



Four Corners Traffic Study



Prepared for the Cities of Belmont and San Carlos

Submitted by
W-Trans

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Introduction

The *Four Corners Traffic Study* presents an analysis of the Alameda de las Pulgas-San Carlos Avenue corridor between Ralston Avenue and Dartmouth Avenue. The study focuses on both vehicle traffic operations and congestion in the corridor as well as access to local schools, access and safety for pedestrians and bicyclists. The study corridor is shown in Figure 1.

Background

The Alameda de Las Pulgas (ADLP)-San Carlos Avenue corridor serves as the main thoroughfare for residents heading to retail destinations in San Carlos and Belmont as well as regional destinations on US 101 and Interstate 280 (I-280). The corridor is also heavily used by commuters from Belmont and San Carlos heading to their employment destinations or the Caltrain stations in each city. The corridor serves a significant volume of peak hour traffic as this project area serves many regional destinations as well as the schools.

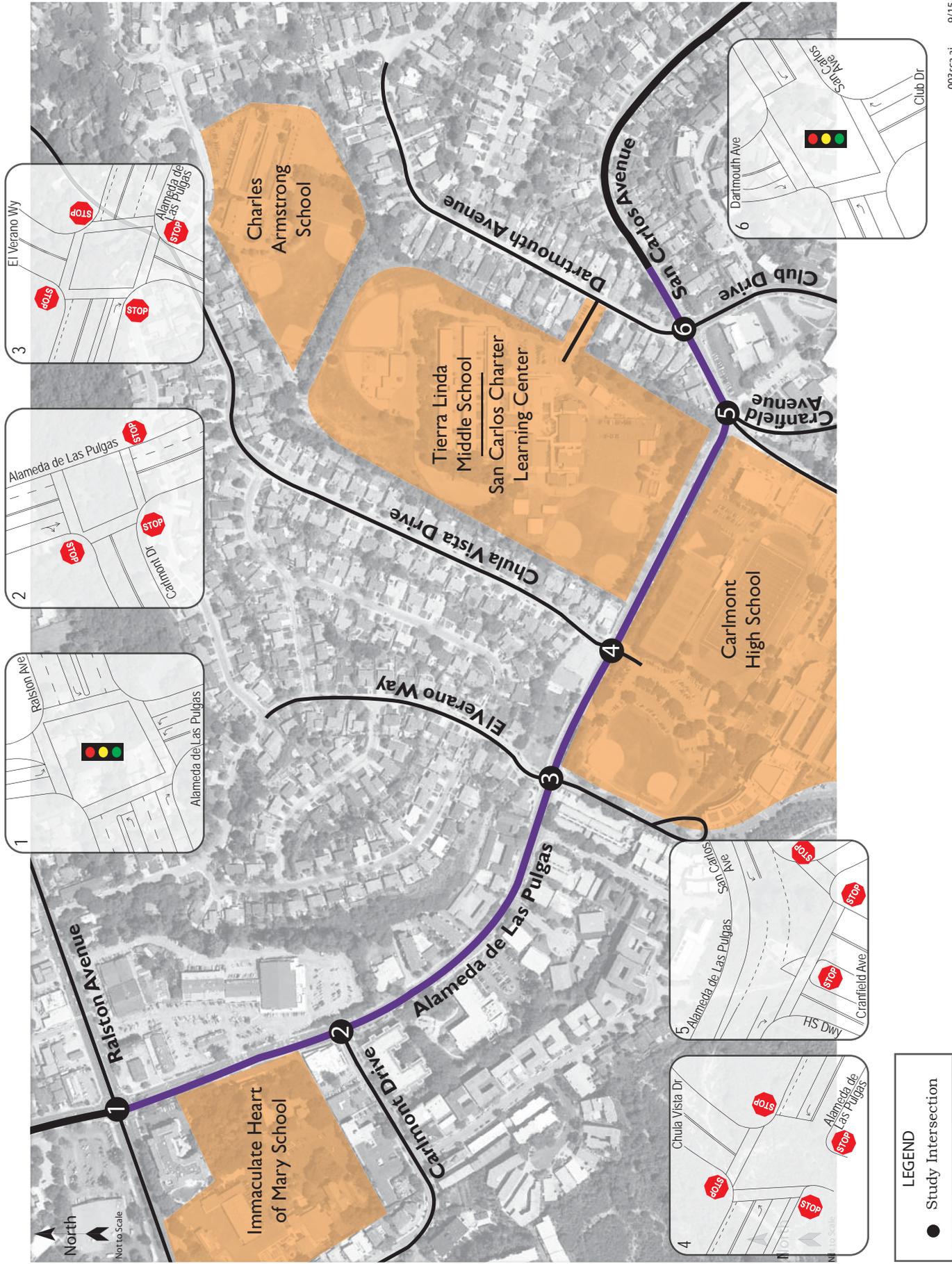
During the school year, the corridor is heavily congested due to traffic accessing Carlmont High School, Immaculate Heart of Mary School, Charles Armstrong School, and Tierra Linda Middle School. In the morning peak period southbound queues on Alameda de Las Pulgas extend from Dartmouth Avenue to Carlmont Drive while northbound queues extend from Carlmont Drive to Dartmouth Avenue. Westbound queues on the Carlmont High School driveway extend 400 feet away from Alameda de Las Pulgas while queues on Dartmouth Avenue and Club Drive extend several blocks from the San Carlos Avenue/Dartmouth Avenue intersection. Queues in the p.m. peak hour are similar but less severe due to differences in overall peak travel times as well as school peak travel times and bell schedules.

The all-way stop-controlled intersections of Alameda de Las Pulgas/Chula Vista Drive and Alameda de Las Pulgas/El Verano Way cause substantial congestion as drivers and pedestrians must determine who has the right of way depending on order of arrival, a process that can be confusing during periods of high demand.

Carlmont High School has entrances from Alameda de Las Pulgas at Cranfield Avenue, Chula Vista Drive, and El Verano Way. The left-turn lanes on Alameda de Las Pulgas to the school function well and do not cause delay to traffic traveling through the corridor; however drivers exiting the school site are generally delayed by the congestion along the corridor. As a result, drivers drop off and pick up students along Alameda de Las Pulgas. Drivers also use Chula Vista Drive, Club Drive and the church parking lot off of Club Drive to pick up/drop off students.

Dartmouth Avenue provides vehicular and pedestrian access to Tierra Linda Middle School, which is located 300 feet from the San Carlos Avenue intersection. The San Carlos Avenue/Dartmouth Avenue intersection experiences heavy congestion during school peak hours. School-destined traffic backs up from the middle school and along Dartmouth Avenue, spilling back beyond the San Carlos Avenue intersection. Traffic leaving the middle school backs up from the signal at San Carlos Avenue to the middle school. As a result of this traffic congestion, some parents drop off and pick up students on Club Drive, in the church parking lot, or along San Carlos Avenue.

Pedestrians at school bell times are abundant as they walk to/from home or transit and are dropped off and picked up along nearby streets. Pedestrian crossing movements at the signalized Dartmouth Avenue intersection are managed reasonably well, but right-turning traffic must yield to pedestrian crossings, substantially reducing the intersection's capacity to handle vehicle demands. Conditions are worse at the stop-sign controlled intersections along Alameda de Las Pulgas where drivers and pedestrians must understand and apply right of way rules, often resulting in delays as users wait for others who are waiting for them.



Alameda de Las Pulgas-San Carlos Avenue Corridor Study
Figure 1 – Study Area and Lane Configurations

Project Goals

The goal of the study was to identify traffic improvements which would improve traffic safety and operations in the corridor with a focus on complete streets and safe routes to school principles. Potential solutions were focused on alternatives for school entrance/exits, reduction of vehicle congestion, bicycle access, safe pedestrian crossings, traffic control improvements, parking, transit and general transportation safety.

Process

The traffic study process has included numerous meetings with the Four Corners Technical Advisory group consisting of Councilmembers and staff from the Cities of Belmont and San Carlos as well as board members and administrators from the two school districts, the San Carlos School District representing Tierra Linda Middle School and the Sequoia Union High School District representing Carmont High School. The process has also included workshops held at both the middle school and high school with neighbors and residents of both cities.

Transportation Setting

Study Area

The study area consists of the segments of Alameda de las Pulgas and San Carlos Avenue between Ralston Avenue and Club Drive-Dartmouth Avenue. The surrounding land uses include single-family and multi-family residential developments along the southern end of the corridor, together with several public and private schools including Carlmont High School (CHS), Tierra Linda Middle School, Immaculate Heart of Mary School and Charles Armstrong School. At the north end of the corridor is the Carlmont Shopping Center; located at the southeast corner of the intersection of Alameda de las Pulgas/Ralston Avenue with access to Alameda de las Pulgas. Figure 1 shows the study area for the Four Corners Traffic Study.

Study Area Roadways

Alameda de las Pulgas-San Carlos Avenue is a north-south arterial that connects the cities of Belmont and San Carlos. The road is currently a four-lane road between Ralston Avenue and Carlmont Drive, a three-lane road with a two-way left-turn lane between Carlmont Drive and Chula Vista Drive, and a two-lane road south of Chula Vista Drive. There is on-street parallel parking on most sections of the road, except for the west side of Alameda de las Pulgas at Carlmont High School where there is diagonal parking. The posted speed limit throughout the corridor in both the City of Belmont and the City of San Carlos is 30 mph. Previously, a road diet was completed on Alameda de las Pulgas in the City of Belmont, converting the road between Carlmont Drive and the Belmont City Limits from a four-lane road to a three-lane road with bicycle lanes.

Within the study area the corridor varies in its alignment. For the purposes of this study, it is considered to be north-south, and all cross-streets were assumed to be aligned east-west.

Ralston Avenue is an east-west arterial of the City of Belmont, and it is the main arterial for the city in the east-west direction connecting US 101 and SR 92. Ralston Avenue is a four-lane divided road west of Alameda de las Pulgas and transitions into a three-lane road east of the study corridor.

Carlmont Drive is a two-lane major collector in the City of Belmont serving local residences immediately southwest of the intersection of Alameda de las Pulgas-Ralston Avenue.

El Verano Way is a two-lane local road in the City of Belmont serving local residences immediately southeast of the intersection of Alameda de las Pulgas-Ralston Avenue. The west leg of El Verano Way serves as the northern access to CHS.

Chula Vista Drive is a two-lane major collector in the City of Belmont that connects Alameda de las Pulgas near CHS to Ralston Avenue near Notre Dame High School.

Cranfield Drive is a narrow local residential street located in the City of San Carlos which parallels the southern CHS access creating an awkward aligned intersection.

Club Drive is a two-lane collector in the City of San Carlos which provides access to the residential areas in the hills along the eastern frontage of Interstate 280. East of San Carlos Avenue, the street becomes Dartmouth Avenue.

Dartmouth Avenue is a local street serving nearby residents as well as Tierra Linda School and the San Carlos Charter School.

Study Intersections

The following six intersections were analyzed as part of the study:

1. Alameda de las Pulgas/Ralston Avenue (Traffic Signal)
2. Alameda de las Pulgas/Carlmont Drive (All-Way Stop)
3. Alameda de las Pulgas/El Verano Way (All-Way Stop)
4. Alameda de las Pulgas/Chula Vista Drive (All-Way Stop)
5. Alameda de las Pulgas-San Carlos Avenue/Cranfield Avenue-Carlmont High School Driveway (Side-Street Stop)
6. San Carlos Avenue/Dartmouth Avenue-Club Drive (Traffic Signal)

The locations of the study intersections and the existing lane configurations and controls are shown in Figure 1.

Study Time Period

Operating conditions during the weekday a.m., school p.m. and p.m. peak periods were evaluated to capture the highest level of congestion along the corridor. The morning peak hour occurs between 7:00 and 9:00 a.m. and reflects conditions during the home to work or school commute, the school p.m. peak hour occurs between 2:00 and 4:00 p.m. and reflects conditions during the school student pick-up times, while the p.m. peak hour occurs between 4:00 and 6:00 p.m. and reflects the level of congestion during the homeward-bound commute.

Traffic Data Collection

For the purposes of the Four Corners Traffic Study, the following traffic data was collected:

- Turning movement counts at the study intersections for the a.m., school p.m., and p.m. peak periods.
- 24-hour daily machine counts were taken along the corridor at three locations. Locations include between Carlmont Drive and El Verano Way, between Chula Vista Drive and Cranfield Avenue, and south of Club Drive-Dartmouth Avenue.
- Travel time runs were conducted to record the actual travel time through the corridor at peak traffic periods.
- Queuing surveys were conducted at Alameda de las Pulgas-El Verano Way and Alameda de las Pulgas-Chula Vista Drive to assess the frequency of queue buildup at the two all-way stop-controlled intersections.
- Parking occupancy surveys were conducted for on-street parking along the corridor. In addition, because there is a strong presence of student parking along the corridor associated with Carlmont High School, parking occupancy surveys were conducted for off-street parking used by Carlmont High School students, including on-campus lots and the parking lot for the church southwest of Alameda de las Pulgas-San Carlos Avenue/Cranfield Avenue-Carlmont High School Driveway.

Data was collected in March 2014, with the exception of parking occupancy surveys and queuing surveys, which were conducted in April 2014. All data was collected while schools were in session and students were not on class field trips. Existing peak hour traffic volumes are shown in Figure 2. Copies of the data collected are provided in Appendix A.

Vehicular Operation - Corridor

Based on the 24-hour machine counts conducted, the ADT of Alameda de las Pulgas in Belmont is approximately 12,000 vehicles per day, and the ADT of San Carlos Avenue south of Club Drive-Dartmouth Avenue is approximately 10,500 vehicles per day. The 24-hour machine counts are summarized in Table 1.

Table 1 – 24-Hour Machine Counts on Alameda de las Pulgas-San Carlos Avenue

Corridor Segment	Average Daily Traffic (vehicles per day)
Between Carlmont Dr and El Verano Way	12,500
Between Chula Vista Dr and Cranfield Ave	12,200
South of Club Dr-Dartmouth Ave	10,700

Travel Time

Travel time runs were conducted to assess the overall speed and delay of vehicular travel through the corridor. The northern limit of the travel time runs was at Ralston Avenue and the southern limit was at Kenton Avenue, one-quarter mile south of Club Drive-Dartmouth Avenue. This segment is approximately 0.9 miles long, and the posted speed limit throughout the study area is 30 mph.

The results of the travel-time runs are summarized in Table 2 and copies are provided in Appendix B. It should be noted that northbound travel times include delay from traffic signals at both Ralston Avenue and Club Drive-Dartmouth Avenue, while southbound travel times only include delays incurred at Club Drive-Dartmouth Avenue. During both the a.m. and school p.m. peak periods, a heavy peak in vehicular travel demand and pedestrian crossings coincided with school bell schedules at the neighboring schools. This resulted in maximum travel times through the corridor that were well above the average.

Table 2 – Travel Time Through Corridor (between Ralston Ave and Kenton Ave)

Scenario	Travel Time (mm:ss)	
	Average	Maximum
Northbound		
AM Peak	5:15	16:22
School PM Peak	4:28	7:15
PM Peak	5:35	8:27
Southbound		
AM Peak	3:27	6:19
School PM Peak	3:28	7:33
PM Peak	3:13	3:53

Intersection Levels of Service

The Existing Conditions scenario provides an evaluation of current corridor operation based on existing traffic volumes during the a.m., school p.m., and p.m. peak periods. A summary of the intersection level of service calculations is contained in Table 3. Copies of the Level of Service calculations are provided in Appendix C.

Table 3 – Existing Peak Hour Intersection Levels of Service

Study Intersection Approach	AM Peak		School PM Peak		PM Peak	
	Delay	LOS	Delay	LOS	Delay	LOS
1. Alameda de las Pulgas/Ralston Ave	45.4	D	40.1	D	43.1	D
2. Alameda de las Pulgas/Carlmont Dr	21.8	C	14.6	B	19.4	C
3. Alameda de las Pulgas/El Verano Way	19.3	C	22.3	C	42.8	E
4. Alameda de las Pulgas/Chula Vista Dr	26.3	D	27.6	D	**	F
5. Alameda de las Pulgas-San Carlos Ave/ Cranfield Ave-Carlmont HS Driveway	**	F	**	F	1.1	A
<i>Eastbound Approach (combined Cranfield-CHS entrance)</i>	**	F	**	F	35.3	E
6. San Carlos Ave/Club Dr-Dartmouth Ave	30.2	C	25.9	C	20.3	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*; ** = delay greater than 120 seconds

Future Conditions

Future traffic forecasts for the horizon year of 2035 were obtained from the San Mateo Countywide gravity demand model, which is maintained by the City/County Association of Governments of San Mateo County (C/CAG). The C/CAG model is built off of a regional model developed by the Santa Clara Valley Transportation Authority (VTA). The VTA model includes a focused traffic analysis zone (TAZ) system that is consistent with the TAZ structure used by the San Mateo Countywide models developed by C/CAG. The VTA model is based on socioeconomic data sets including population, households, income and jobs.

The overall 25-year growth rate for the intersection of Alameda de las Pulgas/Ralston Avenue was determined to be a factor of approximately 1.35, which translates to 1.2 percent per year. This level of growth is typical for most arterials in the area. At all other intersections on the study corridor, the growth assumed in the traffic model forecast was found to be unrealistically high, with some segment volumes forecasted to increase threefold or more by 2035. The model forecasted that large amounts of traffic would use the Alameda de las Pulgas-San Carlos Avenue corridor as a regional cut-through route. Because the capacity of the corridor and the street system that would deliver the traffic to the corridor is not expected to be able to accommodate such large increases in traffic, future traffic volumes for the other study intersections were developed instead using the overall growth rate assumed at the intersection of Alameda de las Pulgas/Ralston Avenue (1.35). Future intersection operating conditions using this growth factor are summarized in Table 4.

Table 4 – Future Peak Hour Intersection Levels of Service

Study Intersection Approach	AM Peak		School PM Peak		PM Peak	
	Delay	LOS	Delay	LOS	Delay	LOS
1. Alameda de las Pulgas/Ralston Ave	79.7	E	77.4	E	82.0	F
2. Alameda de las Pulgas/Carlton Dr	64.5	F	36.0	E	63.2	F
3. Alameda de las Pulgas/El Verano Way	79.1	F	95.0	F	**	F
4. Alameda de las Pulgas/Chula Vista Dr	115.9	F	119.2	F	**	F
5. Alameda de las Pulgas-San Carlos Ave/ Cranfield Ave-Carlton HS Driveway	**	F	**	F	10.4	B
<i>Eastbound (combined Cranfield-CHS entrance) Approach</i>	<i>**</i>	<i>F</i>	<i>**</i>	<i>F</i>	<i>**</i>	<i>F</i>
6. San Carlos Ave/Club Dr-Dartmouth Ave	63.5	E	74.1	E	60.4	E

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*; ** = delay greater than 120 seconds

Queuing

As part of the data collection effort, queuing surveys were conducted for the two all-way stop-controlled intersections on Alameda de las Pulgas (El Verano Way and Chula Vista Drive) near Carlton High School. Results from the queuing surveys are indicated in Table 5. The largest vehicle queues were observed during the a.m. peak, when student drop-off occurred at the various schools nearby. The queuing results are summarized in Appendix D.

Table 5 – Queuing Survey Results

Intersection Approach	Queue Length (# of Cars)					
	AM Peak		School PM Peak		PM Peak	
	Avg	Max	Avg	Max	Avg	Max
3. Alameda de las Pulgas/El Verano Way						
Northbound Approach	7	15*	2	3	3	4
Southbound Approach	10	31	5	8	4	8
Westbound Approach	2	4	0	0	0	0
4. Alameda de las Pulgas/Chula Vista Dr						
Northbound Approach	18	29	4	5	9	20
Southbound Approach	8	14*	4	4	4	6
Westbound Approach	4	19	1	1	0	1

Notes: Avg = Average; Max = Maximum; * Maximum queue extends to next intersection

Traffic Signal Warrant Analysis

Peak Hour Warrant

Signal warrant analyses were conducted for the four unsignalized study intersections using the methodology published in the *California Manual on Uniform Traffic Control Devices (CA-MUTCD)*, California Department of Transportation (Caltrans), 2012. For the purposes of this study, Warrant 3, the Peak Hour Volume Warrant, which determines the need for signalized traffic control based on the highest volume hour of the day, was applied. The four unsignalized intersections include:

2. Alameda de las Pulgas/Carlmont Drive
3. Alameda de las Pulgas/El Verano Way
4. Alameda de las Pulgas/Chula Vista Drive
5. Alameda de las Pulgas-San Carlos Avenue/Cranfield Ave/Carlmont High School Driveway

The Peak Hour Volume Warrant was used in conjunction with the operational analysis to determine the potential need for signalization under Existing Conditions. The results indicate that the Peak Hour Volume Warrant is satisfied for at least one peak period by existing volumes at the intersections of Alameda de Las Pulgas/Carlmont Drive and Alameda de Las Pulgas-San Carlos Avenue/Cranfield Avenue-Carlmont High School Driveway. The results are presented in Table 6 and copies of the warrant calculations are provided in Appendix E.

Table 6 – Peak Hour Traffic Signal Warrant Analysis Results			
Study Intersection	Existing Conditions Peak Hour Warrant: Satisfied?		
	AM Peak	School PM Peak	PM Peak
2. Alameda de Las Pulgas/Carlmont Dr	Yes	No	Yes
3. Alameda de Las Pulgas/El Verano Way	No	No	No
4. Alameda de Las Pulgas/Chula Vista Dr	No	No	No
5. Alameda de Las Pulgas-San Carlos Ave/ Cranfield Ave/Carlmont HS Driveway	Yes	No	No

School Crossing Traffic Signal Warrant

Due to the presence of school crossings and the proximity to schools in the neighborhood, the CA-MUTCD School Crossing Traffic Signal Warrant was also considered. Per the CA-MUTCD, a traffic signal shall be considered when an engineering study “of the frequency and adequacy of gaps in the vehicular traffic stream as related to the number and size of groups of school children at an established school crossing across the major street shows that the number of adequate gaps in the traffic stream during the period when the schoolchildren are using the crossing is less than the number of minutes in the same period and there are a minimum of 20 school children during the highest crossing hour.”

The School Crossing warrant was evaluated for the following three unsignalized study intersections that have marked school crossings that cross the major street, Alameda de Las Pulgas:

2. Alameda de Las Pulgas/Carlmont Drive
3. Alameda de Las Pulgas/El Verano Way
4. Alameda de Las Pulgas/Chula Vista Drive

Based on the pedestrian counts at the study intersections, there are more than 20 pedestrians crossing in each of the marked school crosswalks on Alameda de las Pulgas at the three study locations indicated. However, since all the approaches at the three unsignalized intersections are stop controlled, adequate gaps exist in the traffic stream and therefore, the School Crossing Traffic Signal Warrant is not satisfied for any of the unsignalized intersections.

Pedestrian Network

Existing Pedestrian Facilities

Existing pedestrian facilities within the Alameda De Las Pulgas-San Carlos Corridor include sidewalks, crosswalks, crosswalk enhancements, curb ramps, and pedestrian signal phases at signalized intersections.

Sidewalks

Sidewalks are generally provided on both sides of the street along the study corridor. One notable exception is the east side of Alameda de las Pulgas between Chula Vista Drive and the San Carlos City limits along the TLMS property, where there are currently no sidewalks.

Crosswalks

Pedestrian crosswalks, along with curb ramps, are generally provided at all intersections along the study corridor. At signalized intersections, pedestrian signal equipment including pedestrian signals and pedestrian push-buttons. Uncontrolled crosswalks along the corridor include crosswalks at the Carlmont Village driveway and at the intersection of Alameda de las Pulgas/Garden Court. All uncontrolled crosswalks along the corridor are equipped with in-roadway warning lights and enhanced signs. The crosswalk locations throughout the corridor are summarized in Table 7.

Table 7 – Intersection Crosswalks

Cross-Street	North Leg	East Leg	South Leg	West Leg
1. Ralston Ave Carlton Village Driveway	School None	School None	School Ladder*	School n/a
2. Carlmont Dr Garden Ct	School None	Standard n/a	Standard Standard*	n/a Standard
3. El Verano Way	School	School	School	School
4. Chula Vista Dr	School	School	None	School
5. Cranfield Ave-Carlton HS Driveway	None	n/a	None	School
6. Club Dr-Dartmouth Ave	School	School	None	School

Notes: Standard = standard crosswalk; School = school crosswalk; Ladder = high-visibility ladder crosswalk; n/a = 4th leg of a tee-intersection; * = uncontrolled enhanced crosswalk with in-roadway warning lights and enhanced signs

Existing Pedestrian Crossing Demand

As part of the data collection effort, pedestrian crossings were counted at the study intersections during peak hours. Pedestrian volumes throughout the study corridor are highest during the a.m. and school p.m. peak periods. A majority of pedestrian traffic along the corridor travels on the west side of Alameda de las Pulgas-San Carlos Avenue south of Carlmont Drive. The peak crossing volume for each of the study intersections is summarized in Table 8.

Table 8 – Pedestrian Crossing Volumes

Study Intersection	AM Peak Hour				School PM Peak Hour				PM Peak Hour			
	N	E	S	W	N	E	S	W	N	E	S	W
1. ADLP/Ralston Ave	18	1	2	50	9	9	25	19	6	9	20	4
2. ADLP/Carlmont Dr	7	0	28	33	43	0	158	87	3	0	47	38
3. ADLP/El Verano Way	118	0	28	201	32	10	16	256	1	3	4	37
4. ADLP/Chula Vista Dr	93	5	25	8	3	9	5	60	12	2	2	11
5. ADLP-San Carlos Ave/Cranfield Ave-Carlmont HS Driveway	3	0	0	441	0	0	1	302	10	0	0	23
6. San Carlos Ave/Club Dr-Dartmouth Ave	81	2	5	14	118	19	4	8	2	8	6	6

Notes: ADLP = Alameda de las Pulgas; N, E, S, and W = Pedestrians crossing volumes per hour across the north, east, south, and west legs of each intersection respectively; **Bold** text indicates pedestrian crossing volumes across crossings without marked crosswalks

Bicycle Network

Existing Bicycle Facilities

The *Highway Design Manual*, Caltrans, 2015, classifies bikeways into three categories:

- **Class I Multi-Use Path** – a completely separated right-of-way for the exclusive use of bicycles and pedestrians with cross flows of motorized traffic minimized.
- **Class II Bike Lane** – a striped and signed lane for one-way bike travel on a street or highway.
- **Class III Bike Route** – signing only for shared use with motor vehicles within the same travel lane on a street or highway.

In the Alameda de las Pulgas-San Carlos corridor, bike lanes exist between 150 feet south of Carlmont Drive and the Belmont-San Carlos city limits. Outside of the corridor, bike lanes are currently proposed on Ralston Avenue east of Alameda de las Pulgas, and bike lanes exist on San Carlos Avenue south of Beverly Drive, located one-half mile south of Club Drive, the southern limit of the study area.

According to the *San Mateo County Comprehensive Bicycle and Pedestrian Plan 2011*, and also the *San Carlos 2012 Bicycle Transportation Plan*, a Class III bicycle route is proposed on San Carlos Avenue between the northern City Limit at Cranfield Avenue and Beverly Drive, connecting existing Class II bicycle lanes already on Alameda de las Pulgas and on San Carlos Avenue.

The City of Belmont has recently completed a study of the Ralston Avenue Corridor, which includes recommendations of continuous bicycle lanes on Ralston Avenue east of Alameda de las Pulgas. The City of San Carlos is planning on installing bike “sharrow” markings on San Carlos Avenue between Dartmouth Avenue and Beverly Drive. These Class III improvements, which consist of a bike “sharrow” marking and white edgeline between the parking aisle and travel lane, should be installed by late 2015/ early 2016.

A summary of existing and planned bicycle facilities near the study area is shown in Table 9.

Table 9 – Bicycle Facility Summary

Status Facility	Class	Length (miles)	Begin Point	End Point
Existing				
Alameda de las Pulgas	II	0.4	Carlmont Dr	Belmont-San Carlos City Limits
Ralston Ave	II	0.8*	Academy Ave	South Rd
Planned				
Ralston Ave	II	0.9*	Alameda de las Pulgas	South Rd
San Carlos Ave	III	0.5	Dartmouth Avenue	Beverly Dr

Note: * Existing bike lanes on Ralston Avenue are intermittent and continuous bike lanes are proposed.

Source: *San Mateo County Comprehensive Bicycle and Pedestrian Plan, 2011*

Existing Bicycle Traffic Volumes

Existing bicycle travel near the corridor is currently limited, with approximately 10 to 15 bicycles arriving at each study intersection during the peak hour. There are currently no clear indications of concentrated areas of bicycle travel demand along the corridor.

Transit Operations

Transit facilities near the study corridor include regional rail service operated by Caltrain, and local bus service and paratransit operated by SamTrans. The nearest Caltrain stations are the Belmont Caltrain Station, located 1.25 miles east of the corridor near the intersection of El Camino Real/Ralston Avenue, and the San Carlos Caltrain Station, located two miles southeast of the corridor near the intersection of El Camino Real/San Carlos Avenue. Caltrain operates on weekdays between 5:30 a.m. and 11:00 p.m. and between 8:30 a.m. and 11:00 p.m. on weekends. All local trains, and approximately half of Limited-Stop trains, stop at the Belmont and San Carlos Caltrain stations.

SamTrans Route 295 operates on weekdays from 7:00 a.m. to 7:00 p.m. along the study corridor and provides a transit connection to the San Carlos Caltrain station. Stops along the transit corridor include stops at Ralston Avenue, Carlmont Village shopping center, Belmont Library south of Carlmont Drive, El Verano Way, and Club Drive-Dartmouth Avenue.

SamTrans Routes 260 operates on weekdays from 6:30 a.m. to 6:30 p.m. along the Ralston Avenue corridor and the Redwood Shores neighborhood east of US 101, with stops on the study corridor at Alameda de las Pulgas/Carlmont Drive. During the school a.m. and p.m. peaks, Route 260 runs along the Alameda de las Pulgas corridor, providing school transit service for students from the Redwood Shores neighborhood and along Ralston Avenue to the schools along the study corridor. Transit service along the Route 260 corridor is supplemented by Routes 67 and 261. Route 67 is supplemental transit service operating on school days only on the Route 260 route for the school a.m. and p.m. student pick-up and drop-off route, while Route 261 operates on a shortened Route 260 route on Saturdays between 9:00 a.m. and 7:00 p.m.

Parking Conditions

On-Street Parking

As part of the data collection effort, on-street parking demand data for the study corridor was collected. Parking is currently only provided on the west side of ADLP. The vast majority of on-street parking use south of El Verano

Way was observed to be student parking from CHS. A summary of the available on-parking supply and peak parking demand is indicated in Table 10.

Table 10 – On-Street Parking Summary			
Section of Alameda de las Pulgas Corridor	On-Street Parking (Spaces)		
	Supply	Peak Demand	Time of Peak
ADLP (Ralston Ave to Carlmont Dr)	4	4	2:00 p.m.
ADLP (Carlmont Dr to El Verano Way)	28	27	11:00 a.m.
ADLP (El Verano Way to Chula Vista Dr)	4	4	School Hours
ADLP (Chula Vista Dr to CHS Dwy/Cranfield Ave)	34	34	School Hours
Club Dr (within 1,000 feet of San Carlos Ave)	50	46	School Hours
Chula Vista Dr (ADLP to Fernwood)	60	53	School Hours
El Verano (ADLP to Alomar Way)	25	25	School Hours
Veraga Dr	38	38	School Hours
Total	243	231	

Note: ADLP = Alameda de las Pulgas

Off-Street Parking

Because of the prevalence of student parking observed on-street, data was also collected for off-street lots in the Carlmont High School campus as well as the Methodist Church parking lot southwest of Alameda de las Pulgas-San Carlos Avenue/Cranfield Avenue/Carlmont High School Driveway, where student parking was also observed. A summary of the available off-parking supply and peak parking demand is indicated in Table 11.

Table 11 – Off-Street Parking Summary			
Parking Lot	Off-Street Parking (Spaces)		
	Supply	Peak Demand	Time of Peak
North Parking Lot	123	116	9:00 a.m.
South Parking Lot	101	78	1:00 p.m.
Other Lots	150	146	
Methodist Church Lot	70*	50	1:00 p.m.
Total	444	390	

Note: * Some parking spaces were signed “No Student Parking” and were not included in count

Parking Summary

It is estimated that CHS currently generates approximately 610 parked vehicles including 340 on campus, 50 in the church lot and 220 on adjacent streets. With a potential increase of 300 students, an additional 86 parked vehicles are expected to be generated, increasing the demand to parking for 696 vehicles.

School Drop-off/Pick-up

Due to the proximity of the many schools surrounding the study corridor, traffic patterns during the a.m. and school p.m. peak periods are heavily influenced by the pick-up and drop-off patterns of each school. A meeting

was held with school representatives on April 8, 2014 to discuss and observe school safety issues. Based on the meeting with school staff, field notes from a site visit and a school walking audit, the following school pick-up and drop-off traffic patterns were observed:

Carlmont High School

Students from CHS who do not drive themselves to and from school are picked up at several locations throughout the campus, including drop-off and pick-up locations in a turnaround west of El Verano Way, the north parking lot which is accessed from a driveway located at Alameda de las Pulgas/Chula Vista Drive, and the south parking lot which has access from Alameda de las Pulgas-San Carlos Avenue/Cranfield Avenue-Carlmont High School Driveway. Other observed drop-off and pick-up locations for Carlmont High School students include a church parking lot on the northeast corner of Alameda de las Pulgas/Chula Vista Drive, street parking at Cranfield Avenue, and a church parking lot on the southwest corner of Alameda de las Pulgas-San Carlos Avenue/Cranfield Avenue-CHS Driveway.

Students driving to and from school with parking permits are allowed onto two on-campus parking lots, including the north parking lot at Alameda de las Pulgas/Chula Vista Drive and the south parking lot near Alameda de las Pulgas-San Carlos Avenue/Cranfield Avenue-Carlmont High School Driveway.

Students without parking permits who drive to and from school typically utilize on-street parking, including angled parking on Alameda de las Pulgas on the Carlmont High School Frontage, Chula Vista Drive, and El Verano Way. Students were also observed parking in the Methodist Church parking lot, and a small number of students were observed parking in the 90-degree parking located between Tierra Linda Middle School and Dartmouth Avenue.

Tierra Linda Middle School-San Carlos Charter School

Tierra Linda Middle School shares their campus with the San Carlos Charter School and both are located off of Dartmouth Avenue.

Because the two schools share a campus, student pick-up and drop-off patterns are similar for both schools. Student drop-off and pick-up typically occurs on-site, where a vehicular loop directs parents to the drop-off and pick-up area. In addition, some drivers use street parking on Club Drive or the church parking lot located on the northeast corner of San Carlos Avenue/Club Drive-Dartmouth Avenue as an unofficial school drop-off and pick-up area. As a result, the signalized school crossing of San Carlos Avenue at Club Drive-Dartmouth Avenue is extremely popular among students.

Public Outreach

Four Corners Working Group

The process followed in developing the recommendations in this report has included eight meetings with the Four Corners Working Group, which consists of elected officials and staff from the Cities of Belmont and San Carlos as well as board members and administration from Sequoia Union High School District representing Carlmont High School and San Carlos Elementary School District representing Tierra Linda Middle School. This group provided guidance and input throughout the process on school access, public outreach, alternative treatments, and preferred modifications. The Working Group meetings were noticed public events at which comments were taken from the public in attendance. Meetings for the Four Corners Traffic Study were held on the following dates:

- June 4, 2014
- August 8, 2014
- November 3, 2014
- December 1, 2014
- February 5, 2015
- March 30, 2015
- June 9 2015
- November 3, 2015

Meeting minutes from these discussions and a list of the of the Four Corners working group members are included in Appendix F.

School Walking Audits

School walking audits and meetings with school administrative staff took place on April 8, 2014 at both Carlmont High School and Tierra Linda Middle School. The meetings included a field review with staff to observe pick-up/drop-off and pedestrian activity leaving the site after school. Observation of the morning arrival and drop-off also occurred prior to this date.

Meeting notes from the audits are included in Appendix G.

Workshops

Two workshops were held to present the alternatives to the public:

- **Workshop #1** was held on March 12, 2015 at Carlmont High School.
- **Workshop #2** was held on April 30, 2015 at Tierra Linda Middle School.

Meeting announcements, sign-in sheets, presentations, and input on alternatives are included in Appendix G.

Issues to Address

Transportation Issues

As part of the analysis of traffic data, field observations, meetings with each of the schools and discussions with the Four Corners Technical Advisory Committee, the following critical issues were noted which needed to be addressed as part of the study.

- The intersection of Alameda de las Pulgas-San Carlos Avenue/Cranfield Avenue has a curved alignment with wide pavement areas which results in some vehicle conflicts and driver confusion.
- The Carlmont High School (CHS), Cranfield Avenue and church driveway parallel street configuration approaching Alameda de las Pulgas-San Carlos Avenue creates additional conflicts at the intersection.
- Traffic volumes at the Alameda de las Pulgas (ADLP)-San Carlos Avenue/Cranfield Avenue-Carmont High School intersection warrant enhanced traffic control.
- Tierra Linda Middle School (TLMS) generates excessive traffic on the residential oriented street, Dartmouth Avenue.
- CHS generates significant pedestrian activity to/from the south with students parking on adjacent streets and the church parking lot.
- CHS generates significant pedestrian activity in the area around Cranfield Avenue with students crossing the wide pavement areas in numerous locations.
- CHS generates significant pedestrian activity to/from the east and north with students walking to Carlmont Shopping Center in the afternoon.
- The all-way stop controls at the intersections of ADLP/Carlmont Drive, ADLP/EI Verano Way and ADLP/Chula Vista Drive are the primary source of congestion and queuing on the corridor.
- ADLP/Chula Vista Drive does not currently warrant enhanced traffic control but will operate with increased congestion and queuing with increased traffic in the future.
- The ADLP/EI Verano Way intersection does not currently warrant enhanced traffic control but will operate with increased congestion and queuing with increased traffic in the future.
- Traffic volumes at the ADLP/Carlmont Drive intersection currently warrant enhanced traffic control such as a traffic signal.

Mini-Roundabouts

Background

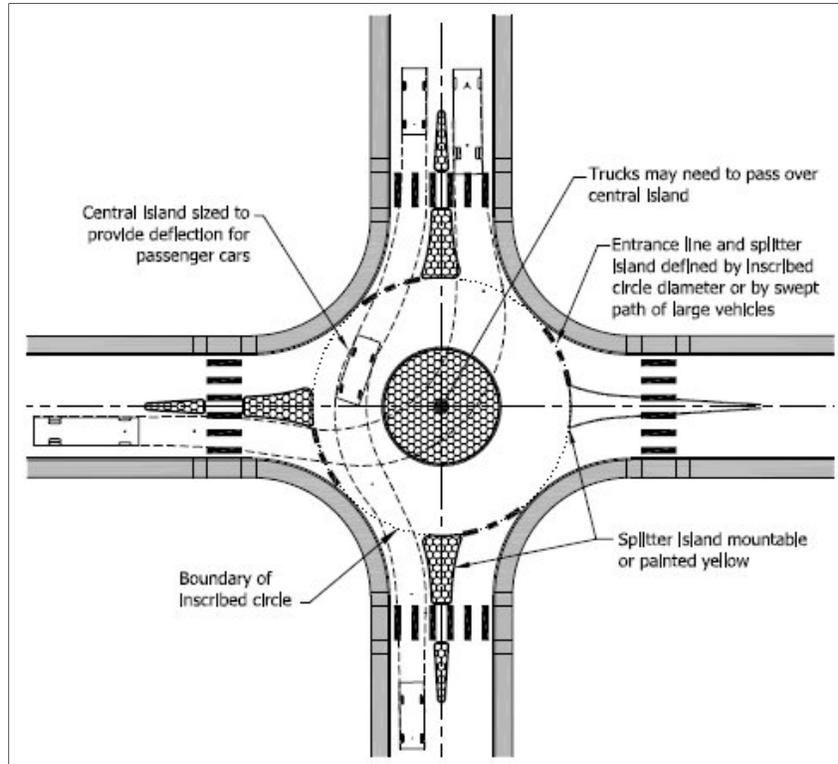
Alternatives for the corridor included consideration of Mini-Roundabouts, so background information on this traffic control option was developed since it not used as frequently as traffic signals. Mini-Roundabouts are small roundabout intersections with a fully traversable central island. They are most commonly used in low-speed urban environments with average operating speeds of 30 mph or less. They can be useful in such environments where conventional roundabout design is precluded by right-of-way constraints. In retrofit applications, mini-roundabouts are relatively inexpensive because they typically require minimal additional pavement at intersecting roads and minor widening at the corner curbs. More information on mini-roundabouts can be found in *Mini-Roundabouts Technical Summary*, FHWA, 2009 and *Roundabouts: An Informational Guide*, NCHRP Report 672.

Characteristics of Mini-Roundabouts

A mini-roundabout is a type of intersection that can be used at physically-constrained locations in place of stop-controlled or signalized intersections to help improve safety problems and reduce excessive delays at minor approaches. Mini-roundabouts generally have an inscribed circle that is small enough to stay within the existing right-of-way (or within the existing curb lines if adequate space is available). Mini-roundabouts operate in the same manner as larger roundabouts, with yield control on all entries and counterclockwise circulation around a mountable (traversable) central island.

Mini-roundabouts are distinguished from neighborhood traffic circles primarily by their traversable islands, geometric design for entry and exit, and yield control on all approaches, which allows them to function as other roundabouts do. Neighborhood traffic circles are typically built at the intersections of local streets for reasons of traffic calming and/or aesthetics. They typically are operated as two-way or all-way stop-controlled intersections and frequently do not include raised channelization to guide approaching traffic into the circulatory roadway. At some neighborhood traffic circles, left-turning vehicles must turn in front of the central island, potentially conflicting with other circulating traffic.

To help promote safe operations, the design of mini-roundabouts generally aligns passenger cars on the approach in such a way as to naturally follow the circulatory roadway and minimize running over the central island to the extent possible. Due to the small footprint, large vehicles are typically required to over-run the fully traversable central island.



Design Features of a Mini-Roundabout

Benefits of Mini-Roundabouts

Mini-roundabouts are emerging in the United States as a potential intersection type. They may be an optimal solution for a safety or operational issue at an existing stop-controlled or signalized intersection where there is insufficient right-of-way for a standard roundabout installation. The benefits of mini-roundabouts and some constraining factors are described below.

- **Compact size** – A mini-roundabout can often be developed to fit within existing right-of-way constraints. Note that mini-roundabouts are generally not recommended for intersections with more than four legs. However, in some cases there may be adequate spacing between legs to allow for two closely-spaced mini-roundabouts.
- **Operational Efficiency** – A mini-roundabout may provide less delay for a critical movement or for an overall intersection in comparison to other intersection alternatives. However, as with all roundabout types, mini-roundabouts do not provide explicit priority to specific users such as trains, transit, or emergency vehicles.
- **Traffic Safety** – Mini-roundabouts have been used successfully in the U.K. to improve safety at intersections with known crash problems, with reported crash rate reductions of approximately 30 percent as compared to signalized intersections.
- **Traffic Calming** – Designed properly, a mini-roundabout reduces speeds and can be implemented as part of a broader traffic calming scheme. The low-speed environment also enhances the intersection for non-motorized users.

- **Access Management** – A mini-roundabout can be used to provide efficient access to a new or existing development. However, in the cases of large trucks and other large vehicles, the diameter may be too small to accommodate U-turn maneuvers that would be readily accommodated at a larger roundabout.
- **Aesthetics** – In comparison to full-size roundabouts, mini-roundabouts do not allow opportunities for landscaping in the central island. As with comparably sized traditional intersections, landscaping opportunities are limited to the periphery of the intersection.
- **Environmental Benefits** – A mini-roundabout may offer an environmental benefit compared to conventional intersections through reduced delay, fuel consumption, and vehicle emissions.



Menlo Park Mini-Roundabout

Alternatives

Design Considerations

- All alternatives included a new access from Tierra Linda Middle School (TLMS) to Alameda de las Pulgas (ADLP).
- If the ADLP/Cranfield intersection were to be reconfigured as a four-legged roundabout intersection with a TLMS access, the roundabout would need to be designed with a larger diameter, perhaps in the 120-foot range. This larger diameter and the roundabout design needs would require that the single family residence adjacent to the TLMS property be acquired.
- Mini-roundabouts with a smaller 80-foot diameter were considered where applicable. See previous section on Mini-Roundabouts.
- If the ADLP/Cranfield intersection were to be reconfigured with a roundabout alignment as a three legged intersection without access to TLMS, a smaller 80 to 90-foot mini-roundabout would be feasible; this could be constructed within the existing right-of-way. A conceptual design for the intersection with a mini-roundabout is included in Appendix H.
- If ADLP/Chula Vista Way were converted to a mini-roundabout, the high school driveway entrance on the south side would need to be slightly re-aligned.
- If ADLP/El Verano Way were converted to a mini-roundabout, a small portion of the empty lot on the southeast corner would need to be acquired (across from the CHS baseball field).
- With a full four-way roundabout at Cranfield Avenue, the CHS access would need to be realigned with the connection to Cranfield Avenue moved south from its current position. This will present some constructability issues due to the change in grades and may result in a 12 percent grade for the realigned connection.
- With a smaller three-way roundabout at Cranfield Avenue, the CHS access is assumed to be realigned further to the west. The existing CHS connection at Cranfield Avenue is shown as an emergency vehicle access (EVA) connection only as it would have a grade change of approximately 8 percent.
- The existing pavement width on ADLP between Cranfield Avenue and Chula Vista Drive is approximately 48 feet. If drop-off/pick-up shoulders are provided either on one side of the street or both, the existing diagonal parking would need to be removed.
- All alternatives include new pedestrian sidewalks on the east side of ADLP between Cranfield Avenue and Chula Vista Way.

Alternative Descriptions

The following alternatives were evaluated with the various traffic control feature options developed to produce the most acceptable traffic operations possible. The objective of this effort was to develop traffic control alternatives to improve circulation, safety, and multi-modal transportation within the Four Corners project area. All of the alternatives include creating a second access point to Tierra Linda Middle School (TLMS) along Alameda de las Pulgas and improving safety and circulation through traffic controls at key intersections. Each alternative provides variations of traffic control measures at the study intersections including signalization, roundabouts, and turning restrictions.

The development of the alternatives evolved from the following:

- Analysis of the traffic data
- Issues identified during the field observations
- Input received at Community Workshops
- Input received from the Four Corners Subcommittee

The resulting alternatives for the study included the following:

- **Alternative 1** – Four-Way Cranfield Intersection
- **Alternative 2A** – Midpoint Access to CHS and TLMS with Traffic Signal
- **Alternative 2B** – Midpoint Access to CHS and TLMS with Roundabout
- **Alternative 3A** – Midpoint Access to CHS and TLMS with Turn Restrictions
- **Alternative 3B** – Offset Midpoint Access to CHS and TLMS with Turn Restrictions

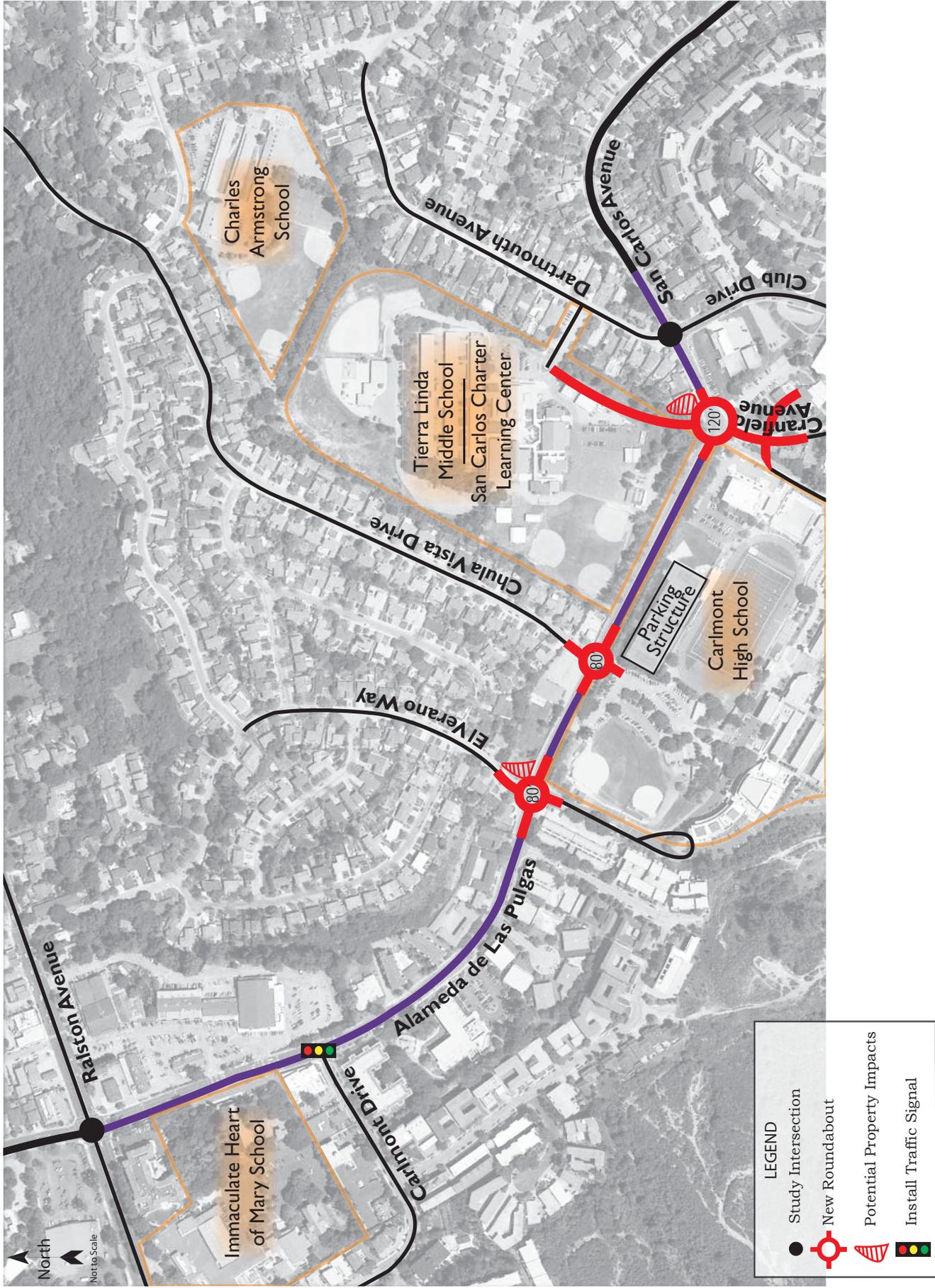
The alternatives are shown in Figures 3-7 with details of the design included in Appendix I.

Access Alternative # 1 – Four-Way Cranfield Avenue Intersection

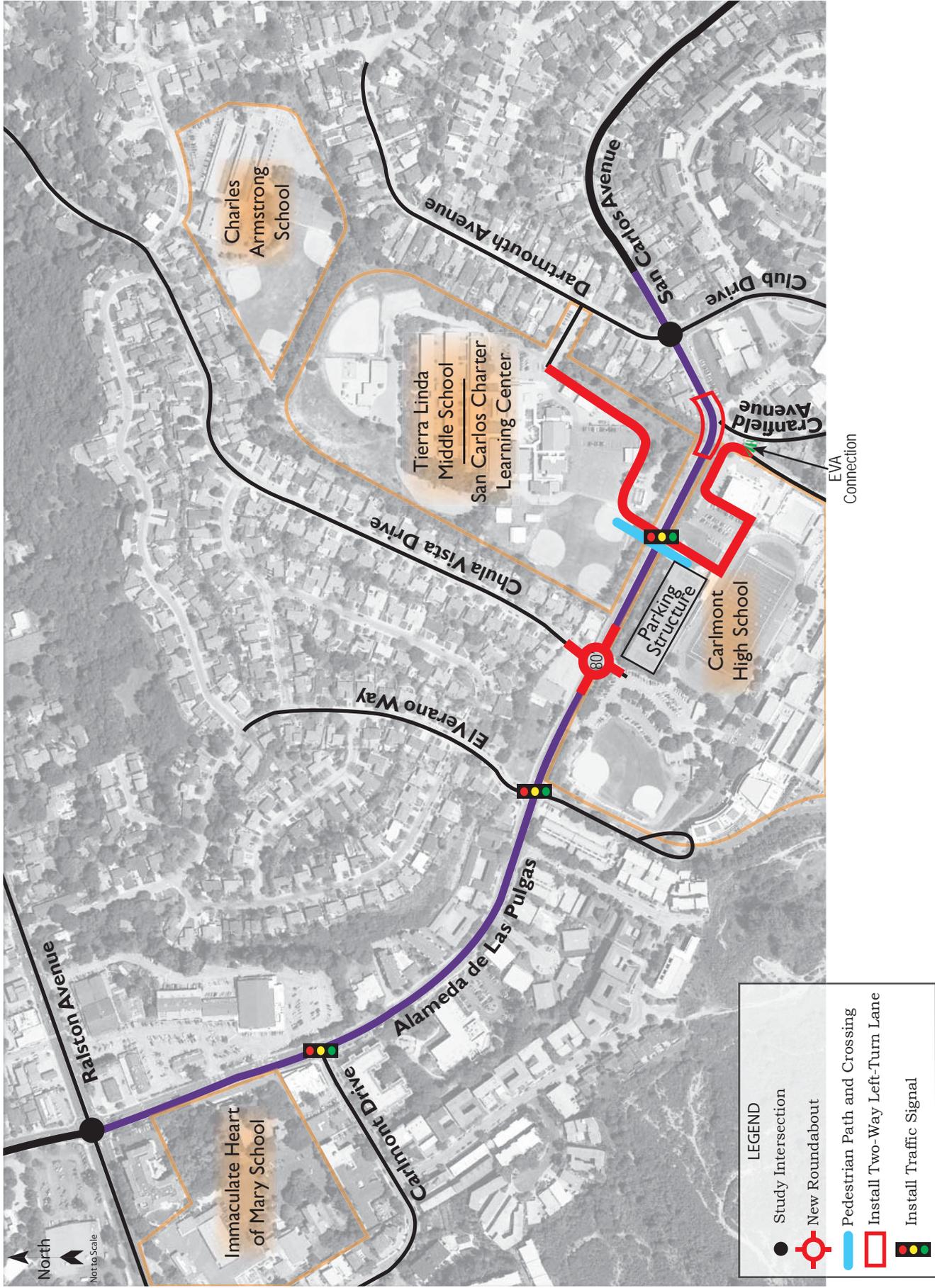
- The four locations with all-way stop- controls would be changed to either signals or roundabouts.
- ADLP/Cranfield Drive would be converted to a four-legged intersection with a full-size roundabout of approximately 120 feet in diameter.
- The four-way intersection at ADLP/Cranfield Avenue would include new access to TLMS.
- The south side of Cranfield Avenue intersection would require realignment of the CHS and Church access points since they currently all converge on the same side of ADLP.
- The parcel on the northeast corner adjacent to the Cranfield Avenue roundabout would need to be acquired.
- The intersections with Chula Vista Drive and El Verano Way would be controlled by mini-roundabouts.
- Some land would need to be acquired from the parcel on the northeast corner adjacent to the El Verano Way intersection.
- A signal would be installed at the Carlmont Drive intersection.
- A new eight-foot sidewalk would be installed on the TLMS side of ADLP.
- Parking would be removed along the front of Carlmont High School on Alameda de las Pulgas and be replaced with parallel parking or drop off space for 20 vehicles.
- Existing bike lanes would be maintained.
- The total cross section on ADLP would be 52 feet, which would require 4 feet of widening.

Access Alternative #2A – Midpoint Access to CHS and TLMS with Traffic Signal

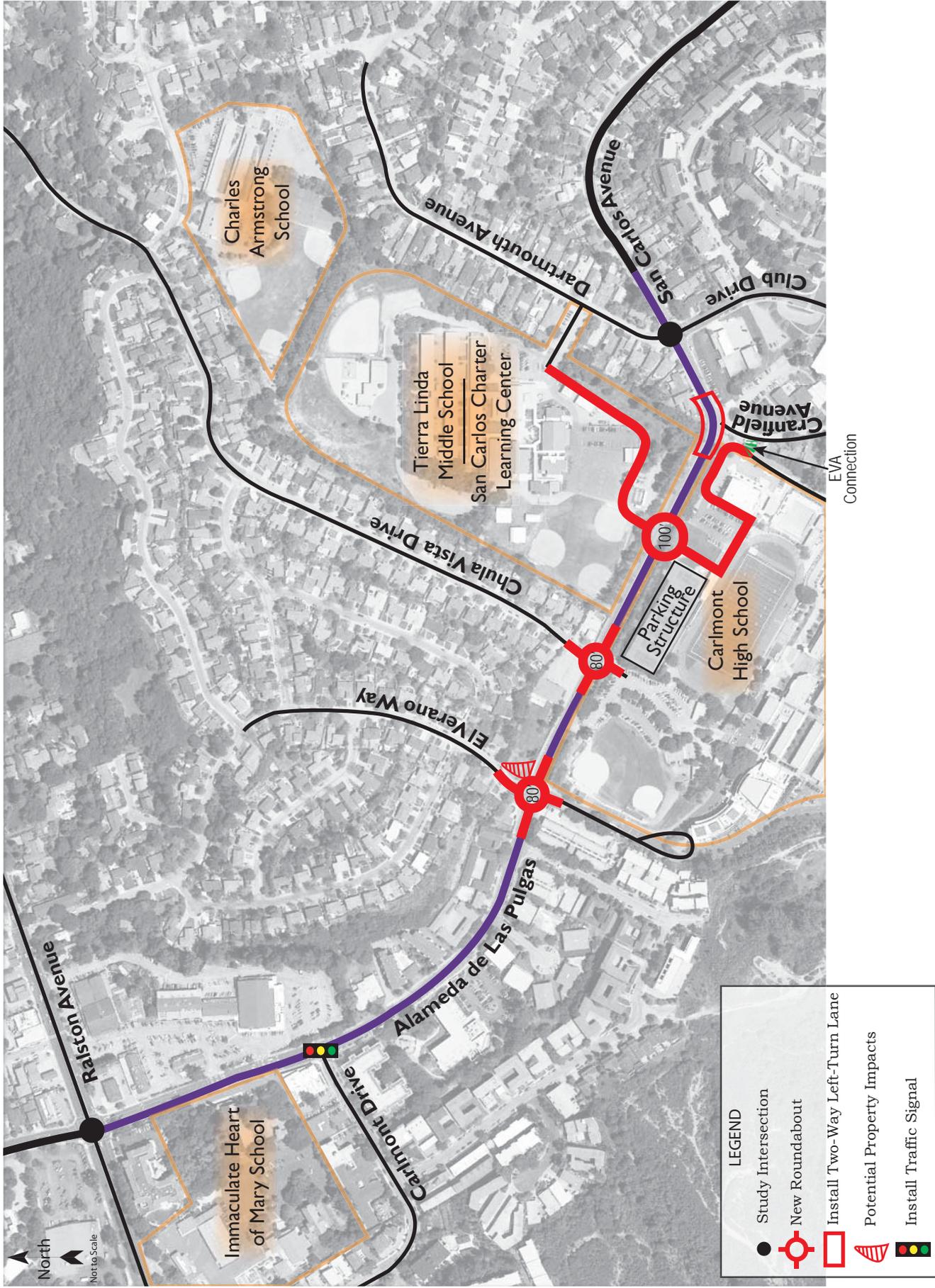
- The four locations with all-way stop controls would be converted to either signals or roundabouts.
- A new signalized intersection would be installed at the new the entrance of Carlmont High School and TLMS.
- A new midpoint access to TLMS off of Alameda de Las Pulgas would be provided through the existing field.
- A new access point to Carlmont High School would be created opposite the new TLMS access and diverting traffic through the existing parking lot then connecting it with its current path of travel.
- Alameda de las Pulgas at Cranfield Avenue would be restriped with a new two-way left-turn lane.
- The existing access to Carlmont High School near Cranfield Avenue would be limited to emergency vehicles only.
- The intersection at Chula Vista Drive would be controlled by a mini-roundabout.
- The intersection at El Verano Way would be controlled by a traffic signal.
- Traffic signals at San Carlos Avenue/Dartmouth, Alameda de las Pulgas/School Access and Alameda de las Pulgas/El Verano Way would be coordinated.
- Parking will be reduced along the frontage of Carlmont High School from 34 spaces to 16 spaces.
- Signal-controlled pedestrian crossings will be provided at the Carlmont High School and TLMS intersections.



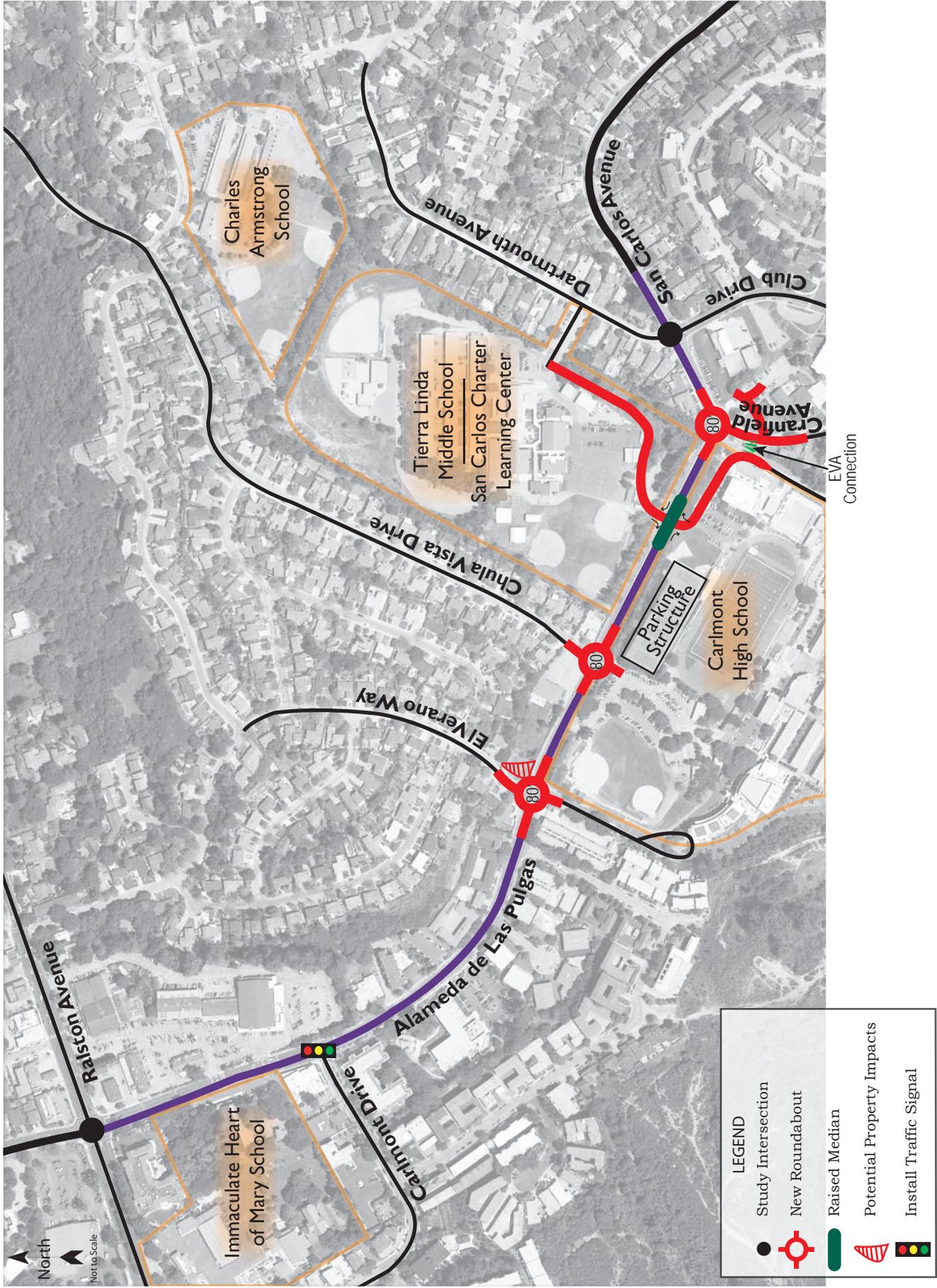
Alameda de Las Pulgas-San Carlos Avenue Corridor Study
Figure 3 – Access Alternative #1



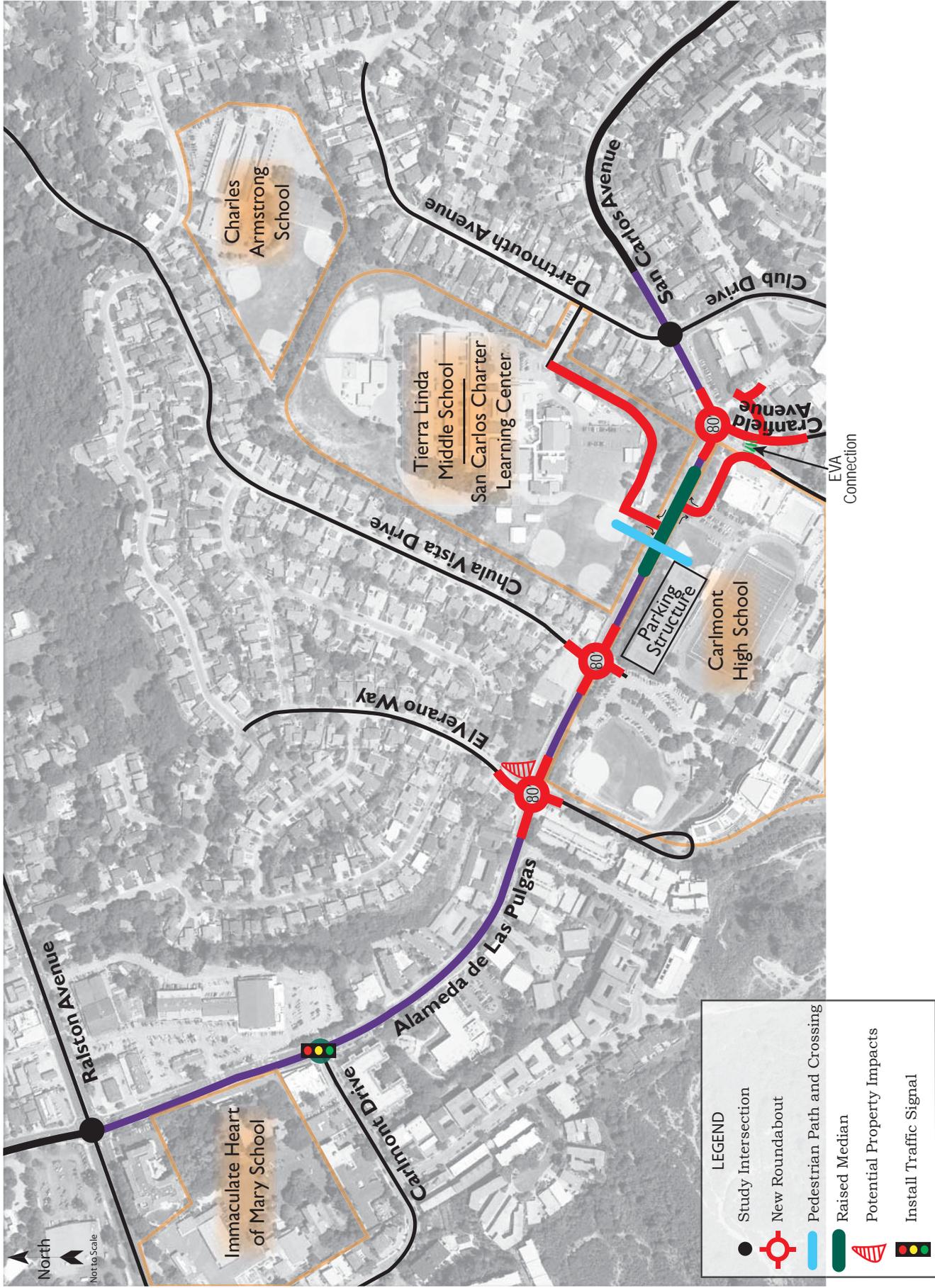
Alameda de Las Pulgas-San Carlos Avenue Corridor Study
Figure 4 – Access Alternative #2A



Alameda de Las Pulgas-San Carlos Avenue Corridor Study
Figure 5 – Access Alternative #2B



Alameda de Las Pulgas-San Carlos Avenue Corridor Study
Figure 6 – Access Alternative #3A



Alameda de Las Pulgas-San Carlos Avenue Corridor Study
Figure 7 – Access Alternative #3B

- A traffic signal would be constructed at Carlmont Drive.
- Existing bike lanes would be maintained.
- The total cross section on ADLP would be 48 feet; this would not require any widening.

Access Alternative #2B - Midpoint Access to CHS and TLMS with Roundabout

- The four all-way stop-controlled intersections would be converted to signals or roundabouts.
- A new roundabout-controlled intersection would be created at the new the entrance to Carlmont High School and TLMS.
- A new midpoint access to TLMS off of Alameda de Las Pulgas would be provided through the existing field.
- A new access point to Carlmont High School would be created by diverting traffic through the existing parking lot.
- Alameda de las Pulgas at Cranfield Avenue would be restriped with a new two-way left-turn lane.
- The existing access point to Carlmont High School near Cranfield Avenue would be limited to emergency vehicles only.
- The intersections at Chula Vista Drive and El Verano Way would be controlled by mini-roundabouts.
- Some land would need to be acquired from the northeast parcel adjacent to the El Verano Way intersection.
- Parking will be reduced along the frontage of Carlmont High School from 34 spaces to 16 spaces.
- Pedestrian crossings would be provided at the Carlmont High School and TLMS intersection with medians at the roundabout.
- ADLP would include a traffic signal at Carlmont Drive.
- Existing bike lanes would be maintained.
- The total cross section on ADLP would be 48 feet; no widening would be required.

Access Alternative #3A - Midpoint Access to CHS and TLMS with Turn Restrictions

- The four all-way stop-controlled intersections would be converted to signal or roundabout controls.
- A new four-way intersection would be created at the new access points to Carlmont High School and TLMS with access restricted to right-turns in and out only.
- Turn restrictions at the Carlmont High School/TLMS intersection would be reinforced by a raised median on Alameda de las Pulgas.
- A new midpoint access to TLMS off of Alameda de Las Pulgas would be created through the existing field.
- Access to Carlmont High School from Alameda de las Pulgas would be created by diverting traffic through the existing parking lot.
- Alameda de las Pulgas/Cranfield Avenue would be controlled by a mini-roundabout.
- The access on the south side of Cranfield Avenue would be limited to emergency vehicles only (EVA).
- A signal would be installed at Alameda de las Pulgas and Carlmont Drive.
- The intersection at Chula Vista Drive would be controlled by a mini-roundabout.
- The intersection at El Verano Way would be controlled by a mini-roundabout.
- Some land would need to be acquired from the northeast parcel adjacent to El Verano Way intersection.
- The number of parking spaces along Alameda de las Pulgas on the Carlmont High School side would be reduced from 34 to 12, with drop off space for 19 vehicles.
- The total cross section on ADLP would be 56 feet, which would require 8 feet of widening.

Access Alternative #3B - Offset Midpoint Access to CHS and TLMS with Turn Restrictions

This alternative is the same as 3A except the new access points to the school at Alameda de las Pulgas would be offset.

Alternatives Analysis

Access Alternative # 1 - Four-Way Cranfield Avenue Intersection

- All intersections would operate acceptably.
- The westbound queue approaching the new four-way roundabout at Cranfield Avenue would extend to Dartmouth Avenue during a very short period in the morning school peak.
- On-street pick-up and drop-off along ADLP could be maximized between Cranfield Avenue and Chula Vista Drive.
- Roundabouts would allow for easy return for those dropping off curbside.
- ADLP between Cranfield Avenue and Chula Vista Drive could either be kept in its current configuration with diagonal parking on the south side, or converted to two travel lanes with drop-off/ pick-up shoulders on one side or both; this would require the removal of the diagonal parking.

Access Alternative #2A - Midpoint Access to CHS and TLMS with Traffic Signal

- All intersections would operate acceptably.
- On-street pick-up and drop-off along ADLP could be provided on both sides of access, but may require students to cross ADLP at some point.
- ADLP between Cranfield Avenue and Chula Vista Drive would need to be converted to two travel lanes plus left-turn pockets to serve turning vehicles at the traffic signal. The three-lane section would require removal of the existing diagonal parking. The remaining 7-8 foot shoulder could be used for drop-off/pick-up and/or parallel parking on both sides of the street.

Access Alternative #2B - Midpoint Access to CHS and TLMS with Roundabout

- All intersections would operate acceptably.
- On-street pick-up and drop-off along ADLP could be provided on both sides of the street, but may require students to cross ADLP at some point.
- Roundabouts would allow for easy return for those dropping off curbside.
- ADLP between Cranfield Avenue and Chula Vista Drive could either be kept in its current configuration with diagonal parking on the south side, or converted to two travel lanes with drop-off/pick-up shoulders on one side or both; this would require the removal of the diagonal parking.

Access Alternative #3A - Midpoint Access to CHS and TLMS with Turn Restrictions

- All intersections would operate acceptably.
- On-street pick-up and drop-off along ADLP could be provided on both sides of the street, but this may require students to cross ADLP at some point.
- Roundabouts would serve left-turn movements that would be prohibited by raised median.
- Raised medians could be used to enhance pedestrian crossings.
- ADLP between Cranfield Avenue and Chula Vista Drive could either be kept in its current configuration with diagonal parking on the south side except in the area of the median, or converted to two travel lanes with drop-off/pick-up shoulders on one side or both with elimination of the diagonal parking.

Access Alternative #3B - Offset Midpoint Access to CHS and TLMS with Turn Restrictions

- All intersections would operate acceptably.
- On-street pick-up and drop-off along ADLP could be provided on both sides of the street, but this may require students to cross ADLP at some point.

- Roundabouts would serve left-turn movements that would be prohibited by raised medians.
- Raised medians could be used to enhance pedestrian crossings.
- ADLP between Cranfield Avenue and Chula Vista Drive could either be kept in its current configuration with diagonal parking on the south side except in the area of the median, or converted to two travel lanes with drop-off/pick-up shoulders on one side or both; this would require the elimination of the diagonal parking.

Summary

The benefits and consequences of implementing each alternative were evaluated and weighed based upon its impact to key transportation issues. The results are summarized in Table 12.

Access Alternative						Benefits	Consequences
	Congestion	Safety	Drop-off	Pedestrian	ROW		
1 Four-way Cranfield Avenue Intersection	+	+	++	+	-	<ul style="list-style-type: none"> • Potential for largest street drop-off area. • Roundabouts would provide easy return travel after pick-up or drop-off. 	<ul style="list-style-type: none"> • Cranfield roundabout requires property acquisition. • Short distance between Cranfield and Dartmouth may create queuing concerns.
2A Midpoint Access with Signal	+	o	+	+	o	<ul style="list-style-type: none"> • Reduces congestion at Cranfield and Chula Vista. • No impact to private property. • Standard traffic signal operation familiar to the general public. 	<ul style="list-style-type: none"> • Reduced pick-up/drop-off area on ADLP. • Traffic signal will create left-turn queuing on ADLP.
2B Midpoint Access with Roundabout	+	+	+	+	o	<ul style="list-style-type: none"> • Reduces congestion at Cranfield and Chula Vista • No impact to private property. • Roundabout will minimize queuing on ADLP. 	<ul style="list-style-type: none"> • Reduced pick-up/drop-off area on ADLP.
3A Midpoint Access with Turn Restrictions	++	++	+	++	o	<ul style="list-style-type: none"> • Reduces congestion at Cranfield and Chula Vista. • Roundabouts would provide easy return travel after pick-up or drop-off. • Reduced conflicts at new access. • Median provides opportunity for safe pedestrian crossing. 	<ul style="list-style-type: none"> • Reduced pick-up/drop-off area on ADLP. • Aligned access restricts access options for each school.
3B Offset Midpoint Access with Turn Restrictions	++	++	+	++	o	<ul style="list-style-type: none"> • Reduces congestion at Cranfield and Chula Vista. • Roundabouts would provide easy return travel after pick-up or drop-off. • Reduced conflicts at new access. • Offset allows flexible access design for each school. • Median provides opportunity for safe pedestrian crossing. 	<ul style="list-style-type: none"> • Reduced pick-up/drop-off area on ADLP.

Notes: + indicates a positive impact; ++ indicates a more substantial positive impact; – indicates a negative impact; o indicates no impact

Evaluation of Preferred Plan

Based on input received at the workshops and from the Four Corners Technical Advisory Committee, a preferred plan based on Alternative 3B was identified.

Alternative 3B includes the following:

- An offset midpoint access to CHS and TLMS with turn restrictions (right-turns in and out only)
- Mini-roundabouts at ADLP/Cranfield Avenue, ADLP/Chula Vista Drive, and ADLP/Verano Way

This alternative was more fully evaluated in terms of intersection levels of service, travel time and queuing. These conditions were assessed for the following scenarios:

- **Existing Conditions with Preferred Plan** – Existing traffic volumes with the Preferred Plan controls/lanes
- **School Expansion with Preferred Plan** – Existing volumes plus the school expansion traffic with the Preferred Plan controls/lanes

Intersection Levels of Service

The intersection levels of service were evaluated for the three scenarios based on volumes during the a.m., school p.m., and p.m. peak periods. Existing conditions were previously described and the levels of service for this scenario are shown in Table 3. The intersection level of service calculations for the Preferred Plan scenarios are summarized in Table 13 and Table 14. Copies of the Level of Service calculations are provided in Appendix J. As shown in Tables 13 and 14, all of the study intersections would be expected to operate at LOS D or better with the Preferred Plan under both Existing volumes and with the added traffic associated with the School Expansion.

Table 13 – Existing with Preferred Plan Peak Hour Intersection Levels of Service

Study Intersection	AM Peak		School PM Peak		PM Peak	
	Delay	LOS	Delay	LOS	Delay	LOS
1. Alameda de las Pulgas/Ralston Ave	45.4	D	40.1	D	43.1	D
2. Alameda de las Pulgas/Carlmont Dr	11.7	B	10.0	A	8.2	A
3. Alameda de las Pulgas/El Verano Way	5.6	A	5.1	A	4.9	A
4. Alameda de las Pulgas/Chula Vista Dr	13.1	B	7.2	A	6.0	A
5. ADLP/Cranfield Ave	6.7	A	2.9	A	2.5	A
6. San Carlos Ave/Club Dr-Dartmouth Ave	21.5	C	19.5	C	20.3	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service

Table 14 – School Expansion with Preferred Plan Peak Hour Intersection Levels of Service

Study Intersection	AM Peak		School PM Peak	
	Delay	LOS	Delay	LOS
1. Alameda de las Pulgas/Ralston Ave	49.4	D	41.2	D
2. Alameda de las Pulgas/Carlmont Dr	12.2	B	10.3	B
3. Alameda de las Pulgas/El Verano Way	5.5	A	5.0	A
4. Alameda de las Pulgas/Chula Vista Dr	17.6	B	7.0	A
5. ADLP/Cranfield Ave	8.5	A	2.9	A
6. San Carlos Ave/Club Dr-Dartmouth Ave	26.2	C	21.0	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service

Bell Schedule Assumptions

For purposes of the evaluation, no changes were assumed in the start times for either Carlmont High School or Tierra Linda Middle School. Traffic analysis methodologies are based on peak hour conditions with some accounting for peaking within the hour. A shifting of start times by 10-15 minutes would likely result in no changes to the level of service ratings for the study intersections. However, shifting of start times would likely provide some benefit to those traveling during the school peak periods.

The intent of the traffic study was to evaluate worst-case conditions and determine if acceptable operation could be achieved for the Alameda corridor with the preferred plan. Based on the analysis performed, it is anticipated that the preferred plan would result in acceptable conditions even if the schools maintain their current schedules. Any shifting of start times may further improve conditions from what is documented in the report.

Corridor Travel Time

Travel time analysis was conducted with the Synchro software to assess the overall speed and delay of vehicular travel through the corridor. The northern limit of the travel time runs was at Ralston Avenue and the southern limit was at Kenton Avenue, one-quarter mile south of Club Drive-Dartmouth Avenue. The results of the travel-time analysis are summarized in Table 15 and copies are provided in Appendix K. As shown in Table 15, travel times in the corridor are expected to decrease, primarily due to the replacement of the all-way stop controls with the mini-roundabouts or traffic signals.

Table 15 – Travel Time Through Corridor (between Ralston Ave and Kenton Ave)

Scenario	Travel Time (mm:ss)		
	Existing	Existing with Preferred Plan	School Expansion with Preferred Plan
Northbound			
AM Peak	5:06	3:22	3:55
School PM Peak	5:36	3:19	3:24
PM Peak	6:48	3:32	
Southbound			
AM Peak	4:28	2:27	2:30
School PM Peak	4:09	2:17	2:22
PM Peak	3:12	2:00	

Queuing

Queuing at the controlled intersections was determined using the Synchro and SimTraffic software. The results of the analysis are shown in Appendix L. Queues would be expected to be contained between intersections which acceptable storage conditions.

Corridor Recommendations

Alternative 3B was refined based on input from the Four Corners Technical Advisory Committee. Following is a list of the final corridor recommendations which are also shown in Figures 8 and 9.

Intersection Traffic Control

- **ADLP/Carlmont Drive** – Install a traffic signal and modify lane geometrics as shown on the plan.
- **ADLP/EI Verano Way** – Install a mini-roundabout which will require acquisition of some property on the southeast corner.
- **ADLP/Chula Vista Drive** – Install a mini-roundabout which will require realignment of the high school parking lot access on the west leg of the intersection.
- **ADLP/Cranfield Avenue** – Install a mini-roundabout as shown on the plans with the west leg of the intersection consolidated with the church property driveway. (The CHS driveway would be closed. See discussion below.)
- **San Carlos Avenue/Dartmouth Avenue** – Modify the traffic signal timing.

Pedestrian Facilities

- **New Sidewalks** – Install new continuous sidewalks along the east side of ADLP between Chula Vista Drive and the terminus of the existing sidewalk near Cranfield Avenue. These should be a minimum of 8 feet in width to accommodate multiple school age pedestrians.
- **Reconstructed Sidewalks** – The City of Belmont should coordinate with the Carlmont Village Shopping Center to reconstruct the existing sidewalks along its frontage on ADLP with a minimum of 8-foot width between Carlmont Drive and Ralston Avenue. This may impact the parking configuration within the shopping center.
- **Crosswalks** – High visibility crosswalks should be considered for installation based on further coordination between the Cities of Belmont and San Carlos, public safety officials, SamTrans and the schools, at the following locations:
 - ADLP/Garden Court (south leg)
 - ADLP/EI Verano Way (south leg)
 - ADLP/Chula Vista Drive (south leg)
 - ADLP/Cranfield Avenue (north leg)
- **Pedestrian Plaza** – CHS should modify the current driveway approach to the ADLP/Cranfield Avenue intersection to a pedestrian only plaza connecting the school to the crosswalk on the west leg of ADLP/Cranfield Avenue mini-roundabout at the western sidewalk along ADLP.
- **Crossing Guards** – Providing crossing guards at the three new mini-roundabouts will improve pedestrian crossings by organizing them into groups for crossing efficiency and to minimize disruption to the traffic flow on the ADLP corridor.



Alameda de las Pulgas-San Carlos Avenue Corridor Study
Figure 8 – Preferred Plan





EXHIBIT 3A - Alameda de las Pulgas/San Carlos Avenue Corridor Plan



Alameda de las Pulgas-San Carlos Avenue Corridor Study
Figure 9 – Preferred Plan (School Area)

- **Median and Fence** – A raised median with a short fence (meeting current standards) and ground landscaping or hardscape should be installed between ADLP/El Verano Way and ADLP/Cranfield Avenue to act as a barrier and channelize pedestrians to crosswalk locations.

Bicycle Facilities

- **Bike Lanes** – The existing bike lane alignment on the ADLP section between Chula Vista Drive and Cranfield Avenue should be modified based on the concept plans.
- **Mini-roundabouts** – The bike lanes should be terminated in advance of the mini-roundabouts in accordance with FHWA design guidelines.
- **School Bike Access and Parking** – Both TLMS and CHS should ensure that bike access is adequate and bike parking is provided on the school grounds.
- **Class III Bike Sharrows** – The City of San Carlos is installing bike sharrow markings and white edgelines on San Carlos Avenue between Dartmouth Avenue and Beverly Drive in late 2015/early 2016.

Parking

- **On-street Parking** – Maintain existing on-street parking in the corridor except on the section between Chula Vista Drive and Cranfield Avenue. On this section, the parking alignment should be reconfigured to parallel parking on both sides of ADLP as shown on the concept plans.
- **Off-street Parking** – CHS should work towards increasing parking on the school campus or on adjacent properties. The 300 student increase will generate a need for an additional 90 parking spaces. It would be beneficial if the campus also provided an additional 100 to 150 spaces for a total of 190 to 240 new spaces to reduce the impact to adjacent neighborhood streets and slight loss of parking along the ADLP frontage.

Transit

- **Transit Stop** – The Cities should work with SamTrans to locate a bus stop at an appropriate location on the section of ADLP between Chula Vista Avenue and Cranfield Avenue.

School Access

- **New Access** – CHS and TLMS should design and install a new school access to ADLP between Chula Vista Avenue and Cranfield Avenue as shown on the concept plans. The location of these access points should allow a minimum of 250 feet of separation between the access points and Cranfield Avenue. The two access points do not need to align with one another. The new access points should be placed no closer to Cranfield Avenue than the “Separator Line” shown in Figure 8. This line would represent the centerline of the new access points.
- **Closed Access** – CHS should close the driveway access adjacent to Cranfield Avenue and replace it with a pedestrian plaza. This existing vehicle access would be routed to the new access to the north.
- **Maintain Existing Access** – TLMS should maintain the existing school access connecting to Dartmouth Avenue in addition to the new access to ADLP as discussed above. The school should allow two-way traffic at both access points and modify on-site circulation to accommodate these two points of access.

- **Staggered School Bells** – The two school districts should continue their efforts to stagger school schedules to spread the vehicle traffic demand as much as possible.

“The House” Church Property

“The House” church property (2811 San Carlos Avenue) located at the corner of San Carlos Avenue/Club Drive was sold and is in the process of obtaining approvals for redevelopment as residential units at the time of this analysis. The project would include eleven single family residential units and is proposed to have a single access onto Club Drive aligned with Exeter Avenue. The project would also include construction on the existing paved vehicle turnaround drive which currently exists opposite Bayview Drive. Parents generally use this turnaround for pick-up and drop-off of students in the area.

Phasing and Project Costs

Phasing/Construction Sequencing

Based on traffic operation considerations, input from staff and the working group, the following phasing and construction sequencing is recommended for the project.

- **Phase 1** – Cranfield Avenue to El Verano Way medians with mini-roundabouts at Chula Vista Drive and El Verano Way
- **Phase 2A** – Cranfield Avenue mini-roundabout with new CHS access
- **Phase 2B** – East side sidewalks with new TLMS access
- **Post Project** – San Carlos Avenue/Dartmouth Avenue signal timing
- **Latter Phase** – Traffic Signal at ADLP/Carlmont Drive, sidewalk improvements

The following issues should be considered in proceeding with these project components:

- School access improvements (new access points) may proceed before City street improvements. If that is the case, the installation of the median on ADLP should be included to prohibit left-turn movements into and out of the two new access points.
- Installation of the two mini-roundabouts at Cranfield Avenue and Chula Vista Drive would be beneficial to accompany the new school access, but are not absolutely essential in the short term.
- The existing CHS entrance adjacent to Cranfield Avenue cannot be closed until the new CHS access is provided.
- The new TLMS access construction should include full frontage improvements along ADLP including the new sidewalks.
- The full medians must be in place with construction of the mini-roundabouts.

Cost Estimates

The recommendations outlined in this report would be expected to cost \$2,547,000 in 2015/2016 dollars as detailed below. These costs include the new school access points between Cranfield Avenue and Chula Vista Drive, but only within the public right-of-way. Costs for road construction on the school grounds were not included in these estimates, nor are the costs of right-of-way acquisition. Cost details are included in Appendix M.

1. San Carlos Avenue-ADLP (Dartmouth to New School Access)	\$ 718,000
2. ADLP (New School Access Points)	\$ 185,000
3. ADLP (School Access Points to Chula Vista Drive)	\$ 517,000
4. ADLP/Chula Vista Drive Roundabout	\$ 159,000
5. ADLP (Chula Vista Drive to El Verano Way)	\$ 146,000
6. ADLP/El Verano Way Roundabout	\$ 223,000
7. ADLP/Carlmont Drive	\$ 599,000
Total	\$ 2,547,000

Funding

This section describes potential sources of grant funding available to plan for the bicycle and pedestrian facilities and safe routes to school components.

The latest congressional federal-aid highway funding act created the US Department of Transportation program “Moving Ahead for Progress in the Twenty-First Century” (MAP-21). MAP-21 combined previous federal “alternative modes” programs including Transportation Enhancements, Safe Routes to School, and Recreational Trails into a single source called the Transportation Alternatives Program (TAP).

More information on TAP, including eligible activities, can be found below and at: www.fhwa.dot.gov/map21/guidance/guidetap.cfm

In California, federal monies are administered through the California Department of Transportation (Caltrans).

Active Transportation Program (ATP)

In 2013, Governor Brown signed legislation creating the Active Transportation Program (ATP). This program is a consolidation of the Federal Transportation Alternatives Program (TAP), California’s Bicycle Transportation Account (BTA), and Federal and California Safe Routes to School (SRTS) programs.

The ATP program is administered by Caltrans’ Division of Local Assistance, Office of Active Transportation and Special Programs. The ATP program goals include:

- Increase the proportion of trips accomplished by biking and walking
- Increase safety and mobility for non-motorized users
- Advance the active transportation efforts of regional agencies to achieve greenhouse gas reduction goals
- Enhance public health
- Ensure that disadvantaged communities fully share in the benefits of the program
- Provide a broad spectrum of projects to benefit many types of active transportation users

As of this Plan (August 2015), the first call for projects has been awarded. The Cycle 2 statewide call for projects was due in June 1, 2015.

The California Transportation Commission ATP Guidelines are available at: www.catc.ca.gov/programs/ATP.htm

The following types of bicycle, pedestrian and Safe Routes to School projects are eligible for ATP funding:

- Infrastructure Projects: Capital improvements that will further program goals. This category typically includes planning, design, and construction.
- Non-Infrastructure Projects: Education, encouragement, enforcement, and planning activities that further program goals. The focus of this category is on pilot and start-up projects that can demonstrate funding for ongoing efforts.
- Infrastructure projects with non-infrastructure components

The minimum request for non-SRTS projects is \$250,000. There is no minimum for SRTS projects.

The local match requirement for non-SRTS projects is 11.47 percent. There is no local match requirement for projects benefiting a disadvantage community, stand-alone non-infrastructure projects and SRTS projects.

Annual funds will be approximately \$130 million for fiscal year 2015-2016. In the initial program, a minimum of \$24 million per year is available for SRTS projects, with at least \$7.2 million for non-infrastructure grants.

Study Participants and References

Study Participants

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