HEXAGON TRANSPORTATION CONSULTANTS, INC.

1155 & 1175 Aster Avenue

Final Transportation Impact Analysis

Prepared for:

City of Sunnyvale

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AUTO TRIP REDUCTION STATEMENT

UPDATED: October 2014

SANTA CLARA Valley Transportation Authority

PROJECT INFORMATION				Relevant TIA Section:	Chapter 1
Project Name: 1155 & 1175 Aster Avenue Residential Development					
Location: 1155 & 1175 Aster Avenue, Sunnyvale					
Description: The project proposes to demolish the existing industrial facilities on-site and construct a residential complex including 412 apartments, 189 condominiums, 140 townhomes, an approximately 2-acre park and a 1,500 square foot coffee shop.					
Size (net new):	741	*D.U. Residential*	1500	*Sq. Ft. Comm.*	*Acres (Gr.)*
Density:	51	*D.U. / Acre*			*Floor Area Ratio (FAR)*
Located within 2000 feet walking distance of an LRT, BRT, BART or Caltrain station or major bus stop? Yes					

PROJECT AUTO TRIP GENERATION				Relevant TIA Section:	Chapter 4
Auto Trips Generated:	268 net	*AM Pk Hr*	299 net	*PM Pk Hr*	3788 net *Total Weekday*
Methodology (check one)	☒ **ITE**		☐ **Other** *(Please describe below)*		

AUTO TRIP REDUCTION APPROACH	Relevant TIA Section:	Chapter 4	
☒ **Standard** *Complete Table A below*	☐ **Peer/Study-Based** *Complete Table B below*	☐ **Target-Based** *Complete Table C below*	☐

TRIP REDUCTION REQUIREMENTS	Relevant TIA Sectio	
Is the project required to meet any trip reduction requirements or targets? Yes/No	**If so, specify percent:**	
Reference code or r		

A. STANDARD APPROACH		Relevant TIA Section:	Chapter 4		
Type of Reduction *Specify reduction. See Table 2 in TIA Guidelines*		**% Reduction from ITE Rates**	**Total Trips Reduced (AM/PM/Daily)**	**TOTAL REDUCTION CLAIMED**	
				%	**Trips**
Transit	Within 2,000-foot walk of Caltrain station	9%	23/31/386	24% AM/ 15% PM/ 14% Daily	105 AM/ 61 PM/ 686 Daily
Mixed-Use	Housing-Retail Mixed-Use	15%	44/16/162		
Financial Incentives					
Shuttle					

B. PEER/STUDY-BASED APPROACH		N/A	
Basis of Reduction		**TOTAL REDUCTION CLAIMED**	
		%	**Trips**

C. TARGET-BASED APPROACH		Relevant TIA Section:	N/A		
Type of Reduction (check all that apply)				TOTAL REDUCTION CLAIMED	
☐ % Trip Reduction	☐ % SOV mode share	☐ Trip Cap		%	Trips
Description					
Time period for reduction	Peak Hour	Peak Period	Full Day		
	☐ AM/PM	AM/PM	☐		

OTHER TDM/REDUCTION MEASURES			
Bicycle/Pedestrian	Yes	Relevant TIA Section:	Chapter 5
Install a crosswalk along the west leg of the Willow Avenue and Aster Avenue intersection. Install sidewalks along its Willow Avnueue and Aster Avnueue frontages. Widen the bike lanes on Aster Avenue fronting the project site to six feet. Install bike lanes along its Willow Avenue frontage. Provide long-term bike lockers in accordance with LSAP requirements.			
Parking Management	No		
Transit	No	Relevant TIA Section:	
Site Planning and Design	Yes	Relevant TIA Section:	Chapter 4
The project is located directly adjacent to the Lawrence Caltrain station.			
TDM Program	No	Relevant TIA Section:	

IMPLEMENTATION	Relevant TIA Section:	N/A
Have the project sponsor and Lead Agency agreed to any of the following measures?		
☐Monitoring		
☐Enforcement		
☐Data Sharing		

Executive Summary

This report presents the results of the transportation impact analysis (TIA) conducted for a residential project proposed on a 16.82-acre site located at 1155 and 1175 Aster Ave in Sunnyvale, California. The project proposes to demolish the existing industrial facilities on-site and construct a residential complex including 412 apartments, 189 condominiums, 140 townhomes, an approximately 2-acre park and a 1,500 square foot (s.f.) coffee shop. Access to the site would be provided via Aster Avenue and Willow Avenue.

This study was conducted for the purpose of identifying the potential near-term traffic impacts related to the proposed development. Because the project is consistent with the recently-adopted Lawrence Station Area Plan (LSAP), potential long-term traffic impacts have already been studied in the *Lawrence Station Area-Wide Transportation Plan and Near-Term TIA* dated December 18, 2015, prepared by Hexagon Transportation Consultants, Inc.

Project Trip Generation

Trip generation resulting from new development proposed within the City of Sunnyvale typically is estimated using the trip rates published in the Institute of Transportation Engineers' (ITE) *Trip Generation Manual, 10th Edition (2017)*. Trip generation rates for the proposed apartments and condominiums are based on the average rates published for "Multifamily Housing (Mid Rise)" (Land Use Code 221). Trip generation rates for the proposed townhomes are based on the average rates published for "Multifamily Housing (Low Rise)" (Land Use Code 220). Trip Generation rates for the proposed coffee shop are based on the average rates published for "Coffee/Donut Shop without Drive-Through Window" (Land Use Code 936).

Trip Reductions

A mixed-use development with complementary land uses such as residential and retail will generate and attract trips internally between the uses. Thus, the number of vehicle trips generated for each use may be reduced, since a portion of the trips would not require entering or exiting the site. The VTA's *Congestion Management Program Transportation Impact Analysis Guidelines* (October 2014) indicates a trip reduction of up to 15 percent is allowed for residential and retail mixed-use developments. The reduction is first applied to the smaller of the two complimentary trip generators (in this case, the retail use), and the same number of trips is then subtracted from the larger trip generator (in this case, the residential use) to account for both trip ends. Trip reductions also factor in that this project is also a Transit Oriented Development (TOD) due to its proximity to the Caltrain station. The VTA's CMP TIA guidelines indicate a trip reduction of up to 9% is allowed for residential uses within a 2,000-foot walk of a Caltrain station. Also, the coffee shop trip generation can be reduced due to Diverted Linked trips. Diverted Link trips are generated by traffic that diverts from its current route to include a stop by the coffee shop, and then ultimately continues on its original path. As documented in the Institute of Transportation Engineers' (ITE) *Trip Generation Handbook, 3rd Edition,* coffee shops have, on average, pass-by trips accounting for 89% of all trips. Since the proposed coffee shop is not located on a busy street where trips could pass-by on their way to their final destination, Hexagon assumed that these trips would instead divert slightly from their original route to the coffee shop. For the purpose of this analysis, Hexagon assumed that the coffee shop could have as high as 89% of all trips be diverted-linked trips. However, the VTA's CMP TIA guidelines indicate a trip reduction of up to 30% is allowed for retail uses to account for diverted-linked trips. Therefore, a 30% diverted-linked trip reduction was applied for the coffee shop trips.

In addition, the proposed project would receive trip credits for the trips generated by the existing on-site use. AM and PM peak hour counts were collected at the existing site driveways on Thursday, May 17, 2018.

Net Project Trips

After applying the ITE trip generation rates and the applicable trip reductions, the proposed project is estimated to generate a net increase of 268 vehicle trips during the AM peak hour (71 inbound and 197 outbound) and 299 vehicle trips during the PM peak hour (189 inbound and 110 outbound).

The trip generation for the proposed project is summarized in Table ES-1.

Table ES- 1
Trip Generation Summary

Land Use	Size	Daily Rate[1]	Daily Trips	AM Peak Hour Rate[1]	AM Peak Hour In	AM Peak Hour Out	AM Peak Hour Total	PM Peak Hour Rate[1]	PM Peak Hour In	PM Peak Hour Out	PM Peak Hour Total
Proposed											
Residential											
Apartments[2]	412 d.u.	5.44	2,241	0.36	38	110	148	0.44	110	71	181
Condominiums[2]	189 d.u.	5.44	1028	0.36	18	50	68	0.44	51	32	83
Townhomes[3]	140 d.u.	7.32	1025	0.46	15	49	64	0.56	49	29	78
Gross Residential Trips			4,294		71	209	280		210	132	342
Mixed-Use Reduction[4]			*(81)*		*(11)*	*(11)*	*(22)*		*(4)*	*(4)*	*(8)*
Transit Reduction[5]			*(386)*		*(5)*	*(18)*	*(23)*		*(19)*	*(12)*	*(31)*
Net New Residential Trips			*3,827*		*55*	*180*	*235*		*187*	*116*	*303*
Commercial											
Coffee Shop[6]	1,500 s.f.	360	540	101.14	78	74	152	36.31	27	27	54
Mixed-Use Reduction[4]			*(81)*		*(11)*	*(11)*	*(22)*		*(4)*	*(4)*	*(8)*
Diverted Linked Reduction[7]			*(138)*		*(19)*	*(19)*	*(38)*		*(7)*	*(7)*	*(14)*
Net New Commercial Trips			*321*		*48*	*44*	*92*		*16*	*16*	*32*
Subtotal Net New Project Trips			**4,148**		**103**	**224**	***327***		**203**	**132**	***335***
Existing											
Driveway Counts[8]			(360)		(32)	(27)	(59)		(14)	(22)	(36)
Net Project Trips			**3,788**		**71**	**197**	**268**		**189**	**110**	**299**

Notes

d.u. = dwelling units, s.f. = square feet

[1] Rate expressed in trips per d.u. for the residential units and trips per 1,000 s.f. for the coffee shop.

[2] Trip generation rates for the proposed apartments and condominiums are based on the ITE's *Trip Generation Manual, 10th Edition* average rates published for "Multifamily Housing (Mid-Rise)" (Land Use Code 221).

[3] Trip generation rates for the proposed townhomes are based on the ITE's *Trip Generation Manual, 10th Edition* average rates published for "Multifamily Housing (Low-Rise)" (Land Use Code 220).

[4] As prescribed by the *VTA Transportation Impact Analysis Guidelines, 2014* , a maximum trip reduction of 15% of the smaller trip generator for mixed-use development projects with housing and retail components was applied to project's trip generation.

[5] As prescribed by the *VTA Transportation Impact Analysis Guidelines, 2014* , a maximum trip reduction of 9% for housing within a 2,000 foot walk of a Caltrain station was applied to proposed residential units. Note that the transit reduction is applied after the mixed-use trip reduction.

[6] The peak hour trip generation rates for the proposed coffee shop are based on the ITE's *Trip Generation Manual, 10th Edition* average rates published for "Coffee/Donut Shop without Drive-Through Window" (Land Use Code 936). The daily trips is derived from the assumption that the PM peak hour represents 10% of the total daily vehicle trips.

[7] As prescribed by the *VTA Transportation Impact Analysis Guidelines, 2014* , a maximum trip reduction of 30% for diverted linked trips was applied to the coffee shop trips. Note that the diverted linked trip reduction is applied after the mixed-use trip reduction.

[8] Existing AM and PM peak-hour driveway counts were collected on Thursday, May 17, 2018. The existing daily trips is derived from the assumption that the PM peak hour represents 10% of the total daily vehicle trips.

Intersection Level of Service Results

The intersection level of service analysis (see Tables ES-2 and ES-3) showed that based on City of Sunnyvale intersection impact criteria, the project would generate a significant intersection impact at the unsignalized study intersection of Willow Avenue and Reed Avenue during both the AM and PM peak hours.

Mitigation Strategy

Mitigation would require installing a sign restricting left-turns from southbound Willow Avenue onto Reed Avenue during the AM (7-9 AM) and PM (4-6 PM) peak periods. With the proposed left-turn restriction during the peak hours, the intersection at Willow Avenue and Reed Avenue would operate at acceptable levels of service. It is assumed that vehicles on southbound Willow Avenue heading to eastbound Reed Avenue would instead turn right onto westbound Reed Avenue first and then perform a legal U-turn on Reed Avenue west of Willow Avenue. The added westbound U-turns on Reed Avenue would not deteriorate roadway operations, thus the proposed mitigation would not create secondary impacts at other locations. With the proposed mitigation, the project impact at the intersection of Willow Avenue and Reed Avenue would be *less than significant*. The project applicant will be responsible for the cost of the proposed mitigation.

Freeway Impacts

The results of the CMP freeway analysis show that the freeway segments currently operating at acceptable levels of service would continue to operate at acceptable levels of service under project conditions. For freeway segments currently operating at unacceptable LOS F, the project generated freeway traffic would not exceed 1%, thus the project freeway impacts would be less than significant.

Freeway Ramp Impacts

The results of the ramp analysis show that the study freeway ramps currently have sufficient capacity to service the existing traffic volumes and the ramps would continue to have sufficient capacity to serve the project traffic volumes under project conditions.

Other Transportation Issues

Hexagon conducted a site plan review, queuing analysis, pedestrian, bicycle and transit facility analysis and parking analysis for the proposed project. Our recommendations are listed below.

Recommendations

- The project proposes a mid-block crosswalk across Aster Avenue at the western end of the project site. Mid-block crosswalks should be installed only after an engineering study determining the feasibility of the crosswalk. The project applicant shall coordinate with City staff to determine the need for a mid-block crosswalk across Aster Avenue at the western end of the project site upon project completion.
- The project applicant shall ensure that there would not be tall vegetation or objects that could block a driver's view 200 feet down the road as they exit the project driveways on Aster Avenue.
- The site plan shows multiple dead-end aisles inside the parking garages. The project applicant shall ensure that parking spaces next to the dead-end aisles are provided sufficient turn-around space.
- To minimize potential conflict of use between loading trucks and trash staging at the two shared-use loading/trash staging areas, it is recommended that the trash bins for the condominiums and apartment be placed in the loading zone only on garbage collection day and that they be removed after the garbage has been collected.
- The project applicant shall ensure the adequate number of accessible parking spaces are located within the condominium garages. The project applicant shall also ensure the van accessible spaces are clearly indicated.

Table ES- 2
Signalized Intersection Level of Service Summary

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing			Existing Plus Project				Background		Background Plus Project			
					Count Date	Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c	Avg. Delay	LOS	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c
1	Fair Oaks Avenue & US 101 NB Ramps	Signal	E	AM	05/08/18	29.7	C	34.9	C-	8.9	0.016	47.2	D	50.9	D	6.1	0.016
				PM	05/08/18	31.3	C	32.0	C	0.8	0.015	48.8	D	50.6	D	2.1	0.015
2	Fair Oaks Avenue & Duane Avenue	Signal	D	AM	05/08/18	36.1	D+	36.1	D+	-0.1	0.001	37.4	D+	37.7	D+	0.0	0.001
				PM	05/08/18	35.7	D+	35.7	D+	-0.1	0.007	39.5	D	39.7	D	0.4	0.007
3	Fair Oaks Avenue & Evelyn Avenue	Signal	D	AM	05/08/18	46.5	D	46.7	D	0.2	0.003	51.7	D-	51.9	D-	0.3	0.002
				PM	05/08/18	39.5	D	39.6	D	0.0	0.002	49.9	D	49.9	D	0.0	0.002
4	Wolfe Road & Stewart Drive	Signal	D	AM	11/15/17	14.5	B	14.2	B	-0.2	0.002	13.7	B	13.5	B	-0.2	0.002
				PM	11/15/17	27.8	C	27.6	C	-0.6	0.006	26.8	C	26.7	C	-0.3	0.005
5	Wolfe Road & Arques Avenue	Signal	D	AM	11/14/17	49.4	D	49.6	D	-0.2	0.001	52.0	D-	52.2	D-	-0.1	0.001
				PM	11/14/17	43.9	D	43.5	D	-0.2	0.010	44.5	D	44.2	D	-0.2	0.009
6	Wolfe Road & Central Expressway Ramps	Signal	E	AM	12/06/17	37.4	D+	38.8	D+	5.7	0.014	59.3	E+	63.7	E	11.6	0.014
				PM	12/06/17	**84.4**	**F**	**85.5**	**F**	**1.5**	**0.018**	**110.7**	**F**	**112.0**	**F**	**1.8**	**0.019**
7	Wolfe Road & Kifer Road	Signal	D	AM	11/14/17	26.2	C	26.0	C	-0.4	0.003	36.7	D+	36.6	D+	0.0	0.012
				PM	11/14/17	36.8	D+	37.2	D+	-0.7	0.007	46.5	D	46.5	D	-1.2	0.007
8	Wolfe Road & Evelyn Avenue	Signal	D	AM	11/15/17	34.3	C-	35.9	D+	2.5	0.040	34.4	C-	36.2	D+	2.8	0.040
				PM	11/15/17	35.8	D+	32.8	C-	31.1	-0.154	34.0	C-	32.3	C-	31.1	-0.164
9	Wolfe Road & Old San Francisco Road/Reed Avenue	Signal	D	AM	11/14/17	38.5	D+	39.4	D	0.4	0.010	37.4	D+	38.3	D+	0.4	0.009
				PM	11/14/17	41.2	D	42.0	D	0.9	0.018	41.5	D	42.3	D	0.9	0.018
10	Wolfe Road & El Camino Real*	Signal	E	AM	11/14/17	61.1	E	61.0	E	0.0	0.000	63.3	E	63.3	E	0.0	0.000
				PM	11/10/16	43.0	D	43.0	D	0.1	0.001	43.9	D	43.9	D	0.0	0.001
11	Wolfe Road & Fremont Avenue	Signal	D	AM	11/14/17	39.7	D	39.7	D	-0.1	0.002	39.9	D	39.9	D	0.0	0.003
				PM	11/14/17	49.5	D	49.4	D	0.1	0.000	50.8	D	50.7	D	0.0	0.001
12	Sequoia Drive & Reed Avenue	Signal	D	AM	05/15/18	14.2	B	14.6	B	0.7	0.037	14.2	B	14.6	B	0.7	0.037
				PM	05/15/18	13.5	B	13.5	B	0.0	0.013	13.5	B	13.5	B	0.0	0.013
13	Evelyn Avenue & Aster Avenue	Signal	D	AM	05/15/18	14.1	B	15.5	B	1.5	0.093	14.2	B	15.7	B	1.6	0.094
				PM	05/15/18	13.3	B	14.7	B	3.5	-0.116	13.6	B	14.8	B	3.9	-0.096
14	Evelyn Avenue & Reed Avenue	Signal	D	AM	11/15/17	9.5	A	9.7	A	0.1	0.023	9.5	A	9.7	A	0.1	0.024
				PM	11/15/17	12.0	B+	12.2	B	0.4	0.024	12.0	B	12.2	B	0.3	0.025
16	Timberpine Avenue & Reed Avenue	Signal	D	AM	05/15/18	20.3	C+	20.2	C+	0.0	0.004	20.3	C+	20.2	C+	0.0	0.004
				PM	05/15/18	17.6	B	17.7	B	-0.1	0.004	17.6	B	17.7	B	-0.1	0.004
19	Lawrence Expressway & US 101 NB Ramps (County)	Signal	E	AM	04/04/17	10.0	B+	10.0	B+	0.0	0.003	10.6	B+	10.6	B+	0.0	0.003
				PM	04/04/17	13.8	B	13.8	B	0.2	0.006	15.1	B	15.4	B	0.5	0.007
20	Lawrence Expressway & US 101 SB Ramps (County)	Signal	E	AM	04/04/17	6.6	A	6.5	A	0.0	0.003	7.3	A	7.3	A	-0.1	0.004
				PM	04/04/17	71.5	E	70.9	E	-1.3	0.006	**88.9**	**F**	**88.2**	**F**	**-1.3**	**0.006**
21	Lawrence Expressway & Oakmead Parkway/Duane Avenue (County)	Signal	E	AM	04/04/17	44.0	D	44.5	D	0.9	0.006	67.4	E	69.4	E	3.6	0.006
				PM	04/04/17	53.5	D-	53.9	D-	0.7	0.006	**85.2**	**F**	**87.4**	**F**	**4.5**	**0.006**
22	Lawrence Expressway & Arques Avenue* (County)	Signal	E	AM	04/04/17	48.2	D	48.6	D	0.7	0.006	59.7	E+	61.1	E	2.5	0.006
				PM	10/04/16	68.1	E	68.2	E	0.3	0.007	**84.3**	**F**	**86.4**	**F**	**3.6**	**0.007**
23	Lawrence Expressway & Kifer Road (County)	Signal	E	AM	03/07/18	54.4	D-	56.8	E+	3.7	0.007	**80.8**	**F**	**83.4**	**F**	**3.9**	**0.008**
				PM	03/07/18	**101.6**	**F**	**102.0**	**F**	**-1.0**	**0.004**	**>120**	**F**	**>120**	**F**	**-1.0**	**0.004**
24	Lawrence Expressway & Monroe Street/Reed Avenue* (County)	Signal	E	AM	03/07/18	**114.8**	**F**	**116.3**	**F**	**2.8**	**0.016**	**>120**	**F**	**>120**	**F**	**2.8**	**0.015**
				PM	10/05/16	74.1	E	74.0	E	3.4	0.131	**83.8**	**F**	**87.1**	**F**	**5.6**	**0.008**
25	Lawrence Expressway & Cabrillo Avenue (County)	Signal	E	AM	03/07/18	52.1	D-	52.0	D-	0.2	0.001	66.2	E	66.2	E	0.2	0.000
				PM	03/07/18	48.6	D	48.9	D	-0.2	0.004	60.7	E	61.3	E	1.1	0.002
26	Lawrence Expressway & El Camino Real Ramps* (SC)	Signal	E	AM	03/07/18	34.5	C-	34.7	C-	0.2	0.002	35.1	D+	35.3	D+	0.2	0.002
				PM	11/10/16	29.9	C	29.9	C	0.1	0.002	30.9	C	31.0	C	0.1	0.002
29	Monticello Way & Monroe Street (SC)	Signal	D	AM	05/15/18	7.8	A	7.7	A	-0.1	0.005	7.8	A	7.7	A	-0.1	0.005
				PM	05/15/18	5.6	A	5.5	A	0.0	0.002	5.6	A	5.5	A	0.0	0.002

Notes

** = CMP, SC = Santa Clara, County = County of Santa Clara*

Level of service for signal controlled intersection is based on the average intersection delay.

">120" indicates the intersection experiences lengthy delay that is beyond the reasonable calculation range of the HCM 2000 methodology.

BOLD indicates substandard level of service.

Table ES- 3
Unsignalized Intersection Level of Service Summary

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing				Existing Plus Project					Background			Background Plus Project				
					Count Date	Avg. Delay (sec)	LOS	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c	Signal Warrant Met[1]
15	Willowbend Driveway & Aster Avenue	Side Street Stop	D	AM	05/15/18	10.2	B	-	11.1	B	0.9	0.003	-	10.3	B	-	11.2	B	0.9	0.003	-
				PM	05/15/18	10.7	B	-	11.9	B	1.2	0.001	-	10.8	B	-	12.1	B	1.3	0.001	-
17	Willow Avenue & Reed Avenue	Side Street Stop	D	AM	05/15/18	26.2	D	No	**43.5**	**E**	**17.3**	**0.282**	**Yes**	26.3	D	No	**43.8**	**E**	**17.5**	**0.283**	**Yes**
				PM	05/15/18	**52.6**	**F**	**Yes**	**85.6**	**F**	**33.0**	**0.215**	**Yes**	**53.2**	**F**	**Yes**	**86.9**	**F**	**33.7**	**0.217**	**Yes**
18	Willow Avenue & Aster Avenue	Side Street Stop	D	AM	05/15/18	9.1	A	-	10.1	B	1.0	0.045	-	9.1	A	-	10.1	B	1.0	0.045	-
				PM	05/15/18	9.6	A	-	11.1	B	1.5	0.044	-	9.6	A	-	11.1	B	1.5	0.044	-
27	French Street & Agate Drive (SC)	All Way Yield	D	AM	05/15/18	5.0	A	-	4.7	A	-	-	-	5.0	A	-	4.7	A	-	-	-
				PM	05/15/18	7.0	A	-	6.7	A	-	-	-	7.0	A	-	6.7	A	-	-	-
28	Monticello Way & Agate Drive (SC)	All Way Stop	D	AM	05/15/18	7.2	A	-	7.2	A	-	-	-	7.2	A	-	7.2	A	-	-	-
				PM	05/15/18	7.2	A	-	7.3	A	-	-	-	7.2	A	-	7.3	A	-	-	-

Notes

SC = Santa Clara

Level of service for side street stop controlled intersections is based on the delay experienced by the worst movement. Level of service for all way yield and all way stop controlled intersections is based on the average intersection delay.

BOLD indicates substandard level of service.

BOLD and boxed indicates a significant impact.

[1] The CA MUTCD peak-hour signal warrant is checked only if the intersection is operating at an unacceptable level of service.

1. Introduction

This report presents the results of the transportation impact analysis (TIA) conducted for a residential project proposed on a 16.82-acre site located at 1155 and 1175 Aster Ave in Sunnyvale, California (see Figure 1). The project proposes to demolish the existing industrial facilities on-site and construct a residential complex including 412 apartments, 189 condominiums, 140 townhomes, an approximately 2-acre park and a 1,500 square foot (s.f.) coffee shop. Access to the site would be provided via Aster Avenue and Willow Avenue (see Figure 2).

Scope of Study

This study was conducted for the purpose of identifying the potential near-term traffic impacts related to the proposed development. Because the project is consistent with the recently-adopted Lawrence Station Area Plan (LSAP), potential long-term traffic impacts have already been studied in the *Lawrence Station Area-Wide Transportation Plan and Near-Term TIA* dated December 18, 2015, prepared by Hexagon Transportation Consultants, Inc.

Since the project is estimated to generate more than 100 peak hour trips, the potential impacts of the project were evaluated following the standards and methodologies set forth by the City of Sunnyvale and the Santa Clara Valley Transportation Authority (VTA). The VTA administers the County Congestion Management Program (CMP). The traffic study includes an analysis of AM and PM peak hour traffic conditions for 29 intersections in the vicinity of the project site. Four of the study intersections are CMP intersections. Five of the study intersections are unsignalized intersections. The study intersections were selected to include locations where the proposed project is expected to generate 10 or more peak-hour trips per lane.

The Santa Clara County VTA CMP guidelines require that freeway segments be evaluated to determine the impact of added traffic for projects that generate trips equal to or greater than one percent of the freeway segment's capacity. Within the project vicinity, two freeway segments were analyzed following the CMP guidelines.

This study also includes an analysis of volume-to-capacity ratios for four freeway ramps at the interchanges of US 101 and Fair Oaks Avenue and US 101 and Lawrence Expressway.

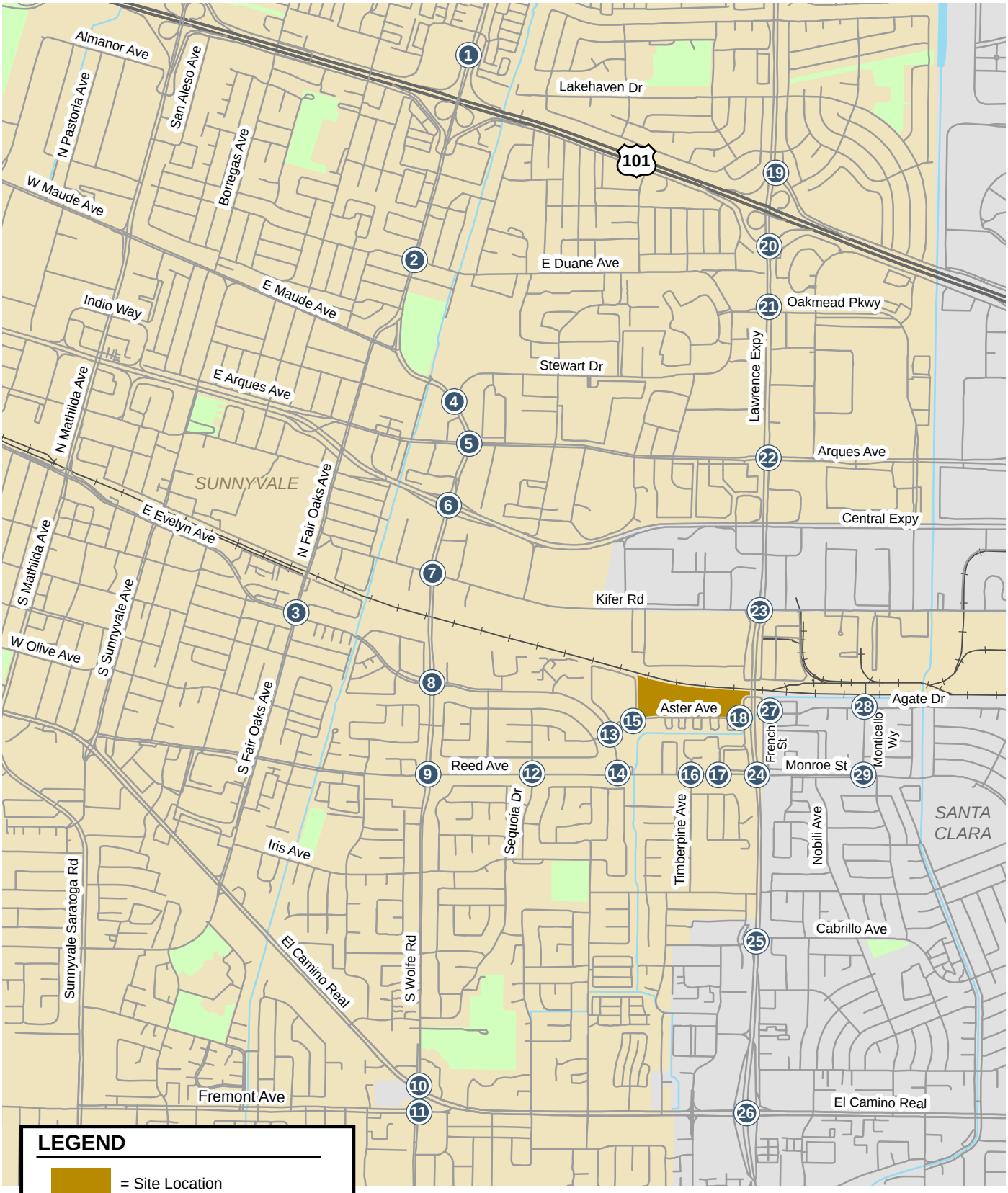


Figure 1
Site Location and Study Intersections

STUDIO T SQUARE
: Architecture
: Planning
: Urban Design

: 1970 Broadway, Suite 500
: Oakland, California 94612
: (510) 451 - 2850

1155 & 1175 Aster Avenue
Sunnyvale, CA

Olympic Residential Group
235 Montgomery St, Suite 960
San Francisco, CA

Sheet Title:
ILLUSTRATIVE SITE PLAN

Job No. 17033
Date: 01/10/2019
Scale: 1" = 60'
Drawn By:

Sheet No:
SP-2.0

Figure 2
Proposed Project Site Plan

NORTH
Not to Scale

The study intersections, freeway segments, and freeway ramps are listed below.

Study Intersections

1. Fair Oaks Avenue & US 101 Northbound Ramps
2. Fair Oaks Avenue & Duane Avenue
3. Fair Oaks Avenue & Evelyn Avenue
4. Wolfe Road & Stewart Drive
5. Wolfe Road & Arques Avenue
6. Wolfe Road & Central Expressway Ramps
7. Wolfe Road & Kifer Road
8. Wolfe Road & Evelyn Avenue
9. Wolfe Road & Old San Francisco Road/Reed Avenue
10. Wolfe Road & El Camino Real *
11. Wolfe Road & Fremont Avenue
12. Sequoia Drive & Reed Avenue
13. Evelyn Avenue & Aster Avenue
14. Evelyn Avenue & Reed Avenue
15. Willowbend Driveway & Aster Avenue (unsignalized)
16. Timberpine Avenue & Reed Avenue
17. Willow Avenue & Reed Avenue (unsignalized)
18. Willow Avenue & Aster Avenue (unsignalized)
19. Lawrence Expressway & US 101 Northbound Ramps
20. Lawrence Expressway & US 101 Southbound Ramps
21. Lawrence Expressway & Oakmead Parkway/Duane Avenue
22. Lawrence Expressway & Arques Avenue *
23. Lawrence Expressway & Kifer Road
24. Lawrence Expressway & Monroe Street/Reed Avenue *
25. Lawrence Expressway & Cabrillo Avenue [City of Santa Clara]
26. Lawrence Expressway & El Camino Real Ramps [City of Santa Clara] *
27. French Street & Agate Drive [City of Santa Clara] (unsignalized)
28. Monticello Way & Agate Drive [City of Santa Clara] (unsignalized)
29. Monticello Way & Monroe Street [City of Santa Clara]

* Denotes CMP intersections

Freeway Segments

1. US 101 between Mathilda Avenue and Fair Oaks Avenue
2. US 101 south of Lawrence Expressway

Study Freeway Ramps

US 101 and Fair Oaks Avenue Interchange

1. Northbound On-Ramp
2. Southbound Off-Ramp to Southbound Fair Oaks Avenue

US 101 and Lawrence Expressway Interchange

3. Southbound On-Ramp from Northbound Lawrence Expressway
4. Northbound Off-Ramp

Traffic conditions at the study intersections, freeway segments, and freeway ramps were analyzed for the weekday AM and PM peak hours of commute traffic. In the study area, the AM peak hour typically occurs between 7:00 AM and 10:00 AM, and the PM peak hour typically occurs between 4:00 PM and 7:00 PM. These are the peak commute hours during which most traffic congestion occurs on the roadway network.

Traffic conditions were evaluated for the scenarios described below.

Scenario 1: *Existing Conditions.* Existing conditions are based on recent traffic counts collected at the study intersections. Existing traffic count data is provided in Appendix A.

Scenario 2: *Background Conditions.* Background conditions were estimated by adding to existing traffic volumes the project traffic from approved but not yet completed and occupied developments in the study area. Approved project trips and approved project trip information were obtained from the City of Sunnyvale and the City of Santa Clara. In addition, roadway improvements associated with the approved developments were assumed as directed by City Staff.

Scenario 3: *Existing Plus Project Conditions.* Existing plus project conditions were estimated by adding to existing traffic volumes the additional traffic generated by the project. Existing plus project conditions were evaluated relative to existing conditions in order to determine the effects the project would have on the existing roadway network.

Scenario 4: *Background Plus Project Conditions.* Background traffic volumes with the project were estimated by adding to background traffic volumes the additional traffic generated by the project. Background plus project conditions were evaluated relative to background conditions in order to determine potential project impacts.

According to VTA's CMP TIA guidelines, a scenario analyzing project impacts under cumulative conditions is also required. Because the project is located within and consistent with the recently-adopted Lawrence Station Area Plan (LSAP), the cumulative project impacts are included in the *Lawrence Station Area-Wide Transportation Plan and Near-Term TIA* report dated for December 18, 2015, prepared by Hexagon Transportation Consultants, Inc. The project's contribution to the cumulative impacts of the LSAP is discusssed in this report.

Methodology

This section presents the methods used to determine the traffic conditions for each scenario described above. It includes descriptions of the data requirements, the analysis methodologies, and the applicable level of service standards.

Data Requirements

The data required for this traffic study were obtained from the City of Sunnyvale, the City of Santa Clara, the VTA CMP TRAFFIX database, county records for freeways and expressways, Institute of Transportation Engineers' (ITE) *Trip Generation Manual, 10th Edition (2017)*, field observations, and previous traffic studies. The following data were collected from these sources:

- Existing traffic volumes,
- Existing lane configurations,
- Signal timing and phasing,
- Applicable trip generation rates, and
- Approved projects information.

Level of Service Standards and Analysis Methodologies

Traffic conditions at the study intersections were evaluated using level of service (LOS). *Level of Service* is a qualitative description of operating conditions ranging from LOS A, or free-flow conditions with little or no delay, to LOS F, or jammed conditions with excessive delays. The level of service analysis was supplemented with a queuing analysis for selected movements at the study intersections and an analysis of freeway segments and freeway ramps in the study area. In addition, the unsignalized intersection of Willow Avenue and Reed Avenue was evaluated to determine if the intersection would meet the peak hour signal warrant. The various analysis methods are described in further detail below.

Signalized Study Intersections

The City of Sunnyvale and City of Santa Clara level of service methodology for signalized intersections is the *Highway Capacity Manual* (HCM) 2000 method. This method is applied using the TRAFFIX software. The HCM 2000 operations method evaluates signalized intersection operations on the basis of average control delay time for all vehicles at the intersection. Since TRAFFIX is also the CMP-designated intersection level of service methodology, the City of Sunnyvale and City of Santa Clara methodology employs the CMP default values for the analysis parameters.

The City of Sunnyvale General Plan level of service standard for signalized intersections is LOS D or better, except that intersections on roadways considered “regionally significant” have a standard of LOS E. In the study area, signalized intersections within Sunnyvale along Lawrence Expressway, El Camino Real, and ramp junctions at Central Expressway and US 101 are considered regionally significant. The correlation between average control delay and level of service is shown in Table 1.

CMP Intersections

The designated level of service methodology for the CMP also is the 2000 HCM operations method for signalized intersections, using TRAFFIX. The CMP level of service standard for signalized intersections within Sunnyvale is LOS E or better.

Unsignalized Study Intersections

The level of service for the unsignalized intersections was evaluated using the 2000 HCM methodology. Level of service for unsignalized (stop-controlled and yield controlled) intersections is evaluated based on the delay experienced by vehicles on the controlled approaches. For two-way or T-intersections, operations are defined by the average control delay experienced by the worst approach. For all-way stop controlled intersections, the level of service is reported based on the average delay for all approaches. The City of Sunnyvale General Plan level of service standard for unsignalized intersections is LOS D or better. The City of Santa Clara does not have an adopted level of service threshold for unsignalized intersections.

The correlation between delay and level of service for unsignalized intersections is shown in Table 2.

Traffic Signal Warrant Analysis

An assessment of the need for signalization was conducted for the unsignalized intersections. For this study, the need for signalization is assessed on the basis of the peak hour volume signal warrant (Warrant #3) described in the 2014 California Manual on Uniform Traffic Control Devices (CA MUTCD). This method provides an indication of whether traffic conditions and peak-hour traffic levels are, or would be, sufficient to justify the installation of a traffic signal. It should be noted that it is just one of the factors/warrants used to indicate whether installation of a traffic control signal is justified.

Table 1
Signalized Intersection Level of Service Definitions Based on Delay

Level of Service	Description	Average Control Delay Per Vehicle (sec/veh)
A	Signal progression is extremely favorable. Most vehicles arrive during the green phase and do not stop at all. Short cycle lengths may also contribute to the very low vehicle delay.	10.0 or less
B+ B B-	Operations characterized by good signal progression and/or short cycle lengths. More vehicles stop than with LOS A, causing higher levels of average vehicle delay.	10.1 to 12.0 12.1 to 18.0 18.1 to 20.0
C+ C C-	Higher delays may result from fair signal progression and/or longer cycle lengths. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant, though may still pass through the intersection without stopping.	20.1 to 23.0 23.1 to 32.0 32.1 to 35.0
D+ D D-	The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable signal progression, long cycle lengths, or high volume-to-capacity (V/C) ratios. Many vehicles stop and individual cycle failures are noticeable.	35.1 to 39.0 39.1 to 51.0 51.1 to 55.0
E+ E E-	This is considered to be the limit of acceptable delay. These high delay values generally indicate poor signal progression, long cycle lengths, and high volume-to-capacity (V/C) ratios. Individual cycle failures occur	55.1 to 60.0 60.1 to 75.0 75.1 to 80.0
F	This level of delay is considered unacceptable by most drivers. This condition often occurs with oversaturation, that is, when arrival flow rates exceed the capacity of the intersection. Poor progression and long cycle lengths may also be major contributing causes of such delay levels.	greater than 80.0
Source:	Transportation Research Board, 2000 Highway Capacity Manual (Washington, D.C., 2000) p10-16. VTA Traffic Level of Service Analysis Guidelines (June 2003), Table 2.	

Table 2
Unsignalized Intersection Level of Service Based on Delay

Level of Service	Description	Average Delay Per Vehicle (sec.)
A	Little or no traffic delay	10.0 or less
B	Short traffic delays	10.1 to 15.0
C	Average traffic delays	15.1 to 25.0
D	Long traffic delays	25.1 to 35.0
E	Very long traffic delays	35.1 to 50.0
F	Extreme traffic delays	greater than 50.0

Source: Transportation Research Board, *2000 Highway Capacity Manual* (Washington, D.C., 2000) p17-2.

Freeway Segments

As prescribed in the Santa Clara County CMP technical guidelines, the level of service for freeway segments is estimated based on vehicle density. Density is calculated by the following formula:

D = V / (N*S)

Where:

D = density, in vehicles per mile per lane (vpmpl)

V = peak hour volume, in vehicle per hour (vph)

N = number of travel lanes

S = average travel speed, in miles per hour (mph)

The vehicle density on a segment is correlated to level of service as shown in Table 3. The CMP requires that mixed-flow lanes and auxiliary lanes be analyzed separately from high-occupancy vehicle (HOV) lanes (otherwise known as carpool lanes). The CMP specifies that a capacity of 2,300 vehicles per hour per lane (vphpl) be used for segments three lanes or wider in one direction, and a capacity of 2,200 vphpl be used for segments two lanes wide in one direction. HOV lanes are specified as having a capacity of 1,650 vphpl. The CMP defines an acceptable level of service for freeway segments as LOS E or better.

Freeway Ramps

A freeway ramp analysis was performed in order to verify that the freeway ramps would have sufficient capacity to serve the expected traffic volumes with and without the project. This analysis consisted of a volume-to-capacity ratio evaluation of the freeway ramps at the selected interchanges. The ramp capacities were obtained from the *Highway Capacity Manual 2000*, and consider the free-flow speed, the number of lanes on the ramp, and the ramp metering.

Table 3
Freeway Segment Level of Service Definitions Based on Density

Level of Service	Description	Density (vehicles/mile/lane)
A	Average operating speeds at the free-flow speed generally prevail. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream.	11.0 or less
B	Speeds at the free-flow speed are generally maintained. The ability to maneuver within the traffic stream is only slightly restricted, and the general level of physical and psychological comfort provided to drivers is still high.	11.0 to 18.0
C	Speeds at or near the free-flow speed of the freeway prevail. Freedom to maneuver within the traffic stream is noticeably restricted, and lane changes require more vigilance on the part of the driver.	18.0 to 26.0
D	Speeds begin to decline slightly with increased flows at this level. Freedom to maneuver within the traffic stream is more noticeably limited, and the driver experiences reduced physical and psychological comfort levels.	26.0 to 46.0
E	At this level, the freeway operates at or near capacity. Operations in this level are volatile, because there are virtually no usable gaps in the traffic stream, leaving little room to maneuver within the traffic stream.	46.0 to 58.0
F	Vehicular flow breakdowns occurs. Large queues form behind breakdown points.	greater than 58.0
Source:	Santa Clara County Valley Transportation Authority, Transportation Impact Analysis Guidelines, Updated March 2009 (Based on the Highway Capacity Manual (2000), Washington, D.C.)	

Vehicle Queuing

For selected high-demand movements at the study intersections, the estimated maximum vehicle queues were compared to the existing or planned storage capacity. The queuing analysis is presented for informational purposes only. The City of Sunnyvale does not have significant impact criteria for intersection queuing. However, in the City of Sunnyvale, a project is said to create an operational deficiency if the background plus project conditions increases the 95th percentile queue by one vehicle for a movement that is already over capacity compared to the background conditions.

Vehicle queues were calculated using a Poisson probability distribution, which estimates the probability of "n" vehicles for a vehicle movement using the following formula:

$$P(x = n) = \frac{\lambda^n e^{-(\lambda)}}{n!}$$

Where:

$P(x = n)$ = probability of "n" vehicles in queue per lane

n = number of vehicles in the queue per lane

λ = Average number of vehicles in the queue per lane (vehicles per hour per lane/signal cycles per hour)

The basis of the analysis is as follows: (1) the Poisson probability distribution is used to estimate the 95th percentile maximum number of queued vehicles per signal cycle for a particular movement; (2) the estimated maximum number of vehicles in the queue is translated into a queue length, assuming 25 feet per vehicle; and (3) the estimated maximum queue length is compared to the existing or planned available storage capacity for the movement.

For signalized intersections, the 95th percentile queue length value indicates that during the peak hour, a queue of this length or less would occur on 95 percent of the signal cycles. Or, a queue length larger than the 95th percentile queue would only occur on 5 percent of the signal cycles (about 3 cycles during the peak hour for a signal with a 60-second cycle length). Therefore, left-turn pocket storage designs based on the 95th percentile queue length would ensure that storage space would be exceeded only 5 percent of the time for a signalized movement. The 95th percentile queue length is also known as the "design queue length."

Significant Impact Criteria

Significance criteria are used to establish what constitutes an impact. For this analysis, the criteria used to determine significant impacts on signalized and unsignalized intersections as well as freeway facilities are based on the City of Sunnyvale and VTA's CMP level of service standards.

The effects of the project on other transportation facilities, such as bicycle facilities and transit service, were determined on the basis of engineering judgment.

Definition of Significant Intersection Impacts at Signalized Intersections

The project is said to create a significant adverse impact on traffic conditions at a signalized intersection in the City of Sunnyvale and the City of Santa Clara if for the study peak hour:

1. The level of service at the intersection drops below its respective level of service standard when project traffic is added; or,
2. An intersection that operates below its level of service standard under no project conditions experiences an increase in critical-movement delay of four (4) or more seconds, *and* the critical volume-to-capacity ratio (v/c) is increased by 0.01 or more when project traffic is added.

The exception to this threshold is when the addition of project traffic reduces the amount of average control delay for critical movements, i.e., the change in average control delay for critical movements are negative. In this case, the threshold is when the project increases the critical V/C value by 0.01 or more.

The operation of principal arterials and state highways located within urbanized Santa Clara County is measured by the level of service at CMP Intersections. CMP intersections are generally high-volume intersections located along these thoroughfares. The definition of a significant impact at a CMP intersection is the same as for the City of Sunnyvale, except that the standard for acceptable level of service for all CMP and regional intersections is LOS E or better.

A significant impact by the City of Sunnyvale, City of Santa Clara and CMP standards is said to be satisfactorily mitigated when measures are implemented that would restore intersection conditions to its LOS standard *or* to an average delay that eliminates the project impact.

Definition of Significant Intersection Impacts at Unsignalized Intersections

City of Sunnyvale

Level of service analysis at unsignalized intersections is generally used to determine the need for modification in type of intersection control (i.e. all-way stop or signalization). As part of this evaluation, traffic volumes, delays, and traffic signal warrants are evaluated to determine if the existing intersection control is appropriate.

Per City of Sunnyvale guidelines, for determining the level of service for unsignalized intersections, the average intersection delay is used for all-way stop controlled intersections, and the worst movement delay is used for side-street stop-controlled intersections. Project impacts at the City's unsignalized intersections would be considered significant if one of the following criteria is met:

1. If an intersection operates at an acceptable LOS (i.e. D or better) without the project and degrades to an unacceptable LOS (i.e. LOS E or F) with the addition of project traffic.

2. If an unsignalized intersection operates at an unacceptable LOS (i.e. LOS E or F) without the project and the addition of project traffic increases:

    a. The average intersection delay by four (4) seconds or more, and the volume-to-capacity value by 0.01 or more for all-way stop controlled intersections; or

    b. The worst movement delay by four (4) seconds or more, and the volume-to-capacity value by 0.01 or more for side-street stop controlled.

3. Intersection meets the warrant(s) for installation of a traffic signal as per the latest edition of California Manual on Uniform Traffic Control Devices.

City of Santa Clara

The City of Santa Clara does not have officially adopted significance criteria for unsignalized intersections. According to previous studies, significant impacts occur when the addition of project traffic causes the average intersection delay for all-way stop-controlled intersections or the worst movement/approach for side-street stop-controlled intersections to degrade to LOS F and the intersection satisfies the peak-hour signal warrant from CA MUTCD. A significant impact is considered mitigated when the installation of traffic signals causes the intersection to operate at an acceptable level.

Definition of Significant Freeway Impacts

For this analysis, the criteria used to determine impacts on freeway segments are based on CMP standards. Per CMP requirements, freeway impacts are measured relative to existing conditions (i.e. there is no evaluation of freeways under background conditions). The project is said to create a significant adverse impact on traffic conditions on a freeway segment if for either peak hour:

1. The level of service of the freeway segment drops below the LOS E standard when project traffic is added; or,

    The level of service of the freeway segment is LOS F under existing conditions and the number of new trips added by the project is more than one percent of the freeway capacity.

Definition of Significant Freeway Ramp Impacts

A freeway ramp analysis was performed in order to verify that the freeway ramps would have sufficient capacity to serve the expected traffic volumes with and without the project. For the purpose of this study, the project is said to create a significant adverse impact on a freeway ramp if its implementation:

1. Causes the volume-to-capacity (v/c) ratio of the freeway ramp to exceed 1.0; or
2. Increases the amount of traffic on a freeway ramp that is already exceeding its capacity by more than one percent (1%) of the ramp's capacity.

Report Organization

The remainder of this report is divided into six chapters. Chapter 2 describes the existing roadway network, transit services, and pedestrian and bicycle facilities. Chapter 3 presents the traffic conditions in the study area under background conditions. Chapter 4 describes the methods used to estimate the project traffic on the roadway network and presents the intersection operations under existing plus project and background plus project conditions. Also included in Chapter 4 are the freeway segment and freeway ramp analyses. Chapter 5 provides an evaluation of other transportation related issues for the proposed project, such as vehicle queuing, potential project impacts on transit, pedestrian, and bicycle facilities, site access and circulation, and parking. Chapter 6 presents the traffic study conclusions, including a summary of any proposed mitigation measures and recommended improvements.

2. Existing Conditions

This chapter describes the existing conditions for transportation facilities in the vicinity of the site, including the roadway network, transit services, and pedestrian and bicycle facilities.

Existing Roadway Network

Regional access to the study area is provided by US 101.

> *US 101* is an eight-lane freeway (three mixed-flow lanes and one HOV lane in each direction) in the vicinity of the site. US 101 extends northward through San Francisco and southward through Gilroy. Access to and from the project area is provided via full interchanges at Fair Oaks Avenue and Lawrence Expressway.

Major roadways within or near the project area include: Lawrence Expressway, Central Expressway, Reed Avenue/Monroe Street, Wolfe Avenue, Evelyn Avenue, Aster Avenue, and Willow Avenue. These roads are described below.

> *Lawrence Expressway* is a north-south, eight-lane expressway with a raised median and a posted speed limit of 50 mph in the study area. It begins at Saratoga Avenue in the south, crosses through Sunnyvale, and extends northward and transitions into Caribbean Drive. Lawrence Expressway connects with US 101 via full-access freeway interchanges. Lawrence Expressway provides access to the project site via Reed Avenue. In the study area, Lawrence Expressway includes sidewalks along both sides and crosswalks at the nearby signalized intersections.
>
> *Central Expressway* is an east-west, four-lane to six-lane expressway. In the study area, Central Expressway has two eastbound lanes and two westbound lanes and a posted speed limit of 50 mph. It begins at Trimble Road in the east, crosses Sunnyvale, extends westward and transitions into Alma Street. Central Expressway connects to Wolfe Road and Lawrence Expressway in the project vicinity.
>
> *Reed Avenue/Monroe Street* is a two-lane to four-lane roadway that begins west at Fair Oaks Avenue as Reed Avenue and extends southeast towards its terminal at Tisch Way in the City of San Jose. Reed Avenue/Monroe Street has posted speed limits of 25 and 35 mph in the study area. Reed Avenue is within the City of Sunnyvale, and transitions to Monroe Street in the City of Santa Clara at its intersection with Lawrence Expressway (Sunnyvale-Santa Clara city boundary). Reed Avenue/Monroe Street includes a center two-way left-turn lane. In the study

area, Reed Avenue includes sidewalks along both sides and crosswalks at the nearby signalized intersections. Reed Avenue provides access to the project site via Willow Avenue and Evelyn Ave.

Wolfe Road is a four-lane to six-lane, north-south arterial that begins at N. Fair Oaks Avenue, and extends into the City of Cupertino, ending at Stevens Creek Boulevard (its transition point into Miller Avenue). Wolfe Road has a raised center median and a posted speed limit of 35 mph in the study area. Wolfe Road has a full-access interchange with Central Expressway. In the study area, Wolfe Road includes sidewalks and bicycle lanes on both sides and crosswalks at the nearby signalized intersections. Wolfe Road provides access to the project site via Evelyn Avenue and Reed Avenue.

Evelyn Avenue is a two-lane to four-lane roadway that begins at Castro Street in the City of Mountain View and extends to its terminal at Reed Avenue in the City of Sunnyvale. In the study area, Evelyn Avenue includes a center two-way left-turn lane and has a posted speed limit of 30 mph. In the study area, Evelyn includes sidewalks and bicycle lanes in both directions and crosswalks at the nearby signalized intersections. Evelyn Avenue provides access to the project site via Aster Avenue.

Aster Avenue is a two-lane, east-west neighborhood street that extends from Willow Avenue in the east and terminates at Aster Court just west of the Evelyn Avenue and Aster Avenue intersection. In the project vicinity, Aster Avenue has a posted speed limit of 30 mph and includes a sidewalk along the south side of the road. Aster Avenue provides direct access to the project site.

Willow Avenue is a two-lane, north-south neighborhood street that extends from Reed Avenue in the south and becomes French Street in the north. Willow Avenue has a posted speed limit of 25 mph, includes some on-street parking, and includes sidewalks along both sides. Willow Avenue provides direct access to the project site.

Existing Transit Service

Existing transit service to the study area is provided by VTA, the Altamont Commuter Express (ACE), and Caltrain. These services are described below and shown on Figure 3.

VTA and ACE Bus Services

The VTA and ACE bus services that operate with the study area are listed in Table 4, including their terminus points, closest scheduled stop, and commute hour headways. VTA bus route 32 stops on Reed Street, south of the project site. VTA bus route 328 operates along Lawrence Expressway, and ACE route 822 operates along Arques Avenue and Kifer Road in the project vicinity.

Table 4
Existing Transit Services

Bus Route	Route Description	Closest Stop	Weekday Hours of Operation	Headway
Local Route 32	San Antonio shopping center to Santa Clara Transit Center	Reed/Willow	5:45 AM - 8:35 PM	30 min
Local Route 822	Ace Gray Shuttle	Kifer/San Ysidro	6:15 AM - 9:35 AM 3:10 PM - 6:40 PM	60 min
Limited Stop Route 328	Almaden Expressway/Camden to Lockheed Martin/Moffett	Lawrence/Kifer	6:00 AM - 8:45 AM 4:50 PM - 7:15 PM	90 min

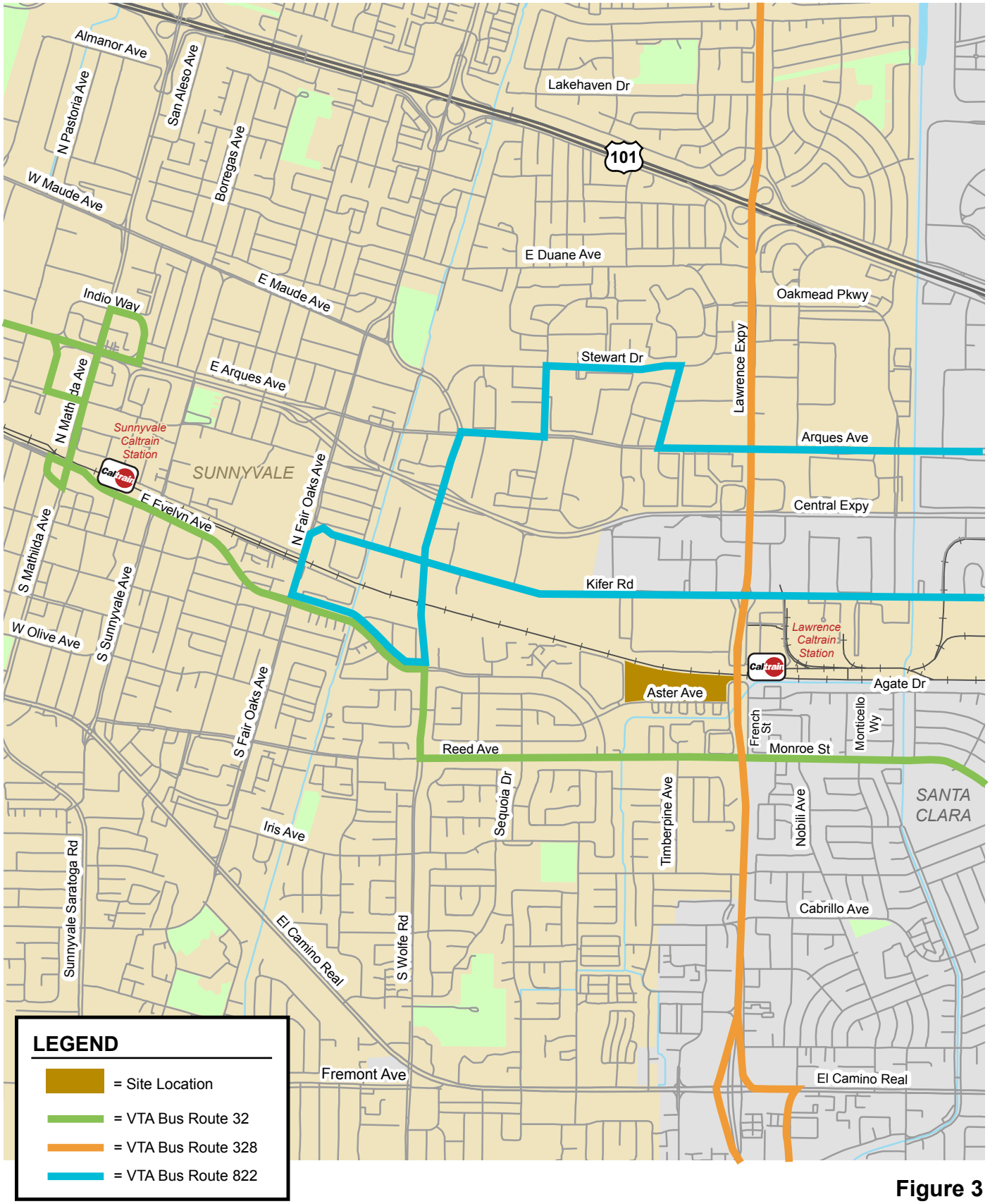


Figure 3
Existing Transit Services

Caltrain Service

The project site is located directly adjacent to the Lawrence Caltrain Station.

Caltrain provides service with approximately 20- to 30-minute headways during the weekday AM and PM commute hours and 60- to 90 -minute headways midday, at night and on weekends. The Lawrence Caltrain Station provides service for Local and Limited trains. Services are provided between 4:40 AM and 1:20 AM (next day). The baby-bullet train does not stop at Lawrence Station.

In addition to the commuter rail service, there are three Caltrain shuttles that provide service at the Lawrence Caltrain Station. These shuttles are described below.

- Duane Avenue Shuttle: This shuttle travels between the Mountain View Caltrain Station and the Lawrence Caltrain Station with stops near the businesses on Stewart Drive/Duane Avenue and Arques Avenue during the weekday commute hours. Shuttles are coordinated with Caltrain schedules.
- Bowers-Walsh Shuttle: This shuttle provides service between the Lawrence Caltrain Station and the Bowers/Walsh area office buildings during the weekday commute periods. Shuttles depart from the Caltrain station in the morning, and from the Bowers/Walsh area to the station in the evening. Shuttles are coordinated with Caltrain schedules.
- Mission Shuttle: This shuttle provides service between the Lawrence Caltrain Station and Mission Area office buildings during the weekday commute periods. Shuttles depart from the Caltrain Station in the morning towards the Intel campus via Mission College, and in the reverse direction in the evening. Shuttles are coordinated with Caltrain schedules.

Existing Pedestrian Facilities

Sidewalks are present along both sides of most major roadways within the project vicinity, including Reed Avenue, Evelyn Avenue, and Wolfe Road. Sidewalk is lacking along the project frontage on Aster Avenue and Willow Avenue. Pedestrian crosswalks and signal heads are present at the nearby signalized study intersections of Evelyn Avenue/Aster Avenue, Evelyn Avenue/Reed Avenue, Timberpine Avenue/Reed Avenue, and Lawrence Expressway/Reed Avenue.

Existing Bicycle Facilities

Bicycle facilities in the project vicinity include bike lanes and bike routes. Bike lanes are lanes on roadways designated for use by bicycles with special lane markings, pavement legends, and signage. Bike routes are streets that accommodate bicycles with pavement markings and signage but are not separate from the travel lanes.

The existing bicycle facilities in the study area are shown on Figure 4. Information about bicycle facilities in the study area is published in the *Sunnyvale Bike Map & Guide to Safe Cycling*, published by the City of Sunnyvale in 2018.The following bicycle facilities exist within the immediate project vicinity:

Bike Lanes:

- Aster Avenue
- Evelyn Avenue
- Reed Avenue/Old San Francisco Road between Sunnyvale Avenue and Lawrence Expressway
- Wolfe Road between Reed Avenue and Fair Oaks Avenue

Bike Routes:

- Wolfe Road between Fremont Avenue and Reed Avenue
- Guided Bike Route 600

Existing Intersection Lane Configurations

The existing lane configurations at the study intersections were obtained by observations in the field and are shown on Figure 5.

Existing Traffic Volumes

The existing traffic volumes were obtained from peak hour traffic counts collected in 2017 and 2018, except for the PM CMP existing traffic counts, which were collected in October 2016. The existing AM and PM peak hour traffic volumes are shown graphically on Figure 6. Traffic count data are included in Appendix A. Traffic volumes at the study intersections for all scenarios of the traffic study are tabulated in Appendix B.

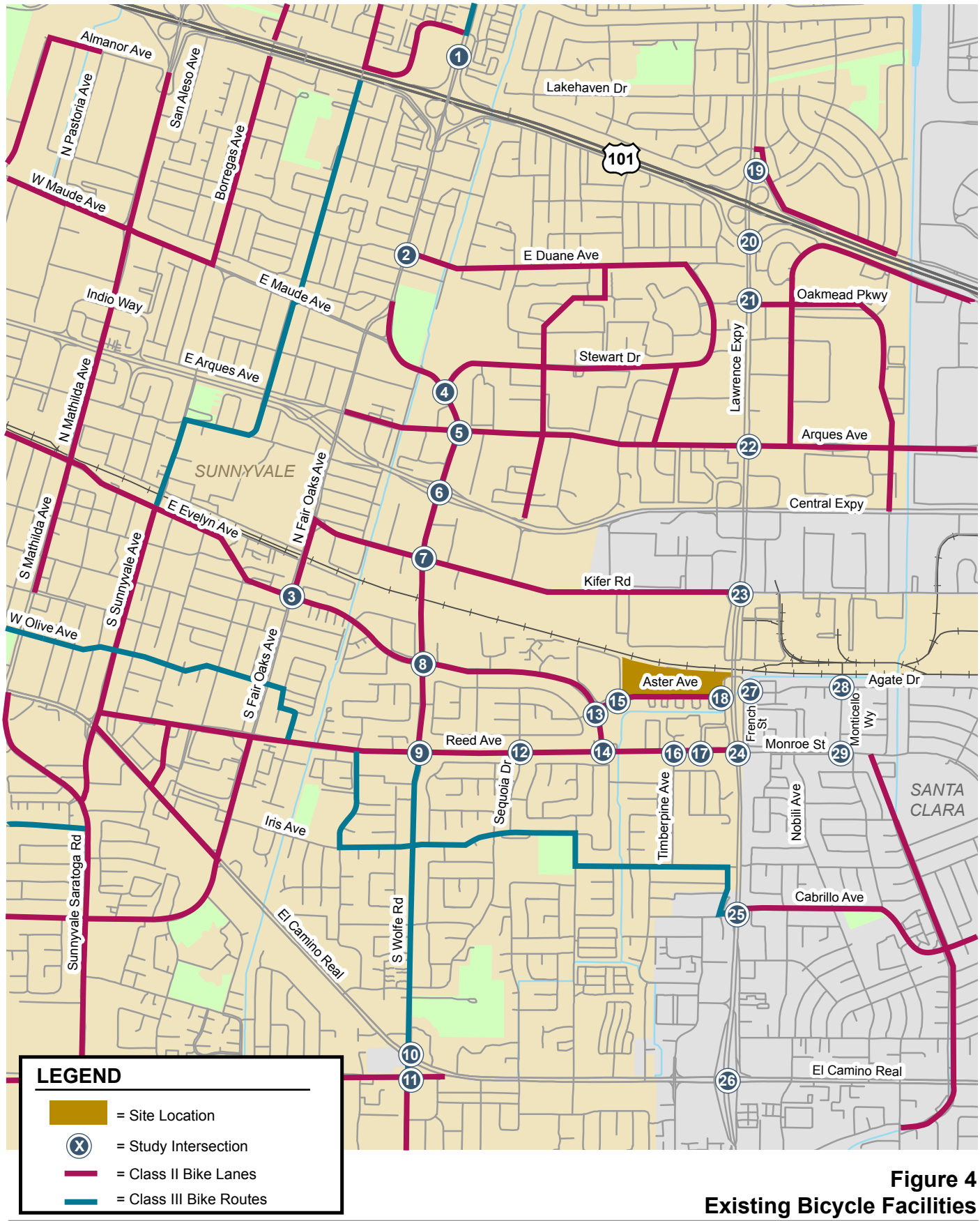
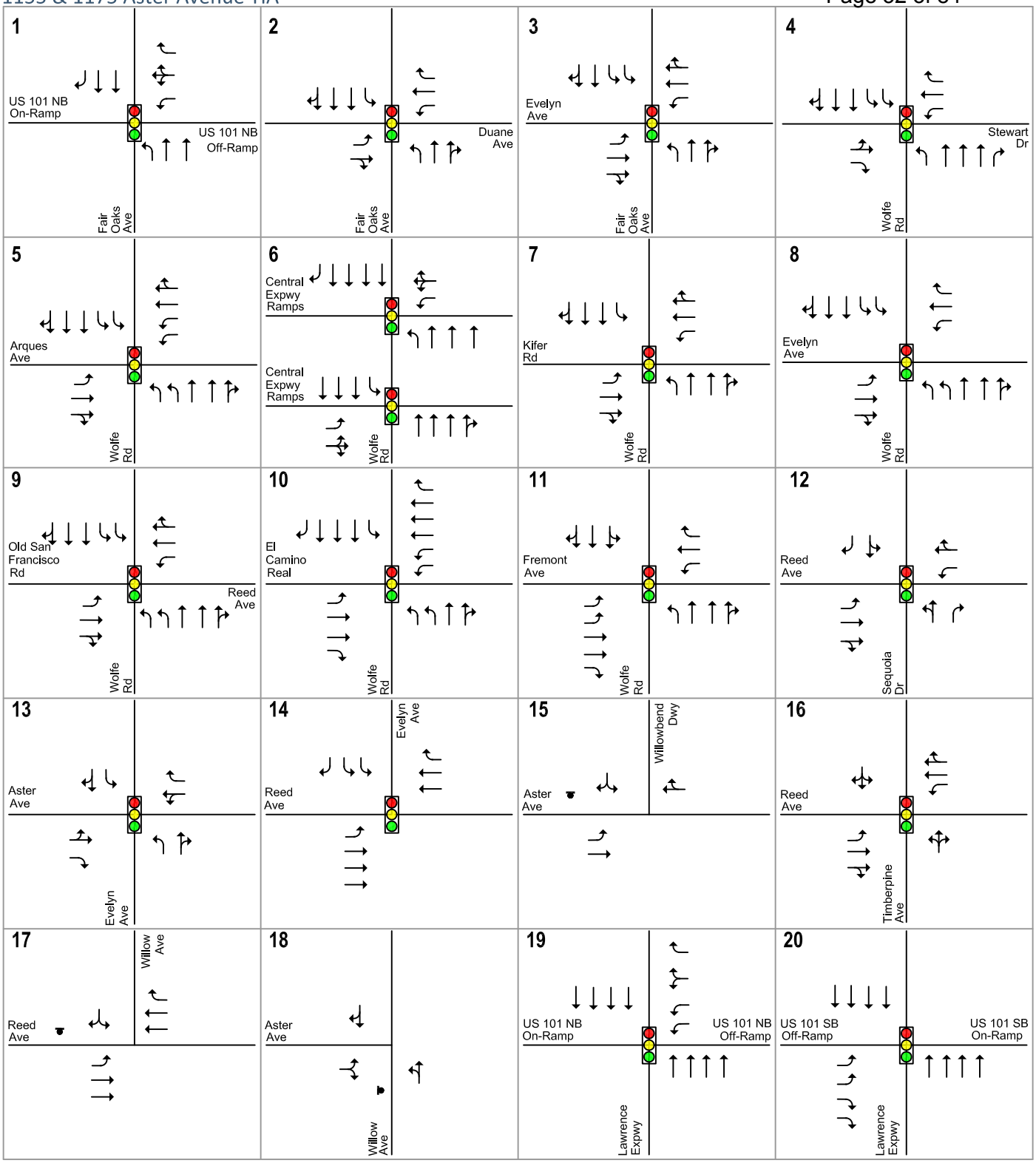


Figure 4
Existing Bicycle Facilities



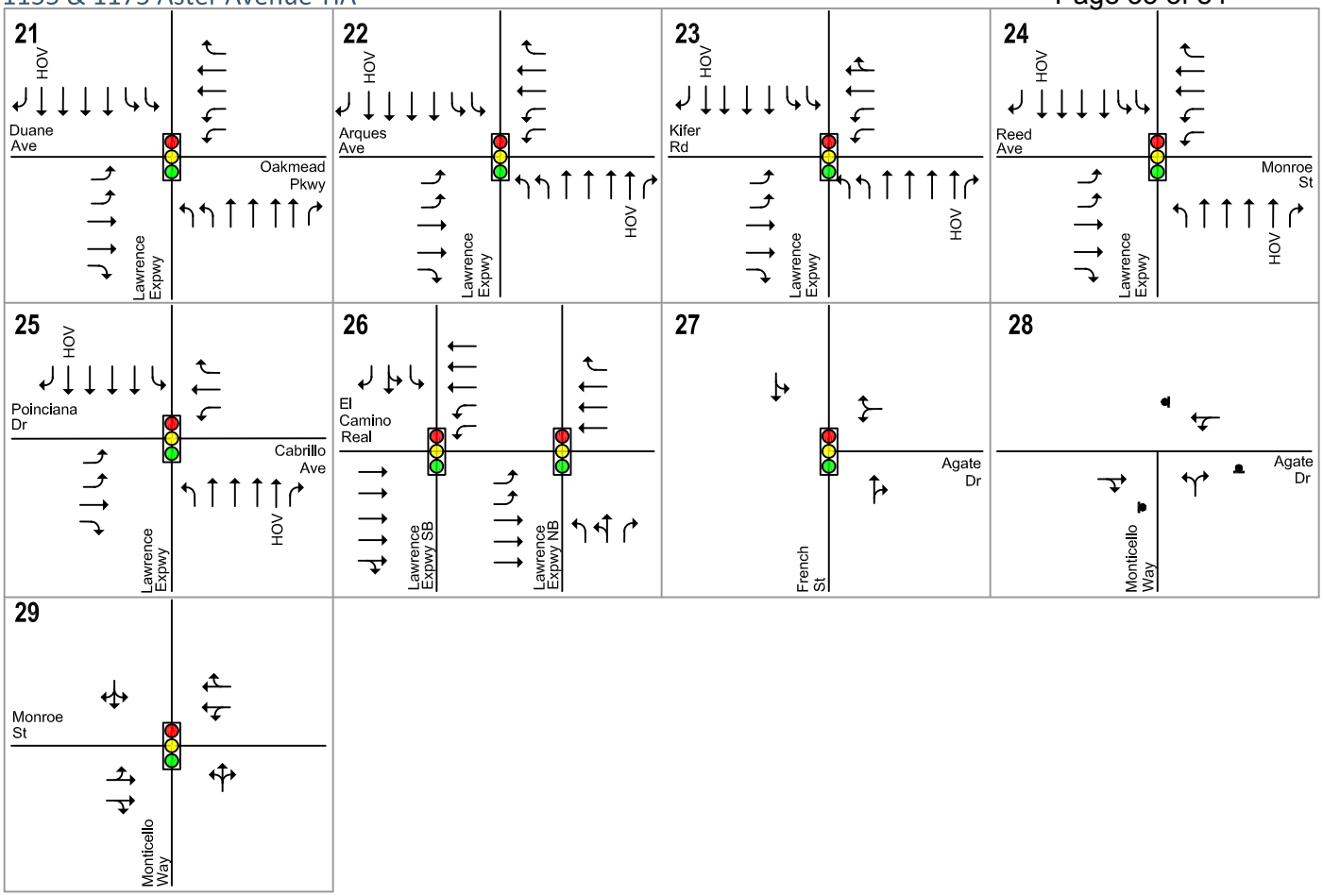
LEGEND

= Stop Sign

= Signalized Intersection

Figure 5
Existing Lane Configurations

NORTH
Not to Scale

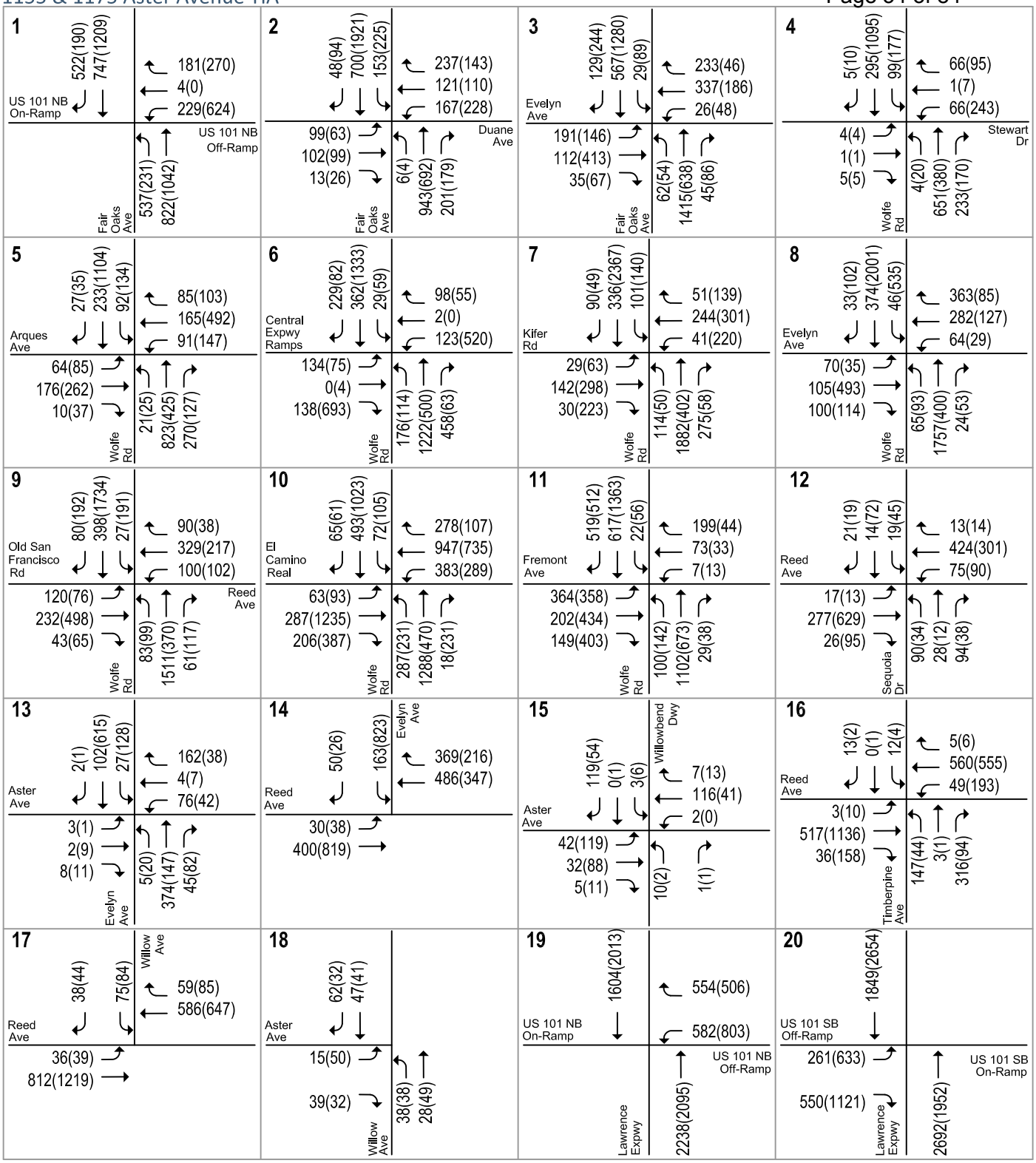


LEGEND

= Stop Sign

= Signalized Intersection

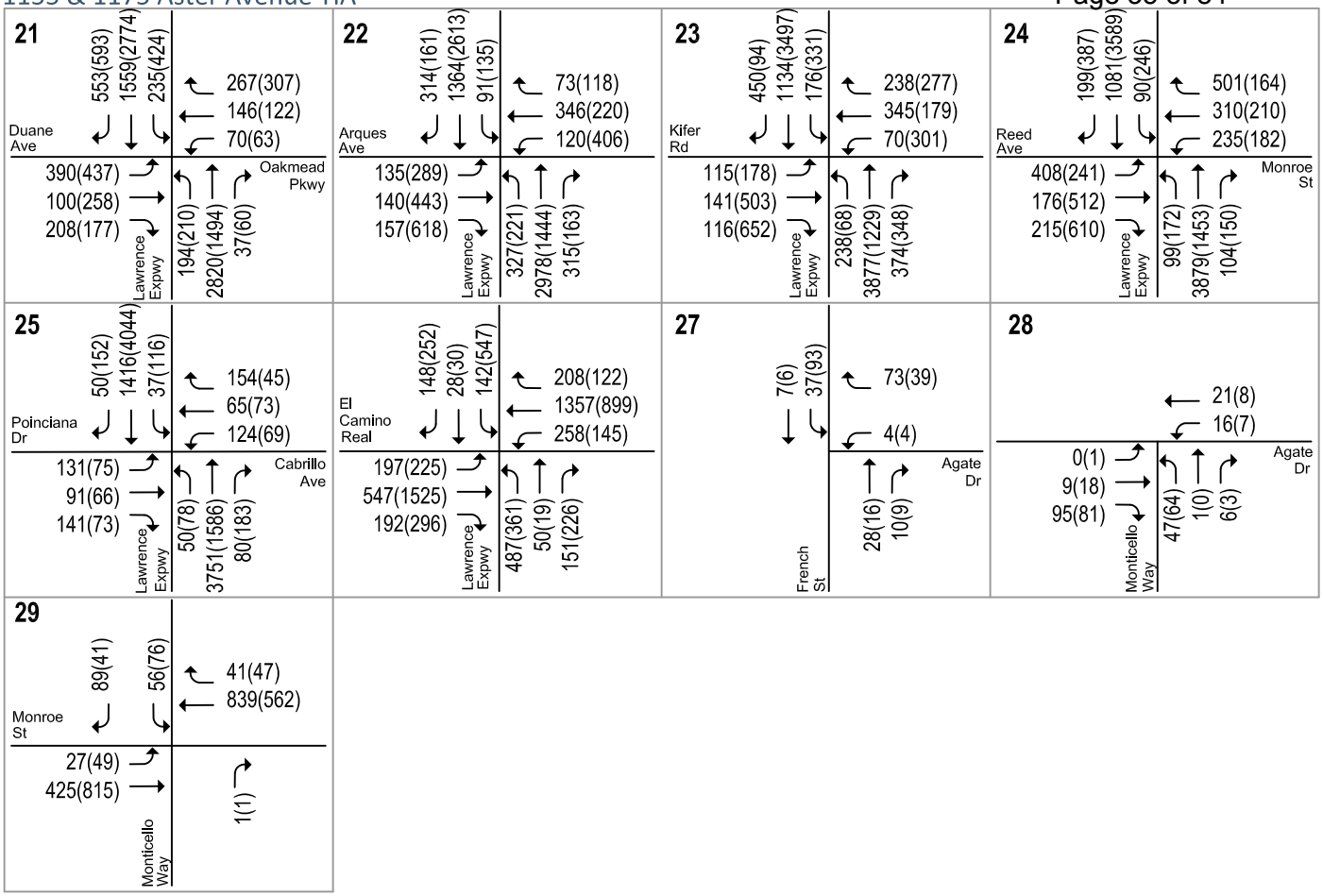
Figure 5
Existing Lane Configurations



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

Figure 6
Existing Traffic Volumes



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

Figure 6
Existing Traffic Volumes

Existing Intersection Level of Service

The intersection level of service at the study intersections were evaluated against the respective city's and CMP standards. The results of the intersection level of service analysis under existing conditions are summarized in Table 5 for the signalized study intersections and Table 6 for the unsignalized study intersections. The results of the analysis show that the majority of the study intersections currently operate at acceptable levels. However, the following study intersections are currently operating below the LOS standard during at least one peak hour:

- Wolfe Road and Central Expressway Ramps (#6) – PM peak hour (LOS F)
- Willow Avenue and Reed Avenue (#17) – PM peak hour (LOS F)
- Lawrence Expressway and Kifer Road (#23) – PM peak hour (LOS F)
- Lawrence Expressway and Monroe Street/Reed Avenue (#24) – AM peak hour (LOS F)

As shown on Table 6, the unsignalized intersection at Willow Avenue and Reed Avenue is currently operating at an unacceptable LOS F during the PM peak hour for the worst approach (the southbound movement). This southbound movement currently experiences lengthy delays because the southbound left-turn movement must wait for a gap in both directions of travel on Reed Avenue before turning. The peak-hour signal warrant was checked for this intersection, and the results show that this intersection currently meets the peak-hour signal warrant during the PM peak hour. All other unsignalized study intersections currently operate at LOS B or better and were thus not checked for signal warrants. The intersection level of service sheets are included in Appendix C. The peak-hour signal warrant worksheet is included in Appendix D.

Table 5
Existing Level of Service Summary - Signalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing		
					Count Date	Avg. Delay (sec)	LOS
1	Fair Oaks Avenue & US 101 NB Ramps	Signal	E	AM	05/08/18	29.7	C
				PM	05/08/18	31.3	C
2	Fair Oaks Avenue & Duane Avenue	Signal	D	AM	05/08/18	36.1	D+
				PM	05/08/18	35.7	D+
3	Fair Oaks Avenue & Evelyn Avenue	Signal	D	AM	05/08/18	46.5	D
				PM	05/08/18	39.5	D
4	Wolfe Road & Stewart Drive	Signal	D	AM	11/15/17	14.5	B
				PM	11/15/17	27.8	C
5	Wolfe Road & Arques Avenue	Signal	D	AM	11/14/17	49.4	D
				PM	11/14/17	43.9	D
6	Wolfe Road & Central Expressway Ramps	Signal	E	AM	12/06/17	37.4	D+
				PM	12/06/17	**84.4**	**F**
7	Wolfe Road & Kifer Road	Signal	D	AM	11/14/17	26.2	C
				PM	11/14/17	36.8	D+
8	Wolfe Road & Evelyn Avenue	Signal	D	AM	11/15/17	34.3	C-
				PM	11/15/17	35.8	D+
9	Wolfe Road & Old San Francisco Road/Reed Avenue	Signal	D	AM	11/14/17	38.5	D+
				PM	11/14/17	41.2	D
10	Wolfe Road & El Camino Real*	Signal	E	AM	11/14/17	61.1	E
				PM	11/10/16	43.0	D
11	Wolfe Road & Fremont Avenue	Signal	D	AM	11/14/17	39.7	D
				PM	11/14/17	49.5	D
12	Sequoia Drive & Reed Avenue	Signal	D	AM	05/15/18	14.2	B
				PM	05/15/18	13.5	B
13	Evelyn Avenue & Aster Avenue	Signal	D	AM	05/15/18	14.1	B
				PM	05/15/18	13.3	B
14	Evelyn Avenue & Reed Avenue	Signal	D	AM	11/15/17	9.5	A
				PM	11/15/17	12.0	B+
16	Timberpine Avenue & Reed Avenue	Signal	D	AM	05/15/18	20.3	C+
				PM	05/15/18	17.6	B
19	Lawrence Expressway & US 101 NB Ramps (County)	Signal	E	AM	04/04/17	10.0	B+
				PM	04/04/17	13.8	B
20	Lawrence Expressway & US 101 SB Ramps (County)	Signal	E	AM	04/04/17	6.6	A
				PM	04/04/17	71.5	E
21	Lawrence Expressway & Oakmead Parkway/Duane Avenue (County)	Signal	E	AM	04/04/17	44.0	D
				PM	04/04/17	53.5	D-
22	Lawrence Expressway & Arques Avenue* (County)	Signal	E	AM	04/04/17	48.2	D
				PM	10/04/16	68.1	E
23	Lawrence Expressway & Kifer Road (County)	Signal	E	AM	03/07/18	54.4	D-
				PM	03/07/18	**101.6**	**F**
24	Lawrence Expressway & Monroe Street/Reed Avenue* (County)	Signal	E	AM	03/07/18	**114.8**	**F**
				PM	10/05/16	74.1	E
25	Lawrence Expressway & Cabrillo Avenue (County)	Signal	E	AM	03/07/18	52.1	D-
				PM	03/07/18	48.6	D
26	Lawrence Expressway & El Camino Real Ramps* (SC)	Signal	E	AM	03/07/18	34.5	C-
				PM	11/10/16	29.9	C
29	Monticello Way & Monroe Street (SC)	Signal	D	AM	05/15/18	7.8	A
				PM	05/15/18	5.6	A

Notes

** = CMP, SC = Santa Clara, County = County of Santa Clara*

Level of service for signal controlled intersection is based on the average intersection delay.

">120" indicates the intersection experiences lengthy delay that is beyond the reasonable calculation range of the HCM 2000 methodology.

BOLD indicates substandard level of service.

Table 6
Existing Level of Service Summary - Unsignalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing			
					Count Date	Avg. Delay (sec)	LOS	Signal Warrant Met[1]
15	Willowbend Driveway & Aster Avenue	Side Street Stop	D	AM	05/15/18	10.2	B	-
				PM	05/15/18	10.7	B	-
17	Willow Avenue & Reed Avenue	Side Street Stop	D	AM	05/15/18	26.2	D	No
				PM	05/15/18	**52.6**	**F**	**Yes**
18	Willow Avenue & Aster Avenue	Side Street Stop	D	AM	05/15/18	9.1	A	-
				PM	05/15/18	9.6	A	-
27	French Street & Agate Drive (SC)	All Way Yield	D	AM	05/15/18	5.0	A	-
				PM	05/15/18	7.0	A	-
28	Monticello Way & Agate Drive (SC)	All Way Stop	D	AM	05/15/18	7.2	A	-
				PM	05/15/18	7.2	A	-

Notes
SC = Santa Clara

Level of service for side street stop controlled intersections is based on the delay experienced by the worst movement. Level of service for all way yield and all way stop controlled intersections is based on the average intersection delay.

BOLD indicates substandard level of service.

[1] The CA MUTCD peak-hour signal warrant is checked only if the intersection is operating at an unacceptable level of service.

Existing Freeway Level of Service

Existing weekday AM and PM peak-hour traffic volumes on the study freeway segments were obtained from the *2017 CMP Monitoring & Conformance Report* published by Santa Clara VTA (see Table 7). Both study freeway segments are operating at LOS F in the northbound direction in the morning and LOS F in the southbound direction in the evening.

Table 7
Existing Freeway Level of Service Summary

Freeway	Dir.	Segment	Peak Hour	Existing Conditions - Mixed Flow Lanes[1]					
				Avg. Speed (mph)	# of Lanes	Capacity	Density (pc/mi/ln)	Volume	LOS[2]
US 101	NB	Great America Parkway On-Ramp to Lawrence Expressway Off-Ramp	AM	16	3	6,900	**74.0**	**3,477**	**F**
			PM	62	3	6,900	25.6	4,803	C
US 101	NB	Fair Oaks Avenue On-Ramp to Mathilda Avenue Off-Ramp	AM	26	3	6,900	**61.1**	**4,710**	**F**
			PM	61	3	6,900	27.4	5,058	D
US 101	SB	Mathilda Avenue On-Ramp to Fair Oaks Avenue Off-Ramp	AM	62	3	6,900	26.3	4,893	D
			PM	25	3	6,900	**61.5**	**4,674**	**F**
US 101	SB	Lawrence Expressway On-Ramp to Bowers Avenue Off-Ramp	AM	58	3	6,900	31.8	5,577	D
			PM	7	3	6,900	**89.9**	**1,845**	**F**

Notes
Dir. = direction, NB = northbound, SB = southbound, mph = miles per hour, pc/mi/ln = passenger cars per mile per lane

[1] Existing freeway conditions information is published in the Santa Clara Valley Transportation Authority (VTA) *2017 CMP Monitoring and Conformance Report*.

[2] The Santa Clara VTA report references the Freeway LOS criteria presented in the *Traffic Level of Service Analysis Guidelines (June 2003)* published by Santa Clara VTA.

BOLD indicates substandard level of service.

Existing Freeway Ramp Capacity Analysis

This analysis consists of a volume-to-capacity ratio evaluation of four freeway ramps at the interchanges of US 101 and Fair Oaks Avenue and US 101 and Lawrence Expressway. The ramp capacities were obtained from the *Highway Capacity Manual 2000*, which considers the free-flow speed, the number of lanes on the study ramp, and ramp metering.

Hexagon conducted field observations at the study freeway ramps in May 2018. The field observations showed that the US 101 southbound on-ramp from northbound Lawrence Expressway was metered during the PM peak hour. The field observations showed minimal ramp queuing at this location, typically one to two vehicles. Due to the low observed queue length, a queuing analysis was omitted from the traffic study. The US 101 on-ramp from Fair Oaks Avenue has ramp meter equipment and Caltrans could turn on the ramp metering in the future. To be conservative, it was assumed that the US 101 on-ramp from Fair Oaks Avenue is metered during the AM peak hour.

It is assumed that the metered ramps would each have a capacity of 900 vehicles per hour for the mixed-flow lanes. A capacity of 900 vehicles per hour is assumed for the HOV lanes. The peak-hour freeway ramp volumes were obtained through intersection counts and Caltrans. As shown on Table 8, all freeway ramps currently have sufficient capacity to serve the existing traffic volumes, with volume-to-capacity ratios that are well below 1.0, which means that the existing traffic demand is lower than the ramp capacity during the AM and PM peak hours.

Table 8
Existing Freeway Ramp Capacity Summary

Interchange	Ramp	Type	Peak Hour	Lanes			Existing Conditions		
				Mixed-Flow	HOV	Meter[1]	Capacity[2]	Peak Volume[3]	v/c
US101/Fair Oaks Avenue	NB On-Ramp from Fair Oaks Avenue	Diagonal	AM	1	1	Equipment Present	1,800	1,061	0.59
			PM				1,800	416	0.23
	SB Off-Ramp to SB Fair Oaks Avenue	Diagonal	AM	1	-	-	2,000	363	0.18
			PM				2,000	893	0.45
US 101/Lawrence Expressway	NB Off-Ramp to Lawrence Expressway	Diagonal	AM	2	-	-	3,800	1,136	0.30
			PM				3,800	1,309	0.34
	SB On-Ramp from NB Lawrence Expressway	Diagonal	AM	2	1	Equipment Present	1,800	709	0.39
			PM				1,800	262	0.15

Notes:
NB=northbound, SB=southbound, v/c = volume-to-capacity ratio

[1] As a conservative approach, if an on-ramp has meter equipment present, the ramp is analyzed assuming it is metered.
[2] Ramp capacities were obtained from the Highway Capacity Manual, 2000 (pg 25-4), and considered the free-flow speed, the number of lanes on the ramp, and ramp metering.
[3] Peak-hour volumes are obtained through intersection counts and Caltrans.

Observed Existing Conditions

Traffic conditions were observed in the field in order to identify existing operational deficiencies and to confirm the accuracy of calculated intersection levels of service. The purpose of this effort was (1) to identify any existing traffic problems that may not be directly related to level of service, and (2) to identify any locations where the level of service analysis does not accurately reflect existing traffic conditions. Hexagon conducted field observations in 2017 and 2018 during the AM peak commute period (7:00 AM to 10:00 AM) and during the PM peak commute period (4:00 PM to 7:00 PM). During the peak commute periods, most of the study intersections had no significant operational issues, and vehicular queues on all approaches were mostly able to clear in one cycle. The observed operational issues at the study intersections are identified below.

Note that the discussion below indicates occasional instances when specific movements could not make it through the intersection in one cycle. Intersection level of service calculations for signalized intersections are based on the average delay of all movements within the peak hour. Therefore, if one movement is failing to clear within one signal cycle but other movements receive minimal delays, the intersection could still operate at an acceptable level of service.

Fair Oaks Avenue and US 101 Northbound Ramps

During the AM peak commute period, the northbound left-turn queues were observed to occasionally extend beyond the existing turn pocket storage space and required two signal cycles to clear the intersection.

During the PM peak commute period, the westbound left-turn movement received heavy traffic volumes and occasionally required two signal cycles to clear the intersection.

Fair Oaks Avenue and Duane Avenue

During the AM peak commute period, southbound and westbound left-turn movements received heavy traffic volumes and required two signal cycles to clear the intersection. This congestion was observed to occur only during the peak 15-minute drop-off operations of the nearby King's Academy school.

Wolfe Road and Arques Avenue

During the PM peak hour, westbound left-turn traffic was heavy and consistently required two signal cycles to clear.

Wolfe Road and Central Expressway Ramps

The intersections on Wolfe Road at the Central Expressway eastbound and westbound ramps were observed to operate as one intersection during the AM and PM peak commute periods. Due to the signal operations, the northbound left-turning vehicles and southbound left-turning vehicles were observed to experience long delays. During the AM peak commute period, the northbound left-turn queues were observed to occasionally extend beyond the storage space.

During the PM peak commute period, the southbound through queues were observed to occasionally spillback to the upstream intersection at Wolfe Road/Arques Avenue and required two signal cycles to clear the intersection.

Wolfe Road and Kifer Road

During the PM peak commute period, westbound left-turn traffic was heavy and consistently required two signal cycles to clear.

Wolfe Road and Evelyn Avenue

During the PM peak commute period, the southbound through queues were observed to extend beyond the entrance to the left-turn pocket which would prevent southbound left-turn vehicles from entering the storage space.

Wolfe Road and El Camino Real

During the AM peak commute period, there was an imbalance of lane use for westbound left-turning vehicles in favor of the outer left-turn lane (second from the left lane). Queues from the outer left-turn lane would extend beyond the turn pocket and block the inner left-turn lane. Westbound left-turn vehicles were observed to fail to clear the intersection in one cycle length. In addition, westbound through queues extended approximately 750 feet and would occasionally fail to clear the intersection in one cycle length.

During the PM peak commute period, southbound left-turn vehicles were observed to frequently fail to clear the intersection in one green cycle. In addition, eastbound through vehicles were observed to occasionally fail to clear the intersection in one green cycle.

Wolfe Road and Fremont Avenue

During the PM peak commute period, there was an imbalance of lane use for eastbound left-turning vehicles in favor of the outer left-turn lane. Queues from the outer left-turn lane would extend beyond the turn pocket and block the inner left-turn lane. Eastbound left-turn vehicles were observed to occasionally fail to clear the intersection in one cycle length. Eastbound through vehicle queues would extend approximately 450 feet and would occasionally fail to clear the intersection in one cycle length. In addition, occasionally there was eastbound downstream spillback from the stop sign at Fremont Avenue and El Camino Real, which caused congestion for eastbound vehicles progressing through the intersection.

Lawrence Expresway and US 101 Northbound Ramps

During the PM peak commute period, southbound vehicle queues would occasionally spill back from the downstream intersection of Lawrence Expressway and US 101 SB Ramps. This congestion would occasionally prevent southbound through vehicles from progressing through the intersection.

Lawrence Expresway and US 101 Southbound Ramps

During the PM peak commute period, southbound vehicle queues would occasionally spillback from the downstream intersection of Lawrence Expressway and Oakmead Parkway. This congestion would occasionally prevent southbound through and eastbound right-turn vehicles from progressing through the intersection. During the southbound red phase, the southbound queues were observed to occasionally spillback to the upstream intersection of Lawrence Expressway and US 101 NB Ramps, approximately 850 feet of queued vehicles. In addition, the eastbound left-turn and eastbound right-turn vehicle queues were observed to occasionally require more than one green cycle to clear the intersection.

Lawrence Expressway & Oakmead Parkway

During the AM peak commute period, northbound through traffic was heavy, but most vehicles cleared within one signal cycle. Vehicles at the back of the northbound left-turn queues occasionally required two cycles to clear the intersection.

During the PM peak commute period, southbound traffic was consistently heavy and required more than one signal cycle to clear.

Lawrence Expressway & Arques Avenue

During the AM peak commute period, vehicles at the back of the northbound left-turn queues occasionally required two cycles to clear the intersection.

During the PM peak commute period, southbound traffic was consistently heavy and required more than one signal cycle to clear.

Central Expressway Loop Ramps at Lawrence Expressway

Hexagon conducted field observations at the Central Expressway square loop ramps at the Lawrence Expressway interchange during the AM and PM peak commute periods. Central Expressway westbound is the AM peak commute direction and Central Expressway eastbound is the PM peak commute direction. During the AM peak commute period, vehicles from northbound Lawrence Expressway to westbound Central Expressway ramp via Cobalt Way would experience some delay due to limited gaps in westbound traffic on Central Expressway. However, the westbound Central Expressway traffic is metered by the upstream intersection at Oakmead Parkway/Central Expressway, and this creates large gaps between the platoons of westbound traffic, which allowed the Cobalt Way queues to fully dissipate. There were no traffic operational deficiencies observed during the PM peak commute period.

3. Background Conditions

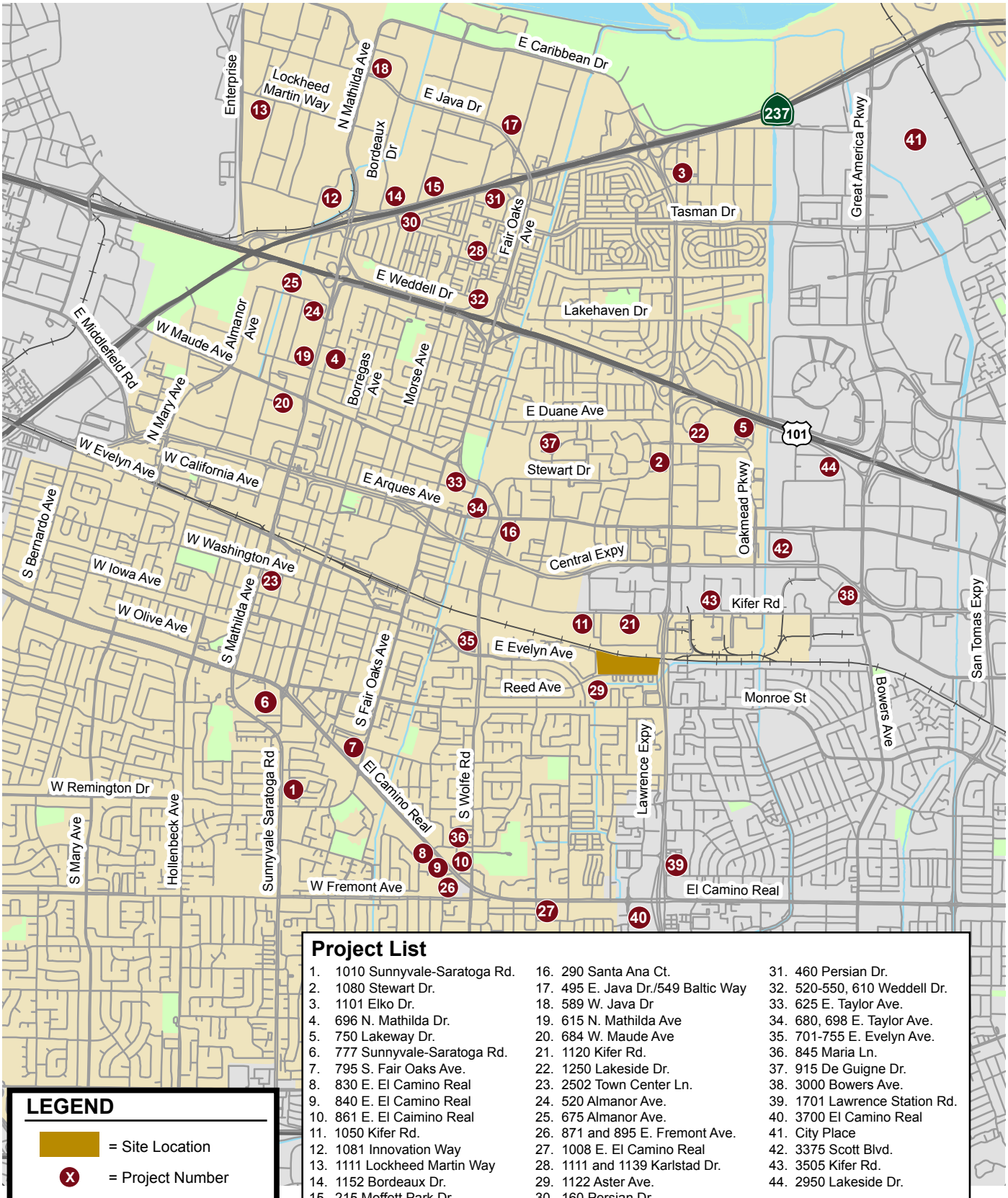
This chapter describes background traffic conditions, which are defined as conditions with the addition of traffic from approved but not yet constructed and occupied projects in the study area. Traffic volumes for background conditions comprise volumes from the existing traffic counts plus traffic generated by approved projects in the vicinity of the site. This chapter describes the procedure used to determine background traffic volumes and the resulting traffic conditions.

Background Transportation Network

It is assumed in this analysis that the transportation network background conditions, including roadway and intersection lane configurations, would be the same as that described under the existing conditions.

Background Traffic Volumes

Background traffic volumes were estimated by adding traffic from approved but not yet completed developments in the study area. Approved developments are those developments that have been approved by local agencies, are under construction, or are built but not yet occupied. Approved project lists were obtained from the City of Sunnyvale and the City of Santa Clara. Based on a review of traffic studies prepared for these projects, the types and sizes of these developments, and their distances from the project site, a total of 43 approved projects were selected for inclusion in the background scenario. Trip generation for all background projects was based on their respective traffic reports provided by City staff, where available. The approved but not yet completed developments included in this study are show on Figure 7. The AM and PM peak-hour traffic volumes at the study intersections under background conditions are shown on Figure 8.



Project List

1. 1010 Sunnyvale-Saratoga Rd.
2. 1080 Stewart Dr.
3. 1101 Elko Dr.
4. 696 N. Mathilda Dr.
5. 750 Lakeway Dr.
6. 777 Sunnyvale-Saratoga Rd.
7. 795 S. Fair Oaks Ave.
8. 830 E. El Camino Real
9. 840 E. El Camino Real
10. 861 E. El Caimino Real
11. 1050 Kifer Rd.
12. 1081 Innovation Way
13. 1111 Lockheed Martin Way
14. 1152 Bordeaux Dr.
15. 215 Moffett Park Dr.
16. 290 Santa Ana Ct.
17. 495 E. Java Dr./549 Baltic Way
18. 589 W. Java Dr
19. 615 N. Mathilda Ave
20. 684 W. Maude Ave
21. 1120 Kifer Rd.
22. 1250 Lakeside Dr.
23. 2502 Town Center Ln.
24. 520 Almanor Ave.
25. 675 Almanor Ave.
26. 871 and 895 E. Fremont Ave.
27. 1008 E. El Camino Real
28. 1111 and 1139 Karlstad Dr.
29. 1122 Aster Ave.
30. 160 Persian Dr.
31. 460 Persian Dr.
32. 520-550, 610 Weddell Dr.
33. 625 E. Taylor Ave.
34. 680, 698 E. Taylor Ave.
35. 701-755 E. Evelyn Ave.
36. 845 Maria Ln.
37. 915 De Guigne Dr.
38. 3000 Bowers Ave.
39. 1701 Lawrence Station Rd.
40. 3700 El Camino Real
41. City Place
42. 3375 Scott Blvd.
43. 3505 Kifer Rd.
44. 2950 Lakeside Dr.

LEGEND

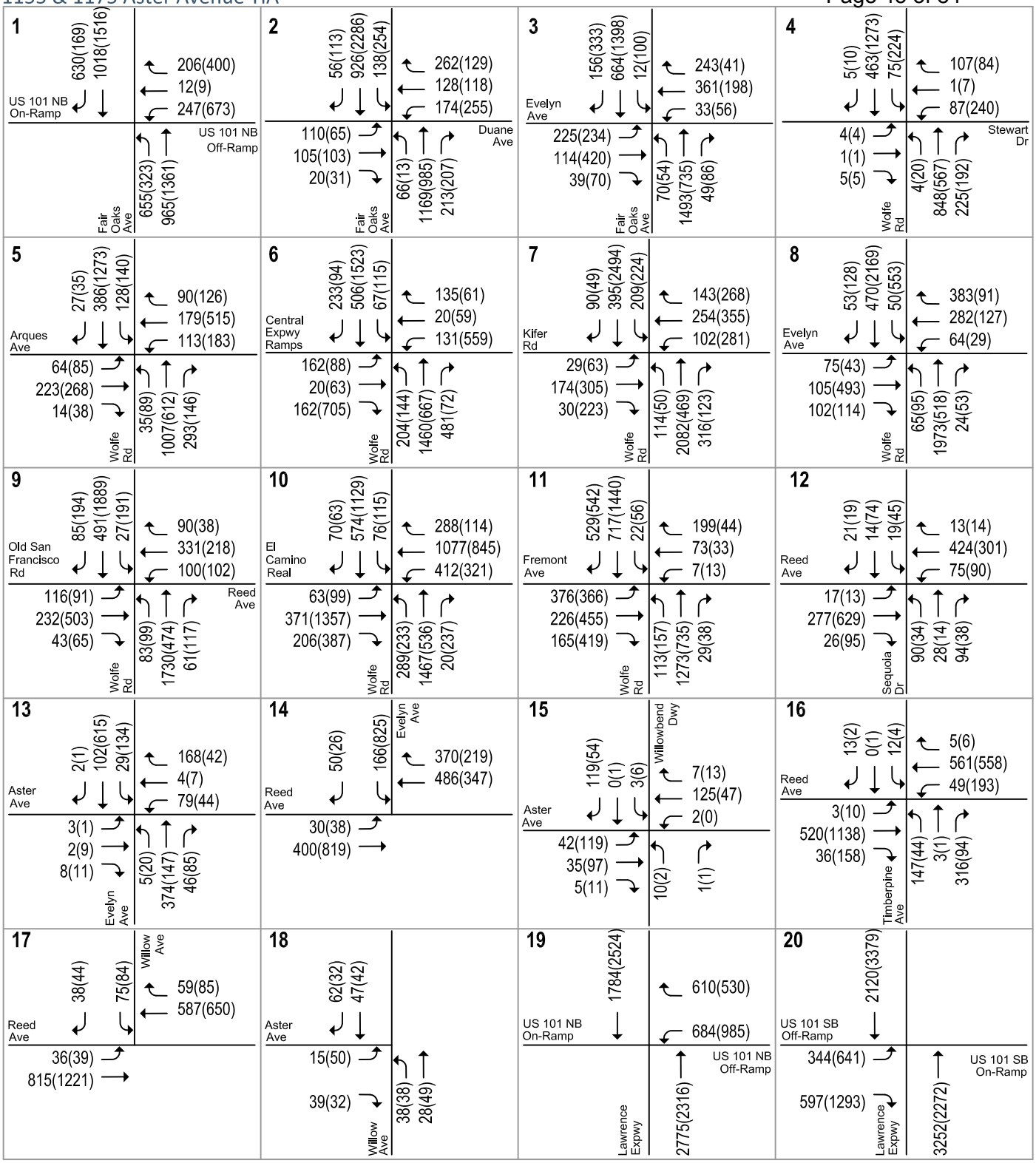
= Site Location

X = Project Number

= City of Sunnyvale

NORTH
Not to Scale

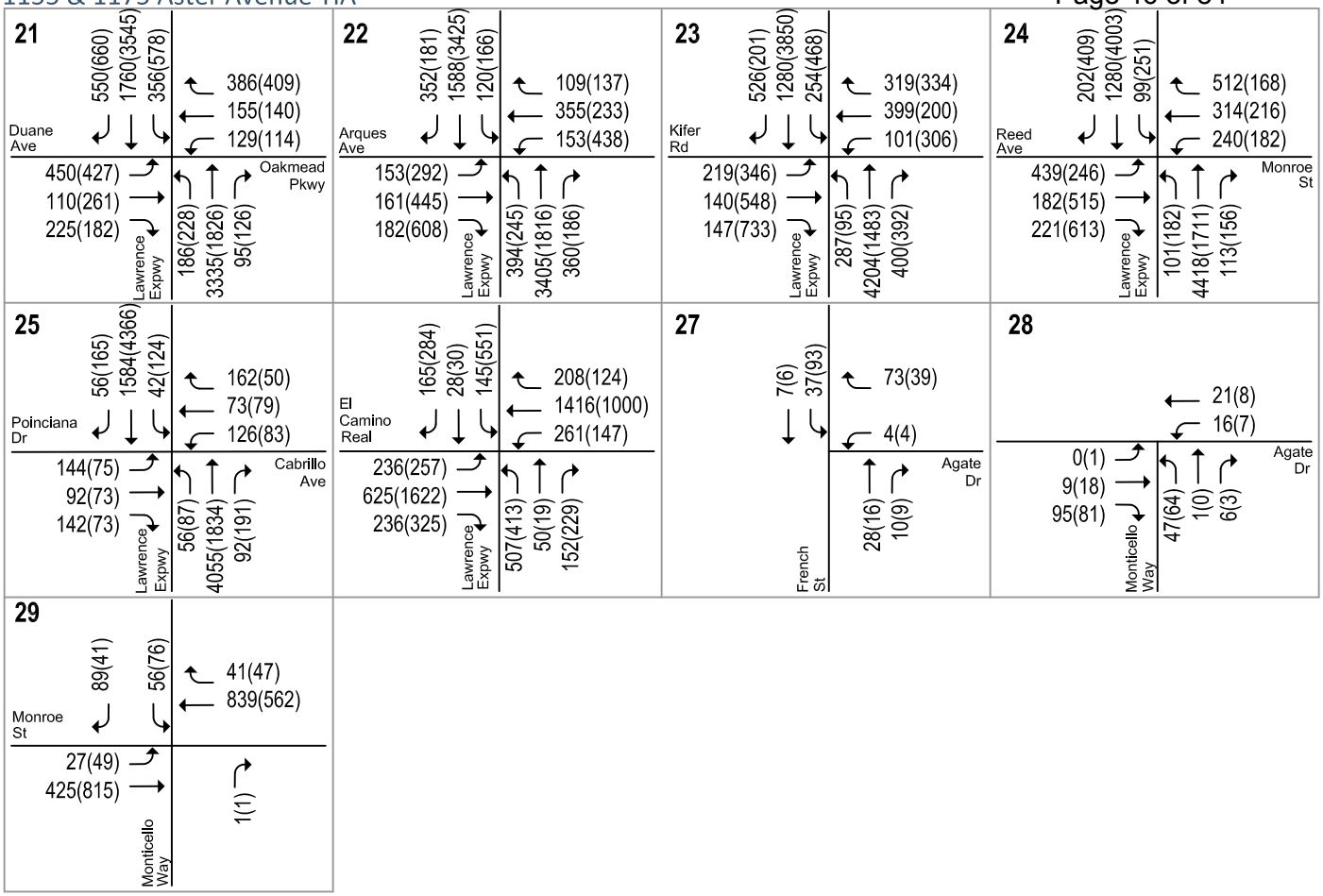
Figure 7
Approved Developments



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

Figure 8
Background Traffic Volumes



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

Figure 8
Background Traffic Volumes

Background Intersection Level of Service

The results of the intersection level of service analysis under background conditions are summarized in Table 9 for the signalized study intersections and Table 10 for the unsignalized study intersections. The results of the analysis show that the majority of the study intersections would operate at acceptable levels. The following study intersections would operate below the LOS standard during at least one peak hour:

- Wolfe Road and Central Expressway Ramps (#6) – PM peak hour (LOS F)
- Willow Avenue and Reed Avenue (#17) – PM peak hour (LOS F)
- Lawrence Expressway and Oakmead Parkway/Duane Avenue (#21) – PM peak hour (LOS F)
- Lawrence Expressway and Arques Avenue (#22) – PM peak hour (LOS F)
- Lawrence Expressway and Kifer Road (#23) – AM and PM peak hour (LOS F)
- Lawrence Expressway and Monroe Street/Reed Avenue (#24) – AM and PM peak hour (LOS F)

Table 9
Background Level of Service Summary - Signalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing		Background	
					Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS
1	Fair Oaks Avenue & US 101 NB Ramps	Signal	E	AM	29.7	C	47.2	D
				PM	31.3	C	48.8	D
2	Fair Oaks Avenue & Duane Avenue	Signal	D	AM	36.1	D+	37.4	D+
				PM	35.7	D+	39.5	D
3	Fair Oaks Avenue & Evelyn Avenue	Signal	D	AM	46.5	D	51.7	D-
				PM	39.5	D	49.9	D
4	Wolfe Road & Stewart Drive	Signal	D	AM	14.5	B	13.7	B
				PM	27.8	C	26.8	C
5	Wolfe Road & Arques Avenue	Signal	D	AM	49.4	D	52.0	D-
				PM	43.9	D	44.5	D
6	Wolfe Road & Central Expressway Ramps	Signal	E	AM	37.4	D+	59.3	E+
				PM	**84.4**	**F**	**110.7**	**F**
7	Wolfe Road & Kifer Road	Signal	D	AM	26.2	C	36.7	D+
				PM	36.8	D+	46.5	D
8	Wolfe Road & Evelyn Avenue	Signal	D	AM	34.3	C-	34.4	C-
				PM	35.8	D+	34.0	C-
9	Wolfe Road & Old San Francisco Road/Reed Avenue	Signal	D	AM	38.5	D+	37.4	D+
				PM	41.2	D	41.5	D
10	Wolfe Road & El Camino Real*	Signal	E	AM	61.1	E	63.3	E
				PM	43.0	D	43.9	D
11	Wolfe Road & Fremont Avenue	Signal	D	AM	39.7	D	39.9	D
				PM	49.5	D	50.8	D
12	Sequoia Drive & Reed Avenue	Signal	D	AM	14.2	B	14.2	B
				PM	13.5	B	13.5	B
13	Evelyn Avenue & Aster Avenue	Signal	D	AM	14.1	B	14.2	B
				PM	13.3	B	13.6	B
14	Evelyn Avenue & Reed Avenue	Signal	D	AM	9.5	A	9.5	A
				PM	12.0	B+	12.0	B
16	Timberpine Avenue & Reed Avenue	Signal	D	AM	20.3	C+	20.3	C+
				PM	17.6	B	17.6	B
19	Lawrence Expressway & US 101 NB Ramps (County)	Signal	E	AM	10.0	B+	10.6	B+
				PM	13.8	B	15.1	B
20	Lawrence Expressway & US 101 SB Ramps (County)	Signal	E	AM	6.6	A	7.3	A
				PM	71.5	E	**88.9**	**F**
21	Lawrence Expressway & Oakmead Parkway/Duane Avenue (County)	Signal	E	AM	44.0	D	67.4	E
				PM	53.5	D-	**85.2**	**F**
22	Lawrence Expressway & Arques Avenue* (County)	Signal	E	AM	48.2	D	59.7	E+
				PM	68.1	E	**84.3**	**F**
23	Lawrence Expressway & Kifer Road (County)	Signal	E	AM	54.4	D-	**80.8**	**F**
				PM	**101.6**	**F**	**>120**	**F**
24	Lawrence Expressway & Monroe Street/Reed Avenue* (County)	Signal	E	AM	**114.8**	**F**	**>120**	**F**
				PM	74.1	E	**83.8**	**F**
25	Lawrence Expressway & Cabrillo Avenue (County)	Signal	E	AM	52.1	D-	66.2	E
				PM	48.6	D	60.7	E
26	Lawrence Expressway & El Camino Real Ramps* (SC)	Signal	E	AM	34.5	C-	35.1	D+
				PM	29.9	C	30.9	C
29	Monticello Way & Monroe Street (SC)	Signal	D	AM	7.8	A	7.8	A
				PM	5.6	A	5.6	A

Notes

** = CMP, SC = Santa Clara, County = County of Santa Clara*

Level of service for signal controlled intersection is based on the average intersection delay.

">120" indicates the intersection experiences lengthy delay that is beyond the reasonable calculation range of the HCM 2000 methodology.

BOLD indicates substandard level of service.

Table 10
Background Level of Service Summary - Unsignalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing			Background		
					Avg. Delay (sec)	LOS	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Signal Warrant Met[1]
15	Willowbend Driveway & Aster Avenue	Side Street Stop	D	AM	10.2	B	-	10.3	B	-
				PM	10.7	B	-	10.8	B	-
17	Willow Avenue & Reed Avenue	Side Street Stop	D	AM	26.2	D	No	26.3	D	No
				PM	**52.6**	**F**	**Yes**	**53.2**	**F**	**Yes**
18	Willow Avenue & Aster Avenue	Side Street Stop	D	AM	9.1	A	-	9.1	A	-
				PM	9.6	A	-	9.6	A	-
27	French Street & Agate Drive (SC)	All Way Yield	D	AM	5.0	A	-	5.0	A	-
				PM	7.0	A	-	7.0	A	-
28	Monticello Way & Agate Drive (SC)	All Way Stop	D	AM	7.2	A	-	7.2	A	-
				PM	7.2	A	-	7.2	A	-

Notes
SC = Santa Clara

Level of service for side street stop controlled intersections is based on the delay experienced by the worst movement. Level of service for all way yield and all way stop controlled intersections is based on the average intersection delay.

BOLD indicates substandard level of service.

[1] The CA MUTCD peak-hour signal warrant is checked only if the intersection is operating at an unacceptable level of service.

4. Project Conditions

This chapter describes the method by which project traffic is estimated, roadway traffic operations under existing plus project conditions and background plus project conditions, and any impacts caused by the project. Existing plus project traffic conditions could potentially occur if the project were to be occupied prior to the other approved projects in the area. However, it is unlikely that this traffic condition would occur, since some of the other approved projects expected to add traffic to the study area would likely be built and occupied during the time this project is going through the development review process.

Project Description

The project proposes to demolish the existing industrial facilities on-site and construct a residential complex, including 412 apartments, 189 condominiums, 140 townhomes, a 2-acre park, and a 1,500 square foot (s.f.) coffee shop. Access to the project would be provided via three driveways. Two full access driveways would be located along Aster Avenue and one right in/out only driveway would be located along Willow Avenue.

Project Trip Estimates

The magnitude of traffic produced by a new development and the locations where that traffic would appear are estimated using a three-step process: (1) trip generation, (2) trip distribution, and (3) trip assignment. In determining project trip generation, the magnitude of traffic traveling to and from the proposed project site was estimated for the AM and PM peak hours. As part of the project trip distribution, the directions to and from which the project trips would travel were estimated. In the project trip assignment, the project trips were assigned to specific streets and intersections. These procedures are described below.

Trip Generation

Through empirical research, data have been collected that quantify the amount of traffic produced by common land uses. Thus, for the most common land uses there are standard trip generation rates that can be applied to help predict the future traffic increases that would result from a new development. The magnitude of traffic added to the roadway system by a particular development is estimated by multiplying the applicable trip generation rates by the size of the development. Trip generation resulting from new development proposed within the City of Sunnyvale typically is estimated using the trip rates published in the Institute of Transportation Engineers' (ITE) *Trip Generation Manual, 10th Edition (2017)*. Trip generation rates for the proposed apartments and condominiums are based on the average rates published for "Multifamily Housing (Mid Rise)" (Land Use Code 221). Trip generation rates for the proposed townhomes are based on the average rates published for "Multifamily Housing (Low Rise)" (Land Use Code 220). Trip Generation rates for the proposed coffee shop are based on the average rates published for "Coffee/Donut Shop without Drive-Through Window" (Land Use Code 936).

Trip Reductions

A mixed-use development with complementary land uses such as residential and retail will generate and attract trips internally between the uses. Thus, the number of vehicle trips generated for each use may be reduced, since a portion of the trips would not require entering or exiting the site. The VTA's *Congestion Management Program Transportation Impact Analysis Guidelines* (October 2014) indicates a trip reduction of up to 15 percent is allowed for residential and retail mixed-use developments. The reduction is first applied to the smaller of the two complimentary trip generators (in this case, the retail use), and the same number of trips is then subtracted from the larger trip generator (in this case, the residential use) to account for both trip ends. Trip reductions also factor in that this project is also a Transit Oriented Development (TOD) due to its proximity to the Caltrain station. The VTA's CMP TIA guidelines indicate a trip reduction of up to 9% is allowed for residential uses within a 2,000 foot walk of a Caltrain station. Also, the coffee shop trip generation can be reduced due to Diverted Linked trips. Diverted Link trips are generated by traffic that diverts from its current route to include a stop by the coffee shop, and then ultimately continues on its original path. As documented in the Institute of Transportation Engineers' (ITE) *Trip Generation Handbook, 3rd Edition,* coffee shops have, on average, pass-by trips accounting for 89% of all trips. Since the proposed coffee shop is not located on a busy street where trips could pass-by on their way to their final destination, Hexagon assumed that these trips would instead divert slightly from their original route to the coffee shop. For the purpose of this analysis, Hexagon assumed that the coffee shop could have as high as 89% of all trips be diverted-linked trips. However, the VTA's CMP TIA guidelines indicate a trip reduction of up to 30% is allowed for retail uses to account for diverted-linked trips. Therefore, a 30% diverted-linked trip reduction was applied for the coffee shop trips. Trip assignment assumptions for these diverted-linked trips are discussed below.

In addition, the proposed project would receive trip credits for the trips generated by the existing on-site use. AM and PM peak hour counts were collected at the existing site driveways on Thursday, May 17, 2018.

Net Project Trips

After applying the ITE trip generation rates and the applicable trip reductions, the proposed project is estimated to generate a net increase of 268 vehicle trips during the AM peak hour (71 inbound and 197 outbound) and 299 vehicle trips during the PM peak hour (189 inbound and 110 outbound).

The trip generation for the proposed project is summarized in Table 11.

Table 11
Trip Generation Summary

Land Use	Size	Daily Rate[1]	Daily Trips	AM Peak Hour Rate[1]	AM Peak Hour In	AM Peak Hour Out	AM Peak Hour Total	PM Peak Hour Rate[1]	PM Peak Hour In	PM Peak Hour Out	PM Peak Hour Total
Proposed											
Residential											
Apartments[2]	412 d.u.	5.44	2,241	0.36	38	110	148	0.44	110	71	181
Condominiums[2]	189 d.u.	5.44	1028	0.36	18	50	68	0.44	51	32	83
Townhomes[3]	140 d.u.	7.32	1025	0.46	15	49	64	0.56	49	29	78
Gross Residential Trips			4,294		71	209	280		210	132	342
Mixed-Use Reduction[4]			*(81)*		*(11)*	*(11)*	*(22)*		*(4)*	*(4)*	*(8)*
Transit Reduction[5]			*(386)*		*(5)*	*(18)*	*(23)*		*(19)*	*(12)*	*(31)*
Net New Residential Trips			*3,827*		*55*	*180*	*235*		*187*	*116*	*303*
Commercial											
Coffee Shop[6]	1,500 s.f.	360	540	101.14	78	74	152	36.31	27	27	54
Mixed-Use Reduction[4]			*(81)*		*(11)*	*(11)*	*(22)*		*(4)*	*(4)*	*(8)*
Diverted Linked Reduction[7]			*(138)*		*(19)*	*(19)*	*(38)*		*(7)*	*(7)*	*(14)*
Net New Commercial Trips			*321*		*48*	*44*	*92*		*16*	*16*	*32*
Subtotal Net New Project Trips			**4,148**		**103**	**224**	***327***		**203**	**132**	***335***
Existing											
Driveway Counts[8]			(360)		(32)	(27)	(59)		(14)	(22)	(36)
Net Project Trips			**3,788**		**71**	**197**	**268**		**189**	**110**	**299**

Notes

d.u. = dwelling units, s.f. = square feet

[1] Rate expressed in trips per d.u. for the residential units and trips per 1,000 s.f. for the coffee shop.

[2] Trip generation rates for the proposed apartments and condominiums are based on the ITE's *Trip Generation Manual, 10th Edition* average rates published for "Multifamily Housing (Mid-Rise)" (Land Use Code 221).

[3] Trip generation rates for the proposed townhomes are based on the ITE's *Trip Generation Manual, 10th Edition* average rates published for "Multifamily Housing (Low-Rise)" (Land Use Code 220).

[4] As prescribed by the *VTA Transportation Impact Analysis Guidelines, 2014* , a maximum trip reduction of 15% of the smaller trip generator for mixed-use development projects with housing and retail components was applied to project's trip generation.

[5] As prescribed by the *VTA Transportation Impact Analysis Guidelines, 2014* , a maximum trip reduction of 9% for housing within a 2,000 foot walk of a Caltrain station was applied to proposed residential units. Note that the transit reduction is applied after the mixed-use trip reduction.

[6] The peak hour trip generation rates for the proposed coffee shop are based on the ITE's *Trip Generation Manual, 10th Edition* average rates published for "Coffee/Donut Shop without Drive-Through Window" (Land Use Code 936). The daily trips is derived from the assumption that the PM peak hour represents 10% of the total daily vehicle trips.

[7] As prescribed by the *VTA Transportation Impact Analysis Guidelines, 2014* , a maximum trip reduction of 30% for diverted linked trips was applied to the coffee shop trips. Note that the diverted linked trip reduction is applied after the mixed-use trip reduction.

[8] Existing AM and PM peak-hour driveway counts were collected on Thursday, May 17, 2018. The existing daily trips is derived from the assumption that the PM peak hour represents 10% of the total daily vehicle trips.

Trip Distribution

Trips generated by the proposed project were distributed to the study network based on the existing travel patterns on the surrounding roadway system and the locations of complementary land uses. Residential uses generate mostly outbound trips in the morning and mostly inbound trips in the evening. The majority of the residential project trips would travel via US 101, Lawrence Expressway, and Central Expressway. The coffee shop project trips would have origins and destinations closer to the project site. The trip distribution for the residential use is shown on Figure 9 and for the coffee shop on Figure 10.

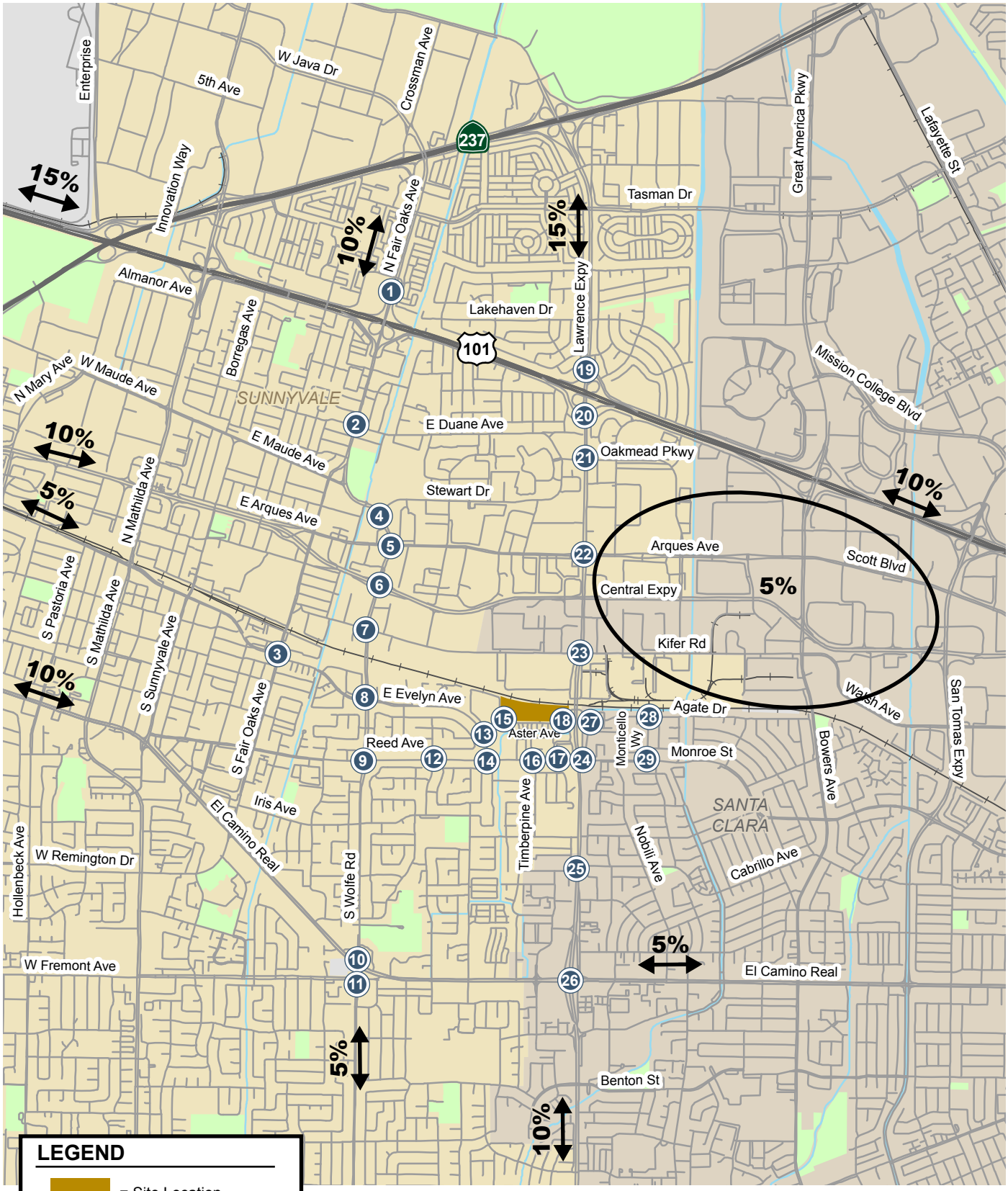


Figure 9
Project Trip Distribution - Residential Use

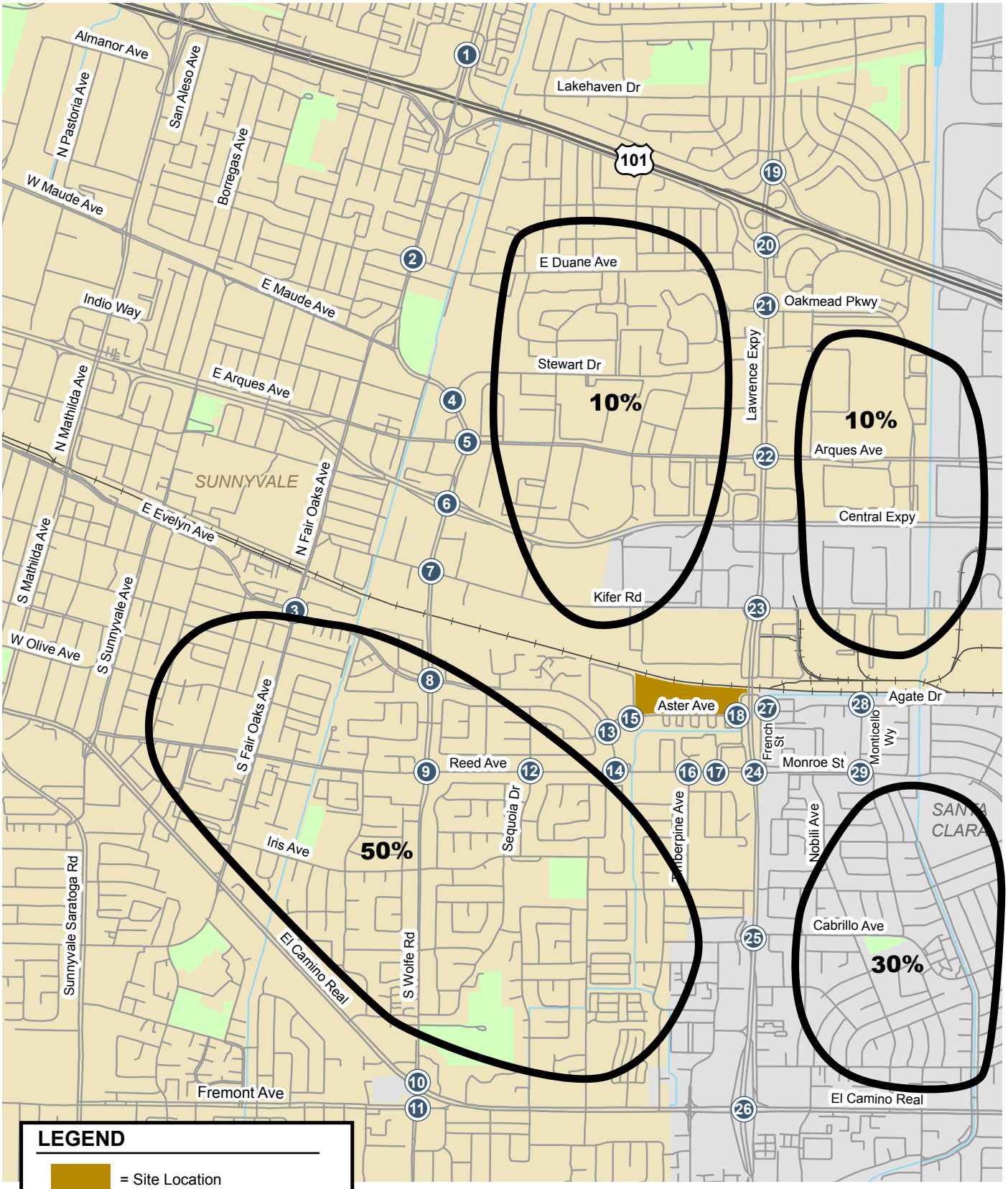


Figure 10
Project Trip Distribution - Commercial Use

Trip Assignment

The project trips were assigned to the roadway network based on the direction of approach and departure, roadway network connections, freeway and expressway access points, and the locations of project driveways. It is assumed that all trips generated by the townhomes would use the western Aster Avenue driveway. All trips generated by the condominiums are assumed to use the eastern Aster Avenue driveway. For the apartment trips, most inbound trips are assumed to use the eastern Aster Avenue driveway. Only the inbound trips on Reed Avenue east of Lawrence Expressway are assumed to use the Willow Avenue driveway. All outbound apartment trips are assumed to use the Willow Avenue driveway as a conservative approach for the intersection analysis at the Willow Avenue and Aster Avenue intersection. For trips generated by the coffee shop, 85% of the inbound trips are assumed to use the eastern Aster Avenue driveway, and the remaining 15% of the inbound trips are assumed to use the Willow Avenue driveway. As a conservative approach, all outbound coffee shop trips are assumed to use the Willow Avenue driveway.

Based on the above assumptions, the net project trips assigned to the three driveways approximately follow the splits identified below:

- The western Aster Avenue driveway is assigned approximately 25% of the inbound and outbound net project trips.
- The eastern Aster Avenue driveway is assigned approximately 70% of the inbound and 10% of the outbound net project trips.
- The Willow Avenue right-in-right-out driveway is assigned approximately 5% of the inbound and 65% of the outbound net project trips.

As discussed above, 30% of the coffee shop trips are assumed as diverted-linked trips. Given the project location and proximity to comparable uses, Hexagon assumed that the diverted-linked trips would all be from trips originally travelling southbound on Evelyn Avenue at the Aster Avenue intersection.

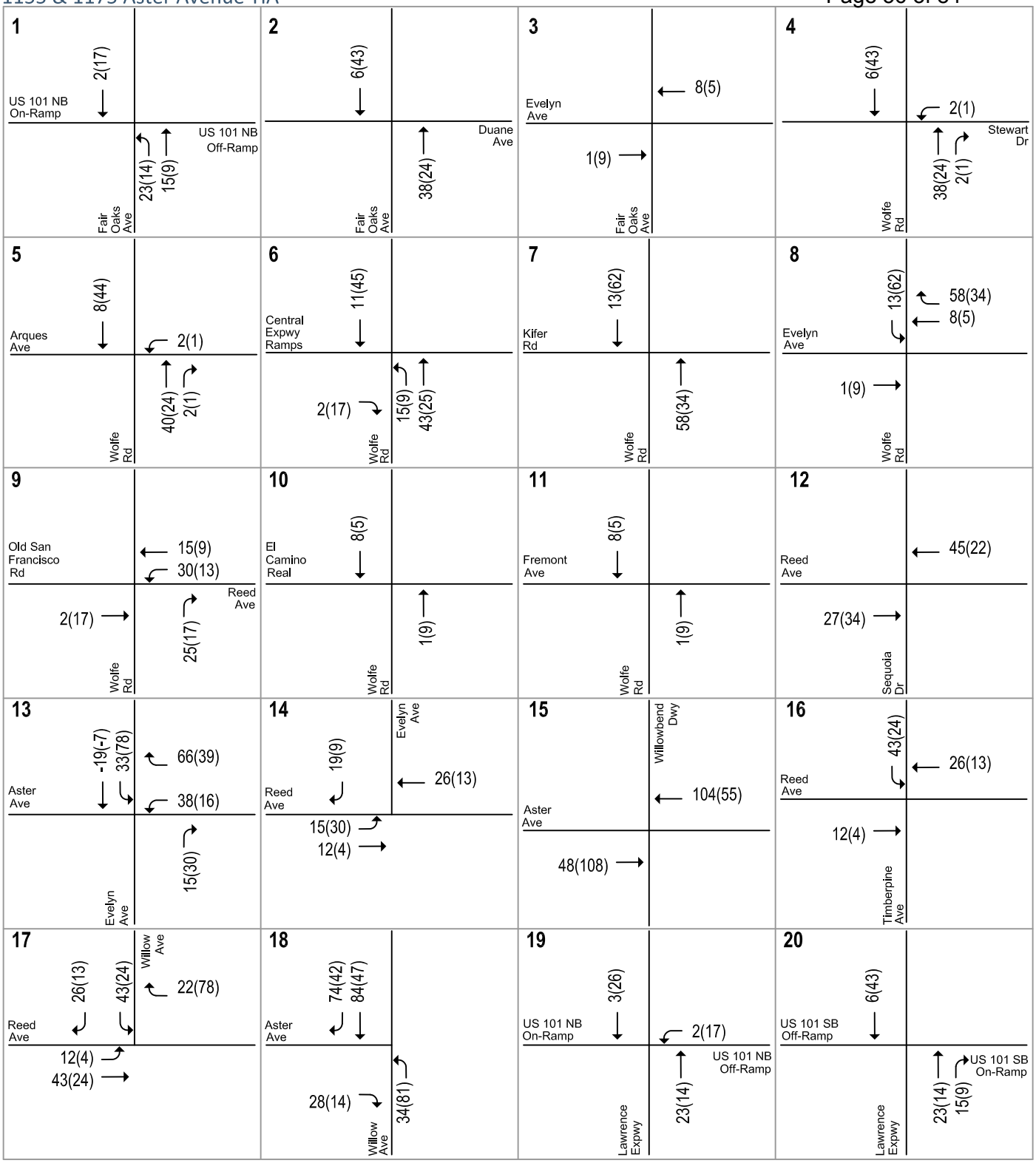
The net project trips at the study intersections is shown on Figure 11.

Intersection Traffic Volumes Under Project Conditions

Project impacts were evaluated relative to both (1) existing traffic volumes and (2) background traffic volumes. For the existing plus project scenario, the net new trips generated by the proposed project were added to the existing traffic volumes to derive the existing plus project traffic volumes. Figure 12 shows the intersection turning-movement volumes under existing plus project. For the background plus project scenario, the net new trips generated by the proposed project were added to the background traffic volumes to derive the background plus project traffic volumes. Figure 13 shows the intersection turning-movement volumes under background plus project conditions.

Transportation Network Under Project Conditions

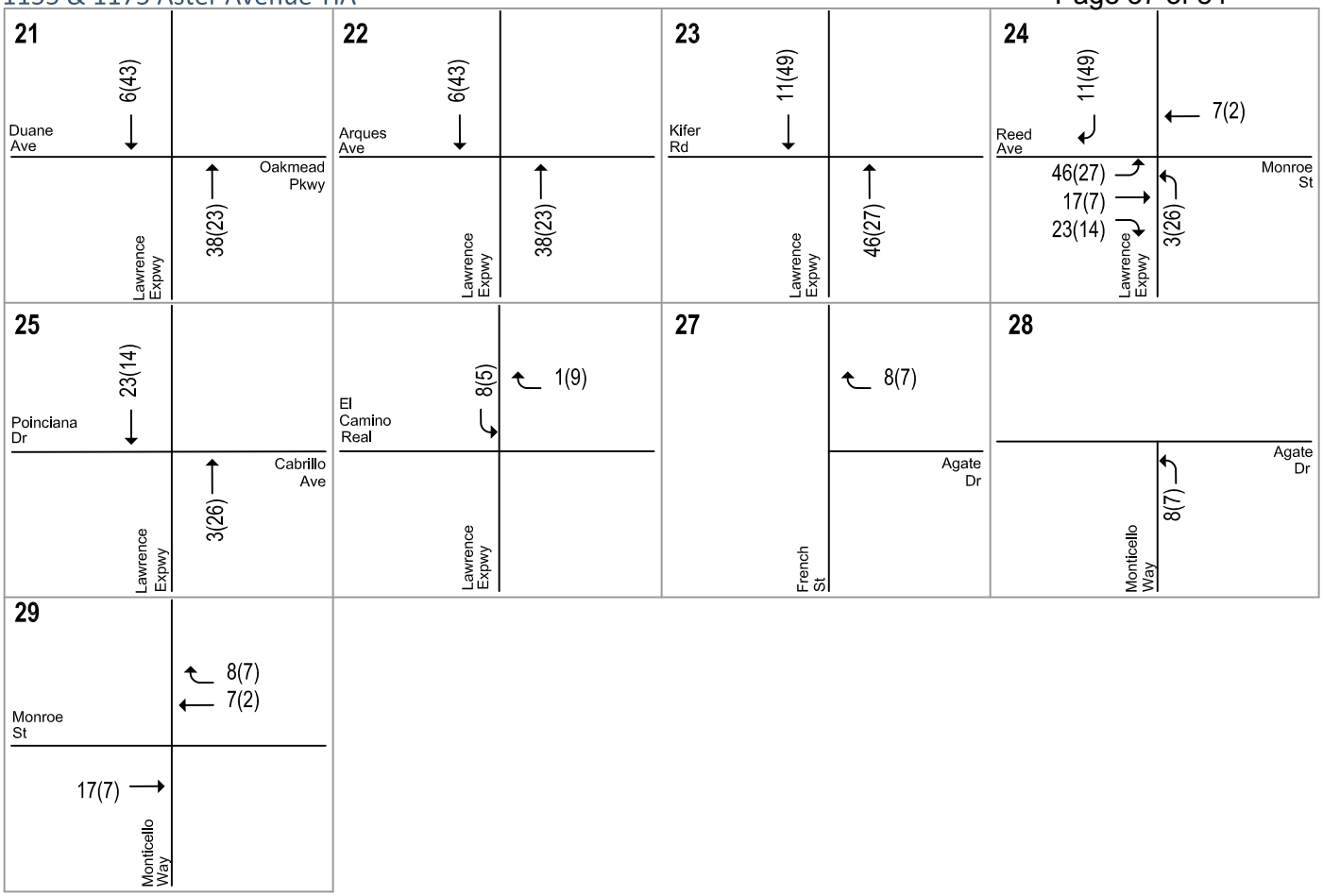
It is assumed in this analysis that the transportation network under existing plus project and background plus project conditions, including roadways and intersection lane configurations, would be the same as that described under existing conditions at all study intersections.



LEGEND

XX(XX) = AM(PM) Peak-Hour Trips

Figure 11
Net Project Trip Assignment



LEGEND

XX(XX) = AM(PM) Peak-Hour Trips

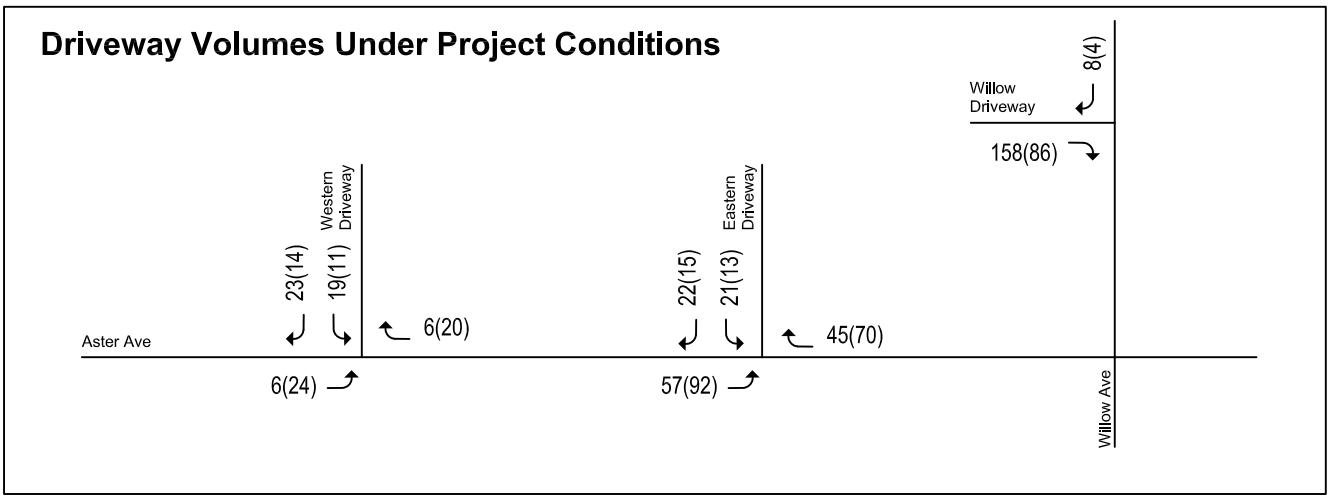
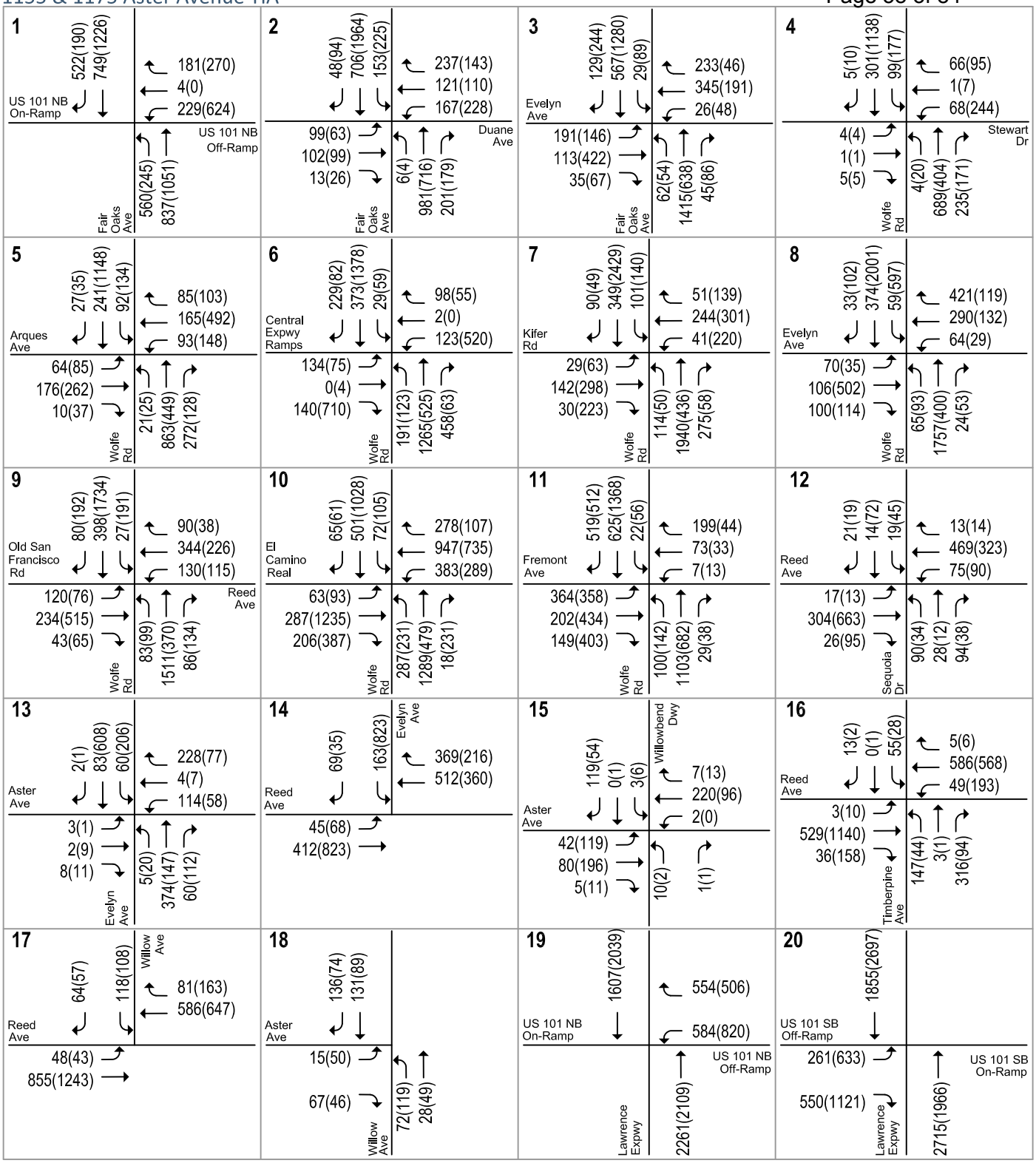


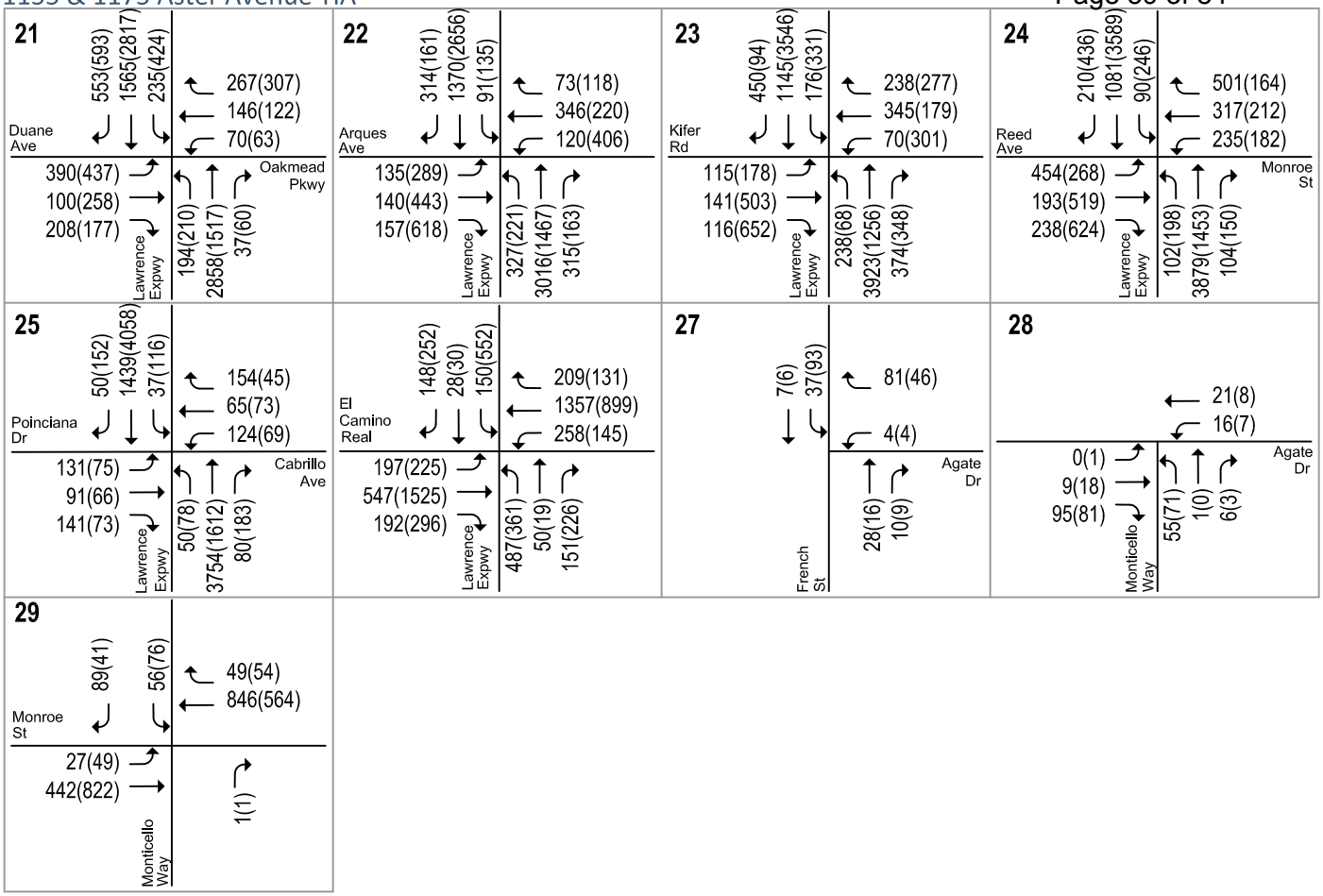
Figure 11
Net Project Trip Assignment



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

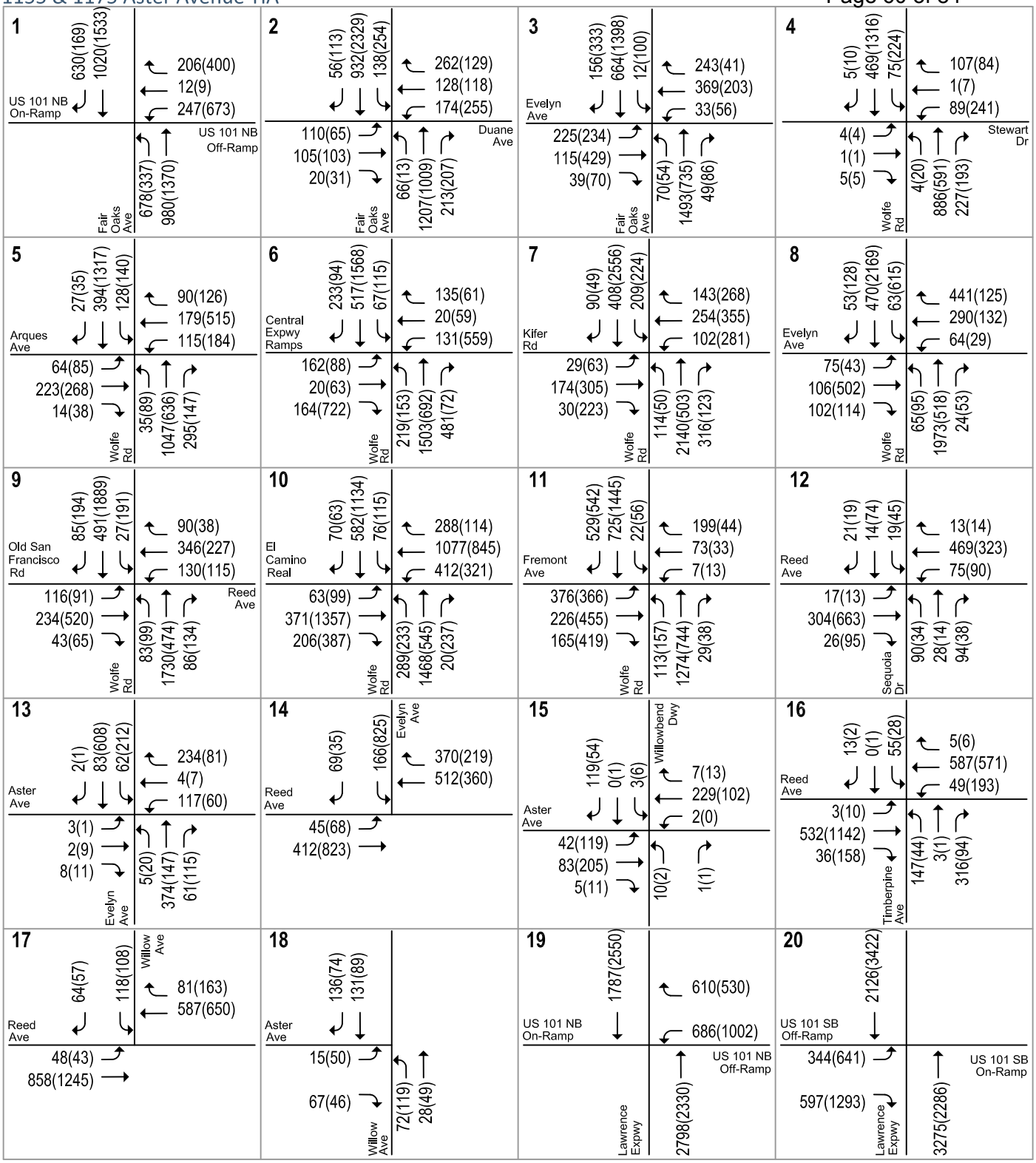
Figure 12
Existing Plus Project Traffic Volumes



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

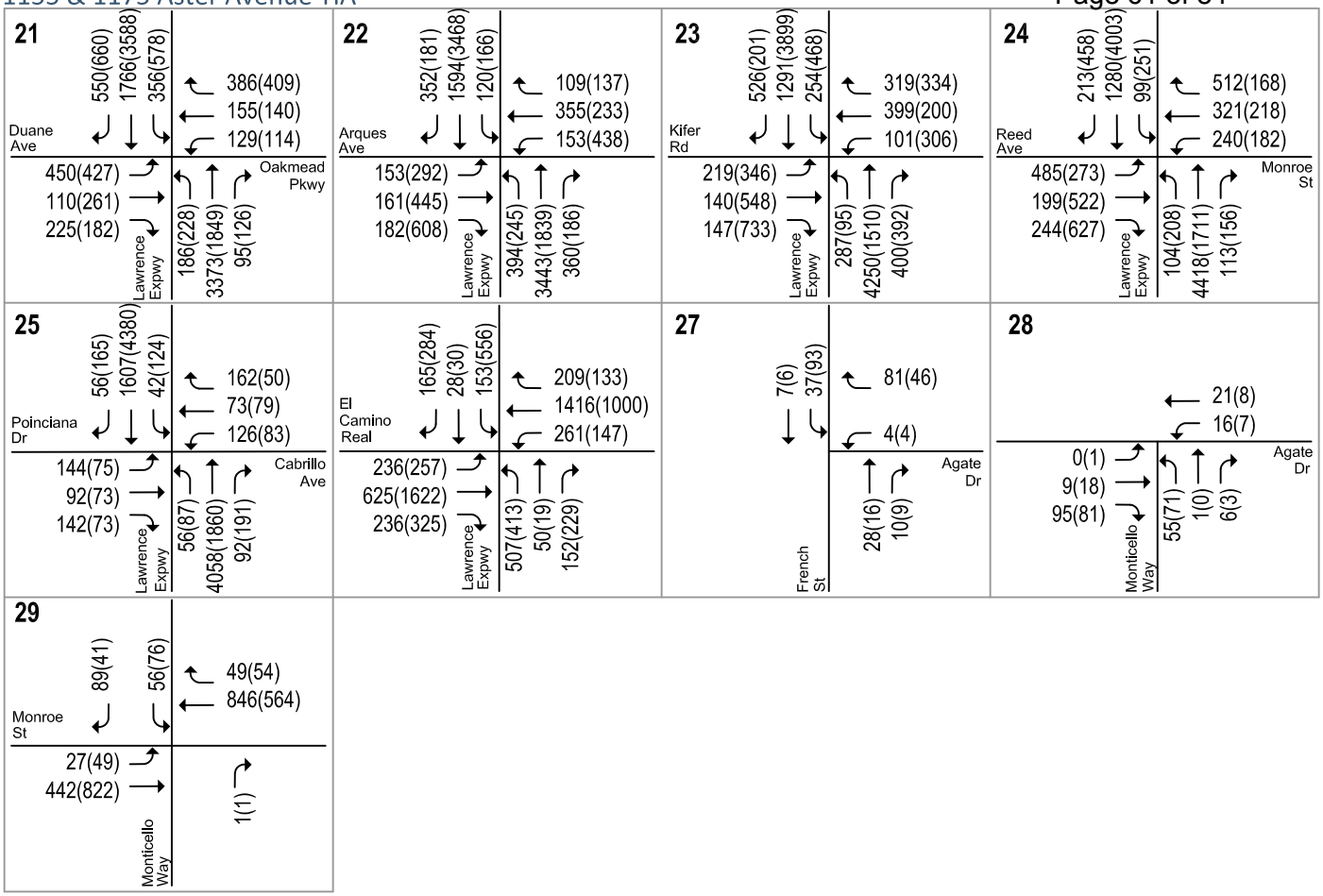
Figure 12
Existing Plus Project Traffic Volumes



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

Figure 13
Background Plus Project Traffic Volumes



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

Figure 13
Background Plus Project Traffic Volumes

Existing Plus Project Intersection Level of Service

The results of the intersection level of service analysis under existing plus project conditions are summarized in Table 12 for the signalized study intersections and Table 13 for the unsignalized study intersections. The results of the analysis show that the project would not create a significant impact at any of the signalized study intersections.

The unsignalized intersection of Willow Avenue and Reed Avenue has an intersection level of service threshold of LOS D. Under existing conditions, the LOS would be an acceptable LOS D during the AM peak hour and an unacceptable LOS F during the PM peak hour. The addition of proposed project traffic would deteriorate the intersection to LOS E during the AM peak hour and a worse LOS F during the PM peak hour. For the PM peak hour, the proposed project traffic would cause an increase in critical delay of 33 seconds and an increase in critical v/c ratio of 0.215. Based on City of Sunnyvale significant impact criteria, the project would generate a significant intersection impact at this intersection during both the AM and PM peak hours.

Mitigation strategies are discussed in the follow section.

Table 12
Existing Plus Project Level of Service Summary - Signalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing		Existing Plus Project			
					Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c
1	Fair Oaks Avenue & US 101 NB Ramps	Signal	E	AM	29.7	C	34.9	C-	8.9	0.016
				PM	31.3	C	32.0	C	0.8	0.015
2	Fair Oaks Avenue & Duane Avenue	Signal	D	AM	36.1	D+	36.1	D+	-0.1	0.001
				PM	35.7	D+	35.7	D+	-0.1	0.007
3	Fair Oaks Avenue & Evelyn Avenue	Signal	D	AM	46.5	D	46.7	D	0.2	0.003
				PM	39.5	D	39.6	D	0.0	0.002
4	Wolfe Road & Stewart Drive	Signal	D	AM	14.5	B	14.2	B	-0.2	0.002
				PM	27.8	C	27.6	C	-0.6	0.006
5	Wolfe Road & Arques Avenue	Signal	D	AM	49.4	D	49.6	D	-0.2	0.001
				PM	43.9	D	43.5	D	-0.2	0.010
6	Wolfe Road & Central Expressway Ramps	Signal	E	AM	37.4	D+	38.8	D+	5.7	0.014
				PM	**84.4**	**F**	**85.5**	**F**	**1.5**	**0.018**
7	Wolfe Road & Kifer Road	Signal	D	AM	26.2	C	26.0	C	-0.4	0.003
				PM	36.8	D+	37.2	D+	-0.7	0.007
8	Wolfe Road & Evelyn Avenue	Signal	D	AM	34.3	C-	35.9	D+	2.5	0.040
				PM	35.8	D+	32.8	C-	31.1	-0.154
9	Wolfe Road & Old San Francisco Road/Reed Avenue	Signal	D	AM	38.5	D+	39.4	D	0.4	0.010
				PM	41.2	D	42.0	D	0.9	0.018
10	Wolfe Road & El Camino Real*	Signal	E	AM	61.1	E	61.0	E	0.0	0.000
				PM	43.0	D	43.0	D	0.1	0.001
11	Wolfe Road & Fremont Avenue	Signal	D	AM	39.7	D	39.7	D	-0.1	0.002
				PM	49.5	D	49.4	D	0.1	0.000
12	Sequoia Drive & Reed Avenue	Signal	D	AM	14.2	B	14.6	B	0.7	0.037
				PM	13.5	B	13.5	B	0.0	0.013
13	Evelyn Avenue & Aster Avenue	Signal	D	AM	14.1	B	15.5	B	1.5	0.093
				PM	13.3	B	14.7	B	3.5	-0.116
14	Evelyn Avenue & Reed Avenue	Signal	D	AM	9.5	A	9.7	A	0.1	0.023
				PM	12.0	B+	12.2	B	0.4	0.024
16	Timberpine Avenue & Reed Avenue	Signal	D	AM	20.3	C+	20.2	C+	0.0	0.004
				PM	17.6	B	17.7	B	-0.1	0.004
19	Lawrence Expressway & US 101 NB Ramps (County)	Signal	E	AM	10.0	B+	10.0	B+	0.0	0.003
				PM	13.8	B	13.8	B	0.2	0.006
20	Lawrence Expressway & US 101 SB Ramps (County)	Signal	E	AM	6.6	A	6.5	A	0.0	0.003
				PM	71.5	E	70.9	E	-1.3	0.006
21	Lawrence Expressway & Oakmead Parkway/Duane Avenue (County)	Signal	E	AM	44.0	D	44.5	D	0.9	0.006
				PM	53.5	D-	53.9	D-	0.7	0.006
22	Lawrence Expressway & Arques Avenue* (County)	Signal	E	AM	48.2	D	48.6	D	0.7	0.006
				PM	68.1	E	68.2	E	0.3	0.007
23	Lawrence Expressway & Kifer Road (County)	Signal	E	AM	54.4	D-	56.8	E+	3.7	0.007
				PM	**101.6**	**F**	**102.0**	**F**	**-1.0**	**0.004**
24	Lawrence Expressway & Monroe Street/Reed Avenue* (County)	Signal	E	AM	**114.8**	**F**	**116.3**	**F**	**2.8**	**0.016**
				PM	74.1	E	74.0	E	3.4	0.131
25	Lawrence Expressway & Cabrillo Avenue (County)	Signal	E	AM	52.1	D-	52.0	D-	0.2	0.001
				PM	48.6	D	48.9	D	-0.2	0.004
26	Lawrence Expressway & El Camino Real Ramps* (SC)	Signal	E	AM	34.5	C-	34.7	C-	0.2	0.002
				PM	29.9	C	29.9	C	0.1	0.002
29	Monticello Way & Monroe Street (SC)	Signal	D	AM	7.8	A	7.7	A	-0.1	0.005
				PM	5.6	A	5.5	A	0.0	0.002

Notes

** = CMP, SC = Santa Clara, County = County of Santa Clara*

Level of service for signal controlled intersection is based on the average intersection delay.

">120" indicates the intersection experiences lengthy delay that is beyond the reasonable calculation range of the HCM 2000 methodology.

BOLD indicates substandard level of service.

Table 13
Existing Plus Project Level of Service Summary - Unsignalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing				Existing Plus Project				
					Count Date	Avg. Delay (sec)	LOS	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c	Signal Warrant Met[1]
15	Willowbend Driveway & Aster Avenue	Side Street Stop	D	AM	05/15/18	10.2	B	-	11.1	B	0.9	0.003	-
				PM	05/15/18	10.7	B	-	11.9	B	1.2	0.001	-
17	Willow Avenue & Reed Avenue	Side Street Stop	D	AM	05/15/18	26.2	D	No	**43.5**	**E**	**17.3**	**0.282**	**Yes**
				PM	05/15/18	**52.6**	**F**	**Yes**	**85.6**	**F**	**33.0**	**0.215**	**Yes**
18	Willow Avenue & Aster Avenue	Side Street Stop	D	AM	05/15/18	9.1	A	-	10.1	B	1.0	0.045	-
				PM	05/15/18	9.6	A	-	11.1	B	1.5	0.044	-
27	French Street & Agate Drive (SC)	All Way Yield	D	AM	05/15/18	5.0	A	-	4.7	A	-	-	-
				PM	05/15/18	7.0	A	-	6.7	A	-	-	-
28	Monticello Way & Agate Drive (SC)	All Way Stop	D	AM	05/15/18	7.2	A	-	7.2	A	-	-	-
				PM	05/15/18	7.2	A	-	7.3	A	-	-	-

Notes

SC = Santa Clara

Level of service for side street stop controlled intersections is based on the delay experienced by the worst movement. Level of service for all way yield and all way stop controlled intersections is based on the average intersection delay.

BOLD indicates substandard level of service.

BOLD and boxed indicates a significant impact.

[1] The CA MUTCD peak-hour signal warrant is checked only if the intersection is operating at an unacceptable level of service.

Existing Plus Project Potential Intersection Mitigation Strategies

Mitigation options were studied for the impacted unsignalized intersection at Willow Avenue and Reed Avenue. It should be noted that the peak-hour signal warrant analysis concluded that a traffic signal is warranted during both the AM and PM peak hours. However, given that the intersection is located within close proximity (less than 500 feet) to a traffic signal in both directions on Reed Avenue (signal at Timberpine Avenue to the west, and Lawrence Expressway to the east), a traffic signal at this intersection could potentially disrupt the traffic flow on Reed Avenue. Further studies should be conducted if the City wants to pursue a traffic signal at the intersection of Willow Avenue and Reed Avenue.

The turning movement that would operate poorly at the Willow Avenue and Reed Avenue intersection is the southbound to eastbound left turn. The project impact could be mitigated by disallowing that left turn movement. Mitigation would require installing a sign restricting left-turns from southbound Willow Avenue onto Reed Avenue during the AM (7-9 AM) and PM (4-6 PM) peak periods. With the proposed left-turn restriction during the peak hours, the intersection at Willow Avenue and Reed Avenue would operate at acceptable levels of service. It is assumed that vehicles on southbound Willow Avenue heading to eastbound Reed Avenue would instead turn right onto westbound Reed Avenue first and then perform a legal U-turn on Reed Avenue west of Willow Avenue. The added westbound U-turns on Reed Avenue would not deteriorate roadway operations, thus the proposed mitigation would not create secondary impacts at other locations. With the proposed mitigation, the project impact at the intersection of Willow Avenue and Reed Avenue would be *less than significant* (see Table 14). The project applicant will be responsible for the cost of the proposed mitigation.

Table 14
Mitigated Existing Plus Project Level of Service Summary

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing		Existing Plus Project		Mitigated Existing Plus Project	
					Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS
17	Willow Avenue & Reed Avenue	Side Street Stop	D	AM	26.2	D	**43.5**	**E**	11.8	B
				PM	**52.6**	**F**	**85.6**	**F**	12.0	B

Notes
Level of service for side street stop intersections is based on the delay experiences by the worst movement.
BOLD indicates substandard level of service.
BOLD and boxed indicates a significant impact.

Background Plus Project Intersection Level of Service and Mitigation Strategy

The results of the intersection level of service analysis under background plus project conditions are summarized in Table 15 for the signalized study intersections and Table 16 for the unsignalized study intersections.

The unsignalized intersection of Willow Avenue and Reed Avenue has an intersection level of service threshold of LOS D. Under background conditions, the LOS for the southbound to eastbound left turn would be an acceptable LOS D during the AM peak hour and an unacceptable LOS F during the PM peak hour. The addition of proposed project traffic would deteriorate the intersection to LOS E during the AM peak hour and a worse LOS F during the PM peak hour. For the PM peak hour, the proposed project traffic would cause an increase in critical delay of 33.7 seconds and an increase in critical v/c ratio of 0.217. Based on City of Sunnyvale impact criteria, the project would generate a significant intersection impact at this intersection during both the AM and PM peak hours under background plus project conditions.

The mitigation strategy at the intersection at Willow Avenue and Reed Avenue under background plus project conditions would be the same as under existing plus project conditions. With the proposed mitigation strategy, the project impact at the unsignalized intersection at Willow Avenue and Reed Avenue under background plus project conditions would be *less than significant* (see Table 17).

Table 15
Background Plus Project Level of Service Summary - Signalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Background		Background Plus Project			
					Avg. Delay	LOS	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c
1	Fair Oaks Avenue & US 101 NB Ramps	Signal	E	AM	47.2	D	50.9	D	6.1	0.016
				PM	48.8	D	50.6	D	2.1	0.015
2	Fair Oaks Avenue & Duane Avenue	Signal	D	AM	37.4	D+	37.7	D+	0.0	0.001
				PM	39.5	D	39.7	D	0.4	0.007
3	Fair Oaks Avenue & Evelyn Avenue	Signal	D	AM	51.7	D-	51.9	D-	0.3	0.002
				PM	49.9	D	49.9	D	0.0	0.002
4	Wolfe Road & Stewart Drive	Signal	D	AM	13.7	B	13.5	B	-0.2	0.002
				PM	26.8	C	26.7	C	-0.3	0.005
5	Wolfe Road & Arques Avenue	Signal	D	AM	52.0	D-	52.2	D-	-0.1	0.001
				PM	44.5	D	44.2	D	-0.2	0.009
6	Wolfe Road & Central Expressway Ramps	Signal	E	AM	59.3	E+	63.7	E	11.6	0.014
				PM	**110.7**	**F**	**112.0**	**F**	**1.8**	**0.019**
7	Wolfe Road & Kifer Road	Signal	D	AM	36.7	D+	36.6	D+	0.0	0.012
				PM	46.5	D	46.5	D	-1.2	0.007
8	Wolfe Road & Evelyn Avenue	Signal	D	AM	34.4	C-	36.2	D+	2.8	0.040
				PM	34.0	C-	32.3	C-	31.1	-0.164
9	Wolfe Road & Old San Francisco Road/Reed Avenue	Signal	D	AM	37.4	D+	38.3	D+	0.4	0.009
				PM	41.5	D	42.3	D	0.9	0.018
10	Wolfe Road & El Camino Real*	Signal	E	AM	63.3	E	63.3	E	0.0	0.000
				PM	43.9	D	43.9	D	0.0	0.001
11	Wolfe Road & Fremont Avenue	Signal	D	AM	39.9	D	39.9	D	0.0	0.003
				PM	50.8	D	50.7	D	0.0	0.001
12	Sequoia Drive & Reed Avenue	Signal	D	AM	14.2	B	14.6	B	0.7	0.037
				PM	13.5	B	13.5	B	0.0	0.013
13	Evelyn Avenue & Aster Avenue	Signal	D	AM	14.2	B	15.7	B	1.6	0.094
				PM	13.6	B	14.8	B	3.9	-0.096
14	Evelyn Avenue & Reed Avenue	Signal	D	AM	9.5	A	9.7	A	0.1	0.024
				PM	12.0	B	12.2	B	0.3	0.025
16	Timberpine Avenue & Reed Avenue	Signal	D	AM	20.3	C+	20.2	C+	0.0	0.004
				PM	17.6	B	17.7	B	-0.1	0.004
19	Lawrence Expressway & US 101 NB Ramps (County)	Signal	E	AM	10.6	B+	10.6	B+	0.0	0.003
				PM	15.1	B	15.4	B	0.5	0.007
20	Lawrence Expressway & US 101 SB Ramps (County)	Signal	E	AM	7.3	A	7.3	A	-0.1	0.004
				PM	**88.9**	**F**	**88.2**	**F**	**-1.3**	**0.006**
21	Lawrence Expressway & Oakmead Parkway/Duane Avenue (County)	Signal	E	AM	67.4	E	69.4	E	3.6	0.006
				PM	**85.2**	**F**	**87.4**	**F**	**4.5**	**0.006**
22	Lawrence Expressway & Arques Avenue* (County)	Signal	E	AM	59.7	E+	61.1	E	2.5	0.006
				PM	**84.3**	**F**	**86.4**	**F**	**3.6**	**0.007**
23	Lawrence Expressway & Kifer Road (County)	Signal	E	AM	**80.8**	**F**	**83.4**	**F**	**3.9**	**0.008**
				PM	**>120**	**F**	**>120**	**F**	**-1.0**	**0.004**
24	Lawrence Expressway & Monroe Street/Reed Avenue* (County)	Signal	E	AM	**>120**	**F**	**>120**	**F**	**2.8**	**0.015**
				PM	**83.8**	**F**	**87.1**	**F**	**5.6**	**0.008**
25	Lawrence Expressway & Cabrillo Avenue (County)	Signal	E	AM	66.2	E	66.2	E	0.2	0.000
				PM	60.7	E	61.3	E	1.1	0.002
26	Lawrence Expressway & El Camino Real Ramps* (SC)	Signal	E	AM	35.1	D+	35.3	D+	0.2	0.002
				PM	30.9	C	31.0	C	0.1	0.002
29	Monticello Way & Monroe Street (SC)	Signal	D	AM	7.8	A	7.7	A	-0.1	0.005
				PM	5.6	A	5.5	A	0.0	0.002

Notes

* = *CMP, SC = Santa Clara, County = County of Santa Clara*

Level of service for signal controlled intersection is based on the average intersection delay.

">120" indicates the intersection experiences lengthy delay that is beyond the reasonable calculation range

BOLD indicates substandard level of service.

Table 16
Background Plus Project Level of Service Summary - Unsignalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Background			Background Plus Project				
					Avg. Delay (sec)	LOS	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c	Signal Warrant Met[1]
15	Willowbend Driveway & Aster Avenue	Side Street Stop	D	AM	10.3	B	0	11.3	B	1.0	0.003	-
				PM	10.8	B	0	12.3	B	1.5	0.001	-
17	Willow Avenue & Reed Avenue	Side Street Stop	D	AM	26.3	D	No	**47.6**	**E**	**21.3**	**0.318**	**Yes**
				PM	**53.2**	**F**	**Yes**	**96.5**	**F**	**43.3**	**0.258**	**Yes**
18	Willow Avenue & Aster Avenue	Side Street Stop	D	AM	9.1	A	0	10.1	B	1.0	0.051	-
				PM	9.6	A	0	11.2	B	1.6	0.057	-
27	French Street & Agate Drive (SC)	Side Street Yield	D	AM	9.3	A	0	9.4	A	-	-	-
				PM	9.2	A	0	9.3	A	-	-	-
28	Monticello Way & Agate Drive (SC)	Side Street Stop	D	AM	7.2	A	0	7.2	A	-	-	-
				PM	7.2	A	0	7.3	A	-	-	-

Notes

SC = Santa Clara

Level of service for side street stop and side street yield controlled intersections is based on the delay experiences by

BOLD indicates substandard level of service.

BOLD and boxed indicates a significant impact.

[1] The CA MUTCD peak-hour signal warrant is checked only if the intersection is operating at an unacceptable level of service.

Table 17
Mitigated Background Plus Project Level of Service Summary

ID #	Intersection	Control	LOS Standard	Peak Hour	Background		Background Plus Project		Mitigated Background Plus	
					Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS
17	Willow Avenue & Reed Avenue	Side Street Stop	D	AM	26.3	D	**43.8**	**E**	11.8	B
				PM	**53.2**	**F**	**86.9**	**F**	12.0	B

Notes

Level of service for side street stop intersections is based on the delay experiences by the worst movement.

BOLD indicates substandard level of service.

BOLD and boxed indicates a significant impact.

Project Conditions Freeway Analysis

The results of the CMP freeway analysis show that the project generated freeway traffic would not exceed 1%, thus the project freeway impacts would be *less than significant* (see Table 18).

Table 18
Project Conditions Freeway Analysis Summary

				Existing Conditions - Mixed Flow Lanes[1]						Project Conditions	
Freeway	Dir.	Segment	Peak Hour	Avg. Speed (mph)	# of Lanes	Capacity	Density (pc/mi/ln)	Volume	LOS[2]	Project Trips	% Capacity
US 101	NB	Great America Parkway On-Ramp to	AM	16	3	6,900	**74.0**	**3,477**	**F**	3	0.04%
		Lawrence Expressway Off-Ramp	PM	62	3	6,900	25.6	4,803	C	21	0.30%
US 101	NB	Fair Oaks Avenue On-Ramp to	AM	26	3	6,900	**61.1**	**4,710**	**F**	27	0.39%
		Mathilda Avenue Off-Ramp	PM	61	3	6,900	27.4	5,058	D	17	0.25%
US 101	SB	Mathilda Avenue On-Ramp to Fair	AM	62	3	6,900	26.3	4,893	D	5	0.07%
		Oaks Avenue Off-Ramp	PM	25	3	6,900	**61.5**	**4,674**	**F**	32	0.46%
US 101	SB	Lawrence Expressway On-Ramp to	AM	58	3	6,900	31.8	5,577	D	18	0.26%
		Bowers Avenue Off-Ramp	PM	7	3	6,900	**89.9**	**1,845**	**F**	12	0.17%

Notes
Dir. = direction, NB = northbound, SB = southbound, mph = miles per hour, pc/mi/ln = passenger cars per mile per lane
[1] Existing freeway conditions information is published in the Santa Clara Valley Transportation Authority (VTA) *2017 CMP Monitoring and Conformance Report*.
[2] The Santa Clara VTA report references the Freeway LOS criteria presented in the *Traffic Level of Service Analysis Guidelines (June 2003)* published by Santa Clara VTA.
BOLD indicates substandard level of service.

Project Conditions Ramp Analysis

Freeway ramp volumes under project conditions were estimated by adding project trips to the existing volumes obtained from Caltrans. The peak hour ramp volumes under existing plus project conditions are shown in Table 19.

The ramp analysis shows that the selected ramps would continue to have sufficient capacity to serve the projected traffic volumes under project conditions.

Table 19
Project Conditions Freeway Ramp Analysis

				Existing Conditions			Project Conditions		
Interchange	Ramp	Type	Peak Hour	Capacity[1]	Peak Volume[2]	v/c	Project Trips	Peak Volume	v/c
US101/Fair Oaks Avenue	NB On-Ramp from Fair Oaks Avenue	Diagonal	AM	1,800	1,061	0.59	27	1,088	0.60
			PM	1,800	416	0.23	17	433	0.24
	SB Off-Ramp to SB Fair Oaks Avenue	Diagonal	AM	2,000	363	0.18	5	368	0.18
			PM	2,000	893	0.45	32	925	0.46
US 101/Lawrence Expressway	NB Off-Ramp to Lawrence Expressway	Diagonal	AM	3,800	1,136	0.30	3	1,139	0.30
			PM	3,800	1,309	0.34	21	1,330	0.35
	SB On-Ramp from NB Lawrence Expressway	Diagonal	AM	1,800	709	0.39	18	727	0.40
			PM	1,800	262	0.15	12	274	0.15

Notes:
NB=northbound, SB=southbound, v/c = volume-to-capacity ratio
[1] Ramp capacities were obtained from the Highway Capacity Manual, 2000 (pg 25-4), and considered the free-flow speed, the number of lanes on the ramp, and ramp metering.
[2] Peak-hour volumes are obtained from Caltrans.
[3] As a conservative approach, if an on-ramp has meter equipment present, the ramp is analyzed assuming it is metered.

Potential Project Effects at Lawrence and Central

The project is expected to add traffic to the Lawrence Expressway and Central Expressway square loop ramps. The project is expected to add six trips during the AM peak hour and seven trips during the PM peak hour to the westbound Central Expressway to southbound Lawrence Expressway off-ramp. In addition, the project is expected to add nine AM peak hour trips and four PM peak hour trips to the northbound Lawrence Expressway to eastbound Central Expressway on-ramp. This equates to a range of approximately one vehicle every six to fifteen minutes. As discussed in Chapter 2, the Lawrence Expressway and Central Expressway square loop ramps do not have any existing significant operational issues. The proposed project would add minimal traffic to the Lawrence Expressway and Central Expressway square loop ramps and is not expected to considerably affect the ramp operations.

5. Other Transportation Issues

This chapter presents an analysis of other transportation issues associated with the project, including:

- operation analysis – vehicle queuing and storage at selected intersections
- potential impacts to transit services and pedestrian and bicycle facilities,
- site access and circulation, and
- parking.

Unlike the level of service impact methodology, which is adopted by the City Council, the analyses in this chapter are based on professional judgment in accordance with the standards and methods employed by the traffic engineering community. Although operational issues are not considered CEQA impacts, they do describe traffic conditions that are relevant to describing the project environment.

Queuing Analysis

The analysis of intersection level of service was supplemented with a queuing analysis for selected movements at the study intersections. Vehicle queues were estimated using a Poisson probability distribution. The operations analysis is based on vehicle queuing for high-demand left-turn movements at intersections where 10 or more project trips per lane were added. This analysis provides a basis for determining whether the addition of project trips would exacerbate peak hour queues and delays, as well as estimating future storage requirements at intersections. For signalized intersections, the estimated queue length was compared to the length of the existing turn pockets. For unsignalized intersections, the estimated queue lengths were compared to the storage space available between the limit line and the upstream intersection.

The queueing analysis is based on vehicle queuing for the twelve movements listed below.

- Northbound left turn at Fair Oaks Avenue and US 101 northbound ramps
- Northbound left turn at Wolfe Road and Central Expressway ramps
- Southbound left turn at Wolfe Road and Evelyn Avenue
- Westbound left turn at Wolfe Road and Old San Francisco Road/Reed Avenue
- Southbound and westbound left turns at Evelyn Avenue and Aster Avenue
- Eastbound left turn at Evelyn Avenue and Reed Avenue
- Southbound left turn at Timberpine Avenue and Reed Avenue
- Southbound left turn at Willow Avenue and Reed Avenue
- Northbound left turn at Willow Avenue and Aster Avenue
- Northbound and eastbound left turns at Lawrence Expressway and Reed Avenue

The queuing results for the background plus project scenario were compared to the background scenario to determine whether the project would cause extensive queuing issues (see Table 20). Under background plus project conditions, left-turn traffic is expected to increase the 95th percentile queue by at least one vehicle for four locations that would operate over capacity under background conditions, thus, creating operational deficiencies. The proposed project would create operational deficiencies at the four locations listed below during at least one peak hour.

- Northbound left turn at Fair Oaks Avenue and US 101 northbound ramps
- Northbound left turn at Wolfe Road and Central Expressway ramps
- Southbound left turn at Wolfe Road and Evelyn Avenue
- Northbound left turn and eastbound left-turn at Lawrence Expressway and Reed Avenue/Monroe Street

Below is a detailed discussion of the above identified locations under background plus project conditions.

Fair Oaks Avenue and US 101 Northbound Ramps

The project is expected to add 23 vehicles during the AM peak hour and 14 vehicles during the PM peak hour onto the northbound left-turn lane under background plus project conditions and would lengthen the 95th percentile queues. Since the 95th percentile queue under background plus project conditions is longer during the AM peak hour (575 feet compared to 350 feet during the PM peak hour), the following discussion is focused on the AM peak hour.

This left-turn movement has one turn lane with a total queue storage space of approximately 260 feet. Under background conditions during the AM peak hour, the 95th percentile queue length would be 550 feet, with the back-of-queue extending out of the turn pocket. Under background plus project conditions, the proposed project would add 23 southbound left-turn vehicles during the AM peak hour, and the 95th percentile queue length would be extended by 25 feet to 575 feet.

There is no room to further extend this left-turn lane. There is no feasible improvement for the identified queuing deficiency.

Wolfe Road and Central Expressway Ramps

The left-turn movement has one turn lane with a total queue storage space of approximately 300 feet. Under background conditions during the AM peak hour, the 95th percentile queue length would be 350 feet, with the back-of-queue extending out of the turn pocket. Under background plus project conditions, the proposed project would add 15 northbound left-turn vehicles during the AM peak hour. The 95th percentile queue length would be extended by 25 feet to 375 feet.

The existing median could be narrowed to extend the northbound left-turn lane to accommodate the background plus project 95th percentile queues. However, narrowing the median would require the removal of several trees.

Wolfe Road and Evelyn Avenue

The project is expected to add 62 vehicles during the PM peak hour to the southbound left-turn movement under background plus project conditions and would lengthen the 95th percentile queue. Under background conditions during the PM peak hour, the 95th percentile queue length would be 450 feet per lane, with the back-of-queue extending out of the turn pocket. Under background plus project conditions, the proposed project would add 62 southbound left-turn vehicles during the PM peak hour. The 95th percentile queue length would be extended by 50 feet per lane to 500 feet per lane.

This left-turn movement has two turn lanes with a total queue storage space of approximately 200 feet of storage per lane. There is no room to further extend these left-turn lanes. There is no feasible improvement for the identified queuing deficiency.

Lawrence Expressway and Monroe Street/Reed Avenue

The project is expected to add 26 vehicles during the PM peak hour to the northbound left-turn movement under background plus project conditions and would lengthen the 95th percentile queue. Under background conditions during the PM peak hour, the 95th percentile queue length would be 375 feet per lane, with the back-of-queue extending out of the turn pocket. Under background plus project conditions, the proposed project would add 26 northbound left-turn vehicles during the PM peak hour. The 95th percentile queue length would be extended by 50 feet to 425 feet.

The project is expected to add 46 vehicles (or 23 vehicles per lane) during the AM peak hour to the eastbound left-turn movement under background plus project conditions and would lengthen the 95th percentile queue. Under background conditions during the AM peak hour, the 95th percentile queue length would be 400 feet per lane, with the back-of-queue extending out of the turn pocket. Under background plus project conditions, the addition of project trips would extend the 95th percentile queue by 50 feet per lane to 450 feet per lane.

The northbound left-turn movement has a total queue storage space of approximately 300 feet. The eastbound left-turn movement has a total queue storage space of approximately 305 feet per lane. There is no room to further extend either left-turn pockets. However, the Sunnyvale Traffic Impact Fee (TIF) identifies an interchange at this location. At the time of this report, the interchange design has not been finalized. It is assumed that the final interchange design would provide adequate queuing space for the left-turn movements. As part of the project, the applicant will be required to pay the Sunnyvale Traffic Impact Fee (TIF), which would constitute the project's fair-share contribution toward the cost of the intersection improvements at Lawrence Expressway and Monroe Street/Reed Avenue.

Table 20
Queuing Analysis Summary

	Fair Oaks Avenue and US 101 NB Ramps		Wolfe Road and Central Expressway Ramps		Wolfe Road and Evelyn Avenue		Wolfe Road and Old San Francisco Road	
Movement:	**NBL**	**NBL**	**NBL**	**NBL**	**SBL**	**SBL**	**WBL**	**WBL**
Peak Hour:	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Existing								
Cycle/Delay[1] (sec)	85	95	160	160	160	160	160	160
Volume (vphpl)	537	231	176	114	23	268	100	102
Avg. Queue (veh/ln.)	13	6	8	5	1	12	4	5
Avg. Queue[2] (ft./ln)	325	150	200	125	25	300	100	125
95th%. Queue (veh/ln.)	19	10	13	9	3	18	8	8
95th%. Queue[2] (ft./ln)	475	250	325	225	75	450	200	200
Storage (ft./ ln.)	260	260	300	300	200	200	300	300
Adequate (Y/N)	N	Y	N	Y	Y	N	Y	Y
Background								
Cycle/Delay[1] (sec)	85	95	160	160	160	160	160	160
Volume (vphpl)	655	323	204	144	25	277	100	102
Avg. Queue (veh/ln.)	15	9	9	6	1	12	4	5
Avg. Queue[2] (ft./ln)	375	225	225	150	25	300	100	125
95th%. Queue (veh/ln.)	22	14	14	11	3	18	8	8
95th%. Queue[2] (ft./ln)	550	350	350	275	75	450	200	200
Storage (ft./ ln.)	260	260	300	300	200	200	300	300
Adequate (Y/N)	N	N	N	Y	Y	N	Y	Y
Background Plus Project								
Cycle/Delay[1] (sec)	85	95	160	160	160	160	160	160
Volume (vphpl)	678	337	219	153	32	308	130	115
Avg. Queue (veh/ln.)	16	9	10	7	1	14	6	5
Avg. Queue[2] (ft./ln)	400	225	250	175	25	350	150	125
95th%. Queue (veh/ln.)	23	14	15	11	4	20	10	9
95th%. Queue[2] (ft./ln)	575	350	375	275	100	500	250	225
Storage (ft./ ln.)	260	260	300	300	200	200	300	300
Adequate (Y/N)	N	N	N	Y	Y	N	Y	Y
Project Related Operational Deficiency?	**Yes**	No	**Yes**	No	No	**Yes**	No	No

Notes:
[1] Vehicle queue calculations based on cycle length for signalized intersections.
[2] Assumes 25 feet per vehicle queued.

Table 20
Queuing Analysis Summary (Continued)

	Evelyn Avenue and Aster Avenue				Evelyn Avenue and Reed Avenue		Timberpine Avenue and Reed Avenue	
Movement:	**SBL**	**SBL**	**WBL**	**WBL**	**EBL**	**EBL**	**SBL**	**SBL**
Peak Hour:	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Existing								
Cycle/Delay[1] (sec)	45	50	45	50	38	46	70	85
Volume (vphpl)	27	128	80	49	30	38	25	7
Avg. Queue (veh/ln.)	0	2	1	1	0	0	0	0
Avg. Queue[2] (ft./ln)	0	50	25	25	0	0	0	0
95th%. Queue (veh/ln.)	1	4	3	2	1	2	2	1
95th%. Queue[2] (ft./ln)	25	100	75	50	25	50	50	25
Storage (ft./ ln.)	150	150	300	300	150	150	300	300
Adequate (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y
Background								
Cycle/Delay[1] (sec)	45	50	45	50	38	46	70	85
Volume (vphpl)	29	134	83	51	30	38	25	7
Avg. Queue (veh/ln.)	0	2	1	1	0	0	0	0
Avg. Queue[2] (ft./ln)	0	50	25	25	0	0	0	0
95th%. Queue (veh/ln.)	2	4	3	2	1	2	2	1
95th%. Queue[2] (ft./ln)	50	100	75	50	25	50	50	25
Storage (ft./ ln.)	150	150	300	300	150	150	300	300
Adequate (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y
Background Plus Project								
Cycle/Delay[1] (sec)	45	50	45	50	38	46	70	85
Volume (vphpl)	62	212	121	67	45	68	68	31
Avg. Queue (veh/ln.)	1	3	2	1	0	1	1	1
Avg. Queue[2] (ft./ln)	25	75	50	25	0	25	25	25
95th%. Queue (veh/ln.)	2	6	4	3	2	3	3	2
95th%. Queue[2] (ft./ln)	50	150	100	75	50	75	75	50
Storage (ft./ ln.)	150	150	300	300	150	150	300	300
Adequate (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y
Project Related Operational Deficiency?	No	No	No	No	No	No	No	No

Notes:
[1] Vehicle queue calculations based on cycle length for signalized intersections.
[2] Assumes 25 feet per vehicle queued.

Table 20
Queuing Analysis Summary (Continued)

	Willow Avenue and Reed Avenue		Willow Avenue and Aster Avenue		Lawrence Expressway and Monroe Street/Reed Avenue			
Movement:	**SBL**	**SBL**	**NBL**	**NBL**	**NBL**	**NBL**	**EBL**	**EBL**
Peak Hour:	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Existing								
Cycle/Delay[1] (sec)	26.2	52.6	7.5	7.4	173	190	173	190
Volume (vphpl)	113	128	38	38	99	172	204	121
Avg. Queue (veh/ln.)	1	2	0	0	5	9	10	6
Avg. Queue[2] (ft./ln)	25	50	0	0	125	225	250	150
95th%. Queue (veh/ln.)	3	4	1	1	9	14	15	11
95th%. Queue[2] (ft./ln)	75	100	25	25	225	350	375	275
Storage (ft./ ln.)	350	350	350	350	330	330	305	305
Adequate (Y/N)	Y	Y	Y	Y	Y	N	N	Y
Background								
Cycle/Delay[1] (sec)	26.3	53.2	7.5	7.4	173	190	173	190
Volume (vphpl)	113	128	38	38	101	182	220	123
Avg. Queue (veh/ln.)	1	2	0	0	5	10	11	6
Avg. Queue[2] (ft./ln)	25	50	0	0	125	250	275	150
95th%. Queue (veh/ln.)	3	4	1	1	9	15	16	11
95th%. Queue[2] (ft./ln)	75	100	25	25	225	375	400	275
Storage (ft./ ln.)	350	350	350	350	330	330	305	305
Adequate (Y/N)	Y	Y	Y	Y	Y	N	N	Y
Background Plus Project								
Cycle/Delay[1] (sec)	43.8	86.9	7.9	7.8	173	190	173	190
Volume (vphpl)	182	165	72	119	104	208	243	137
Avg. Queue (veh/ln.)	2	4	0	0	5	11	12	7
Avg. Queue[2] (ft./ln)	50	100	0	0	125	275	300	175
95th%. Queue (veh/ln.)	5	8	1	1	9	17	18	12
95th%. Queue[2] (ft./ln)	125	200	25	25	225	425	450	300
Storage (ft./ ln.)	350	350	350	350	330	330	305	305
Adequate (Y/N)	Y	Y	Y	Y	Y	N	N	Y
Project Related Operational Deficiency?	No	No	No	No	No	**Yes**	**Yes**	No

Notes:
[1] Vehicle queue calculations based on cycle length for signalized intersections, and movement delay for unsignalized intersections.
[2] Assumes 25 feet per vehicle queued.

Potential Impacts to Transit Facilities

The project site is located adjacent to the Lawrence Caltrain Station. Under existing conditions, there is not a continuous pedestrian path between the project site and the Lawrence Caltrain Station. The proposed project includes frontage improvements along Willow Avenue and Aster Avenue to connect the sidewalk between the project site and the Lawrence Caltrain Station. Given the project site's proximity to the Caltrain station, it is expected that several future residents would utilize Caltrain. Several trains currently operate at or near capacity. Caltrain has plans to increase the number of trains serving the Lawrence Caltrain station. As part of the Caltrain electrification project, ten more commuter trains are expected to serve the Lawrence Caltrain station. These should provide sufficient capacity to serve the project.

There are also three bus routes plus shuttles that operate in the project vicinity. There probably would be residents of the project that would ride these buses. All routes have sufficient capacity to accommodate additional riders.

Transit Travel Time Impacts

Currently, VTA bus routes 32 and 328 and ACE bus route 822 travel within the project vicinity through some of the study intersections. To assess the transit travel time impacts, the bus route travel times in the study area under background plus project conditions were compared to background conditions. Bus route travel times are estimated using published schedules and adjusted based on delays experienced at study intersection movements. VTA does not have established criteria to determine impact to transit services. Therefore, this analysis is presented for information purposes only.

The results show that there would be minimal changes in transit delay in the study area under the project scenario. For the bus routes in the study area, the project would increase route delay by less than 20 seconds. The proposed project is located within and consistent with the recently-adopted Lawrence Station Area Plan (LSAP), and the cumulative transit related impacts are included in the *Lawrence Station Area-Wide Transportation Plan and Near-Term TIA* report dated for December 18, 2015, prepared by Hexagon Transportation Consultants, Inc. The project is expected to worsen left-turn queuing at three left-turn movements (identified in above section). None of the transit routes would turn left at these three left-turn movements. The results of the transit travel time comparison are summarized in Table 21.

Table 21
Transit Travel Time Delay Analysis

Route	Peak Hour	Existing		Background	Background + Project		
		Travel Time (min)	Delay in the Study Area (sec)	Delay in the Study Area (sec)	Delay in the Study Area (sec)	Change in Delay (sec)	%Change in Travel Time
VTA 32							
Eastbound	AM	60	259.9	259.2	259.5	0.3	0.01%
	PM	70	297.1	298.7	312.3	13.6	0.32%
Westbound	AM	70	230	233.2	236.3	3.1	0.07%
	PM	60	198.5	203.3	202.4	-0.9	-0.02%
VTA 328 [1]							
Northbound	AM	85	402.9	606.2	620.1	13.9	0.26%
Southbound	PM	80	385.6	562	582.9	20.9	0.42%
ACE 822 (Gray Shuttle) [2]							
Northbound	PM	35	323.4	368.2	369	0.8	0.04%
Southbound	AM	32	323	441.7	443.7	2.0	0.10%

Notes
[1] VTA 328 operates with northbound services during the AM peak commute period and southbound services during the PM peak commute period.
[2] VTA 328 operates with northbound services during the PM peak commute period and southbound services during the AM peak commute period.

Potential Impacts to Pedestrian Facilities

The proposed project is expected to generate pedestrian walking trips between the project site and the nearby Lawrence Caltrain Station. As part of the proposed project, sidewalks will be added on the Willow Avenue and Aster Avenue project frontages. This improvement would create a continuous pedestrian path between the project site and the Lawrence Caltrain Station.

Outside of trips to and from the Caltrain station, the project is expected to generate minimal pedestrian traffic to the surrounding area. The closest school to the project site is the Santa Clara Christian School, which is located approximately 3,500 feet from the project site and is not considered within walking distance for school children.

The proposed project would install a crosswalk along the west leg of the Willow Avenue and Aster Avenue intersection. This crosswalk would create a continuous pedestrian route between the project site, Reed Avenue, and Lawrence Expressway. The project also proposes a mid-block crosswalk across Aster Avenue at the western end of the project site. This crosswalk could be used to provide pedestrian/bicycle connectivity to the proposed open space or the on-site bicycle/pedestrian trails. However, mid-block crosswalks should be installed only after an engineering study determining the feasibility of the crosswalk.

Recommendation

The project applicant shall coordinate with City staff to determine the need for a mid-block crosswalk across Aster Avenue at the western end of the project site upon project completion.

Potential Impacts to Bicycle Facilities

Within the immediate project vicinity, bike lanes are present on Aster Avenue, Evelyn Avenue, Wolfe Avenue and Reed Avenue (see Figure 4 in Chapter 2). The project site is located within a residential area, and nearby residential streets carry low traffic volumes and are conducive to bicyclists. Overall, the project site has good connectivity to existing bicycle facilities. The project is located within biking distance of three schools: the Santa Clara Christian School, Adrian Wilcox High School and Ponderosa Elementary School. There are no continuous bicycle facilities connecting the project site to these schools. However, the project proposes bicycle facility improvements along its project frontage. Aster Avenue along the project frontage currently has two five-foot bike lanes. The project proposes to restripe the roadway to widen the bike lanes to six feet and include a four-foot bike buffer, which is an improvement over existing conditions. Willow Avenue currently has no bike lanes along the project frontage. The project proposes to restripe the roadway to include two six-foot bike lanes. The proposed bicycle facility improvements would enhance the bicycle connectivity to the Lawrence Caltrain station.

Site Access and Circulation

The evaluation of site access and circulation is based on the plan set prepared by Studio T Square, dated January 10, 2019. Site access and circulation was reviewed in accordance with generally accepted traffic engineering standards.

Site Access

Vehicular access to the project site would be provided via three driveways. Two driveways would be located along Aster Avenue and one driveway would be located in the northeast corner of the project site along the Willow Avenue frontage. The two Aster Avenue driveways are shown to be 26 feet wide, measured at the throat, and would be full access. The western Aster Avenue driveway would provide direct access to the townhomes and the condominiums. The eastern Aster Avenue driveway would provide direct access to the condominiums, apartments, coffee shop, and two on-site loading zones. The Willow Avenue driveway is shown to be 26 feet wide, measured at the throat, and would be limited to right in/out movements only. The Willow Avenue driveway would provide direct access to the parking garage for the apartments and coffee shop. The eastern project driveway on Aster Avenue is not aligned with the existing driveways to the south. From a traffic operations perspective, it would be preferable if the driveway was aligned. However, because the driveways to the south carry low traffic volumes, it is not expected that the misalignment would cause any operational issues.

Site Distance at the Project Driveways

The project access points should be free and clear of any obstructions to optimize sight distance, thereby ensuring that exiting vehicles can see pedestrians on the sidewalk and other roadway users travelling on adjacent roadways. Landscaping and parking should not conflict with a driver's ability to locate a gap in traffic and see oncoming pedestrians and bicyclists. Adequate corner sight distance (sight distance triangles) should be provided at all site access points in accordance with City standards.

The Aster Avenue driveways would allow all movements, thus the project traffic exiting these driveways would need to have adequate sight distance in both directions. The speed limit on Aster Avenue is 30 miles per hour. The Caltrans recommended stopping sight distance is 200 feet. Aster Avenue under project conditions would not have roadway curves or on-street parking that would block a driver's view of oncoming traffic 200 feet down the road. The project proposes to preserve some of the trees near the driveways. However, these trees are assumed to have slender trunks and high canopies, and it is anticipated that drivers would be able to see around the trees.

The Willow Avenue driveway would allow only right in/out movements, thus project traffic exiting this driveway would need to have adequate sight distance looking east. The speed limit on Willow Avenue is 25 miles per hour. The Caltrans recommended stopping sight distance is 150 feet. According to the site plan, there would be no tall vegetation or objects that could block a driver's view 150 feet down the road as they exit the project site.

Recommendation

The project applicant shall ensure that there would not be tall vegetation or objects that could block a driver's view 200 feet down the road as they exit the project driveways on Aster Avenue.

Site Driveway Operations

The traffic volumes along Aster Avenue and Willow Avenue are low and should allow the project traffic at the site driveways to experience minimal delays. The proposed project traffic making left-turns into and out of the Aster Avenue driveways may potentially need to wait for a gap in conflicting traffic, however, this is not expected to have an adverse effect on traffic operations. The delays that would be experienced at the Aster Avenue driveways were analyzed in TRAFFIX using the HCM 2000 methodology. The results showed that all inbound and outbound movements at the Aster Avenue driveways would operate with low levels of delay (generally less than ten seconds per vehicle) during the AM and PM peak hours. The Willow Avenue driveway would be limited to right in/out movements, and it is expected that the right-turn out vehicles would experience minimal delays during the AM and PM peak hours. It is estimated that vehicle queues turning into and out of all project driveways would not exceed one vehicle at a time. A two-way left-turn lane has the potential to improve safety by allowing left-turning vehicles to queue outside of the travel lanes while waiting for a sufficient gap in the opposing traffic to turn into their driveways.

Circulation

The drive aisles through the project site, including the parking garages, are shown to be at least 24 feet wide, which would be adequate for two-way vehicle travel. The project site would have two main north-south driveway aisles (one aligned at each of the Aster Avenue driveways) and one main east-west drive aisle (located along the northern project edge and aligned with the Willow Avenue driveway). Entrances to the podium garages for the condos would be adjacent to the eastern north/south drive aisle and the adjacent to the east/west drive aisle. The parking garage for the apartments and coffee shop would be accessible from the east/west drive aisle.

The parking spaces within the parking garages are shown to be 8 feet 6 inches by 18 feet long, which satisfies the City of Sunnyvale standard parking space requirements. The drive aisles are shown to be 24 feet wide which would be adequate to allow two-way traffic and to allow maneuvering in/out of parking spaces. There are dead-end drive aisles within the parking garages for the condos.

Recommendation

It is recommended that the project applicant ensure parking spaces next to the dead-end aisles are provided sufficient turn-around space.

Condominium Parking Garage

The parking garage for the condominiums would include parking stackers. The project applicant should ensure that all car lift spaces are adequately sized to accommodate all passenger car types. Passenger vehicles can have heights up to seven feet, so the lifts need to be able to accommodate this height. Individual two-level car lifts without a pit level would require both spaces to be assigned to the same unit.

Emergency Vehicles, Truck Access and Circulation

All driving aisles on the project site are shown to exceed the minimum 20-foot width requirement for emergency vehicle access and circulation and meet the City standards.

There are two designated shared-use loading zones/trash staging areas located along the northern edge of the project area accessible via the eastern north-south drive aisle. On garbage collection days, trash bins from the condominiums and apartments would be wheeled out to the trash staging areas. Garbage trucks would navigate through the north-south and east-west drive aisle for the townhomes to collect trash from the townhome units. Overall, the site shows adequate access and circulation for garbage and loading trucks.

Recommendation

To minimize potential conflict of use between loading trucks and trash staging at the two shared-use loading/trash staging areas, it is recommended that the trash bins for the condominiums and apartment be placed in the loading zone only on garbage collection day and that they be removed after the garbage has been collected.

Parking

The review of on-site parking is based on the plan set prepared by Studio T Square, dated January 10, 2019, and on the LSAP parking requirements.

Vehicle Parking

The proposed project vehicle parking supply and requirement are summarized in Table 22. The proposed project would provide 1,196 vehicle parking spaces. Based on LSAP parking requirements, the proposed project would be required to provide between 911 and 1,320 vehicle parking spaces. Thus, the project vehicle parking requirement would be satisfied.

Table 22
Proposed Project Vehicle Parking Supply and Requirement

Land Use	Rate	Vehicle Parking Spaces
Proposed		
Townhome Garages	-	280
Condominium Podium Garages	-	304
Apartment/Retail Garage	-	572
Surface Parking	-	40
Total Proposed Vehicle Parking Supply		***1,196***
LSAP Parking Requirements		
Residential[1]	1.0 - 2.0 per unit	908 - 1,314
Retail	2.0 - 4.0 per 1,000 s.f.	3 - 6
Total Vehicle Parking Spaces Required		***911 - 1,320***

Notes
s.f. = square feet

[1] Required parking varies by number of bedrooms.

[2] Proposed parking supply and requirements is a based on the plan set prepared by Studio T Square dated January 10, 2019.

Accessible Parking

Accessible parking stalls shall be provided in accordance with the 2016 California Building Code (CBC) Table 11B-208.2. There are three parking garages located on-site, two for the condominium complexes and one for the apartment complex, each with 146, 158 and 567 parking spaces, respectively. The garages would be required to provide five (one van accessible), six (one van accessible) and 11 (two van accessible) accessible parking spaces, respectively. The project site plan proposes a total of 22 accessible spaces, but the number of spaces provided within the two condominium garages does not meet the CBC requirements. The site plan does not indicate the locations of the van accessible spaces.

Recommendation

Prior to final design, the project applicant shall ensure the adequate number of accessible parking spaces are located within the condominium garages. The project applicant shall also ensure the van accessible spaces are clearly indicated.

Bicycle Parking Requirements

The proposed project bicycle parking supply and requirement are summarized in Table 23. The proposed project would provide 151 long-term bicycle parking spaces and 82 short-term bicycle parking spaces. Based on LSAP parking requirements, the proposed project would be required to provide 45 short-term bicycle parking spaces and 151 long-term bicycle parking spaces. Note that it is assumed that the proposed project would only need to provide bicycle parking spaces for the multifamily units, i.e. the condominiums and apartments, because the proposed townhomes would operate like single family homes. The project site plan does not indicate the locations of the short-term bicycle parking spaces.

Table 23
Proposed Project Bicycle Parking Supply and Requirement

Land Use		Rate	Bicycle Parking Short Term	Bicycle Parking Long Term
Proposed				
Condominiums		-	26	48
Apartments		-	56	103
Total Proposed Bicycle Parking Supply			***82***	***151***
LSAP Parking Requirements				
Residential[2]	1.0	long term per 4 units		151
	1.0	short term per 15 units	41	
Retail[3,4]	1.0	long term per 30 employees		-
	1.0	short term per 25% of 6,000 s.f.	4	
Total Bicycle Parking Spaces Required			***45***	***151***

Notes

s.f. = square feet

[1] Proposed parking supply and requirements is a based on the plan set prepared by Studio T Square dated November 19, 2018.

[2] According to the City's Municipal Code (Section 19.46.150), enclosed garages assigned to one unit is considered one secured bicycle parking space. Thus, since each townhome will have its own garage, long term bicycle spaces need to be provided for the condominiums and apartments.

[3] It is assumed that the coffee shop would have less than 30 employees, thus, no long term bicycle parking spaces would be required.

[4] The LSAP notes that the minimum number of short term bicycle spaces in any location should be 2 racks (4 bicycle capacity).

6. Conclusions

This report presents the results of the transportation impact analysis (TIA) conducted for a residential project proposed on a 16.82-acre site located at 1155 and 1175 Aster Ave in Sunnyvale, California. The project proposes to demolish the existing industrial facilities on-site and construct a residential complex including 412 apartments, 189 condominiums, 140 townhomes, an approximately 2-acre park and a 1,500 square foot (s.f.) coffee shop. Access to the site would be provided via Aster Avenue and Willow Avenue.

This study was conducted for the purpose of identifying the potential near-term traffic impacts related to the proposed development. Because the project is consistent with the recently-adopted Lawrence Station Area Plan (LSAP), potential long-term traffic impacts have already been studied in the *Lawrence Station Area-Wide Transportation Plan and Near-Term TIA* dated December 18, 2015, prepared by Hexagon Transportation Consultants, Inc.

Intersection Level of Service Results

The intersection level of service analysis concluded that based on City of Sunnyvale intersection impact criteria, the project would generate a significant intersection impact at the unsignalized study intersection at Willow Avenue and Reed Avenue during both the AM and PM peak hours.

Mitigation Strategy

Mitigation would require installing a sign restricting left-turns from southbound Willow Avenue onto Reed Avenue during the AM (7-9 AM) and PM (4-6 PM) peak periods. With the proposed left-turn restriction during the peak hours, the intersection at Willow Avenue and Reed Avenue would operate at acceptable levels of service. It is assumed that vehicles on southbound Willow Avenue heading to eastbound Reed Avenue would instead turn right onto westbound Reed Avenue first and then perform a legal U-turn on Reed Avenue west of Willow Avenue. The added westbound U-turns on Reed Avenue would not deteriorate roadways operations, thus the proposed mitigation would not create secondary impacts at other locations. With the proposed mitigation, the project impact at the intersection of Willow Avenue and Reed Avenue would be *less than significant*. The project applicant will be responsible for the cost of the proposed mitigation.

Freeway Impacts

The results of the CMP freeway analysis show that the freeway segments currently operating at acceptable levels of service would continue to operate at acceptable levels of service under project

conditions. For freeway segments currently operating at unacceptable LOS F, the project generated freeway traffic would not exceed 1%, thus the project freeway impacts would be less than significant.

Freeway Ramp Impacts

The results of the ramp analysis show that the study freeway ramps currently have sufficient capacity to service the existing traffic volumes and the ramps would continue to have sufficient capacity to serve the project traffic volumes under project conditions.

Other Transportation Issues

Hexagon conducted a site plan review, queuing analysis, pedestrian, bicycle and transit facility analysis and parking analysis for the proposed project. Our recommendations are listed below.

Recommendations

- The project proposes a mid-block crosswalk across Aster Avenue at the western end of the project site. Mid-block crosswalks should be installed only after an engineering study determining the feasibility of the crosswalk. The project applicant shall coordinate with City staff to determine the need for a mid-block crosswalk across Aster Avenue at the western end of the project site upon project completion.
- The project applicant shall ensure that there would not be tall vegetation or objects that could block a driver's view 200 feet down the road as they exit the project driveways on Aster Avenue.
- The site plan shows multiple dead-end aisles inside the parking garages. The project applicant shall ensure that parking spaces next to the dead-end aisles are provided sufficient turn-around spaces.
- To minimize potential conflict of use between loading trucks and trash staging at the two shared-use loading/trash staging areas, it is recommended that the trash bins for the condominiums and apartment be placed in the loading zone only on garbage collection day and that they be removed after the garbage has been collected.
- The project applicant shall ensure the adequate number of accessible parking spaces are located within the condominium garages. The project applicant shall also ensure the van accessible spaces are clearly indicated.