0	2.2
HCM LOS	C		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	293	612	1013	-
HCM Lane V/C Ratio	-	-	0.352	0.236	0.105	-
HCM Control Delay (s)	-	-	23.8	12.7	9	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	1.5	0.9	0.4	-

HCM 6th TWSC  
 2: Marksheffel Road & Sterling Ranch Road

Background Traffic Volumes  
 PM Peak Hour - Year 2027

Intersection						
Int Delay, s/veh	5.2					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↑↑	↑↑	↗	↘	↗
Traffic Vol, veh/h	123	78	125	213	133	103
Future Vol, veh/h	123	78	125	213	133	103
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	150	-	-	150	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	134	85	136	232	145	112

























Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	368	0	-	0	447 68
Stage 1	-	-	-	-	136 -
Stage 2	-	-	-	-	311 -
Critical Hdwy	4.14	-	-	-	6.84 6.94
Critical Hdwy Stg 1	-	-	-	-	5.84 -
Critical Hdwy Stg 2	-	-	-	-	5.84 -
Follow-up Hdwy	2.22	-	-	-	3.52 3.32
Pot Cap-1 Maneuver	1187	-	-	-	540 981
Stage 1	-	-	-	-	876 -
Stage 2	-	-	-	-	716 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1187	-	-	-	479 981
Mov Cap-2 Maneuver	-	-	-	-	479 -
Stage 1	-	-	-	-	777 -
Stage 2	-	-	-	-	716 -

Approach	SE	NW	SW
HCM Control Delay, s	5.2	0	12.8
HCM LOS			B

Minor Lane/Major Mvmt	NWT	NWR	SEL	SETSWLn1SWLn2		
Capacity (veh/h)	-	-	1187	-	479	981
HCM Lane V/C Ratio	-	-	0.113	-	0.302	0.114
HCM Control Delay (s)	-	-	8.4	-	15.7	9.1
HCM Lane LOS	-	-	A	-	C	A
HCM 95th %tile Q(veh)	-	-	0.4	-	1.3	0.4

Timings  
1: Vollmer Road & Marksheffel Road

Background Traffic Volumes  
AM Peak Hour - Year 2040

												
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	120	865	40	128	962	83	100	190	56	130	508	185
Future Volume (vph)	120	865	40	128	962	83	100	190	56	130	508	185
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.151			0.117			0.251			0.610		
Satd. Flow (perm)	281	3539	1583	218	3539	1583	468	3539	1583	1136	3539	1583
Satd. Flow (RTOR)			142			142			142			201
Lane Group Flow (vph)	130	940	43	139	1046	90	109	207	61	141	552	201
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6		6	2		2	4		4	8		8
Detector Phase	1	6	6	5	2	2	7	4	4	3	8	8
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	15.0	40.0	40.0	15.0	40.0	40.0	15.0	30.0	30.0	15.0	30.0	30.0
Total Split (%)	15.0%	40.0%	40.0%	15.0%	40.0%	40.0%	15.0%	30.0%	30.0%	15.0%	30.0%	30.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	C-Max	Max	C-Max	C-Max	None	Min	Min	None	Min	Min
Act Effct Green (s)	43.8	34.0	34.0	51.9	39.4	39.4	30.5	20.3	20.3	31.1	20.7	20.7
Actuated g/C Ratio	0.44	0.34	0.34	0.52	0.39	0.39	0.30	0.20	0.20	0.31	0.21	0.21
v/c Ratio	0.51	0.78	0.07	0.42	0.75	0.13	0.42	0.29	0.14	0.34	0.76	0.41
Control Delay	20.6	35.2	0.2	28.6	23.0	0.7	26.0	33.9	0.7	23.9	44.1	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.6	35.2	0.2	28.6	23.0	0.7	26.0	33.9	0.7	23.9	44.1	7.3
LOS	C	D	A	C	C	A	C	C	A	C	D	A
Approach Delay		32.1			22.0			26.3			32.6	
Approach LOS		C			C			C			C	
Queue Length 50th (ft)	40	281	0	42	174	0	46	58	0	60	173	0
Queue Length 95th (ft)	76	359	0	118	#216	m5	80	87	0	100	225	55
Internal Link Dist (ft)		603			799			699			290	
Turn Bay Length (ft)	150		150	150		150	150		150	150		150
Base Capacity (vph)	277	1203	631	333	1394	709	276	849	487	423	849	532
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.78	0.07	0.42	0.75	0.13	0.39	0.24	0.13	0.33	0.65	0.38

Intersection Summary

Cycle Length: 100  
 Actuated Cycle Length: 100  
 Offset: 0 (0%), Referenced to phase 2:NWTL and 6:SETL, Start of Green, Master Intersection  
 Natural Cycle: 70  
 Control Type: Actuated-Coordinated

# Timings

## 1: Vollmer Road & Marksheffel Road

# Background Traffic Volumes

AM Peak Hour - Year 2040

Maximum v/c Ratio: 0.78

Intersection Signal Delay: 28.1

Intersection LOS: C

Intersection Capacity Utilization 71.2%

ICU Level of Service C









Analysis Period (min) 15

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.













m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Vollmer Road & Marksheffel Road

 Ø1	 Ø2 (R)	 Ø3	 Ø4
15 s	40 s	15 s	30 s
 Ø5	 Ø6 (R)	 Ø7	 Ø8
15 s	40 s	15 s	30 s

Timings  
2: Marksheffel Road & Sterling Ranch Road

Background Traffic Volumes  
AM Peak Hour - Year 2040

						
Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	135	895	845	168	446	328
Future Volume (vph)	135	895	845	168	446	328
Satd. Flow (prot)	1770	3539	3539	1583	3433	1583
Flt Permitted	0.231				0.950	
Satd. Flow (perm)	430	3539	3539	1583	3433	1583
Satd. Flow (RTOR)				170		257
Lane Group Flow (vph)	147	973	918	183	485	357
Turn Type	pm+pt	NA	NA	Perm	Prot	Perm
Protected Phases	1	6	2		8	
Permitted Phases	6			2		8
Detector Phase	1	6	2	2	8	8
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	15.0	65.0	50.0	50.0	35.0	35.0
Total Split (%)	15.0%	65.0%	50.0%	50.0%	35.0%	35.0%
Yellow Time (s)	3.0	4.0	4.0	4.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	6.0	6.0	6.0	5.0	5.0
Lead/Lag	Lead		Lag	Lag		
Lead-Lag Optimize?	Yes		Yes	Yes		
Recall Mode	None	C-Max	C-Max	C-Max	None	None
Act Effct Green (s)	69.4	68.4	55.0	55.0	20.6	20.6
Actuated g/C Ratio	0.69	0.68	0.55	0.55	0.21	0.21
v/c Ratio	0.36	0.40	0.47	0.19	0.69	0.67
Control Delay	10.8	4.1	15.8	3.4	41.6	17.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.8	4.1	15.8	3.4	41.6	17.0
LOS	B	A	B	A	D	B
Approach Delay		4.9	13.7		31.1	
Approach LOS		A	B		C	
Queue Length 50th (ft)	13	51	174	4	148	55
Queue Length 95th (ft)	m38	81	277	41	187	142
Internal Link Dist (ft)		799	496		405	
Turn Bay Length (ft)	150			150	150	
Base Capacity (vph)	435	2422	1946	947	1029	654
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.34	0.40	0.47	0.19	0.47	0.55
<b>Intersection Summary</b>						
Cycle Length: 100						
Actuated Cycle Length: 100						
Offset: 0 (0%), Referenced to phase 2:NWT and 6:SETL, Start of Green						
Natural Cycle: 60						
Control Type: Actuated-Coordinated						

# Timings

## 2: Marksheffel Road & Sterling Ranch Road

Background Traffic Volumes  
AM Peak Hour - Year 2040

Maximum v/c Ratio: 0.69

Intersection Signal Delay: 15.3

Intersection LOS: B

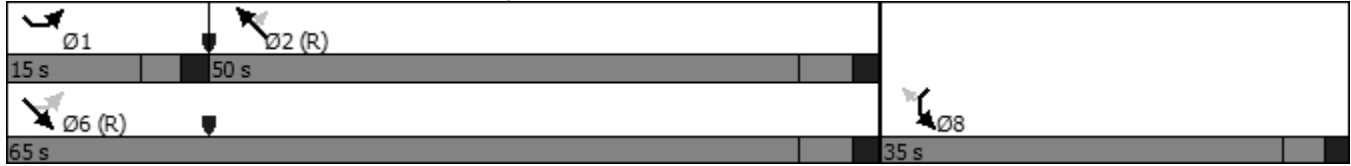
Intersection Capacity Utilization 56.9%

ICU Level of Service B

Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Marksheffel Road & Sterling Ranch Road



Timings  
1: Vollmer Road & Marksheffel Road

Background Traffic Volumes  
PM Peak Hour - Year 2040

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	290	942	90	195	757	196	160	595	150	145	332	290
Future Volume (vph)	290	942	90	195	757	196	160	595	150	145	332	290
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.175			0.118			0.360			0.187		
Satd. Flow (perm)	326	3539	1583	220	3539	1583	671	3539	1583	348	3539	1583
Satd. Flow (RTOR)			118			164			164			315
Lane Group Flow (vph)	315	1024	98	212	823	213	174	647	163	158	361	315
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6		6	2		2	4		4	8		8
Detector Phase	1	6	6	5	2	2	7	4	4	3	8	8
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	30.0	50.0	50.0	20.0	40.0	40.0	20.0	35.0	35.0	15.0	30.0	30.0
Total Split (%)	25.0%	41.7%	41.7%	16.7%	33.3%	33.3%	16.7%	29.2%	29.2%	12.5%	25.0%	25.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	C-Max	Max	C-Max	C-Max	None	Min	Min	None	Min	Min
Act Effct Green (s)	63.4	44.0	44.0	59.0	41.4	41.4	40.5	26.4	26.4	34.0	23.2	23.2
Actuated g/C Ratio	0.53	0.37	0.37	0.49	0.34	0.34	0.34	0.22	0.22	0.28	0.19	0.19
v/c Ratio	0.76	0.79	0.15	0.63	0.67	0.33	0.50	0.83	0.34	0.73	0.53	0.56
Control Delay	30.3	39.2	3.4	48.1	29.3	5.9	32.7	54.5	7.5	49.2	46.5	8.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.3	39.2	3.4	48.1	29.3	5.9	32.7	54.5	7.5	49.2	46.5	8.7
LOS	C	D	A	D	C	A	C	D	A	D	D	A
Approach Delay		34.8			28.5			42.9			32.7	
Approach LOS		C			C			D			C	
Queue Length 50th (ft)	127	368	0	112	293	10	94	250	0	85	132	0
Queue Length 95th (ft)	229	453	25	#223	239	46	149	314	54	#155	182	79
Internal Link Dist (ft)		603			799			699			290	
Turn Bay Length (ft)	150		150	150		150	150		150	150		150
Base Capacity (vph)	482	1297	655	337	1221	653	373	855	506	217	707	568
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.65	0.79	0.15	0.63	0.67	0.33	0.47	0.76	0.32	0.73	0.51	0.55

Intersection Summary

Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 0 (0%), Referenced to phase 2:NWTL and 6:SETL, Start of Green, Master Intersection  
 Natural Cycle: 75  
 Control Type: Actuated-Coordinated



# Timings

## 1: Vollmer Road & Marksheffel Road

# Background Traffic Volumes

PM Peak Hour - Year 2040

Maximum v/c Ratio: 0.83

Intersection Signal Delay: 34.4

Intersection LOS: C

Intersection Capacity Utilization 79.8%









ICU Level of Service D

Analysis Period (min) 15

# 95th percentile volume exceeds capacity, queue may be longer.













Queue shown is maximum after two cycles.

Splits and Phases: 1: Vollmer Road & Marksheffel Road

 Ø1	 Ø2 (R)	 Ø3	 Ø4
30 s	40 s	15 s	35 s
 Ø5	 Ø6 (R)	 Ø7	 Ø8
20 s	50 s	20 s	30 s

Timings  
2: Marksheffel Road & Sterling Ranch Road

Background Traffic Volumes  
PM Peak Hour - Year 2040

						
Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	283	957	932	476	289	216
Future Volume (vph)	283	957	932	476	289	216
Satd. Flow (prot)	1770	3539	3539	1583	3433	1583
Flt Permitted	0.217				0.950	
Satd. Flow (perm)	404	3539	3539	1583	3433	1583
Satd. Flow (RTOR)				370		235
Lane Group Flow (vph)	308	1040	1013	517	314	235
Turn Type	pm+pt	NA	NA	Perm	Prot	Perm
Protected Phases	1	6	2		8	
Permitted Phases	6			2		8
Detector Phase	1	6	2	2	8	8
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	30.0	90.0	60.0	60.0	30.0	30.0
Total Split (%)	25.0%	75.0%	50.0%	50.0%	25.0%	25.0%
Yellow Time (s)	3.0	4.0	4.0	4.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	6.0	6.0	6.0	5.0	5.0
Lead/Lag	Lead		Lag	Lag		
Lead-Lag Optimize?	Yes		Yes	Yes		
Recall Mode	None	C-Max	C-Max	C-Max	None	None
Act Effct Green (s)	93.6	92.6	73.8	73.8	16.4	16.4
Actuated g/C Ratio	0.78	0.77	0.62	0.62	0.14	0.14
v/c Ratio	0.65	0.38	0.47	0.46	0.67	0.56
Control Delay	28.9	3.1	14.7	5.6	56.2	11.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.9	3.1	14.7	5.6	56.2	11.1
LOS	C	A	B	A	E	B
Approach Delay		9.0	11.6		36.9	
Approach LOS		A	B		D	
Queue Length 50th (ft)	99	54	198	43	121	0
Queue Length 95th (ft)	m178	81	345	153	161	70
Internal Link Dist (ft)		799	496		405	
Turn Bay Length (ft)	150			150	150	
Base Capacity (vph)	599	2730	2177	1116	715	515
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.51	0.38	0.47	0.46	0.44	0.46

Intersection Summary

Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 0 (0%), Referenced to phase 2:NWT and 6:SETL, Start of Green  
 Natural Cycle: 65  
 Control Type: Actuated-Coordinated

# Timings

## 2: Marksheffel Road & Sterling Ranch Road

Background Traffic Volumes  
PM Peak Hour - Year 2040

Maximum v/c Ratio: 0.67

Intersection Signal Delay: 14.6

Intersection LOS: B

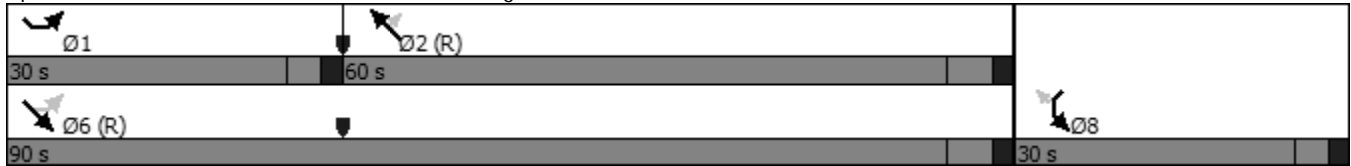
Intersection Capacity Utilization 63.0%

ICU Level of Service B

Analysis Period (min) 15

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Marksheffel Road & Sterling Ranch Road



HCM 6th TWSC  
1: Vollmer Road & Marksheffel Road

Total Traffic Volumes  
AM Peak Hour - Year 2027

Intersection						
Int Delay, s/veh	27.5					
Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↙	↗	↑	↗	↙	↑↑
Traffic Vol, veh/h	331	106	225	122	118	391
Future Vol, veh/h	331	106	225	122	118	391
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	150	150	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	360	115	245	133	128	425

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	714	245	0	0	378	0
Stage 1	245	-	-	-	-	-
Stage 2	469	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	382	793	-	-	1179	-
Stage 1	795	-	-	-	-	-
Stage 2	597	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 340	793	-	-	1179	-
Mov Cap-2 Maneuver	~ 340	-	-	-	-	-
Stage 1	795	-	-	-	-	-
Stage 2	532	-	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	78.9	0	2
HCM LOS	F		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	340	793	1179	-
HCM Lane V/C Ratio	-	-	1.058	0.145	0.109	-
HCM Control Delay (s)	-	-	100.9	10.3	8.4	-
HCM Lane LOS	-	-	F	B	A	-
HCM 95th %tile Q(veh)	-	-	12.9	0.5	0.4	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

HCM 6th TWSC  
2: Sterling Ranch Road & Marksheffel Road

Total Traffic Volumes  
AM Peak Hour - Year 2027

Intersection												
Int Delay, s/veh	10											
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↘	↑↑	↗	↘	↑↑	↗	↘	↑	↗	↘	↑	↗
Traffic Vol, veh/h	102	85	13	0	65	129	170	0	0	237	0	202
Future Vol, veh/h	102	85	13	0	65	129	170	0	0	237	0	202
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	150	150	-	150	150	-	150	150	-	150
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	111	92	14	0	71	140	185	0	0	258	0	220

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	211	0	0	106	0	0	350	525	46	339	399	36
Stage 1	-	-	-	-	-	-	314	314	-	71	71	-
Stage 2	-	-	-	-	-	-	36	211	-	268	328	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	1357	-	-	1483	-	-	580	456	1014	591	538	1029
Stage 1	-	-	-	-	-	-	671	655	-	931	835	-
Stage 2	-	-	-	-	-	-	975	726	-	714	646	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1357	-	-	1483	-	-	427	419	1014	554	494	1029
Mov Cap-2 Maneuver	-	-	-	-	-	-	427	419	-	554	494	-
Stage 1	-	-	-	-	-	-	616	601	-	855	835	-
Stage 2	-	-	-	-	-	-	767	726	-	656	593	-

Approach	SE			NW			NE			SW		
HCM Control Delay, s	4			0			19.7			13.5		
HCM LOS							C			B		

Minor Lane/Major Mvmt	NELn1	NELn2	NELn3	NWL	NWT	NWR	SEL	SET	SER	SWLn1	SWLn2	SWLn3
Capacity (veh/h)	427	-	-	1483	-	-	1357	-	-	554	-	1029
HCM Lane V/C Ratio	0.433	-	-	-	-	-	0.082	-	-	0.465	-	0.213
HCM Control Delay (s)	19.7	0	0	0	-	-	7.9	-	-	17	0	9.4
HCM Lane LOS	C	A	A	A	-	-	A	-	-	C	A	A
HCM 95th %tile Q(veh)	2.1	-	-	0	-	-	0.3	-	-	2.4	-	0.8

HCM 6th TWSC  
3: Vollmer Road & Business Drive

Total Traffic Volumes  
AM Peak Hour - Year 2027

Intersection						
Int Delay, s/veh	2.6					
Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↙	↗	↑	↗	↙	↗↗
Traffic Vol, veh/h	136	34	343	194	13	709
Future Vol, veh/h	136	34	343	194	13	709
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	200	200	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	148	37	373	211	14	771

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	787	373	0	0	584
Stage 1	373	-	-	-	-
Stage 2	414	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13
Critical Hdwy Stg 1	5.43	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219
Pot Cap-1 Maneuver	344	672	-	-	989
Stage 1	696	-	-	-	-
Stage 2	636	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	339	672	-	-	989
Mov Cap-2 Maneuver	339	-	-	-	-
Stage 1	696	-	-	-	-
Stage 2	627	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	21	0	0.2
HCM LOS	C		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	339	672	989	-
HCM Lane V/C Ratio	-	-	0.436	0.055	0.014	-
HCM Control Delay (s)	-	-	23.6	10.7	8.7	-
HCM Lane LOS	-	-	C	B	A	-
HCM 95th %tile Q(veh)	-	-	2.1	0.2	0	-

HCM 6th TWSC  
4: Business Drive & Marksheffel Road

Total Traffic Volumes  
AM Peak Hour - Year 2027

Intersection						
Int Delay, s/veh	0					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑↑	↑		↑↑		↑
Traffic Vol, veh/h	201	39	0	437	0	0
Future Vol, veh/h	201	39	0	437	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	150	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	218	42	0	475	0	0

Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	-	-	-	109
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	3.32
Pot Cap-1 Maneuver	-	-	0	-	0	924
Stage 1	-	-	0	-	0	-
Stage 2	-	-	0	-	0	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	924
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	SE	NW	NE
HCM Control Delay, s	0	0	0
HCM LOS			A

Minor Lane/Major Mvmt	NELn1	NWT	SET	SER
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	0	-	-	-
HCM Lane LOS	A	-	-	-
HCM 95th %tile Q(veh)	-	-	-	-

HCM 6th TWSC  
1: Vollmer Road & Marksheffel Road

Total Traffic Volumes  
PM Peak Hour - Year 2027

Intersection						
Int Delay, s/veh	25					
Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↙	↗	↑	↗	↙	↗
Traffic Vol, veh/h	237	149	440	139	135	313
Future Vol, veh/h	237	149	440	139	135	313
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	150	150	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	258	162	478	151	147	340

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	942	478	0	0	629	0
Stage 1	478	-	-	-	-	-
Stage 2	464	-	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219	-
Pot Cap-1 Maneuver	276	586	-	-	951	-
Stage 1	623	-	-	-	-	-
Stage 2	600	-	-	-	-	-
Platoon blocked, %			-	-	-	-
Mov Cap-1 Maneuver	~ 233	586	-	-	951	-
Mov Cap-2 Maneuver	~ 233	-	-	-	-	-
Stage 1	623	-	-	-	-	-
Stage 2	507	-	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	88.2	0	2.9
HCM LOS	F		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	233	586	951	-
HCM Lane V/C Ratio	-	-	1.106	0.276	0.154	-
HCM Control Delay (s)	-	-	135.1	13.5	9.5	-
HCM Lane LOS	-	-	F	B	A	-
HCM 95th %tile Q(veh)	-	-	11.5	1.1	0.5	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon



HCM 6th TWSC  
2: Sterling Ranch Road & Marksheffel Road

Total Traffic Volumes  
PM Peak Hour - Year 2027

Intersection												
Int Delay, s/veh	7.6											
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations	↘	↑↑	↗	↘	↑↑	↗	↘	↑	↗	↘	↑	↗
Traffic Vol, veh/h	123	78	18	0	125	213	158	0	0	133	0	103
Future Vol, veh/h	123	78	18	0	125	213	158	0	0	133	0	103
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	150	150	-	150	150	-	150	150	-	150
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	134	85	20	0	136	232	172	0	0	145	0	112

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	368	0	0	105	0	0	421	721	43	447	509	68
Stage 1	-	-	-	-	-	-	353	353	-	136	136	-
Stage 2	-	-	-	-	-	-	68	368	-	311	373	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.54	5.54	-	6.54	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	1187	-	-	1484	-	-	517	352	1018	495	466	981
Stage 1	-	-	-	-	-	-	637	629	-	853	783	-
Stage 2	-	-	-	-	-	-	934	620	-	674	617	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1187	-	-	1484	-	-	418	312	1018	452	413	981
Mov Cap-2 Maneuver	-	-	-	-	-	-	418	312	-	452	413	-
Stage 1	-	-	-	-	-	-	565	558	-	757	783	-
Stage 2	-	-	-	-	-	-	827	620	-	598	547	-

Approach	SE	NW	NE	SW
HCM Control Delay, s	4.7	0	19.5	13.4
HCM LOS			C	B

Minor Lane/Major Mvmt	NELn1	NELn2	NELn3	NWL	NWT	NWR	SEL	SET	SER	SWLn1	SWLn2	SWLn3
Capacity (veh/h)	418	-	-	1484	-	-	1187	-	-	452	-	981
HCM Lane V/C Ratio	0.411	-	-	-	-	-	0.113	-	-	0.32	-	0.114
HCM Control Delay (s)	19.5	0	0	0	-	-	8.4	-	-	16.7	0	9.1
HCM Lane LOS	C	A	A	A	-	-	A	-	-	C	A	A
HCM 95th %tile Q(veh)	2	-	-	0	-	-	0.4	-	-	1.4	-	0.4

HCM 6th TWSC  
3: Vollmer Road & Business Drive

Total Traffic Volumes  
PM Peak Hour - Year 2027

Intersection						
Int Delay, s/veh	2.8					
Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↙	↗	↑	↗	↙	↑↑
Traffic Vol, veh/h	126	31	548	277	18	532
Future Vol, veh/h	126	31	548	277	18	532
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	200	200	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	137	34	596	301	20	578

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	925	596	0	0	897
Stage 1	596	-	-	-	-
Stage 2	329	-	-	-	-
Critical Hdwy	6.63	6.23	-	-	4.13
Critical Hdwy Stg 1	5.43	-	-	-	-
Critical Hdwy Stg 2	5.83	-	-	-	-
Follow-up Hdwy	3.519	3.319	-	-	2.219
Pot Cap-1 Maneuver	283	503	-	-	755
Stage 1	549	-	-	-	-
Stage 2	702	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	276	503	-	-	755
Mov Cap-2 Maneuver	276	-	-	-	-
Stage 1	549	-	-	-	-
Stage 2	684	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	26.7	0	0.3
HCM LOS	D		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	276	503	755	-
HCM Lane V/C Ratio	-	-	0.496	0.067	0.026	-
HCM Control Delay (s)	-	-	30.2	12.7	9.9	-
HCM Lane LOS	-	-	D	B	A	-
HCM 95th %tile Q(veh)	-	-	2.6	0.2	0.1	-

HCM 6th TWSC  
4: Business Drive & Marksheffel Road

Total Traffic Volumes  
PM Peak Hour - Year 2027

Intersection						
Int Delay, s/veh	0					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑↑	↑		↑↑		↑
Traffic Vol, veh/h	218	56	0	386	0	0
Future Vol, veh/h	218	56	0	386	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	150	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	237	61	0	420	0	0

























Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	-	-	-	119
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	3.32
Pot Cap-1 Maneuver	-	-	0	-	0	910
Stage 1	-	-	0	-	0	-
Stage 2	-	-	0	-	0	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	-	-	-	910
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	SE	NW	NE
HCM Control Delay, s	0	0	0
HCM LOS			A

Minor Lane/Major Mvmt	NELn1	NWT	SET	SER
Capacity (veh/h)	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-
HCM Control Delay (s)	0	-	-	-
HCM Lane LOS	A	-	-	-
HCM 95th %tile Q(veh)	-	-	-	-

Timings  
1: Vollmer Road & Marksheffel Road

Total Traffic Volumes  
AM Peak Hour - Year 2040

												
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	120	899	61	135	999	90	134	197	56	135	513	185
Future Volume (vph)	120	899	61	135	999	90	134	197	56	135	513	185
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.126			0.103			0.241			0.618		
Satd. Flow (perm)	235	3539	1583	192	3539	1583	449	3539	1583	1151	3539	1583
Satd. Flow (RTOR)			142			142			142			201
Lane Group Flow (vph)	130	977	66	147	1086	98	146	214	61	147	558	201
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6		6	2		2	4		4	8		8
Detector Phase	1	6	6	5	2	2	7	4	4	3	8	8
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	15.0	40.0	40.0	15.0	40.0	40.0	15.0	30.0	30.0	15.0	30.0	30.0
Total Split (%)	15.0%	40.0%	40.0%	15.0%	40.0%	40.0%	15.0%	30.0%	30.0%	15.0%	30.0%	30.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	C-Max	Max	C-Max	C-Max	None	Min	Min	None	Min	Min
Act Effct Green (s)	43.8	34.0	34.0	51.2	38.8	38.8	31.5	20.9	20.9	31.3	20.8	20.8
Actuated g/C Ratio	0.44	0.34	0.34	0.51	0.39	0.39	0.32	0.21	0.21	0.31	0.21	0.21
v/c Ratio	0.55	0.81	0.10	0.47	0.79	0.14	0.55	0.29	0.14	0.35	0.76	0.41
Control Delay	23.0	36.6	0.3	35.0	20.2	1.5	29.4	33.7	0.6	23.8	44.1	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.0	36.6	0.3	35.0	20.2	1.5	29.4	33.7	0.6	23.8	44.1	7.3
LOS	C	D	A	C	C	A	C	C	A	C	D	A
Approach Delay		33.0			20.4			27.4			32.7	
Approach LOS		C			C			C			C	
Queue Length 50th (ft)	41	295	0	53	111	0	62	60	0	63	175	0
Queue Length 95th (ft)	80	376	0	m123	#444	m5	104	90	0	104	227	55
Internal Link Dist (ft)		603			337			450			290	
Turn Bay Length (ft)	150		150	150		150	150		150	150		150
Base Capacity (vph)	260	1203	631	313	1373	700	275	849	487	428	849	532
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.50	0.81	0.10	0.47	0.79	0.14	0.53	0.25	0.13	0.34	0.66	0.38
<b>Intersection Summary</b>												
Cycle Length: 100												
Actuated Cycle Length: 100												
Offset: 0 (0%), Referenced to phase 2:NWTL and 6:SETL, Start of Green, Master Intersection												
Natural Cycle: 75												
Control Type: Actuated-Coordinated												

**Timings**  
**1: Vollmer Road & Marksheffel Road**

**Total Traffic Volumes**  
 AM Peak Hour - Year 2040

Maximum v/c Ratio: 0.81

Intersection Signal Delay: 27.9 Intersection LOS: C

Intersection Capacity Utilization 74.2% ICU Level of Service D









Analysis Period (min) 15

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

























m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Vollmer Road & Marksheffel Road

 Ø1	 Ø2 (R)	 Ø3	 Ø4
15 s	40 s	15 s	30 s
 Ø5	 Ø6 (R)	 Ø7	 Ø8
15 s	40 s	15 s	30 s

Timings  
2: Sterling Ranch Road & Marksheffel Road

Total Traffic Volumes  
AM Peak Hour - Year 2040

												
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	152	895	13	117	845	168	51	71	153	446	67	328
Future Volume (vph)	152	895	13	117	845	168	51	71	153	446	67	328
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.176			0.178			0.950			0.950		
Satd. Flow (perm)	328	3539	1583	332	3539	1583	1770	1863	1583	3433	1863	1583
Satd. Flow (RTOR)			185			185			196			341
Lane Group Flow (vph)	165	973	14	127	918	183	55	77	166	485	73	357
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6		6	2		2			4			8
Detector Phase	1	6	6	5	2	2	7	4	4	3	8	8
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	15.0	35.0	35.0	15.0	35.0	35.0	15.0	25.0	25.0	25.0	35.0	35.0
Total Split (%)	15.0%	35.0%	35.0%	15.0%	35.0%	35.0%	15.0%	25.0%	25.0%	25.0%	35.0%	35.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	C-Max	None	C-Max	C-Max	None	None	None	None	None	None
Act Effct Green (s)	54.0	42.2	42.2	50.6	40.6	40.6	8.2	9.5	9.5	18.2	21.6	21.6
Actuated g/C Ratio	0.54	0.42	0.42	0.51	0.41	0.41	0.08	0.10	0.10	0.18	0.22	0.22
v/c Ratio	0.50	0.65	0.02	0.43	0.64	0.24	0.38	0.44	0.51	0.78	0.18	0.59
Control Delay	30.4	28.5	0.0	16.0	28.2	4.6	50.6	49.7	9.4	48.1	33.6	8.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.4	28.5	0.0	16.0	28.2	4.6	50.6	49.7	9.4	48.1	33.6	8.9
LOS	C	C	A	B	C	A	D	D	A	D	C	A
Approach Delay		28.4			23.5			27.4			31.7	
Approach LOS		C			C			C			C	
Queue Length 50th (ft)	71	183	0	36	244	0	34	47	0	151	39	8
Queue Length 95th (ft)	m105	257	m0	71	#373	47	72	91	40	205	75	85
Internal Link Dist (ft)		382			496			549			405	
Turn Bay Length (ft)	150		150	150		150	150		150	150		150
Base Capacity (vph)	347	1494	775	324	1435	752	177	372	473	686	558	713
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.48	0.65	0.02	0.39	0.64	0.24	0.31	0.21	0.35	0.71	0.13	0.50

Intersection Summary

Cycle Length: 100  
 Actuated Cycle Length: 100  
 Offset: 0 (0%), Referenced to phase 2:NWTL and 6:SETL, Start of Green  
 Natural Cycle: 85  
 Control Type: Actuated-Coordinated

# Timings

## 2: Sterling Ranch Road & Marksheffel Road

Total Traffic Volumes  
AM Peak Hour - Year 2040

Maximum v/c Ratio: 0.78

Intersection Signal Delay: 27.5

Intersection LOS: C

Intersection Capacity Utilization 64.5%

ICU Level of Service C









Analysis Period (min) 15

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Sterling Ranch Road & Marksheffel Road

 Ø1	 Ø2 (R)	 Ø3	 Ø4
15 s	35 s	25 s	25 s
 Ø5	 Ø6 (R)	 Ø7	 Ø8
15 s	35 s	15 s	35 s

HCM 6th TWSC  
3: Vollmer Road & Business Drive

Total Traffic Volumes  
AM Peak Hour - Year 2040

Intersection						
Int Delay, s/veh	0.6					
Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↘	↗	↑↑	↗	↘	↑↑
Traffic Vol, veh/h	7	41	346	10	26	683
Future Vol, veh/h	7	41	346	10	26	683
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	200	200	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	8	45	376	11	28	742

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	803	188	0	0	387
Stage 1	376	-	-	-	-
Stage 2	427	-	-	-	-
Critical Hdwy	6.84	6.94	-	-	4.14
Critical Hdwy Stg 1	5.84	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-
Follow-up Hdwy	3.52	3.32	-	-	2.22
Pot Cap-1 Maneuver	*725	822	-	-	1168
Stage 1	*664	-	-	-	-
Stage 2	*756	-	-	-	-
Platoon blocked, %	1	-	-	-	-
Mov Cap-1 Maneuver	*708	822	-	-	1168
Mov Cap-2 Maneuver	*708	-	-	-	-
Stage 1	*664	-	-	-	-
Stage 2	*738	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	9.7	0	0.3
HCM LOS	A		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	708	822	1168	-
HCM Lane V/C Ratio	-	-	0.011	0.054	0.024	-
HCM Control Delay (s)	-	-	10.1	9.6	8.2	-
HCM Lane LOS	-	-	B	A	A	-
HCM 95th %tile Q(veh)	-	-	0	0.2	0.1	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon



HCM 6th TWSC  
4: Business Drive & Marksheffel Road

Total Traffic Volumes  
AM Peak Hour - Year 2040

Intersection						
Int Delay, s/veh	0.1					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑↑	↑		↑↑		↑
Traffic Vol, veh/h	1064	26	0	1224	0	17
Future Vol, veh/h	1064	26	0	1224	0	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	150	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1157	28	0	1330	0	18

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	-	-	579
Stage 1	-	-	-	-	-
Stage 2	-	-	-	-	-
Critical Hdwy	-	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	3.32
Pot Cap-1 Maneuver	-	0	-	0	*648
Stage 1	-	0	-	0	-
Stage 2	-	0	-	0	-
Platoon blocked, %	-	-	-	-	1
Mov Cap-1 Maneuver	-	-	-	-	*648
Mov Cap-2 Maneuver	-	-	-	-	-
Stage 1	-	-	-	-	-
Stage 2	-	-	-	-	-

























Approach	SE	NW	NE
HCM Control Delay, s	0	0	10.7
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NWT	SET	SER
Capacity (veh/h)	648	-	-	-
HCM Lane V/C Ratio	0.029	-	-	-
HCM Control Delay (s)	10.7	-	-	-
HCM Lane LOS	B	-	-	-
HCM 95th %tile Q(veh)	0.1	-	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

Timings  
1: Vollmer Road & Marksheffel Road

Total Traffic Volumes  
PM Peak Hour - Year 2040

												
Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	290	990	120	201	792	202	192	601	150	152	339	290
Future Volume (vph)	290	990	120	201	792	202	192	601	150	152	339	290
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	3539	1583	1770	3539	1583
Flt Permitted	0.176			0.093			0.338			0.189		
Satd. Flow (perm)	328	3539	1583	173	3539	1583	630	3539	1583	352	3539	1583
Satd. Flow (RTOR)			118			151			131			315
Lane Group Flow (vph)	315	1076	130	218	861	220	209	653	163	165	368	315
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6		6	2		2	4		4	8		8
Detector Phase	1	6	6	5	2	2	7	4	4	3	8	8
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0
Total Split (s)	25.0	50.0	50.0	20.0	45.0	45.0	20.0	35.0	35.0	15.0	30.0	30.0
Total Split (%)	20.8%	41.7%	41.7%	16.7%	37.5%	37.5%	16.7%	29.2%	29.2%	12.5%	25.0%	25.0%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0	5.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	C-Max	Max	C-Max	C-Max	None	Min	Min	None	Min	Min
Act Effct Green (s)	63.2	44.0	44.0	60.7	43.3	43.3	41.4	26.6	26.6	33.5	22.6	22.6
Actuated g/C Ratio	0.53	0.37	0.37	0.51	0.36	0.36	0.34	0.22	0.22	0.28	0.19	0.19
v/c Ratio	0.81	0.83	0.20	0.68	0.67	0.33	0.60	0.83	0.36	0.77	0.55	0.57
Control Delay	34.6	41.3	6.5	56.2	22.0	6.9	35.6	54.7	12.4	52.4	47.4	8.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.6	41.3	6.5	56.2	22.0	6.9	35.6	54.7	12.4	52.4	47.4	8.9
LOS	C	D	A	E	C	A	D	D	B	D	D	A
Approach Delay		36.9			25.2			44.0			34.1	
Approach LOS		D			C			D			C	
Queue Length 50th (ft)	127	395	6	132	94	3	115	252	20	89	136	0
Queue Length 95th (ft)	#251	485	47	m#242	202	m56	177	318	77	#168	185	79
Internal Link Dist (ft)		603			337			450			290	
Turn Bay Length (ft)	150		150	150		150	150		150	150		150
Base Capacity (vph)	420	1297	655	320	1277	667	365	855	481	216	707	568
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.83	0.20	0.68	0.67	0.33	0.57	0.76	0.34	0.76	0.52	0.55

Intersection Summary

Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 0 (0%), Referenced to phase 2:NWTL and 6:SETL, Start of Green, Master Intersection  
 Natural Cycle: 80  
 Control Type: Actuated-Coordinated

**Timings**  
**1: Vollmer Road & Marksheffel Road**

**Total Traffic Volumes**  
 PM Peak Hour - Year 2040

Maximum v/c Ratio: 0.83  
 Intersection Signal Delay: 34.7 Intersection LOS: C  
 Intersection Capacity Utilization 81.9% ICU Level of Service D  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Vollmer Road & Marksheffel Road

Ø1	Ø2 (R)	Ø3	Ø4
25 s	45 s	15 s	35 s
Ø5	Ø6 (R)	Ø7	Ø8
20 s	50 s	20 s	30 s

Timings  
2: Sterling Ranch Road & Marksheffel Road

Total Traffic Volumes  
PM Peak Hour - Year 2040

Lane Group	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	299	957	18	166	932	476	47	66	142	289	96	216
Future Volume (vph)	299	957	18	166	932	476	47	66	142	289	96	216
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.129			0.226			0.950			0.950		
Satd. Flow (perm)	240	3539	1583	421	3539	1583	1770	1863	1583	3433	1863	1583
Satd. Flow (RTOR)			155			302			164			235
Lane Group Flow (vph)	325	1040	20	180	1013	517	51	72	154	314	104	235
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6		6	2		2			4			8
Detector Phase	1	6	6	5	2	2	7	4	4	3	8	8
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	10.0	24.0	24.0	10.0	24.0	24.0	10.0	24.0	24.0	24.0	24.0	24.0
Total Split (s)	25.0	50.0	50.0	20.0	45.0	45.0	15.0	25.0	25.0	25.0	35.0	35.0
Total Split (%)	20.8%	41.7%	41.7%	16.7%	37.5%	37.5%	12.5%	20.8%	20.8%	20.8%	29.2%	29.2%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.0	6.0	6.0	5.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	C-Max	None	C-Max	C-Max	None	None	None	None	None	None
Act Effct Green (s)	78.9	60.9	60.9	62.4	49.5	49.5	8.3	10.0	10.0	16.1	19.9	19.9
Actuated g/C Ratio	0.66	0.51	0.51	0.52	0.41	0.41	0.07	0.08	0.08	0.13	0.17	0.17
v/c Ratio	0.71	0.58	0.02	0.51	0.69	0.62	0.41	0.46	0.55	0.68	0.34	0.51
Control Delay	47.8	17.5	0.1	16.3	34.0	16.2	63.2	61.4	14.1	57.0	47.5	9.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.8	17.5	0.1	16.3	34.0	16.2	63.2	61.4	14.1	57.0	47.5	9.6
LOS	D	B	A	B	C	B	E	E	B	E	D	A
Approach Delay		24.3			26.8			35.4			38.4	
Approach LOS		C			C			D			D	
Queue Length 50th (ft)	206	143	0	49	343	128	38	54	0	121	74	0
Queue Length 95th (ft)	m279	237	m0	95	#491	287	80	100	55	164	122	68
Internal Link Dist (ft)		382			496			549			405	
Turn Bay Length (ft)	150		150	150		150	150		150	150		150
Base Capacity (vph)	463	1797	880	408	1459	830	147	310	400	572	465	572
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.70	0.58	0.02	0.44	0.69	0.62	0.35	0.23	0.39	0.55	0.22	0.41

Intersection Summary

Cycle Length: 120  
 Actuated Cycle Length: 120  
 Offset: 0 (0%), Referenced to phase 2:NWTL and 6:SETL, Start of Green  
 Natural Cycle: 95  
 Control Type: Actuated-Coordinated

# Timings

## 2: Sterling Ranch Road & Marksheffel Road

Total Traffic Volumes  
PM Peak Hour - Year 2040

Maximum v/c Ratio: 0.71

Intersection Signal Delay: 28.4

Intersection LOS: C

Intersection Capacity Utilization 70.6%

ICU Level of Service C

Analysis Period (min) 15

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Sterling Ranch Road & Marksheffel Road

Ø1	Ø2 (R)	Ø3	Ø4
25 s	45 s	25 s	25 s
Ø5	Ø6 (R)	Ø7	Ø8
20 s	50 s	15 s	35 s

HCM 6th TWSC  
3: Vollmer Road & Business Drive

Total Traffic Volumes  
PM Peak Hour - Year 2040

Intersection						
Int Delay, s/veh	0.6					
Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations	↘	↗	↑↑	↗	↘	↑↑
Traffic Vol, veh/h	6	38	905	15	37	623
Future Vol, veh/h	6	38	905	15	37	623
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	200	200	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	41	984	16	40	677

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	1403	492	0	0	1000
Stage 1	984	-	-	-	-
Stage 2	419	-	-	-	-
Critical Hdwy	6.84	6.94	-	-	4.14
Critical Hdwy Stg 1	5.84	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-
Follow-up Hdwy	3.52	3.32	-	-	2.22
Pot Cap-1 Maneuver	*199	522	-	-	688
Stage 1	*323	-	-	-	-
Stage 2	*800	-	-	-	-
Platoon blocked, %	1	-	-	-	-
Mov Cap-1 Maneuver	*187	522	-	-	688
Mov Cap-2 Maneuver	*187	-	-	-	-
Stage 1	*323	-	-	-	-
Stage 2	*754	-	-	-	-

Approach	NW	NE	SW
HCM Control Delay, s	14.2	0	0.6
HCM LOS	B		

Minor Lane/Major Mvmt	NET	NER	NWLn1	NWLn2	SWL	SWT
Capacity (veh/h)	-	-	187	522	688	-
HCM Lane V/C Ratio	-	-	0.035	0.079	0.058	-
HCM Control Delay (s)	-	-	24.9	12.5	10.6	-
HCM Lane LOS	-	-	C	B	B	-
HCM 95th %tile Q(veh)	-	-	0.1	0.3	0.2	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

HCM 6th TWSC  
4: Business Drive & Marksheffel Road

Total Traffic Volumes  
PM Peak Hour - Year 2040

Intersection						
Int Delay, s/veh	0.1					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑↑	↑		↑↑		↑
Traffic Vol, veh/h	1255	37	0	1195	0	16
Future Vol, veh/h	1255	37	0	1195	0	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	150	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1364	40	0	1299	0	17

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	-	-	682
Stage 1	-	-	-	-	-
Stage 2	-	-	-	-	-
Critical Hdwy	-	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	3.32
Pot Cap-1 Maneuver	-	0	-	0	*567
Stage 1	-	0	-	0	-
Stage 2	-	0	-	0	-
Platoon blocked, %	-	-	-	-	1
Mov Cap-1 Maneuver	-	-	-	-	*567
Mov Cap-2 Maneuver	-	-	-	-	-
Stage 1	-	-	-	-	-
Stage 2	-	-	-	-	-

Approach	SE	NW	NE
HCM Control Delay, s	0	0	11.6
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NWT	SET	SER
Capacity (veh/h)	567	-	-	-
HCM Lane V/C Ratio	0.031	-	-	-
HCM Control Delay (s)	11.6	-	-	-
HCM Lane LOS	B	-	-	-
HCM 95th %tile Q(veh)	0.1	-	-	-

Notes  
 -: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

## **APPENDIX D**

### **Internal Capture Worksheets**



NCHRP 684 Internal Trip Capture Estimation Tool					
Project Name:	Rhetoric Site			Organization:	SM ROCHA LLC
Project Location:				Performed By:	SS
Scenario Description:				Date:	6/16/2022
Analysis Year:				Checked By:	
Analysis Period:	AM Street Peak Hour			Date:	

Table 1-A: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)						
Land Use	Development Data (For Information Only)			Estimated Vehicle-Trips <sup>3</sup>		
	ITE LUCs <sup>1</sup>	Quantity	Units	Total	Entering	Exiting
Office				0		
Retail	822	24	KSF	55	33	22
Restaurant	937	2	KSF	172	88	84
Cinema/Entertainment				0		
Residential	220	504	DU	201	48	153
Hotel				0		
All Other Land Uses <sup>2</sup>	151,945,948	VAR	VAR	229	115	114
				657	284	373

Table 2-A: Mode Split and Vehicle Occupancy Estimates						
Land Use	Entering Trips			Exiting Trips		
	Veh. Occ. <sup>4</sup>	% Transit	% Non-Motorized	Veh. Occ. <sup>4</sup>	% Transit	% Non-Motorized
Office						
Retail	1.17	0%	0%	1.16	0%	0%
Restaurant	1.00	0%	0%	1.00	0%	0%
Cinema/Entertainment						
Residential	1.13	0%	0%	1.09	0%	0%
Hotel						
All Other Land Uses <sup>2</sup>	1.00	0%	0%	1.00	0%	0%

Table 3-A: Average Land Use Interchange Distances (Feet Walking Distance)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-A: Internal Person-Trip Origin-Destination Matrix*						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail	0		3	0	1	0
Restaurant	0	3		0	3	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	2	18	0		0
Hotel	0	0	0	0	0	

Table 5-A: Computations Summary			
	Total	Entering	Exiting
All Person-Trips	687	296	391
Internal Capture Percentage	9%	10%	8%
External Vehicle-Trips <sup>5</sup>	601	255	346
External Transit-Trips <sup>6</sup>	0	0	0
External Non-Motorized Trips <sup>6</sup>	0	0	0

Table 6-A: Internal Trip Capture Percentages by Land Use		
Land Use	Entering Trips	Exiting Trips
Office	N/A	N/A
Retail	13%	15%
Restaurant	24%	7%
Cinema/Entertainment	N/A	N/A
Residential	7%	12%
Hotel	N/A	N/A

<sup>1</sup>Land Use Codes (LUCs) from *Trip Generation Manual*, published by the Institute of Transportation Engineers.

<sup>2</sup>Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.

<sup>3</sup>Enter trips assuming no transit or non-motorized trips (as assumed in ITE *Trip Generation Manual*).

<sup>4</sup>Enter vehicle occupancy assumed in Table 1-A vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments must be made to Tables 5-A, 9-A (O and D). Enter transit, non-motorized percentages that will result with proposed mixed-use project complete.

<sup>5</sup>Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A.

<sup>6</sup>Person-Trips

\*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas A&M Transportation Institute - Version 2013.1

<b>Project Name:</b>	Rhetoric Site
<b>Analysis Period:</b>	AM Street Peak Hour

Land Use	Table 7-A (D): Entering Trips			Table 7-A (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	0	0	1.00	0	0
Retail	1.17	33	39	1.16	22	26
Restaurant	1.00	88	88	1.00	84	84
Cinema/Entertainment	1.00	0	0	1.00	0	0
Residential	1.13	48	54	1.09	153	167
Hotel	1.00	0	0	1.00	0	0

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	8		3	0	4	0
Restaurant	26	12		0	3	3
Cinema/Entertainment	0	0	0		0	0
Residential	3	2	33	0		0
Hotel	0	0	0	0	0	

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		12	20	0	0	0
Retail	0		44	0	1	0
Restaurant	0	3		0	3	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	7	18	0		0
Hotel	0	2	5	0	0	

Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles <sup>1</sup>	Transit <sup>2</sup>	Non-Motorized <sup>2</sup>
Office	0	0	0	0	0	0
Retail	5	34	39	29	0	0
Restaurant	21	67	88	67	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	4	50	54	44	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses <sup>3</sup>	0	115	115	115	0	0

Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles <sup>1</sup>	Transit <sup>2</sup>	Non-Motorized <sup>2</sup>
Office	0	0	0	0	0	0
Retail	4	22	26	19	0	0
Restaurant	6	78	84	78	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	20	147	167	135	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses <sup>3</sup>	0	114	114	114	0	0

<sup>1</sup>Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A  
<sup>2</sup>Person-Trips  
<sup>3</sup>Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator  
\*Indicates computation that has been rounded to the nearest whole number.

NCHRP 684 Internal Trip Capture Estimation Tool			
Project Name:	Rhetoric Site	Organization:	SM ROCHA LLC
Project Location:		Performed By:	SS
Scenario Description:		Date:	6/16/2022
Analysis Year:		Checked By:	
Analysis Period:	PM Street Peak Hour	Date:	

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)						
Land Use	Development Data (For Information Only)			Estimated Vehicle-Trips <sup>3</sup>		
	ITE LUCs <sup>1</sup>	Quantity	Units	Total	Entering	Exiting
Office				0		
Retail	822	24	KSF	154	77	77
Restaurant	937	2	KSF	78	39	39
Cinema/Entertainment				0		
Residential	220	504	DU	257	162	95
Hotel				0		
All Other Land Uses <sup>2</sup>	151,945,948	VAR	VAR	344	172	172
				833	450	383

Table 2-P: Mode Split and Vehicle Occupancy Estimates						
Land Use	Entering Trips			Exiting Trips		
	Veh. Occ. <sup>4</sup>	% Transit	% Non-Motorized	Veh. Occ. <sup>4</sup>	% Transit	% Non-Motorized
Office						
Retail	1.21	0%	0%	1.18	0%	0%
Restaurant	1.27	0%	0%	1.30	0%	0%
Cinema/Entertainment						
Residential	1.15	0%	0%	1.21	0%	0%
Hotel						
All Other Land Uses <sup>2</sup>	1.00	0%	0%	1.00	0%	0%

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-P: Internal Person-Trip Origin-Destination Matrix*						
Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	0		15	0	24	0
Restaurant	0	21		0	9	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	9	7	0		0
Hotel	0	0	0	0	0	

Table 5-P: Computations Summary			
	Total	Entering	Exiting
All Person-Trips	930	501	429
Internal Capture Percentage	18%	17%	20%
External Vehicle-Trips <sup>5</sup>	693	379	314
External Transit-Trips <sup>6</sup>	0	0	0
External Non-Motorized Trips <sup>6</sup>	0	0	0

Table 6-P: Internal Trip Capture Percentages by Land Use		
Land Use	Entering Trips	Exiting Trips
Office	N/A	N/A
Retail	32%	43%
Restaurant	44%	59%
Cinema/Entertainment	N/A	N/A
Residential	18%	14%
Hotel	N/A	N/A

<sup>1</sup>Land Use Codes (LUCs) from *Trip Generation Manual*, published by the Institute of Transportation Engineers.

<sup>2</sup>Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.

<sup>3</sup>Enter trips assuming no transit or non-motorized trips (as assumed in ITE *Trip Generation Manual*).

<sup>4</sup>Enter vehicle occupancy assumed in Table 1-P vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments must be made.

<sup>5</sup>Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P.

<sup>6</sup>Person-Trips

\*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas A&M Transportation Institute - Version 2013.1

<b>Project Name:</b>	Rhetoric Site
<b>Analysis Period:</b>	PM Street Peak Hour

Land Use	Table 7-P (D): Entering Trips			Table 7-P (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	0	0	1.00	0	0
Retail	1.21	77	93	1.18	77	91
Restaurant	1.27	39	50	1.30	39	51
Cinema/Entertainment	1.00	0	0	1.00	0	0
Residential	1.15	162	186	1.21	95	115
Hotel	1.00	0	0	1.00	0	0

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	2		26	4	24	5
Restaurant	2	21		4	9	4
Cinema/Entertainment	0	0	0		0	0
Residential	5	48	24	0		3
Hotel	0	0	0	0	0	

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		7	1	0	7	0
Retail	0		15	0	86	0
Restaurant	0	47		0	30	0
Cinema/Entertainment	0	4	2		7	0
Residential	0	9	7	0		0
Hotel	0	2	3	0	0	

Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles <sup>1</sup>	Transit <sup>2</sup>	Non-Motorized <sup>2</sup>
Office	0	0	0	0	0	0
Retail	30	63	93	52	0	0
Restaurant	22	28	50	22	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	33	153	186	133	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses <sup>3</sup>	0	172	172	172	0	0

Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles <sup>1</sup>	Transit <sup>2</sup>	Non-Motorized <sup>2</sup>
Office	0	0	0	0	0	0
Retail	39	52	91	44	0	0
Restaurant	30	21	51	16	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	16	99	115	82	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses <sup>3</sup>	0	172	172	172	0	0

<sup>1</sup>Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P

<sup>2</sup>Person-Trips

<sup>3</sup>Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator


\*Indicates computation that has been rounded to the nearest whole number.

# ENG-P22016-R1-TIS.pdf Markup Summary


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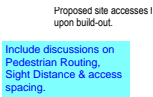


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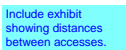


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CDurham (11)



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**Subject:** Callout  
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**Date:** 8/23/2022 1:17:14 PM  
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**Subject:** Callout  
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**Date:** 8/23/2022 1:18:27 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Traffic calming may be necessary on Business Drive. Can be examined during Preliminary Plan submittal



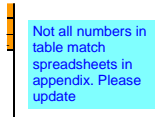
**Subject:** Text Box  
**Page Label:** 13  
**Author:** CDurham  
**Date:** 8/23/2022 1:21:34 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Include reference to report for Sterling Ranch East Minor Plan Amend (SKP224) & Preliminary Plan (SP224)



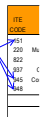
**Subject:** Text Box  
**Page Label:** 14  
**Author:** CDurham  
**Date:** 8/23/2022 1:22:41 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

State whether S.R.R. south of Marksheffel is constructed or not.



**Subject:** Text Box  
**Page Label:** 20  
**Author:** CDurham  
**Date:** 8/23/2022 1:24:04 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Not all numbers in table match spreadsheets in appendix. Please update



**Subject:** Callout  
**Page Label:** 21  
**Author:** CDurham  
**Date:** 8/23/2022 1:25:00 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

From previous paragraph, these 3 items do not have a reduction, why is one shown in table?

CWT	670				32
Other	14%	9%	9%	9%	18%
Total	8,919	259	340	559	369

Include description on how this % was obtained or interim capture VTR. Reference Table 6 I to generate approximately 8,919 daily trip

**Subject:** Callout  
**Page Label:** 21  
**Author:** CDurham  
**Date:** 8/23/2022 1:25:21 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Include description on how this % was obtained.

1. The various scenarios and comparison were implemented based on all conservative assumptions defined in this appendix. The study shall take all future levels of service comparable to Year 2040 background traffic volume base long-term operations at LOS 'C' or better during peak traffic.

Include discussion on accel/decel lanes per City comments for Vollmer & Marksheffel, as well as for Sterling Ranch Road. Ensure these lanes work with access spacing.

Notes and Presentation Comments

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**Subject:** Text Box  
**Page Label:** 30  
**Author:** CDurham  
**Date:** 8/23/2022 1:26:56 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Include discussion on accel/decel lanes per City comments for Vollmer & Marksheffel, as well as for Sterling Ranch Road. Ensure these lanes work with access spacing.

Sterling Ranch Road intersections will need to be included in analysis and discussions.

---

**Subject:** Text Box  
**Page Label:** 30  
**Author:** CDurham  
**Date:** 8/23/2022 1:30:02 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Sterling Ranch Road intersections will need to be included in analysis and discussions.



# ENG-P22016-R1-TIS.pdf Markup Summary

CDurham (11)

Proposed site accesses upon build-out.

Include discussions on Pedestrian Routing, Sight Distance & access spacing.

**Subject:** Text Box  
**Page Label:** 30  
**Author:** CDurham  
**Date:** 8/23/2022 1:12:56 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Include discussions on Pedestrian Routing, Sight Distance & access spacing.

Include exhibit showing distances between accesses.

**Subject:** Text Box  
**Page Label:** 7  
**Author:** CDurham  
**Date:** 8/23/2022 1:13:48 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Include exhibit showing distances between accesses.



**Subject:** Callout  
**Page Label:** 7  
**Author:** CDurham  
**Date:** 8/23/2022 1:17:14 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Are these accesses Full or R In/R Out? It not likely full movements will be allowed at both.



**Subject:** Callout  
**Page Label:** 7  
**Author:** CDurham  
**Date:** 8/23/2022 1:18:27 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Traffic calming may be necessary on Business Drive. Can be examined during Preliminary Plan submittal



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**Page Label:** 13  
**Author:** CDurham  
**Date:** 8/23/2022 1:21:34 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Include reference to report for Sterling Ranch East Minor Plan Amend (SKP224) & Preliminary Plan (SP224)



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**Author:** CDurham  
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State whether S.R.R. south of Marksheffel is constructed or not.

Not all numbers in table match spreadsheets in appendix. Please update

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**Author:** CDurham  
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**Color:** ■  
**Layer:**  
**Space:**

From previous paragraph, these 3 items do not have a reduction, why is one shown in table?

CWT	670	*	*	*	32
ation:	14%	9%	9%	9%	18%
Total	8,919	229	340	599	369

Include description on how this % was obtained.

**Subject:** Callout  
**Page Label:** 21  
**Author:** CDurham  
**Date:** 8/23/2022 1:25:21 PM  
**Status:**  
**Color:** ■  
**Layer:**  
**Space:**

Include description on how this % was obtained.

Vehicle discussion on accelerated lanes per City comments for Vollmer & Marksheffel, as well as for Sterling Ranch Road. Ensure these lanes work with access spacing.

**Subject:** Text Box  
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**Author:** CDurham  
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Include discussion on accel/decel lanes per City comments for Vollmer & Marksheffel, as well as for Sterling Ranch Road. Ensure these lanes work with access spacing.

Sterling Ranch Road intersections will need to be included in analysis and discussions.

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Sterling Ranch Road intersections will need to be included in analysis and discussions.