



Memorandum



Date: December 7, 2020
To: Matt Morley, Town of Los Gatos
From: Gary Black, Rueben Rodriguez
Subject: Blossom Hill Road Traffic Calming Feasibility Study



Hexagon Transportation Consultants, Inc. has completed a feasibility study for Blossom Hill Road in Los Gatos, California. The purpose of the feasibility study was to evaluate traffic calming options for the section of Blossom Hill Road between Camelia Terrace and Hillbrook Drive/Cherrystone Drive (see Figure 1). The goal of this feasibility study was to develop alternatives that would improve bicycle and pedestrian connectivity and circulation without adversely disrupting vehicle progression along this study segment. This feasibility study includes an analysis of the existing and proposed conditions, a collision analysis, and a level of traffic stress analysis. The results and recommendations of the feasibility study are described below.



Existing Conditions



The section of Blossom Hill Road between Camelia Terrace and Hillbrook Drive/Cherrystone Drive is approximately 0.5 miles long and is classified as an arterial in the Town's General Plan. Along this segment of Blossom Hill Road, there are driveways located along both sides that serve the adjacent residential, school, and park uses, and there is a signalized intersection at Cherry Blossom Lane/Blossom Hill Road. West of the Cherry Blossom Lane/Blossom Hill Road intersection, Blossom Hill Road is a four-lane divided roadway with two-lanes in each direction. Between Hillbrook Drive/Cherrystone Drive and Cherry Blossom Lane, Blossom Hill Road merges from two lanes to one lane in the eastbound direction, widens from one lane to two lanes in the westbound direction, and includes a two-way left-turn lane (TWLTL).



Traffic counts for the study area were collected in January 2019. The traffic counts show that this section of Blossom Hill Road carries approximately 7,000 to 8,000 daily vehicles in the eastbound and westbound directions. The AM and PM peak-hour vehicle turning movement counts for the intersection of Cherry Blossom Lane/Blossom Hill Road and the daily traffic volumes along Blossom Hill Road are shown on Figure 2.



The traffic operations of the Cherry Blossom Lane/Blossom Hill Road intersection were evaluated based on the 2000 *Highway Capacity Manual (HCM)* level of service methodology using the TRAFFIX software. This method evaluates signalized intersection operations on the basis of average control delay time for all vehicles at the intersection. Level of Service (LOS) 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 correlation between average delay and level of service is shown in Table 1. The Town's acceptable level of service standard for signalized intersections is LOS D.





Figure 1
Project Study Area

Blossom Hill Road (Los Gatos) Traffic Calming Feasibility Study

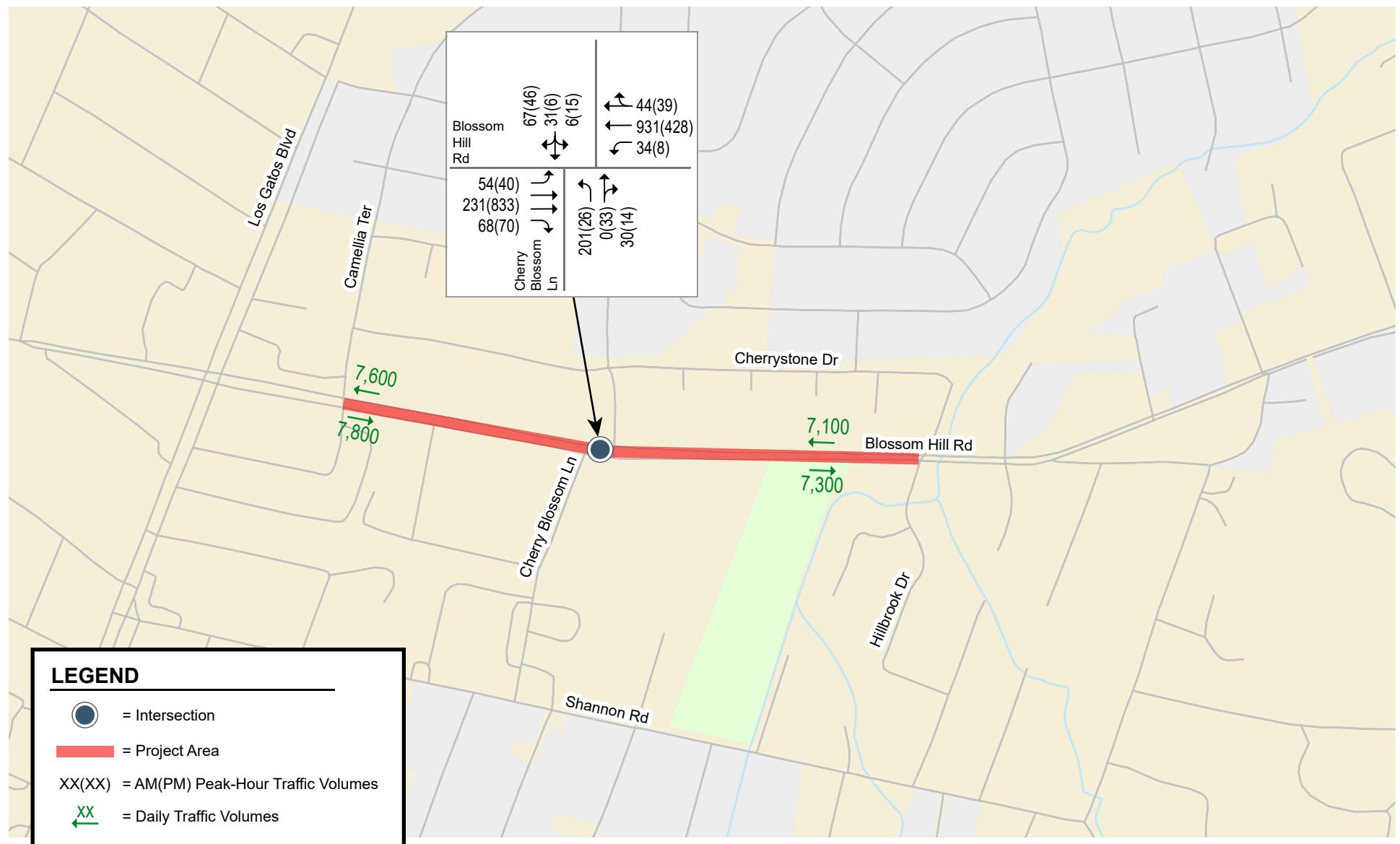


Figure 2
Existing Traffic Volumes

The results of the existing conditions level of service analysis show that with the existing AM and PM peak-hour volumes, the intersection of Cherry Blossom Lane/Blossom Hill Road operates at a LOS C during the AM peak hour and LOS B during the PM peak hour (see Table 2). Thus, the intersection of Cherry Blossom Lane/Blossom Hill Road currently operates at an acceptable level of service during the peak hours.

Table 1
Signalized Intersection Level of Service Definitions Based on Average Control Delay

| Level of Service | Description | Average Control Delay Per Vehicle (sec) |
|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| A | Operations with very low delay occurring with favorable progression and/or short cycle lengths. | Up to 10.0 |
| B | Operations with low delay occurring with good progression and/or short cycle lengths. | 10.0 to 20.0 |
| C | Operations with average delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear. | 20.1 to 35.0 |
| D | Operations with longer delays due to a combination of unfavorable progression, long cycle lengths, or high V/C ratios. Many vehicles stop and individual cycle failures are noticeable. | 35.1 to 55.0 |
| E | Operations with high delay values indicating poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences. | 55.1 to 80.0 |
| F | Operation with delays unacceptable to most drivers occurring due to oversaturation, poor progression, or very long cycle lengths. | Greater than 80.0 |
| Source: Transportation Research Board, <i>2000 Highway Capacity Manual (HCM)</i> , (Washington, D.C., 2000) p10-16. | | |

Table 2
Existing Level of Service Summary

| Intersection | Peak Hour | Existing | |
|-----------------------------------------|-----------|----------------------|-----|
| | | Avg. Delay (sec/veh) | LOS |
| Cherry Blossom Lane & Blossom Hill Road | AM | 24.4 | C |
| | PM | 16.1 | B |

From Camelia Terrace to Hillbrook Drive/Cherrystone Drive, there are bike lanes in the eastbound and westbound direction that are mostly continuous. In the eastbound direction the bike lane abruptly stops at the Cherry Blossom Lane/Blossom Hill Road intersection and then restarts just downstream of the intersection. The westbound bike lane stops approximately 80 feet east of the Cherry Blossom Lane/Blossom Hill Road intersection and restarts approximately 60 feet downstream of the intersection. Between Camelia Terrace and Cherry Blossom Lane, in the eastbound direction there is approximately a 750-foot section with a 2-foot wide striped buffer between the bike lane and adjacent vehicle travel lane. Between Camelia Terrace and Cherry Blossom Lane, in the westbound direction there is approximately a 240-foot section with a 2-foot wide striped buffer between the bike lane and adjacent vehicle travel lane. Between Camelia Terrace and Cherry Blossom Lane, there is green pavement enhancement on the east end and west end of the eastbound bike lane and on the east end of the westbound bike lane. In addition, in both directions along Blossom Hill Road, the bike lane has dashed striping at the main right-turn conflict sections. These existing bicycle facilities are depicted on Figure 3.

The section of Blossom Hill Road between Camelia Terrace and Hillbrook Drive/Cherrystone Drive has sidewalks along both sides. There is a high visibility crosswalk with a rectangular rapid flashing beacon (RRFB) on the west leg of the Hillbrook Drive/Cherrystone Drive and Blossom Hill Road intersection. There are four high visibility crosswalks at the offset intersection of Cherry Blossom Lane/Blossom Hill Road. There are marked crosswalks along the north and west legs of the Camelia Terrace/Blossom Hill Road intersection.

Existing Opportunities for Improvement

There are opportunities to improve the vehicle, bicycle, and pedestrian facilities along the segment of Blossom Hill Road between Camelia Terrace and Hillbrook Drive/Cherrystone Drive. These opportunities are described below and shown on Figure 4.

At the intersection of Cherry Blossom Lane/Blossom Hill Road, the eastbound left-turns and westbound left-turns operate under protected-permitted phasing. This means that the Blossom Hill Road left-turns can receive a green ball indication at the same time that the crosswalks along the north and south legs receive pedestrian walk symbols. This is typical for permitted left-turns and crosswalk operations. Since the Blossom Hill Road left-turns switch between permitted and protected operations, this creates some confusion for pedestrians and makes it difficult for both pedestrians and vehicles to navigate through the intersection.

The bike lanes along Blossom Hill Road are discontinuous at the intersection of Cherry Blossom Lane/Blossom Hill Road. In the westbound direction, the bike lane tapers off and in the eastbound direction the bike lane abruptly stops at the intersection. These gaps force cyclists to merge with the vehicular traffic to navigate through the intersection. In addition, at the intersection of Cherry Blossom Lane/Blossom Hill Road eastbound and westbound cyclists that desire to make a left-turn into the neighborhoods need to either cross two lanes of vehicle traffic to position themselves into the left-turn vehicle turn pocket or complete their movement using the pedestrian crosswalks.

The eastbound right-turn traffic at the intersection of Cherry Blossom Lane/Blossom Hill Road has a right-turn channel. This right-turn channel enables turning vehicles to complete their movement at higher speeds, which improves vehicle progression but reduces pedestrian and bicycle comfort and circulation.

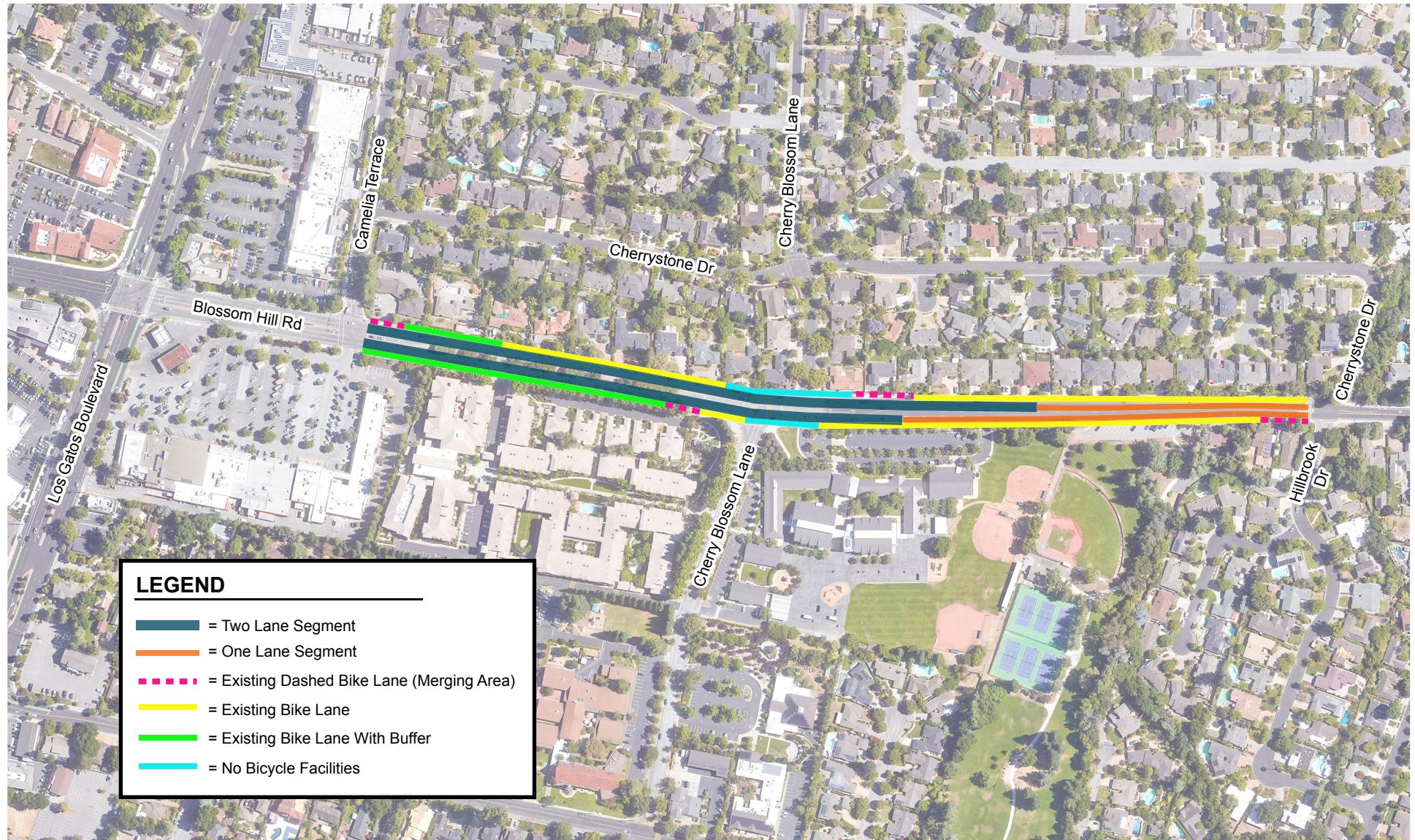


Figure 3
Existing Bicycle Facilities

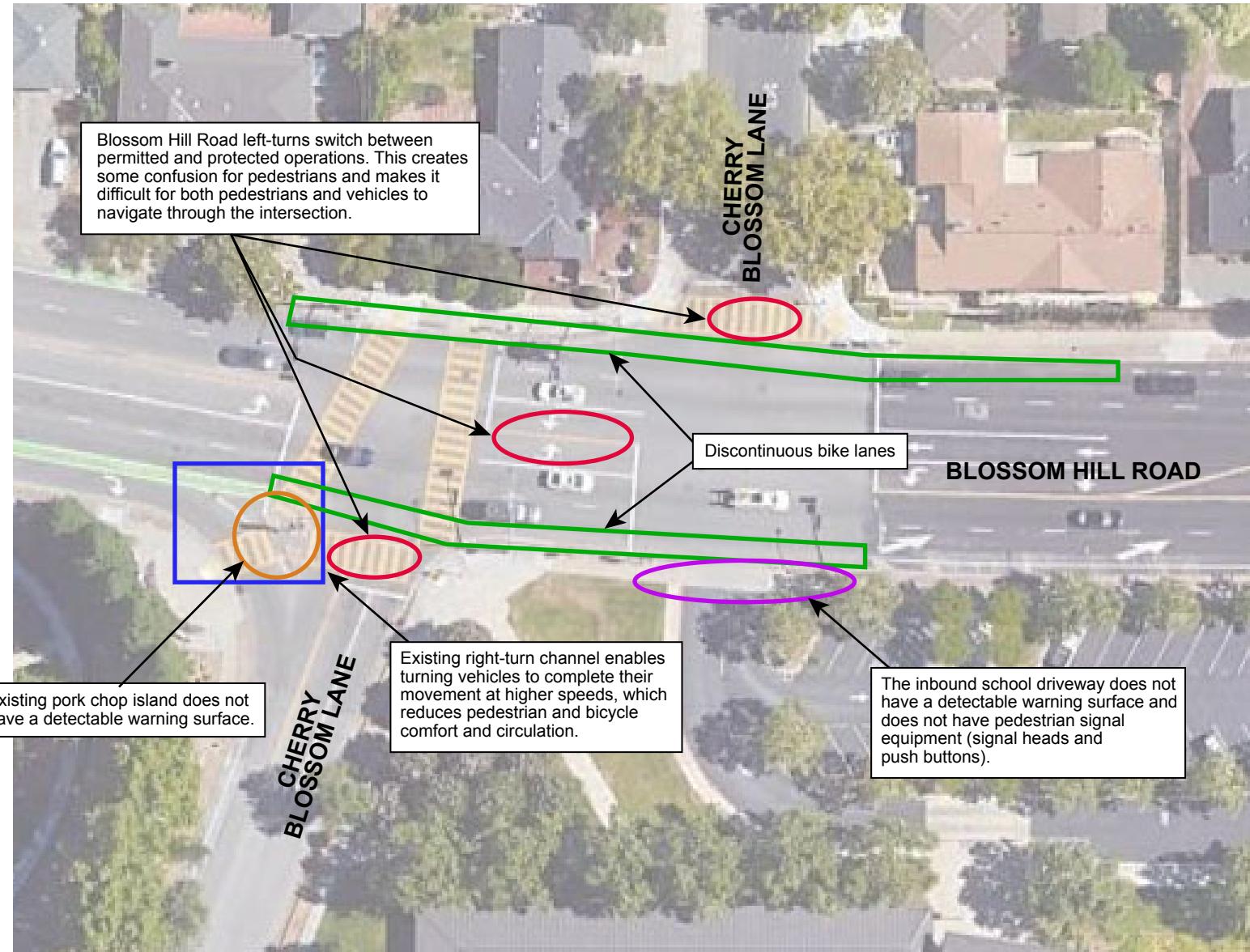


Figure 4
Opportunities for Improvement

Per the Americans with Disabilities Act (ADA) and California Department of Transportation (Caltrans) requirements, a detectable warning surface, e.g. truncated domes, is typically included at all pedestrian-vehicle conflict points. In the study area, truncated domes are provided at most of the pedestrian-vehicle conflict points except on the pork chop island on the southwest corner of the Cherry Blossom Lane/Blossom Hill Road intersection and at the inbound driveway to the school in the southeast corner of the Cherry Blossom Lane/Blossom Hill Road intersection.

Typically for pedestrian-vehicle conflict points like the inbound school driveway, there are pedestrian signal heads and pedestrian push buttons. However, there is not any pedestrian signal equipment at this conflict point.

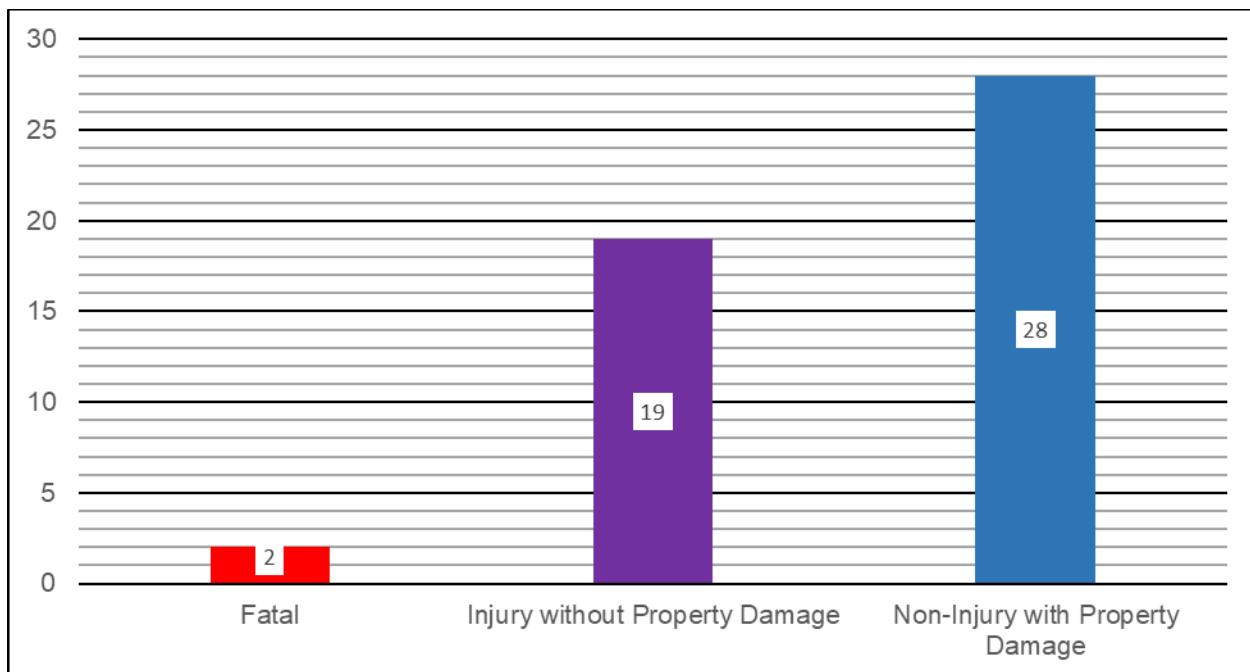
Collision Analysis

The collision analysis is based on data provided by the Town of Los Gatos. A review of the Town of Los Gatos collision data shows that along the section of Blossom Hill Road between Camelia Terrace and Hillbrook Drive/Cherrystone Drive there were 49 collisions between January 1, 2010 and December 31, 2019. The number of collisions by severity and by primary collision factor violation are shown on Figure 5 and Figure 6, respectively. Based on an average daily traffic (ADT) of 14,900 vehicles, this 0.5-mile segment of Blossom Hill Road has an accident rate of 1.802 accidents per million vehicle miles (MVM). Along the study segments, 18 of the 49 collisions occurred at the intersection of Blossom Hill Road/Cherry Blossom Lane. This equates to an intersection accident rate of 0.331 accidents per million vehicles (MV) entering the intersection. Two collisions between Cherry Blossom Lane and Hillbrook Drive/Cherrystone Drive resulted in a fatality. This equates to a fatality rate of 0.074 fatality per MVM for this segment of Blossom Hill Road.

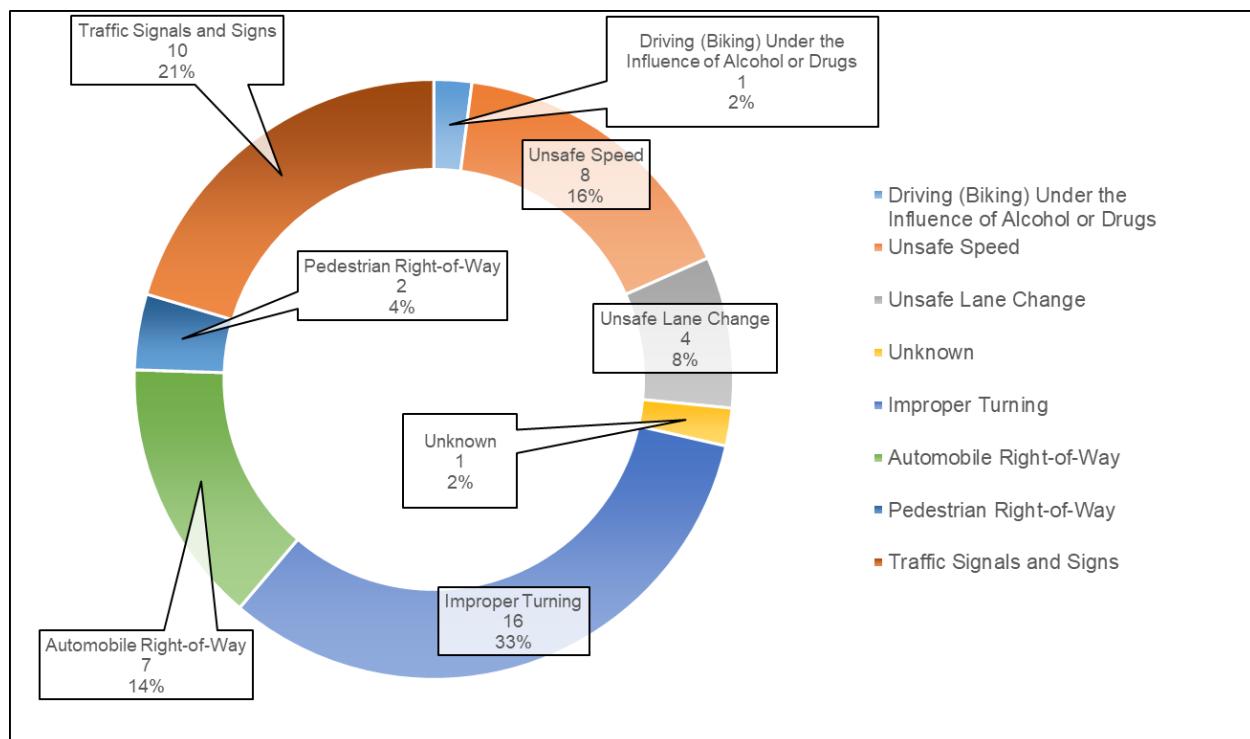
The California Department of Transportation (Caltrans) publishes collision data for the state of California. The published collision data provides average accident rates for roadway segments, intersections, and ramps. Based on the 2017 Caltrans collision data (the latest report available), the average accident rates for a 4-lane divided and 4-lane undivided suburban road with speeds less than 55 mph are 1.134 accidents/MVM and 0.93 accidents/MVM, respectively. In addition, the 2017 Caltrans collision data shows that the average accident rate for a 2-lane undivided suburban road with speeds less than 45 mph is 1.60 accidents/MVM. Based on the 2017 Caltrans collision data, the average accident rate for suburban signals that are offset, multi-legged, or four-legged is 0.420 accidents per MV entering the intersection.

The collision data for this study segment and the corresponding 2017 Caltrans collision data are summarized in Table 3. For the ten-year period of 2010-2019, the section of Blossom Hill Road between Camelia Terrace and Hillbrook Drive/Cherrystone Drive had collision rates higher than the comparable average collision rates published in the 2017 Caltrans collision data. However, the intersection of Blossom Hill Road/Cherry Blossom Lane had a lower collision rate than the comparable average intersection rate published in the 2017 Caltrans collision data during this period.

Further analysis shows that 4 of the 49 collisions along the study segment involved a vehicle and bicyclists, and 2 of the 48 collisions along the study segment involved a vehicle and pedestrian. Thus, approximately 12% of collisions involved a pedestrian or bicyclist. Also, note that 8 of the 49 collisions, or 16% of the collisions, listed unsafe speed as the primary collision factor (see Figure 6).

**Figure 5 Number of Collisions by Severity**

(Source: Town of Los Gatos Collision Data, January 1, 2010 through December 31, 2019)

**Figure 6 Number of Collisions by Primary Collision Factor Violation**

(Source: Town of Los Gatos Collision Data, January 1, 2010 through December 31, 2019)

Table 3
Collision Data Summary

| Category | Units | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| Roadway Data | | |
| Length of Segment | 0.5 | miles |
| Daily Traffic | 14,900 | vehicles |
| Study Period | 10 | years |
| Total Number of Collisions ¹ | 49 | |
| Number of Intersection Collisions ² | 18 | |
| Number of Fatality Incidents | 2 | |
| Study Segment Avg. Rate | | |
| Caltrans 2017 Collision Data | 1.802 | accidents/MVM |
| 4-lane divided roadway ^{3,4} | 1.134 | accidents/MVM |
| 4-lane undivided roadway ^{3,4} | 0.93 | accidents/MVM |
| 2-lane undivided roadway ^{3,5} | 1.60 | accidents/MVM |
| Study Intersection Avg. Rate | | |
| Caltrans Intersection Avg. Rate ^{3,6} | 0.331 | accidents/MV |
| 0.42 | | accidents/MV |
| Study Segment Fatality Rate | | |
| | 0.074 | accidents/MVM |
| <u>Notes:</u> | | |
| accidents/MVM = accidents per million vehicle miles | | |
| accidents/MV = accidents per million vehicle entering the intersection | | |
| 1 Total number of collisions includes all collisions along the study segment (injury, non-injury, fatal, non fatal, etc.). Collision data was provided by the Town of Los Gatos. | | |
| 2 Number of intersection collisions includes only the collisions that occurred at the intersection of Cherry Blossom Lane/Blossom Hill Road. | | |
| 3 Based on the California Department of Transportation (Caltrans) published collision data for 2017 (the latest report available). | | |
| 4 Based on a facility that is in a suburban area with a speed less than or equal to 55 miles per hour. | | |
| 5 Based on a conventional 2 lane or less facility in a suburban area with a speed less than or equal to 45 miles per hour. | | |
| 6 Based on a signal in a suburban area that is four-legged, multi-legged, or offset. | | |

Speed Study

Traffic speed counts were collected on Blossom Hill Road east of Camellia Terrace and west of Hillbrook Drive/Cherrystone Drive. The counts show that in the eastbound and westbound direction near Camellia Terrace the 85th percentile speeds were 36 miles per hour (mph) and 34 mph, respectively. The counts show that in the eastbound and westbound direction near Hillbrook Drive/Cherrystone Drive the 85th percentile speeds were 38 mph and 40 mph, respectively. The segment of Blossom Hill Road between Camellia Terrace and Hillbrook Drive/Cherrystone Drive is current signed for 35 mph. Note that there is an existing electronic speed feedback sign approximately 400' west of the Cherry Blossom Lane/Blossom Hill Road intersection facing eastbound traffic. The electronic feedback sign is also accompanied by a school zone 25 mph speed limit sign.

Traffic speed counts were also collected for Cherry Blossom Lane south of the Cherry Blossom Lane/Blossom Hill Road intersection. The counts show that the northbound and southbound 85th percentile speeds were 29 mph. Cherry Blossom Lane from Shannon Road to Blossom Hill Road is signed for 25 mph.

A posted speed limit of 35 mph for Blossom Hill Road, is typical for an arterial roadway such as the study segment. The collision analysis showed that there were 8 collisions over a 10-year period along this study segment that listed unsafe speed as the primary factor. This equates to less than one speed related collision per year. Based on the speed study and collision analysis, there is not evidence that would justify adjusting the posted speed limit of Blossom Hill Road along the study segment.

Evaluation of Alternatives

The existing conditions and the traffic calming alternatives were evaluated for level of service, queuing, bicycle level of traffic stress, and effects on vehicle, bicycle, and pedestrian traffic.

Traffic Calming Alternatives

This study evaluated traffic calming options for the section of Blossom Hill Road between Camellia Terrace and Hillbrook Drive/Cherrystone Drive. The two traffic calming alternatives evaluated are described below.

Alternative 1: Under Alternative 1, the eastbound right-turn lane at the intersection of Cherry Blossom Lane/Blossom Hill Road would be removed, and the eastbound through lanes would be converted from two through lanes to one through lane and one shared through-right lane.

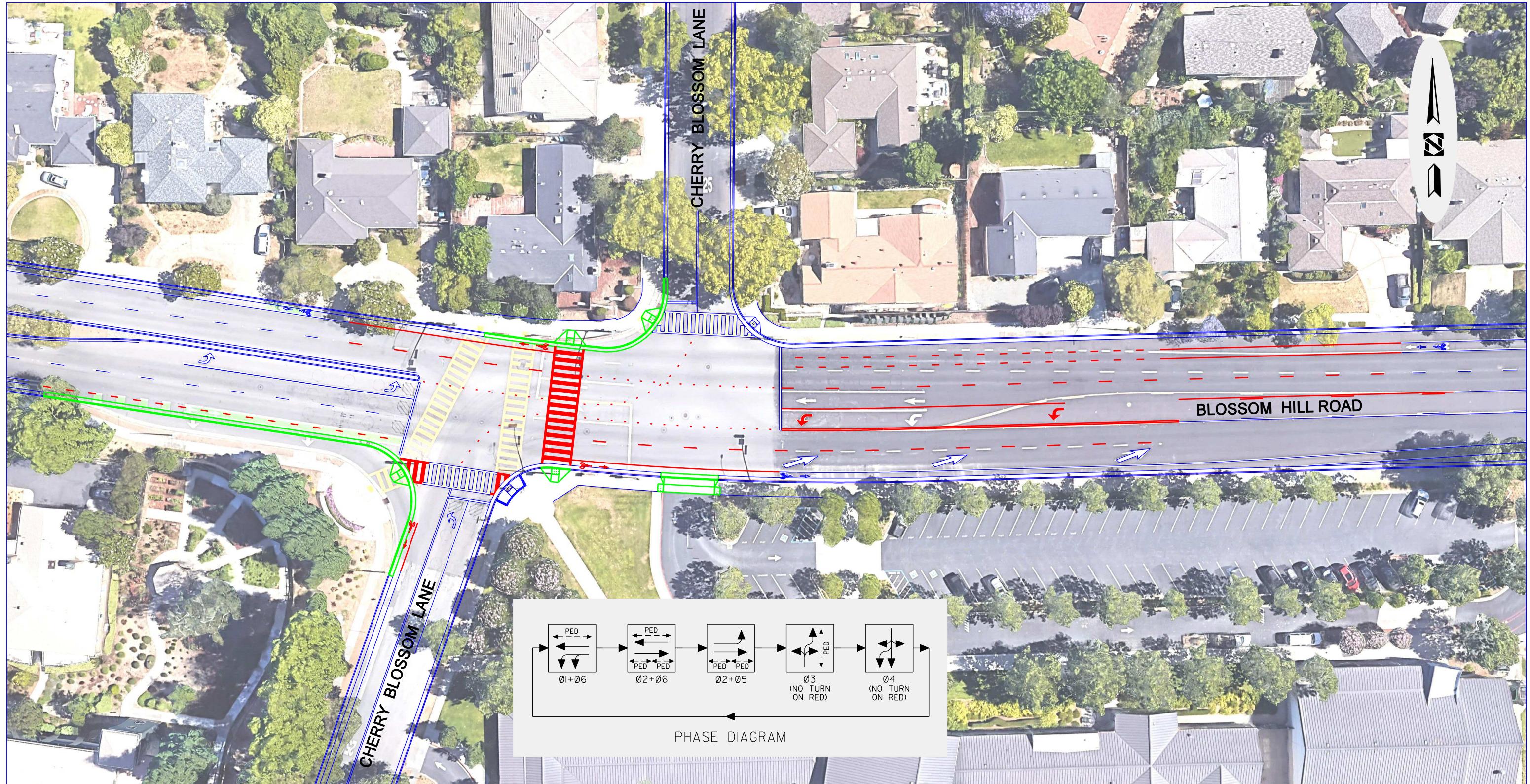
Alternative 2: Under Alternative 2, the number of vehicle lanes would be reduced to one eastbound lane and one westbound lane within the project limits. In addition, at the intersection of Cherry Blossom Lane/Blossom Hill Road the eastbound right-turn lane would be removed.

In order to improve vehicle, bicycle, and pedestrian circulation and connectivity, both alternative 1 and 2 would reconfigure the signal at Cherry Blossom Lane/Blossom Hill Road. Both alternatives would remove the pork chop island in the southwest corner of the intersection, remove the eastbound right-turn lane, and reduce the south leg crosswalk walking distance by installing a smaller radius curb return. Both alternatives would restripe the intersection and provide eastbound

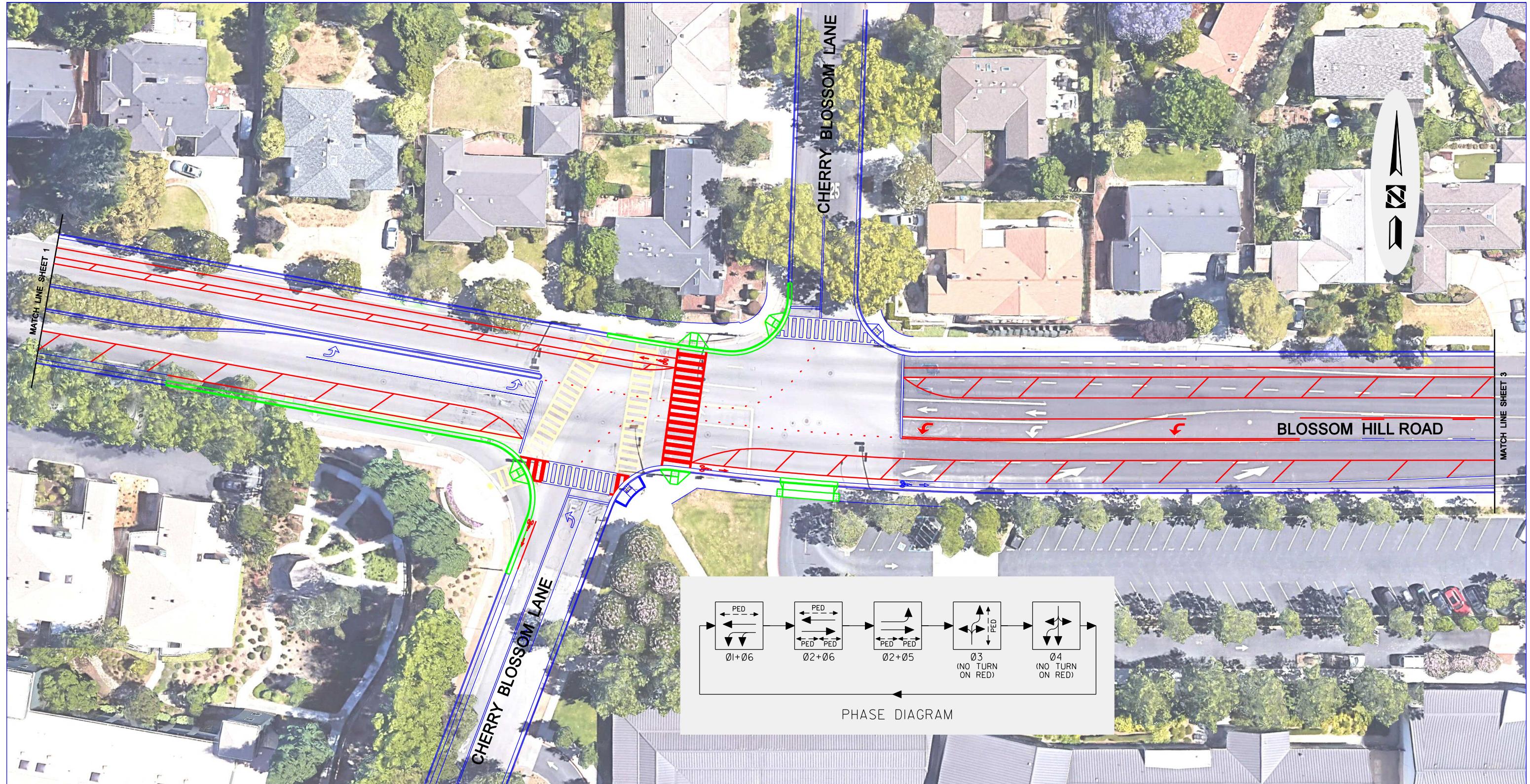
and westbound bike lanes through the intersection and would remove the western most crosswalk that crosses Blossom Hill Road. Also, both alternatives would reconfigure the northwest corner of the intersection to provide a smaller radius curb return, which would increase the available sidewalk and pedestrian space. In addition, both alternatives would improve the pedestrian-vehicle conflict point at the inbound school driveway by adding truncated domes to the pedestrian approaches and adding pedestrian signal equipment (signal heads and push buttons). Under each alternative, some modifications to the signal equipment, timing, and phasing, would be needed at the intersection of Cherry Blossom Lane/Blossom Hill Road in order to accommodate the improvements.

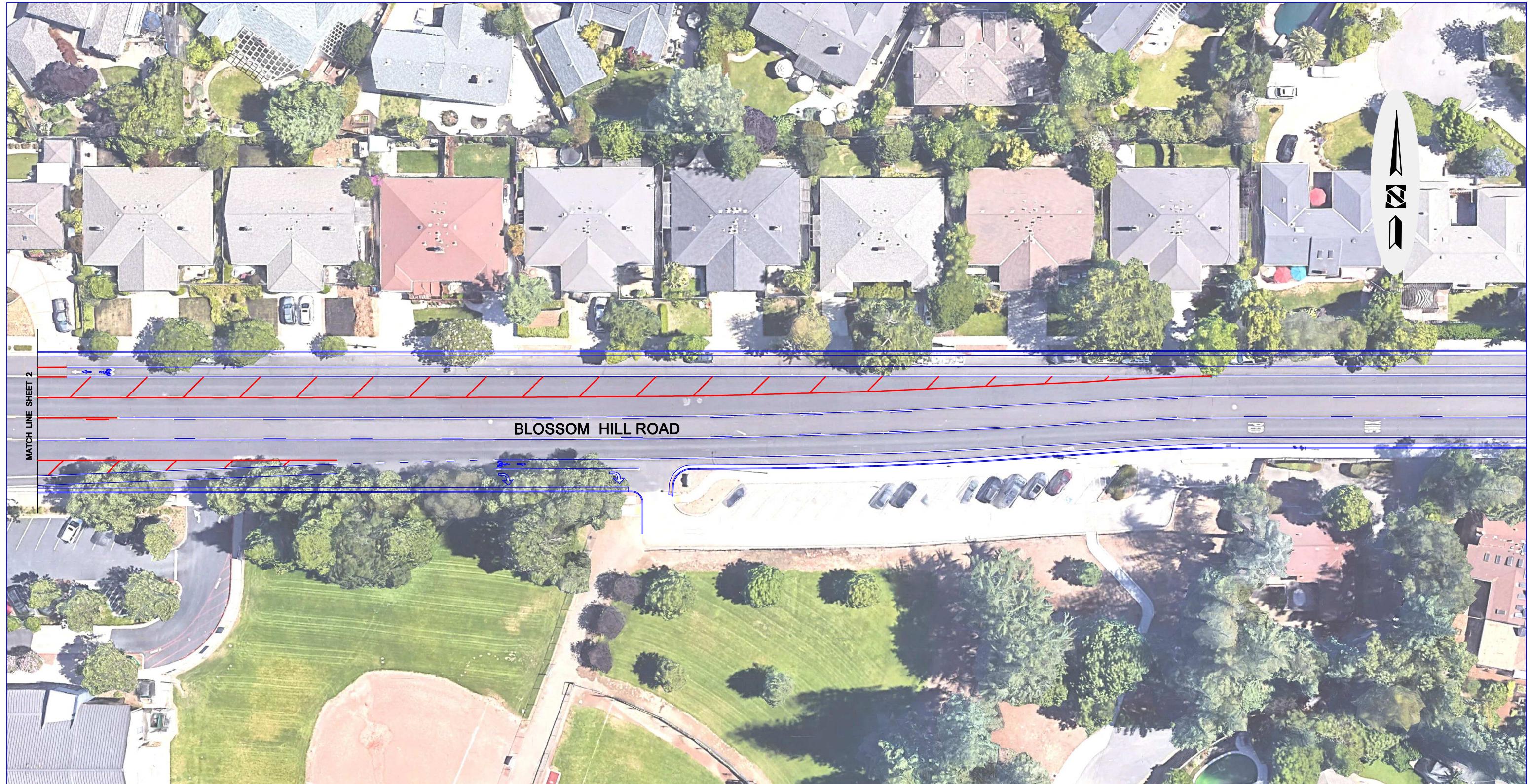
For alternative 1, the improvements would be focused on the Cherry Blossom Lane/Blossom Hill Road intersection. Alternative 1 would modify the intersection by removing the eastbound right-turn lane and converting the eastbound through lanes from two through lanes to one through lane and one shared through-right lane. A conceptual plan of the alternative 1 improvements is shown on Figure 7.

For the alternative 2, the space from the removed through lanes would be used to create a buffer between the vehicle lanes and the bicycle lanes along this segment of Blossom Hill Road. The bicycle buffer could be formed with a mix of striping, raised delineators, and raised curb. In addition, the removed lanes could be repurposed as on-street parking. The bicycle buffer would need to allow maneuvering in and out of the driveways that run along Blossom Hill Road. Alternative 2 would maintain the same lane configurations at the Camilla Terrace and Blossom Hill Road intersection and the Hillbrook Drive/Cherrystone Drive and Blossom Hill Road intersection. A conceptual plan of the eastbound and westbound lane reductions along Blossom Hill Road is shown on Figure 8.









Intersection of Cherry Blossom Lane/Blossom Hill Road

Both alternative 1 and 2 include improvements at the intersection of Cherry Blossom Lane/Blossom Hill Road. The reason for this is that this intersection serves as a pinch point for circulation along Blossom Hill Road. The existing phasing creates some confusion for pedestrians and makes it difficult for both pedestrians and vehicles to navigate through the intersection. The existing discontinuous bike lanes make it difficult for bicycles to traverse this route. In order to improve circulation and for a traffic calming alternative to be successful, this intersection would need to be improved.

Eastbound Right-Turn Lane

Part of the improvements of alternative 1 and 2 would be to remove the eastbound right-turn lane and the associated pork chop island. This movement experiences low volumes during the AM and PM peak hours. During the AM and PM peak hours, the eastbound right-turn traffic volume is approximately 70 vehicles per hour and removing this right-turn lane would not have an adverse effect on eastbound through and right-turn traffic circulation. Removing this lane would have minimal effect on vehicular circulation, while greatly improving bicycle and pedestrian comfort and circulation. Removing the eastbound right-turn lane would reduce the speed of right-turning vehicles and would remove the weaving area between bicycles and vehicles. This would enhance the bicycle facilities by allowing the bike lane to continue straight through the intersection without having to move to the left of the right-turn lane. For pedestrians, this would remove the pedestrian-vehicle conflict point in the right-turn channel and it would reduce the crossing distance for the south leg.

Other Alternatives

It is possible to have a traffic calming alternative that only reduces the vehicle lanes in one direction along Blossom Hill Road. This would be similar to alternative 2, just with improvements in one direction, either the eastbound direction or the westbound direction. However, alternative 2, was analyzed, which reduces the travel lanes in both directions, as a worst-case scenario for vehicular traffic.

Vehicle Speeds

Alternative 1 is expected to have a negligible effect on eastbound and westbound 85th percentile vehicle speeds along Blossom Hill Road. Under alternative 2, because of the road diet, it is possible that the 85th percentile vehicle speeds may be reduced.

Level of Service Analysis

The intersection level of service of Cherry Blossom Lane/Blossom Hill Road was evaluated with the improvements of each of the two alternatives. The existing traffic volumes were used for each alternative and the results were compared to the level of service of the existing conditions. The level of service shows that during the AM and PM peak hours, the intersection of Cherry Blossom Lane/Blossom Hill Road would operate at a LOS D or better under each alternative (see Table 4).

Table 4
Traffic Calming Alternatives Level of Service Summary

| Intersection | Peak Hour | Existing | | Alternative 1 | | Alternative 2 | |
|-----------------------------------------|-----------|----------------------|-----|----------------------|-----|----------------------|-----|
| | | Avg. Delay (sec/veh) | LOS | Avg. Delay (sec/veh) | LOS | Avg. Delay (sec/veh) | LOS |
| Cherry Blossom Lane & Blossom Hill Road | AM | 24.4 | C | 24.6 | C | 37.3 | D |
| | PM | 16.1 | B | 16.2 | B | 21.3 | C |

The level of service shown in Table 4 is based on the average control delay time for all vehicles at the intersection. To further evaluate the effect each alternative would have on the intersection of Cherry Blossom Lane/Blossom Hill Road, Table 5 shows the average delay for each movement under each alternative. In general, the level of service analysis shows that the intersection average delay and average delay for each movement remains relatively similar for each peak hour under each analysis scenario. However, for the northbound left-turn movement the average delay under alternative 2 would be higher than under existing and alternative 1 conditions: 84.0 versus 36.6 seconds per vehicle, respectively.

Table 5
Level of Service Summary for Each Movement

| Movement | Peak Hour | Existing | | Alternative 1 | | Alternative 2 | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------------------|------|----------------------|------|----------------------|------|---|
| | | Avg. Delay (sec/veh) | LOS | Avg. Delay (sec/veh) | LOS | Avg. Delay (sec/veh) | LOS | |
| <u>Eastbound</u> | | | | | | | | |
| Blossom Hill Road | Eastbound Left | AM | 47.1 | D | 47.1 | D | 47.1 | D |
| | | PM | 29.6 | C | 29.5 | C | 37.7 | D |
| | Eastbound Through-Right ¹ | AM | 24.1 | C | 24.7 | C | 17.7 | B |
| | | PM | 10.1 | B | 10.2 | B | 20.4 | C |
| <u>Westbound</u> | | | | | | | | |
| Cherry Blossom Lane | Westbound Left | AM | 30.4 | C | 30.4 | C | 33.2 | C |
| | | PM | 43.7 | D | 43.7 | D | 43.7 | D |
| | Westbound Through-Right | AM | 18.2 | B | 18.2 | B | 32.0 | C |
| | | PM | 18.4 | B | 18.2 | B | 15.0 | B |
| <u>Northbound</u> | | | | | | | | |
| | Northbound Left | AM | 36.6 | D | 36.6 | D | 84.0 | F |
| | | PM | 41.5 | D | 41.5 | D | 41.5 | D |
| | Northbound Through-Right | AM | 31.6 | C | 31.6 | C | 39.3 | D |
| | | PM | 42.4 | D | 42.4 | D | 42.4 | D |
| <u>Southbound</u> | | | | | | | | |
| | Southbound Left-Through-Right | AM | 45.2 | D | 45.2 | D | 48.5 | D |
| | | PM | 42.8 | D | 43.5 | D | 43.5 | D |
| <u>Notes:</u> | | | | | | | | |
| 1 Under existing conditions, the eastbound through-right average delay depicts the average delay for the eastbound through movement only, since there is a dedicated eastbound right-turn lane. Under alternative 1 and alternative 2 conditions, the eastbound through-right average delay depicts the average delay for the eastbound through and right vehicles since the dedicated eastbound right-turn lane would be removed. | | | | | | | | |

Queuing Analysis

The existing conditions and the traffic calming alternatives were evaluated for vehicle queuing at the Cherry Blossom Lane/Blossom Hill Road intersection. For the eastbound and westbound through movements at the Cherry Blossom Lane/Blossom Hill Road intersection, the estimated maximum vehicle queues were compared to the existing or planned storage capacity. The queuing analysis is presented to compare the queuing lengths between the different traffic calming alternatives and to evaluate the effects the traffic calming alternatives would have on vehicular traffic. 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 queuing 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, 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."

The queuing analysis is based on vehicle queues for the eastbound and westbound through queues at the Cherry Blossom Lane/Blossom Hill Road intersection. For the eastbound and westbound through movements at the Cherry Blossom Lane/Blossom Hill Road intersection, the estimated queue length was compared to the available storage space between Cherry Blossom Lane and upstream intersections at Camilla Terrace and Hillbrook Drive/Cherrystone Drive, respectively.

Table 6 shows that under both scenarios the eastbound and westbound queues would not spillback to the upstream intersections. Thus, there is sufficient storage space for the existing traffic volumes, with and without the traffic calming alternatives.

There are residential driveways located along Blossom Hill Road, and queues from the Cherry Blossom Lane/Blossom Hill Road may occasionally block some of these driveways. However, when this happens, vehicles going to/from the residential driveways can wait for the queues to clear. The queues would clear with each signal cycle, i.e., there would be no standing queues. In addition, note that the queuing analysis represents a worst-case analysis during the peak hours. The eastbound and westbound queues would be shorter outside of the peak hours.

Table 6
Queuing Analysis Summary

| Movement: Peak Hour: | Cherry Blossom Lane/Blossom Hill Road | | | |
|----------------------------------------------------------------|---------------------------------------|-----|------|------|
| | EBT | | WBT | |
| AM | PM | AM | PM | |
| <i>Existing</i> | | | | |
| Cycle Length ¹ (sec) | 100 | 100 | 100 | 100 |
| Volume (vphpl) | 116 | 417 | 488 | 234 |
| 95th %. Queue (veh/ln) | 6 | 17 | 20 | 11 |
| 95th %. Queue ² (ft/ln) | 150 | 425 | 500 | 275 |
| Storage (ft/ln) | 965 | 965 | 965 | 965 |
| Adequate (Y/N) | Y | Y | Y | Y |
| <i>Alternative 1</i> | | | | |
| Cycle Length ¹ (sec) | 100 | 100 | 100 | 100 |
| Volume (vphpl) | 150 | 452 | 488 | 234 |
| 95th %. Queue (veh/ln) | 8 | 19 | 20 | 11 |
| 95th %. Queue ² (ft/ln) | 200 | 475 | 500 | 275 |
| Storage (ft/ln) | 965 | 965 | 965 | 965 |
| Adequate (Y/N) | Y | Y | Y | Y |
| <i>Alternative 2</i> | | | | |
| Cycle/Delay ¹ (sec) | 100 | 100 | 100 | 100 |
| Volume (vph) | 299 | 903 | 975 | 467 |
| 95th %. Queue (veh) | 13 | 34 | 36 | 19 |
| 95th %. Queue (ft.) | 325 | 850 | 900 | 475 |
| Storage | 965 | 965 | 1200 | 1200 |
| Adequate (Y/N) | Y | Y | Y | Y |
| <u>Notes:</u> | | | | |
| ¹ Vehicle queue calculations based on cycle length. | | | | |
| ² Assumes 25 feet per vehicle queued. | | | | |

Bicycle Level of Traffic Stress Analysis

The bicycle facilities along Blossom Hill Road from Camelia Terrace to Hillbrook Drive/Cherrystone Drive and at the intersection of Cherry Blossom Lane/Blossom Hill Road were evaluated using the level of traffic stress criteria. The Mineta Transportation Institute's *Low-Stress Bicycling and Network Connectivity* (May 2012) report (MTI report) defines level of traffic stress (LTS) as a qualitative description for classifying bicycle facilities (segments and intersections) by the degree of traffic stress they impose on the cyclists. The LTS methodology ranges from LTS 1, which is a facility that presents little stress and is suitable for almost all cyclists, to LTS 4, which is a facility with high stress that is only suitable for cyclists defined as "strong and fearless." The level of traffic stress classifications are described further in Table 7.

Table 7
Level of Traffic Stress Definitions

| Level of Traffic Stress (LTS) | Description |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LTS 1 | Presenting little traffic stress and demanding little attention from cyclists. Suitable for almost all cyclists, including children trained to cross intersections. |
| LTS 2 | Presenting little traffic stress and therefore suitable to most adult cyclists but demanding more attention than might be expected from children. |
| LTS 3 | More traffic stress than LTS 2, yet markedly less than the stress of integrating with multilane traffic, and therefore welcome to many people currently riding bikes in American cities. |
| LTS 4 | A level of stress beyond LTS 3. Most stressful facilities that are suitable for cyclists described as "strong and fearless." |

Source: Mineta Transportation Institute's *Low-Stress Bicycling and Network Connectivity* (May 2012) (p. 13-14)

The MTI report outlines criteria for determining LTS for a variety of bicycle facilities. The MTI report includes LTS criteria for bicycle lanes (class II facilities), bicycle routes (class III facilities), and bicycle facilities at intersection approaches. The criteria for determining LTS includes factors such as presence of on-street parking, speed of adjacent vehicle traffic, street width, and right-turning vehicle treatment.

Under existing conditions, the bicycle facilities along Blossom Hill Road from Camelia Terrace and Hillbrook Drive/Cherrystone Drive fall into the LTS 3 and LTS 4 categories (see Figure 9). Although the bike lanes in the eastbound and westbound directions have limited adjacent parking and some portions with a bicycle buffer, due to the speed of the adjacent vehicle lanes, the bicycle lane segments fall into the LTS 3 category. At the intersection of Cherry Blossom Lane/Blossom Hill Road, at the eastbound approach to Hillbrook Drive/Cherrystone Drive, and at the westbound approach to Camelia Terrace, the bicycle facilities fall into the LTS 4 category. The bicycle facilities at each intersection along the study segment are within the LTS 4 category due to the limited separation between bicycle and vehicle traffic, right-turn traffic treatment, and vehicular speeds.

The level of traffic stress category for the bicycle facilities along the study segment is governed by the speed of vehicles traveling along Blossom Hill Road and by the intersection of Cherry Blossom Lane/Blossom Hill Road. Thus, if alternative 1 were implemented, the Blossom Hill Road bike lanes would still be categorized as LTS 3. In order to improve the bike lane facilities to a LTS 2 or better, traffic calming measures to reduce the vehicle speeds along Blossom Hill Road would need to be implemented. Since Blossom Hill Road is an arterial, it is not recommended that speed reducing measures, e.g. speed humps, be implemented. It is reasonable to assume that reducing the number of travel lanes could reduce the vehicle speeds, but it is unlikely that the vehicle speeds would be reduced enough to improve the bicycle facilities to LTS 2 or better. For the bicycle facilities at the intersection of Cherry Blossom Lane/Blossom Hill Road, under each alternative the LTS category is dependent on the right-turn treatment. In the eastbound and westbound directions, both alternatives would have a shared through-right lane adjacent to the bike lane and the LTS methodology does not have specific criteria for evaluating this configuration. However, under both alternatives the bike lanes would be LTS 3 before and after the intersection, and the bike lanes would be configured to continue through the intersection, therefore, the bike lanes at the intersection of Cherry Blossom Road/Blossom Hill Road can be classified as an LTS 3 category under each alternative.

For bicycle traffic, the main deficiencies are at the intersection of Cherry Blossom Lane/Blossom Hill Road. Under each alternative, this intersection would be restriped to improve bicycle circulation. Alternatives 1 and 2 would enhance bicycle circulation by providing eastbound and westbound bike lanes through the intersection and by removing the pork chop island in the southwest corner of the intersection. Removing the pork chop island would improve bicycle circulation by removing the eastbound right-turn conflict area where bicycles have to weave around right-turning vehicles. Alternative 2 would add a bicycle buffer along this Blossom Hill Road study segment. This bicycle buffer would increase rider comfort and would increase the lateral separation between bicycles and vehicles. The intersection improvements would improve the bicycle facilities at the intersection of Cherry Blossom Lane/Blossom Hill Road from a LTS 4 under existing conditions to a LTS 3 under both alternatives. Both alternatives would improve the overall bicycle facilities by removing the discontinuity at the Cherry Blossom Lane/Blossom Hill Road intersection.

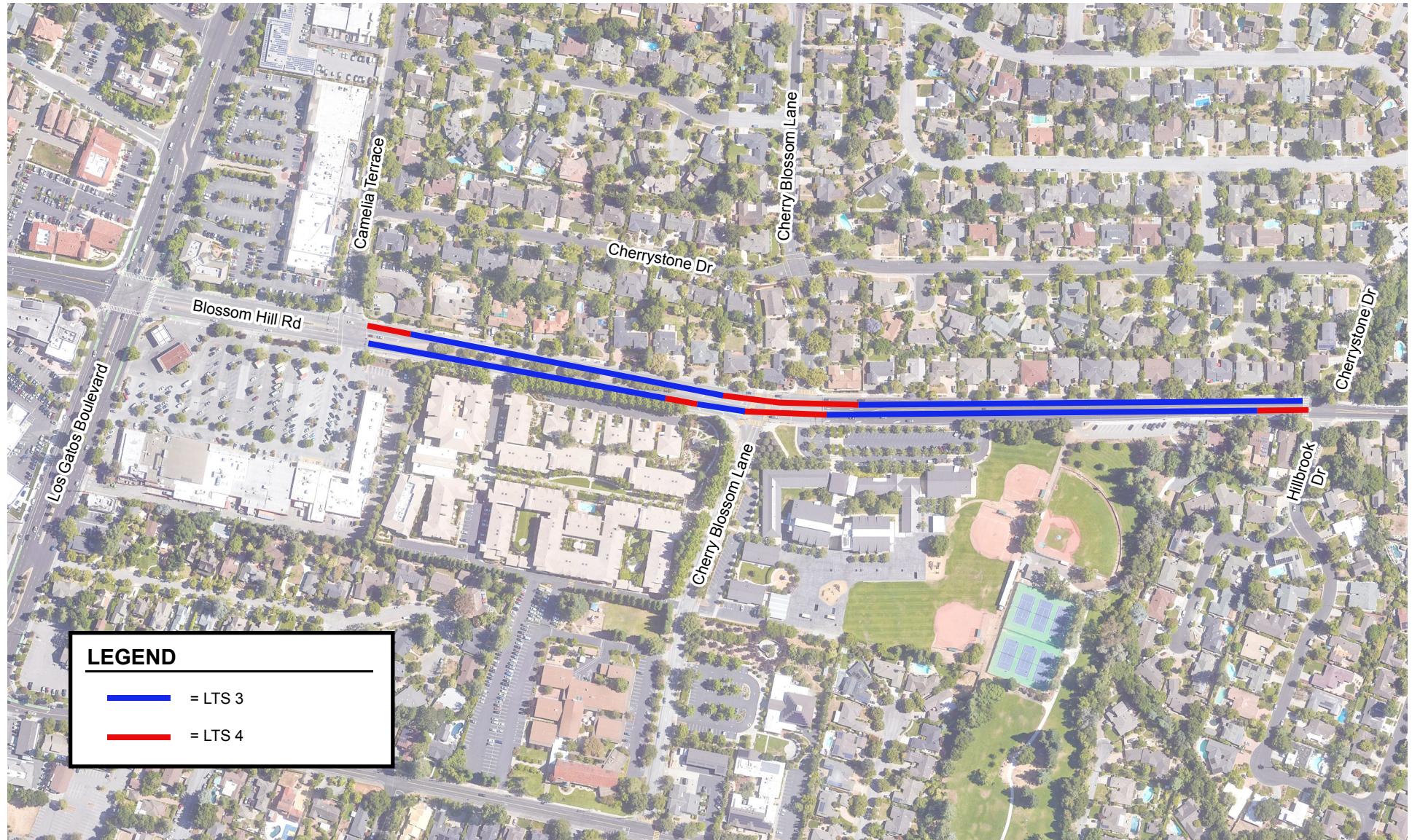


Figure 9
Existing Level of Traffic Stress (LTS) Categories

Effects on Pedestrians

The study area generally has good pedestrian connectivity. The existing pedestrian facilities include sidewalks, crosswalks, a flashing beacon crosswalk, curb ramps, and pedestrian signals. Under existing conditions, the pork chop island and the inbound school driveway at the Cherry Blossom Lane/Blossom Hill Road lack detectable warning surfaces at the pedestrian-vehicle conflict points. Each alternative would provide some pedestrian improvements at the intersection of Cherry Blossom Lane/Blossom Hill Road, including improving the warning surfaces at the pedestrian-vehicle conflict points.

Both alternatives would improve pedestrian circulation at the intersection of Cherry Blossom Lane/Blossom Hill Road by removing the eastbound right turn lane. This would remove a conflict point with uncontrolled traffic and would shorten the crossing distance. This represents a substantial improvement in pedestrian comfort and safety. In addition, both alternatives would reconfigure the northwest corner of the intersection to provide a smaller radius curb return. This would increase the available sidewalk and pedestrian space, which would be beneficial for the pedestrian school traffic. These improvements would remove this right-turning vehicle and pedestrian conflict area, improve pedestrian comfort and circulation, increase pedestrian storage area, and reduce the south leg crossing time.

In addition, both alternatives would improve the pedestrian-vehicle conflict point at the inbound school driveway at the southeast corner of the Cherry Blossom Lane/Blossom Hill Road intersection. Both alternatives would install truncated domes on the pedestrian approaches to this driveway. In addition, it is recommended that pedestrian signal equipment (signal heads and push buttons) be included as part of the improvements. This would require some modification to the existing signal system, but it would improve circulation by removing the phasing conflicts between the vehicles and pedestrians.

Conclusions

The purpose of the feasibility study was to evaluate traffic calming options for the section of Blossom Hill Road between Camelia Terrace and Hillbrook Drive/Cherrystone Drive. The goal of this feasibility study was to develop alternatives that would improve bicycle and pedestrian connectivity and circulation without adversely disrupting vehicle progression along this study segment. The analysis of existing conditions showed that the main deficiencies in the study area are at the intersection of Cherry Blossom Lane/Blossom Hill Road. This study analyzed vehicle, bicycle, and pedestrian circulation. Based on the analysis, both alternative 1 and 2 are viable options. Both alternatives would improve the intersection of Cherry Blossom Lane/Blossom Hill Road by:

- restriping the intersection,
- removing the eastbound right-turn lane,
- removing the pork chop island in the southwest corner,
- removing the eastbound and westbound bicycle lane discontinuities,
- increasing the pedestrian storage area at the northwest corner,
- improving the pedestrian facilities at the inbound school driveway,
- and reducing the south leg crosswalk crossing distance.

Under alternative 1 and 2, the intersection of Cherry Blossom Lane/Blossom Hill Road would operate at an acceptable level of service with the existing traffic volumes during the AM and PM

peak hours. Both alternative 1 and 2 would improve vehicle, bicycle, and pedestrian circulation along this segment of Blossom Hill Road. The difference between alternatives is that alternative 1 would keep four lanes on Blossom Hill Road, and alternative 2 would reduce Blossom Hill Road to two lanes (one in each direction), which would provide space for increased buffering of the bike lane.