City of Palo Alto

City Council Staff Report

(ID # 12062)

Report Type: Action Items **Meeting Date: 5/3/2021**

Summary Title: Alma Street-Churchill Avenue Railroad Crossing Near-Term Section 130 Safety Improvement Project

Title: Planning and Transportation Commission Recommend Review of two Concept Plan Alternatives for Improvements to the Alma Street and Churchill Avenue Intersection and Direct Staff to Complete Final Design Plans, Environmental Analysis, Specifications and Estimates for Construction for the Selected Alternative 2

From: City Manager

Lead Department: Transportation Department

Recommendation

The Planning and Transportation Commission and staff recommend that Council approve concept plan Alternative 2 as the preferred alternative for the near-term safety improvements to the Alma Street and Churchill Avenue Railroad Crossing and direct staff to complete final design plans, environmental analysis, specifications and estimates for construction.

Recommended Motion

The City Council approves concept plan Alternative 2 as the preferred alternative for the near-term safety improvements to the Alma Street and Churchill Avenue Railroad Crossing and directs staff to complete final design plans, environmental analysis, specifications and estimates for construction.

Executive Summary

The California Department of Transportation Division of Rail, in cooperation with the Peninsula Corridor Joint Power Board (also known as Caltrain or JPB) and the City of Palo Alto, proposes a railroad crossing improvement project at Churchill Avenue in Palo Alto. The intersection was identified by California Public Utilities Commission (CPUC) for safety improvements as part of Section 130 federal funding for hazard elimination on the railroad crossing.

In September 2020, City Council authorized a contract with BKF Engineers to prepare plan line concepts, final design plans, permits, and construction documents for improvements to the intersection of Alma Street and Churchill Avenue. The objectives of the project are to improve

the safety, efficiency, and experience of the intersection and rail crossing for pedestrians, bicyclists, and motorists. As per the scope of improvements listed in the Service Contract with Caltrans, BKF Engineers in consultation with City staff, developed two alternative concept plans as shown in Attachment B and as described below:

- **Alternative 1** includes installation of a traffic pre-signal, relocation of some traffic signals, replacement of the existing pedestrian crossing markings, reconstruction of pedestrian curb ramps, widening pedestrian sidewalks at the northeast and northwest corners of the intersection, additional bike lane markings at the east and west of the intersection, relocation of pedestrian emergency gates, extension of pedestrian railroad gate arm, and installation of additional concrete walkway area at the northwestern pedestrian railroad crossing.

- **Alternative 2** includes all of the improvements listed in Alternative 1 with the addition of the removal of the right turn only lane from southbound Alma to westbound Churchill, allowing for the construction of additional concrete pedestrian area at the northwest corner of the intersection, the construction of green infrastructure at the location of the existing right turn lane, and the increase in lane widths on Alma Street north of the intersection. The second through southbound lane will be converted to a shared through-right turn.

At its March 31, 2021 meeting, the PTC reviewed and discussed the two concept plan alternatives for this project and recommended Alternative #2 as the preferred alternative by a vote of 6-0 (1 absent).

Background

The intersection of Alma Street and Churchill Avenue is situated in a key location due to its proximity to an active railroad, Palo Alto High School, and a separated bike path. This intersection has been an area of concern due to the high volumes of vehicular, bicycle, and pedestrian traffic that occurs predominantly around the morning and afternoon commutes as students are traveling to and from school.

The intersection was identified for safety improvements for hazard elimination on the railroad crossing by the CPUC. The final recommendations of the CPUC Rail Crossing Engineering Section staff for purposes of itemizing the safety improvements for the above noted at-grade railroad crossing, was developed by a diagnostic team. The diagnostic team analyzed the existing situation with respect to vehicular travel, bicycle travel, pedestrian pathways, and rail traffic, and determined that the identified improvements will improve safety and that these improvements are 100% funded by the Section 130 Program. The Peninsula Corridor Joint Powers Board (JPB) and the City will be required to coordinate their respective work items.

The Railway-Highway Crossings (Section 130) Program overseen by The US Department of Transportation Federal Highway Administration (FHWA) provides funds for the elimination of

hazards at railway-highway crossings. The Section 130 Program has been correlated with a significant decrease in collisions and fatalities at railway-highway grade crossings. The Section 130 program funds are eligible for projects at all public crossings including roadways, bike trails, and pedestrian paths.

In August 2019, the California Department of Transportation's (Caltrans) Division of Rail and Mass Transportation executed a Service Contract No. 75LX335, with the City of Palo Alto. This was regarded as Notice to Proceed for the City to complete the work as outlined in the Service Contract.

On September 28, 2020, the City Council authorized a contract with BKF Engineers for the Churchill Avenue and Alma Street Railroad Crossing Safety Improvement Plan, which includes preparation of concept plans, final design plans, and construction documents, for intersection improvements at Churchill avenue and Alma Road. Improvements include, but are not limited to, traffic signal modifications, sidewalk widening, high-visibility crosswalks, signing and striping, and pedestrian railroad crossing improvements.

Concurrently with the above described City project, JPB is developing project plans for improvements within their right-of-way at this intersection. JPB and the City are coordinating the improvements at the intersection to ensure that each entity's respective work items are compatible. JPB will be responsible for the majority of the construction and improvements within their right of way, and the City will manage the construction and improvements within the City's right-of-way. Attachment F shows the City's and JPB's limits of work for each alternative concept plan.

Discussion

This report provides detailed information on the various stages of this work and the following section is organized as follows:

- Initial conceptual design
- Traffic study and the observed conditions
- Proposed project improvements
- Summary of community outrech and project coordination
- Current design

Based on the compilation of this data, the Planning and Transportation Commission (PTC) and staff recommend that Council approve concept plan Alternative 2 for near-term safety improvements to the Alma/Churchill railroad/train crossing. If approved, these near-term improvements do not preclude the City Council from taking separate longer-term actions as part of the railroad/train crossing grade separation initiatives that have been explored as part of the XCAP.

Initial Conceptual Design

A diagnostic team comprising of staff from CPUC, Caltrans, JPB, and the City of Palo Alto developed the initial scope of work for the project as detailed in the City's contract with Caltrans. The specific scope of work is limited to:

- Installation of a traffic signal pre-signal
- Modification of existing traffic signals including
    - Relocating traffic signals
    - Replacing traffic signal poles and heads
    - Updating the phasing and timing of the intersection
- Replacement of the existing pedestrian crossing markings
- Reconstruction of pedestrian curb ramps
- Widen pedestrian sidewalks at northeast and northwest corners of the intersection
- Extension of pedestrian sidewalk gate mast arm
- Relocation of pedestrian emergency access swing gate
- Installation of concrete panels at the pedestrian railroad crossing
- Install new street lighting
- Relocation of utilities as necessary

Using the scope of improvements outlined in the contract with Caltrans, BKF Engineers in consultation with City staff created a conceptual plan showing two alternatives (see Attachment A, January 12, 2021 Conceptual Plan Exhibit).

Alternative 1 proposes:

- Installation of a traffic signal pre-signal
- Relocation of traffic signals
- Replacement of the existing pedestrian crossing markings
- Reconstruction of pedestrian curb ramps
- Widened pedestrian sidewalks at the northeast and northwest corners of the intersection

Alternative 2 proposes all the improvements of Alternative 1 with the addition of the removal of the right turn only lane from southbound Alma to westbound Churchill and changing the outer through lane to a through and right turn lane. The removal of the right turn lane results in:

- The construction of additional pedestrian queuing space at the northwestern corner of the intersection
- The reduction on the length of the pedestrian crosswalk from the northeastern corner to the northwestern corner
- The ability to widen the existing vehicle lanes on Alma west of the intersection to meet City standards
- The construction of green infrastructure in the location of the existing right-turn lane

Traffic Study

Hexagon Transportation Consultants prepared a traffic analysis of Alma Street and Churchill Avenue intersection titled "Traffic Analysis of Potential Alma Street/Churchill Avenue Railroad Crossing Safety Improvements" in February 2021. This memo is included in this report as Attachment C. The memo analyzed the performance of the intersection in the existing condition, in the proposed alternative one condition, in the proposed alternative one condition with signal timing improvements, and in the proposed alternative two conditions with signal timing improvements.

Observed Existing Traffic Conditions

As part of the project concept development, Hexagon observed existing traffic conditions and utilized existing (pre-pandemic) data at the project study location, during AM and PM peak periods. They identified several operational issues, all of which are discussed below:

AM Peak Hour

- Long vehicular queues were observed for the northbound left-turn movement on Alma Street and westbound Churchill Avenue.
- Vehicles in the northbound left-turn lane frequently extended out of the left-turn pocket, into the adjacent through lane, because of signal preemption and school traffic.
- Palo Alto High School is located on the northwest quadrant of Alma Street and Churchill Avenue, and during the school peak hour, which starts around 8 AM, it was observed that vehicular queues from Palo Alto High School frequently extended up to Alma Street. As a result, during some cycles, the northbound left-turning vehicles could not turn on green.
- After signal pre-emption, vehicles in the northbound left-turn lane have to wait for approximately two minutes before receiving a green signal. As a result, queues for the northbound left-turn movement frequently extended past Tennyson Avenue and did not clear in one signal cycle.
- Vehicular queues on westbound Churchill frequently extended past Emerson Street. No turn lanes are provided on westbound Churchill Avenue. Although through traffic is restricted during the AM school peak hour, the right turning traffic must yield to a high number of bicycles and pedestrians crossing the north leg of this intersection, resulting in long vehicular queues.

PM Peak Hour

- Long vehicular queues were observed on eastbound Churchill Avenue.
- Queues frequently extended past Madrono Avenue due to signal preemption. Vehicular queues on eastbound Churchill Avenue could not clear in one signal cycle.

After School Peak Hour

- Based on the traffic counts, long vehicular queues exist on eastbound Churchill Avenue, which extend onto Paly Road because of school traffic leaving the school. Paly Road provides access to Palo Alto High School.

Proposed Project Improvements

The proposed railroad crossing improvements include the installation of a pre-signal on eastbound Churchill Avenue to prevent vehicles from queueing on the railroad tracks. The pre-signal would restrict vehicles from turning right on red and would potentially affect vehicular capacity at the Churchill/Alma intersection.

The analysis of the installation of a pre-signal on eastbound Churchill Avenue showed that the delay for the eastbound approach would increase significantly during the analyzed time periods. However, with the implementation of improvements to the traffic signal operations, the analysis showed that the adverse effects to vehicular traffic from the pre-signal proposed railroad crossing safety improvements would be mitigated.

Analysis of the alternative 2 concept that includes the elimination of the southbound right-turn lane on Alma Street in order to provide a larger waiting area for pedestrians and bicycles on the northwest corner of the Alma/Churchill Avenue intersection was performed. The analysis showed that this improvement would increase the delay for the southbound approach on Alma Street as the right-turns would occur from the outer through lane on Alma Street. However, with the implementation of the improvements to the traffic signal operations, the overall intersection delay during the peak hour periods would be lower than the delay in the baseline existing, and baseline electrification conditions.

The table below, from the Traffic Analysis memo, summarizes AM, After School, and PM peak hour intersection delays and levels of service at the Alma/Churchill intersection under existing conditions and with the proposed safety improvements.

		Existing [1]		Existing + Safety Improvement [2]		Existing + Safety + Signal Improvement [3]		Existing + Safety + Signal Improvement + No Right-Turn Lane [4]	
Intersection	Peak Hour	Avg. Delay	LOS	Avg. Delay	LOS	Avg. Delay	LOS	Avg. Delay	LOS
Alma Street and Churchill Avenue	AM	88.51	F	96.13	F	55.9	E	63.76	E
	After School	55.86	E	108.18	F	54.17	D	56.65	E
	PM	67.15	E	91.06	F	59.53	E	61.23	E

Notes:

Avg Delay = Average Delay in seconds; LOS = Level of Service;

assumed to operate during the weekday AM and PM commute peak hours and a total of 2 tranis were assumed to operate during the school PM peak hour.

[2] Safety improvements consists of relocation of the stop line on eastbound Churchill Avenue from east of the tracks to west of the tracks. The eastbound right-turn traffic would not be allowed to turn on red.

[3] Analysis assumes relocation of the stop line on eastbound Churchill Avenue to the west of the tracks and an overlap phasing for the eastbound right-turn traffic. Also assumes modifications to the signal timings that would allow a lag phasing for the northbound left-turn movement on Alma Street, the eastbound phase to be called before the westbound phase on Churchill Avenue, and increasing the green time for the westbound approach.

[4] Analysis includes elimination of the southbound right-turn lane on Alma to provide a larger waiting space for pedestrians on the northwest corner of the intersection.

Collision Data

Federal Railroad Administration (FRA) reported six collisions from January 2015 – January 2021. The FRA reporting tool only captures railroad crossing incidents reported by the railroad operator (Caltrain) to the FRA specific to the Churchill Ave Railroad Crossing only. These do not include any incidents that occurred within the intersection or local streets.

Based on the traffic collisions report investigated by Palo Alto Police Department, Alma Street and Churchill Avenue intersection documented 30 collisions from 2016 to March 2020.

Community Outreach and Project Coordination

Various outreach and coordination meetings have been conducted to educate the community on project objectives, solicit site-specific feedback on existing issues, understand existing community concerns, and coordinate proposed improvements with entities that operate and oversee the nearby railroad facilities.

Community Meeting #1

The first community meeting was held virtually on January 21, 2021 over Zoom; it was attended by 28 people. Residents living within 1000 feet radius of Alma/Churchill intersection were notified of this meeting through a postcard. An ad was also published in the local newspaper one month before the meeting date. Meeting details were also posted on City's social media sites such as Nextdoor and Facebook encouraging people to attend and/or send comments. The purpose of this virtual meeting was to introduce the project, present existing conditions, and receive feedback from the public on preliminary designs. A formal presentation of the project and two design alternatives was followed by a question-and-answer session during which attendees could share their questions and comments verbally or through the Q&A panel in Zoom. Polls were conducted to better understand how attendees currently use the intersection and which of the two preliminary designs they preferred.

Staff received many constructive comments from the community. Most were related to specific bicycle and pedestrian improvements, safety, and overall connectivity. Below is a list of some of the concerns and questions that attendees expressed about the proposed project:

- Some attendees were concerned that alternative 2 would prevent motorists from turning right from southbound Alma Street onto westbound Churchill Avenue. It was clarified that alternative 2 retains the ability for motorists to make a southbound right turn by providing a shared through/right turn lane.
- Some attendees expressed concerns about the impacts of the Churchill Avenue pre-signal creating a traffic backup for eastbound Churchill Avenue to El Camino Real. It was noted that based on the traffic analysis, the net effect of the pre-signal in conjunction with various signal phasing and timing changes would be a significant potential decrease in overall delay at the intersection.
- Attendees also had questions and comments regarding how the proposed changes will impact traffic within the intersection and along corridors adjacent to the intersection.

At the end of the presentation and Q&A, the attendees were polled as to which alternative they preferred. Of the response received, 6 attendees noted that they would prefer alternative 1, and 4 attendees noted that they would prefer alternative 2.

A full summary of the community meeting held on January 21, 2021 prepared by Callander Associates is included in this report as Attachment D.

Pedestrian and Bicycle Advisory Committee (PABAC) Meeting #1

At the February 2, 2021 virtual PABAC meeting, the project team presented this project to the committee followed by an opportunity for the committee members to share their questions and comments. In addition to the questions shared during the meeting, the committee was encouraged to submit any follow-up questions or comments via e-mail to staff.

Staff received many constructive comments from the committee. Most were related to specific bicycle and pedestrian improvements, safety, and overall connectivity. Below is a list of some of the concerns and questions that attendees had about the proposed project:

- Some attendees were concerned that there are difficulties for bikers coming from school to continue east on Churchill Avenue on the correct side of the street with the normal flow of traffic.
- Some attendees noted bike marking improvements, and signal timing improvements found at other locations in Palo Alto as a means to provide safer movements for bicyclists and pedestrians through the intersection.
- Attendees expressed gratitude that the proposed project is moving forward due to the high volume of pedestrian and bicyclists that use this intersection.

A full summary of the PABAC meeting held on February 2, 2021 prepared by Callander Associates is included in this report as Attachment E.

City School Traffic Safety Committee Meeting (CSTSC) #1

At the February 18, 2021 virtual CSTSC meeting, staff presented this project to the committee followed by an opportunity for the committee members to share their questions and comments. In addition to the questions shared during the meeting, the committee was encouraged to submit any follow-up questions or comments via e-mail to staff.

Staff received one comment in support for the addition of traffic pre-signal for eastbound traffic on Churchill Avenue. This pre-signal would reduce the number of vehicles waiting on tracks between signal times as witnessed several times by this attendee. Another comment received was to extend the clearance time for the tracks by increasing the yellow phase for eastbound traffic on Churchill.

Palo Alto Unified School District (PAUSD)

The two proposed concept plans were shared with the PAUSD staff. A PAUSD representative attended the Planning and Transportation Commission (PTC) meeting and provided comments as summarized in the PTC meeting information below.

Planning and Transportation Commission (PTC) Meeting

At its March 31, 2021 meeting, the PTC reviewed and discussed the two concept plan alternatives for this project and recommended Alternative #2 as the preferred alternative by a vote of 6-0 (1 absent). Here are the March 31 PTC meeting minutes.

During the public comment period at the PTC, representative from PAUSD expressed concerns about the right turn lane elimination from southbound Alma to westbound Churchill as proposed in Alternative #2 and its potential impacts on school bus operations. In response to this concern, staff developed Attachment G showing turning movement for a 40 feet long school bus for both concept plans and under existing condition. For Alternative #2, staff is also proposing to increase the turning radii from 15 feet as currently proposed to 20 feet during final design to facilitate bus operations for the northwest corner of this intersection. The exhibits show that the project improves turning for buses compared to existing conditions. With the elimination of eastbound cars waiting between the tracks and Alma Street, buses will now have more turning area over the eastbound lanes and can more easily make right turns onto Churchill.

Current Design

Through input from the community, the stakeholders, and the City, the conceptual plan showing the two proposed alternatives were updated, see Attachment B - March 11, 2021 Conceptual Plan Exhibit.

The design revisions are implemented in both alternatives, and they include:

- The addition of green pavement markings within the intersection indicating the path that bicyclists should take through the intersection.
- The addition of green-painted bike lanes on Churchill Avenue west of the intersection in both directions to delineate the bike lanes.
- The addition of “Keep Clear” markings at the railroad crossing for vehicles traveling in both directions.
- The extension of the pedestrian gate arm to 15’ to allow for a wider pedestrian crossing area across the railroad.
- The addition of a small concrete area at the location of the connection to the existing Embarcadero bike path to provide more connectivity from the bike path to the intersection crossing.
- The widening of the curb ramp at the northwestern corner of the intersection to provide access to the pedestrian railroad crossing for a larger number of pedestrians.

Timeline
Upon Council approval, staff will advise BKF Engineers to develop final design plans, specifications, and engineer's estimate based on the approved conceptual design. Staff will work closely with JPB, Caltrans, CPUC and Palo Alto High School during the final design phase.

Per the contract between the City of Palo Alto and BKF Engineers and assuming approval of the current recommendation as part of this item, design work is scheduled to be completed by September 2021. Construction would be scheduled thereafter and expected to be completed by end of 2022.

Resource Impact
Funding for improvements to the Alma Street and Churchill Avenue intersection is provided through the approved Churchill Avenue/Alma Street Railroad Crossing Safety Improvements Capital Improvement Project PL-20000. This railroad crossing intersection was identified through the Federal Section 130 funds, a federally funded program administered by the states (Caltrans administers this is in California), for increasing safety at at-grade highway-rail crossings.

As per the agreement between the City of Palo Alto and the California Department of Transportation (Caltrans) Division of Rail and Mass Transportation, Service Contract No. 75LX335, the City will receive federal funding through the Section 130 Grade Crossing Improvement Program on a reimbursement basis. The reimbursement amount of $3,996,000 is available for reimbursement from the Section 130 Program for all work to be completed as part of the project. The existing design contract with BKF Engineers is for $286,686. The preliminary cost estimates for construction of the project is $3.55 million.

Previous estimates for the project came in at $4.5M. However, upon further refinement of the project, it was determined that the cost to design and construct changes to the intersection would be $3,996,000. The agreement the City has entered into with Caltrans provides the City with $3,996,000. The overall project budget is being aligned with funding sources from other agencies (Caltrans). However, the project will be competitively bid for procurement of the construction contract and the actual project cost will depend upon the bid proposals received for construction.

Staff will return to Council with an updated cost upon the completion of final design and for the award of project construction. Funding for future years is subject to City Council approval through the annual budget process.

Policy Implications
Goals and policies from the Palo Alto 2030 Comprehensive Plan that are supported and advanced by the proposed improvements include:

Goal T-1 Create a sustainable transportation system, complemented by a mix of land uses, that emphasizes walking, bicycling, use of public transportation and other methods to reduce GHG emissions and the use of single-occupancy motor vehicles.

Policy T-1.16 Promote personal transportation vehicles an alternative to cars (e.g. bicycles, skateboards, roller blades) to get to work, school, shopping, recreational facilities and transit stops.

Policy T-1.18 Increase cooperation with surrounding communities and other agencies to establish and maintain off-roadway bicycle and pedestrian paths and trails that are integrated with creek, utility, railroad rights-of-way and green spaces in a manner that helps enhance and define the community and avoids environmental impacts.

Policy T-1.19 Provide facilities that encourage and support bicycling and walking.

Goal T-3 Maintain an efficient roadway network for all users.

Policy T-3.2 Enhance connections to, from and between parks, community centers, recreation facilities, libraries and schools for all users

Policy T-3.5 When constructing or modifying roadways, plan for use of the roadway by all users.

Policy T-3.6 Consider pedestrians, bicyclists, e-bikes and motorcycles when designing road surfaces, curbs, crossings, signage, landscaping and sight lines.

Policy T-3.14 Continue to prioritize the safety of school children in street modification projects that affect school travel routes, including during construction.

Policy T-3.17 Until grade separation is completed, improve existing at-grade rail crossings to ensure the highest feasible level of safety along the corridor and provide additional safe, convenient crossings

Goal T-6 Provide a safe environment for motorists, pedestrians and bicyclists on Palo Alto streets

Policy T-6.1 Continue to make safety the first priority of citywide transportation planning. Prioritize pedestrian, bicycle and automobile safety over motor vehicle level of service at intersections and motor vehicle parking.

Policy T-6.3 Continue to work with Caltrain to increase safety at train crossings, including improving gate technology and signal coordination.

Stakeholder Engagement

Since October 2020, the design team has been conducting monthly stakeholder check-in meetings to give the pertinent stakeholders an update on the project's progress, and provide a forum for the design team, City, and stakeholders to discuss and coordinate the proposed improvements. The stakeholders that are involved with the monthly meeting include:

- Design team - BKF Engineers, Hexagon Transportation Consultants, Callander Associates
- The City of Palo Alto
- Caltrans
- The California Public Utilities Commission (CPUC)
- Caltrain/JPB

City staff has also been coordinating internally with another City project "Churchill Avenue Enhanced Bikeway project" which is currently underway and extends the bike path along Churchill Avenue from Castilleja Avenue/Paly Road to Stanford Perimeter Trail. In addition, the project includes safety improvements at the intersection of El Camino Real and Churchill Avenue and various improvements at intersections on Churchill Avenue from Castilleja Avenue to El Camino Real.

Project limit for Churchill Avenue/Alma Street Railroad Crossing Safety Improvement project ends on Churchill Alma just east of Mariposa Avenue. Upon discussing with Caltrans during the stakeholder's meetings and explaining the potential gap in paving for one block (on Churchill from Castilleja Avenue to Mariposa Avenue), Caltrans has agreed to extend the paving limits on Churchill Avenue until just east of Castilleja Avenue as a part of this project to match with Enhanced Bikeway project.

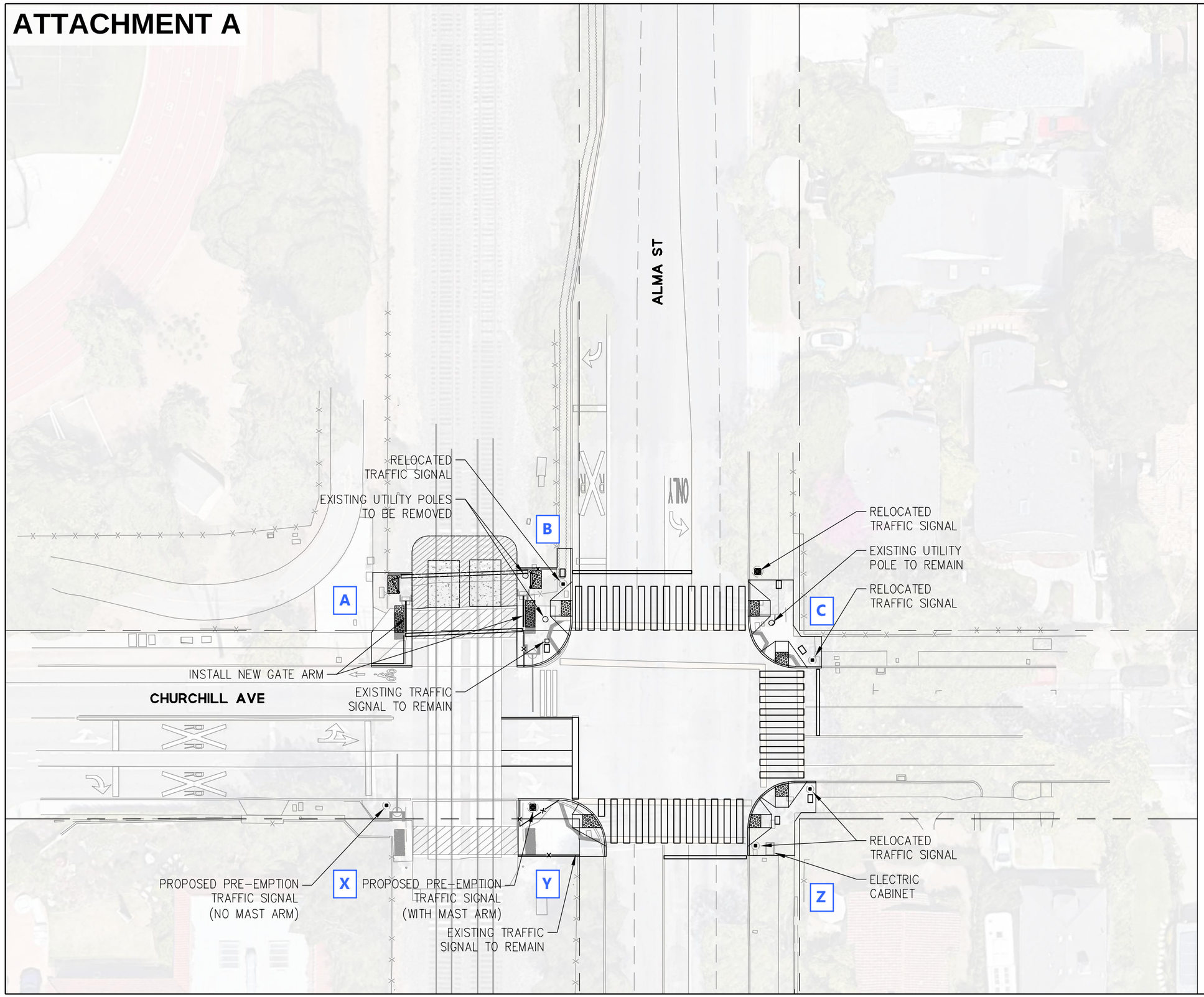
Environmental Review

The project is a collaboration between Caltrans, City of Palo Alto, and Peninsula Corridor Joint Powers Board. Caltrans will be leading efforts in performing NEPA and City will perform the CEQA review.

Attachments:

- Attachment A: January 12, 2021 Conceptual Plan Exhibit
- Attachment B: March 11, 2021 Conceptual Plan Exhibit
- Attachment C: Traffic Analysis memo by Hexagon Transportation Consultants
- Attachment D: 01/21/2021 Community Meeting Summary
- Attachment E: 02/02/2021 PABAC Meeting Summary
- Attachment F: City's and JPB's limits of work for each alternative concept plan
- Attachment G: School Bus Turning Movement

ATTACHMENT A



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CONCEPTUAL PLAN EXHIBIT – ALTERNATIVE 1
PALO ALTO
SANTA CLARA COUNTY
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Revisions	No.

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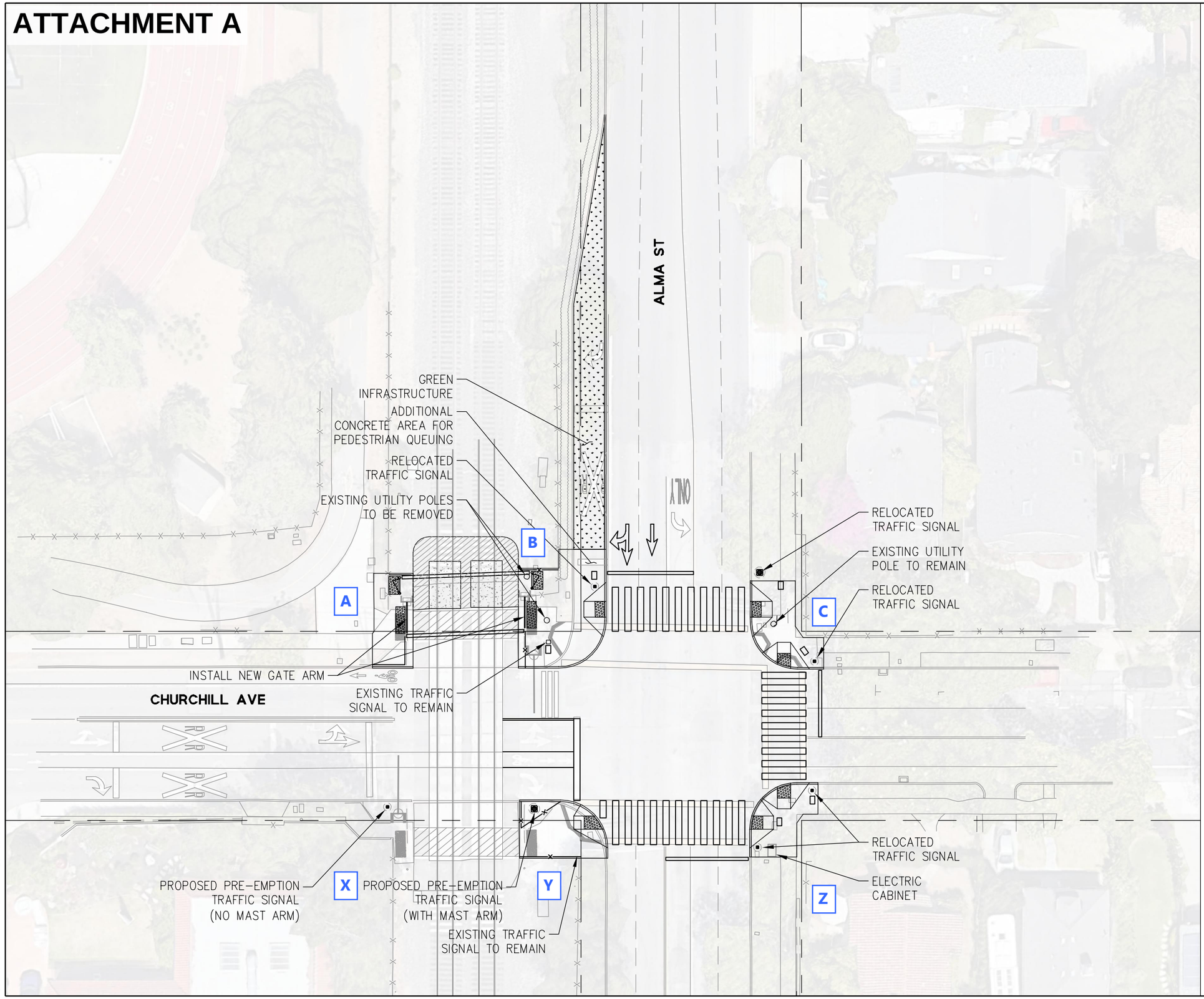
ATTACHMENT A



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ALMA ST CHURCHILL AVE INTERSECTION IMPROVEMENT PROJECT
CONCEPTUAL PLAN EXHIBIT – ALTERNATIVE 2

PALO ALTO
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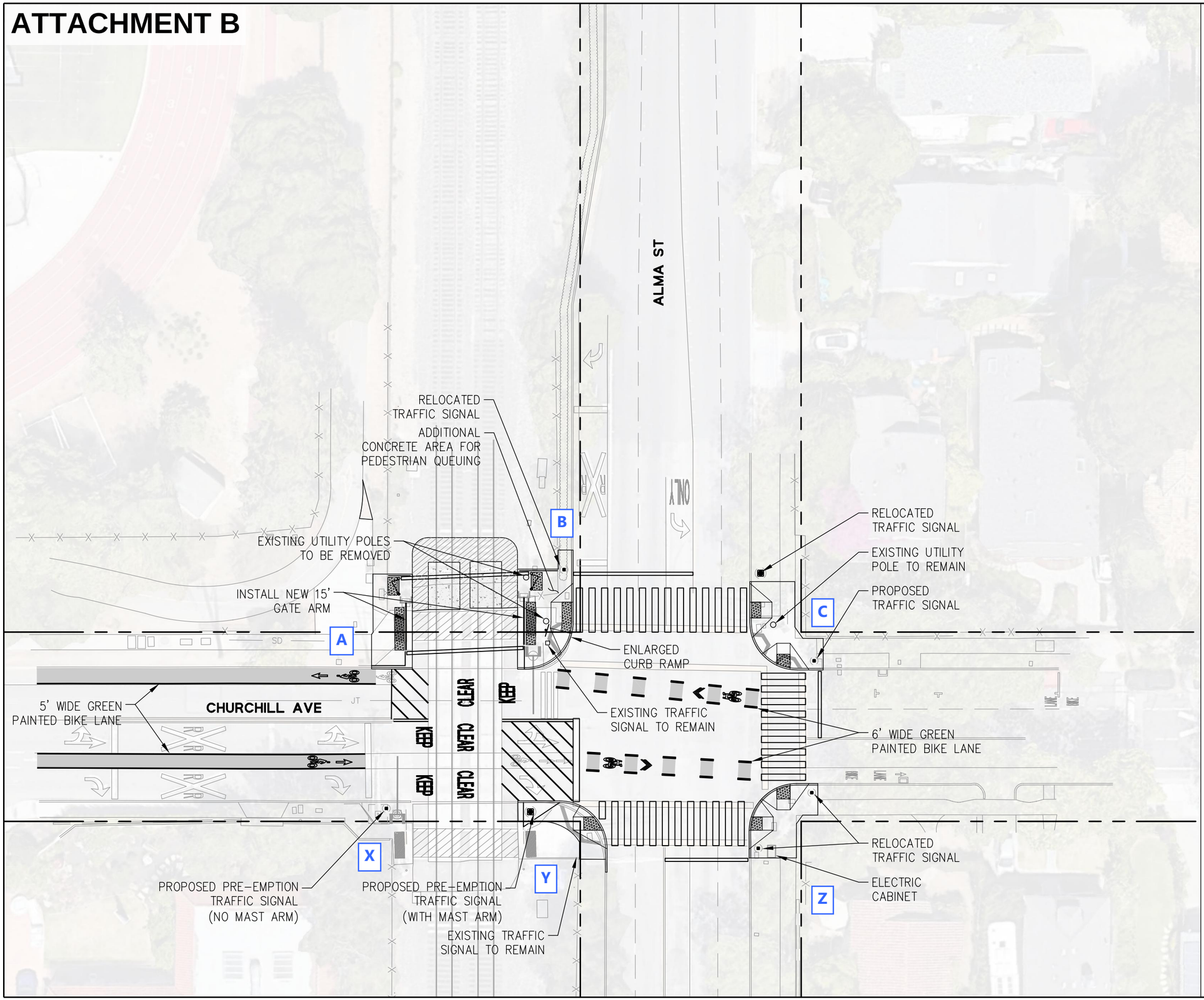
ATTACHMENT B



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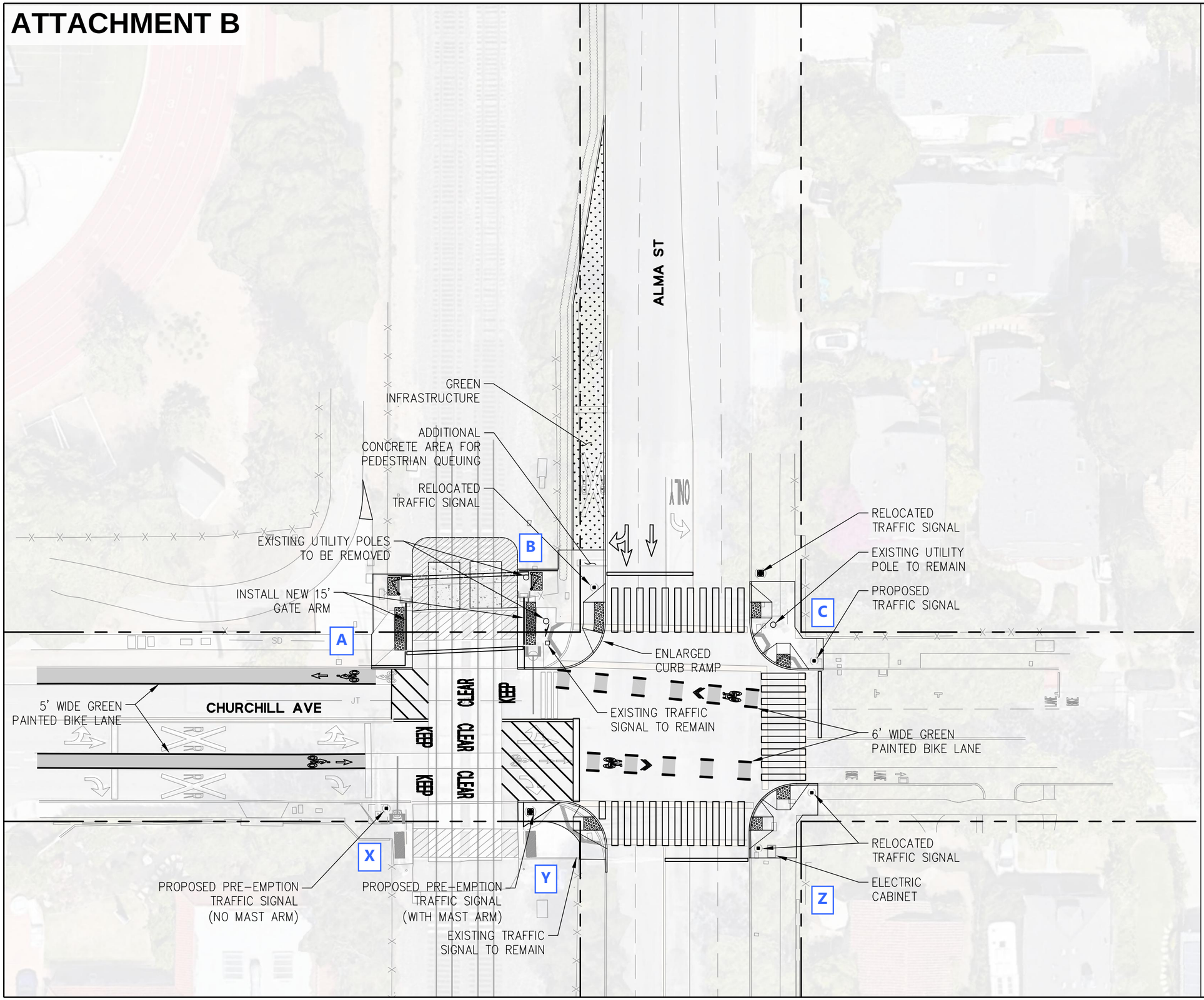
ATTACHMENT B



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HEXAGON TRANSPORTATION CONSULTANTS, INC.

Memorandum

Date: February 4, 2020

To: City of Palo Alto
CC: Mr. Jason Mansfield, BKF Engineers

From: Trisha Dudala

Subject: Traffic Analysis of Potential Alma Street/Churchill Avenue Railroad Crossing Safety Improvements

Summary

The City of Palo Alto is proposing pedestrian safety improvements at the intersection of Alma Street and Churchill Avenue and the adjacent railroad crossing. Because it is adjacent to Palo Alto High School, the railroad crossing is used by hundreds of bicycles and many pedestrians during peak hours. In addition to widening the crosswalks and sidewalks at the intersection, the proposed railroad crossing improvements include the installation of a pre-signal on eastbound Churchill Avenue to prevent vehicles from queueing on the railroad tracks. The pre-signal would restrict vehicles from turning right on red and would potentially affect vehicular capacity at the Churchill/Alma intersection. The study looked at traffic impacts during three time periods - the weekday commute AM (7-9), after school (2-4), and commute PM (4-6) peak hours. It is during these hours that the intersection experiences the most traffic congestion. The analysis was conducted using the simulation software VISSIM by PTV Vision, which has the ability to analyze signal pre-emption. The traffic analysis was conducted under existing conditions and with Caltrain electrification, which would increase the frequency of trains through Palo Alto.

The analysis of the installation of a pre-signal on eastbound Churchill Avenue showed that the delay for the eastbound approach would increase significantly during all three time periods. Improvements to the traffic signal operations, consisting of an overlap phase for the eastbound right-turns on Churchill, a lagging phase for the northbound left-turn on Alma, serving eastbound Churchill before westbound Churchill and allocating additional green time to Churchill Avenue were identified. With the implementation of these improvements, the analysis showed that the adverse effects to vehicular traffic from the proposed railroad crossing safety improvements would be mitigated.

An optional improvement was analyzed that would require the elimination of the southbound right-turn lane on Alma Street in order to provide a larger waiting area for pedestrians and bicycles on the northwest corner of the Alma/Churchill Avenue intersection. The analysis showed that this improvement would increase the delay for the southbound approach on Alma Street as the right-turns would occur from the outer through lane on Alma Street. However, with the implementation of the identified improvements to the traffic signal operations, the overall intersection delay during the peak hour periods would be lower than the baseline existing and baseline electrification conditions.

Alma Street and Churchill Avenue Intersection – Traffic Analysis

Existing Conditions Analysis

The existing conditions analysis was conducted based on existing peak hour traffic volumes, existing lane geometries, existing signal timings, and the number of trains during the peak hours as described below.

Existing Lane Geometry and Traffic Volumes

Separate left turn lanes are provided on Alma Street in both the northbound and southbound directions to Churchill Avenue (see Figure 1). In addition, there is a southbound right turn lane on Alma Street to westbound Churchill Avenue (toward the high school). Eastbound Churchill Avenue has a separate right turn lane and a shared through/left turn lane at Alma Street. Westbound Churchill Avenue at Alma Street has one all-movement lane and another lane that allows on-street parking. Parking is prohibited from 7-8 AM, and through traffic is prohibited 7:45 to 8:30 AM Monday through Friday. The existing traffic signal operates with protected phasing for the northbound and southbound left-turns on Alma Street. Churchill Avenue operates with split phase signal timing, with the westbound approach being served before the eastbound approach.

Due to shelter in place orders first issued in March 2020, most businesses and schools closed, and people started working at home to the extent possible. While some businesses have subsequently reopened subject to certain restrictions, traffic volumes continue to be substantially below pre-COVID conditions. Thus, to be conservative, this transportation analysis report is based on pre-COVID conditions.

AM and PM peak hour turning movement counts for vehicles, pedestrians, and bicycles were conducted at the Alma/Churchill intersection in December 2018, and the after school peak hour counts were conducted in November 2017, when schools were in session. These counts are shown on Figure 1. As shown on Figure 1, a total of 2,592 vehicles and approximately 400 bicycles and pedestrians were counted during the AM peak hour, 2,523 vehicles and approximately 252 bicycles and pedestrians were counted during the after school peak hour, and a total of 3,312 vehicles and approximately 80 bicycles and pedestrians were counted during the PM peak hour.

These counts were compared to more recent counts conducted in 2019 and 2020, and the 2017/2018 counts were found to be higher during the AM and PM peak hours. Therefore, the 2017/2018 counts were used for the analysis of the Alma/Churchill Avenue railroad crossing safety improvements.

Figure 1
Alma Street and Churchill Avenue Existing Lane Geometry and Traffic Volumes

Signal Timings

The existing signal timing data at the Alma and Churchill intersection were obtained from the City of Palo Alto. Additional information regarding turn restrictions during certain time periods was obtained from field observations. The Alma and Churchill intersection currently operates at 150- second (2 ½ minutes) and 180- second (3 minutes) cycle lengths during the AM and PM peak hours, respectively. Also, through traffic on westbound Churchill is prohibited (via signage installed at the intersection) during the morning school peak hour that occurs between 7:45 – 8:30 AM.

Signal Pre-emption and Number of Trains

As the Churchill Avenue railroad crossing is located only 25 feet to the west of Alma Street, the intersection of Alma Street and Churchill Avenue is equipped to receive a traffic preemption signal when there is a train detection. This is a special control mode in the traffic signal controller designed to start up and clear any vehicular traffic on the roadway approach crossing the railroad tracks. Before the train approaches the intersection, eastbound vehicular queues on Churchill Avenue between the railroad gate and Alma street are cleared. Only through traffic on Alma street, which does not conflict with the railroad movement, receives a green light for the duration of the train movement. A gate closure time of 45 seconds was assumed based on field observations.

Based on the number of gate closures observed during the field visit, the existing conditions analysis assumed a total of 8 trains (4 northbound and 4 southbound) during each of the AM and PM peak hours. Based on the pre-COVID Caltrain schedule, there can be up to 10 trains in the AM and PM peak hours. Because the actual train spacing varies daily, the analysis assumed a constant time interval between consecutive trains, which calculates to one train every 7 ½ minutes. This represents average conditions. Occasionally trains arrive closer together, which creates longer delays, or more spread out, which creates shorter delays. Analysis of the after school peak hour assumed the operation of 2 trains (1 train in each direction) based on the Caltrain schedule.

Field Observations

AM Peak Hour

During the AM peak, long vehicular queues were observed for the northbound left-turn movement on Alma Street and also on westbound Churchill Avenue. Vehicles in the northbound left-turn lane frequently extended out of the left-turn pocket, into the adjacent through lane, because of signal preemption and because of the school traffic. Palo Alto High School is located on the northwest quadrant of Alma Street and Churchill Avenue, and during the school peak hour, which starts around 8 AM, it was observed that vehicular queues from Palo Alto High School frequently extended up to Alma Street. As a result, during some cycles, the northbound left-turning vehicles could not turn on green. After pre-emption, vehicles in the north-bound left-turn lane have to wait for approximately two minutes before receiving a green signal. As a result, queues for the northbound left-turn movement frequently extended past Tennyson Avenue and did not clear in one signal cycle. Vehicular queues on westbound Churchill frequently extended past Emerson Street. No turn lanes are provided on westbound Churchill Avenue. Although through traffic is restricted during the AM school peak hour, the right turning traffic has to yield to a high number of bicycles and pedestrians crossing the north leg of this intersection, resulting in long vehicular queues.

PM Peak Hour

During the PM peak hour, long vehicular queues were observed on eastbound Churchill Avenue. Queues frequently extended past Madrono Avenue due to signal preemption. Vehicular queues on eastbound Churchill Avenue could not clear in one signal cycle.

After School Peak Hour

Based on the traffic counts, long vehicular queues exist on eastbound Churchill Avenue, which extend onto Paly Road because of school traffic leaving the school. Paly Road provides access to Palo Alto High School.

Proposed Safety Improvements

The Alma/Churchill Avenue intersection is located immediately east of the crossing and there is enough storage space for only one vehicle between the intersection and the railroad tracks. This crossing experiences a large volume of bicycle and pedestrian traffic during the AM, after school and PM commute hours. Some of the proposed safety improvements include widening the existing crosswalks on the north leg and the east leg of the intersection, providing a larger waiting space in the northwest and northeast quadrants of the intersection by widening the sidewalks, and installing a pre-signal on eastbound Churchill Avenue (see Figure 2). The pre-signal would relocate the stop line for eastbound Churchill Avenue traffic to the west of the tracks and would prevent motorists from queueing within the train crossing area. The pre-signal would restrict right-turns on red for eastbound Churchill Avenue traffic.

Analysis of the impact of the proposed railroad crossing improvements on existing traffic conditions at Alma Street and Churchill Avenue was conducted. Table 1 below summarizes AM, after school and PM peak hour intersection delays and levels of service at the Alma/Churchill intersection under existing conditions and with the proposed safety improvements.

Table 1
Alma and Churchill Intersection Delay and Levels of Service – Existing Conditions

		Existing [1]		Existing + Safety Improvement [2]		Existing + Safety + Signal Improvement [3]		Existing + Safety + Signal Improvement + No Right-Turn Lane [4]	
Intersection	Peak Hour	Avg. Delay	LOS	Avg. Delay	LOS	Avg. Delay	LOS	Avg. Delay	LOS
Alma Street and Churchill Avenue	AM	88.51	F	96.13	F	55.9	E	63.76	E
	After School	55.86	E	108.18	F	54.17	D	56.65	E
	PM	67.15	E	91.06	F	59.53	E	61.23	E

Notes:

Avg Delay = Average Delay in seconds; LOS = Level of Service;

assumed to operate during the weekday AM and PM commute peak hours and a total of 2 tranis were assumed to operate during the school PM peak hour.

[2] Safety improvements consists of relocation of the stop line on eastbound Churchill Avenue from east of the tracks to west of the tracks. The eastbound right-turn traffic would not be allowed to turn on red.

[3] Analysis assumes relocation of the stop line on eastbound Churchill Avenue to the west of the tracks and an overlap phasing for the eastbound right-turn traffic. Also assumes modifications to the signal timings that would allow a lag phasing for the northbound left-turn movement on Alma Street, the eastbound phase to be called before the westbound phase on Churchill Avenue, and increasing the green time for the westbound approach.

[4] Analysis includes elimination of the southbound right-turn lane on Alma to provide a larger waiting space for pedestrians on the northwest corner of the intersection.

As shown in Table 1, under existing conditions, the Churchill/Alma Street intersection currently operates at LOS F during the AM peak hour and LOS E during the after school and commute PM peak hours. With the proposed railroad crossing improvements, which would include a pre-signal on eastbound Churchill Avenue, the analysis showed that the delay for the eastbound approach would

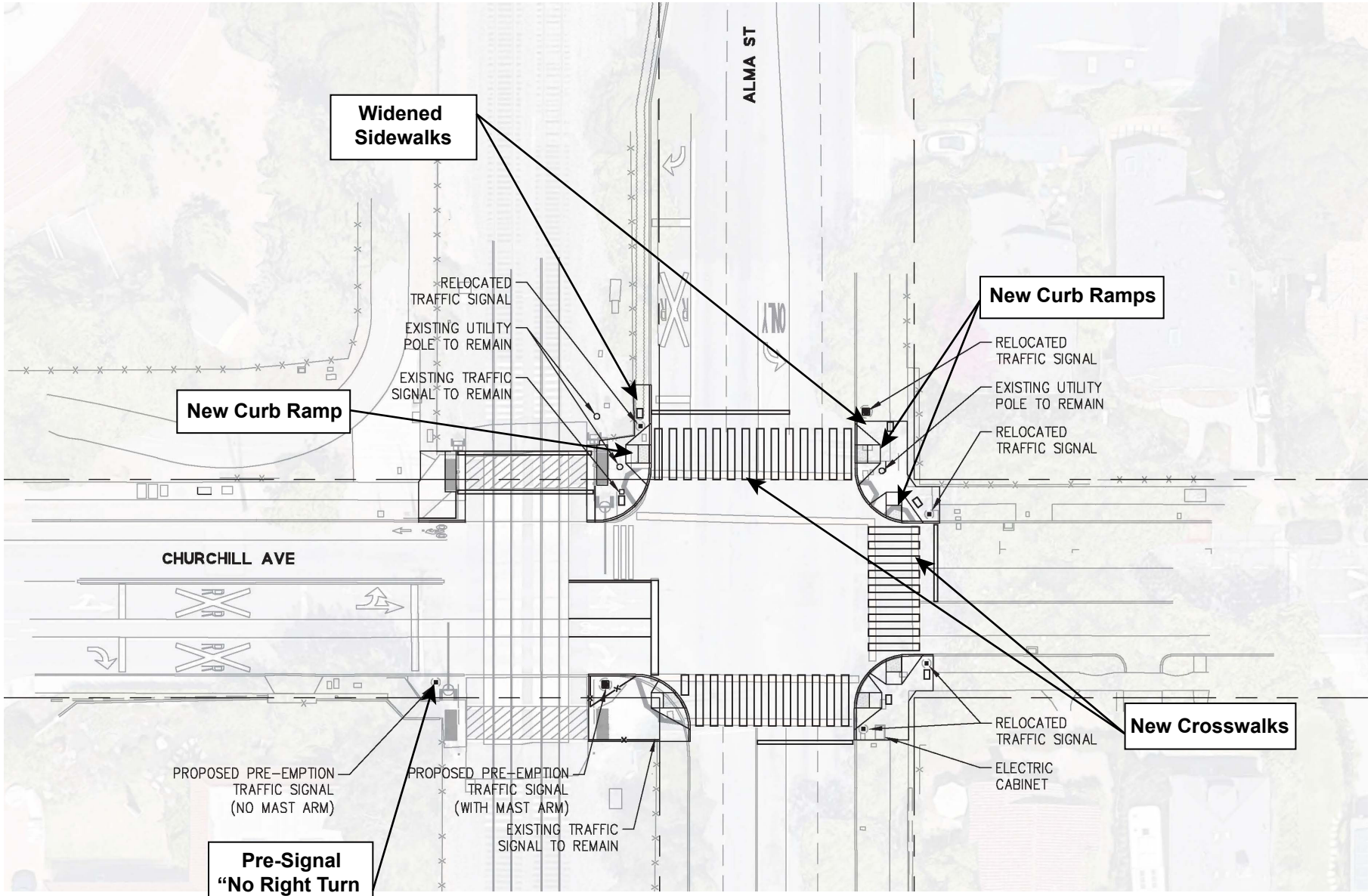

Figure 2
Proposed Railroad Crossing Improvements (Alternative 1)

NORTH
Not to Scale

increase significantly and would cause the intersection to operate at LOS F during all three time periods with a higher average intersection delay. Traffic counts during all three time periods show a relatively high volume of right-turning traffic from eastbound Churchill to southbound Alma Street. Under existing conditions, a significant number of these vehicles turn right on red. The proposed pre-signal would restrict right turns on red and would cause vehicles to queue on eastbound Churchill Avenue. Tables 2, 3 and 4 show the queue delays for the through lanes and the turn lanes at the Alma/Churchill intersection during the AM peak, after school and PM peak hours. As shown in these tables, the proposed pre-signal would result in a significant increase in delays for the eastbound Churchill Traffic during all three time periods.

Recommendation

The following improvements/modifications to the traffic signal operations are recommended to reduce the overall intersection delay and vehicular queues on eastbound Churchill Avenue in conjunction with the proposed railroad crossing safety improvements:

1. Overlap Phasing for eastbound right-turns – Provide an overlap phase for the eastbound right-turns, which would allow the right-turn traffic to go concurrently with the northbound left-turn traffic on Alma Street.
2. Lagging Phase for northbound left-turns – Provide a lagging phase for the northbound left-turns on Alma Street, where the northbound left-turns are served after the northbound and southbound through traffic on Alma Street is served.
3. Churchill Phasing – To facilitate a continuous traffic flow for the eastbound right-turns on Churchill Avenue, the phase sequence in the traffic controller should be modified so that the eastbound phase is called before the westbound phase on Churchill Avenue.
4. Increase green time for Churchill Avenue – Calling the eastbound phase prior to the westbound phase would result in increased delays for the westbound Churchill traffic especially during the AM peak hour. To reduce delays for this approach, it is recommended that an additional 15 seconds of green time be allocated to this approach during the AM peak hour by reducing the green time for traffic on Alma Street. During after school, with a high number of vehicles making a right turn from eastbound Churchill to southbound Alma, it is recommended that an additional 10 seconds of green time be allocated to the eastbound approach by reducing the green time for traffic on Alma Street.

The analysis showed that with the implementation of these improvements/modifications to the signal timing, the average intersection delays would be reduced to less than the delays under existing conditions. The intersection would operate at LOS E during the AM and PM commute hours and LOS D during the after school peak (see Table 1). The analysis showed that the delay for the eastbound traffic would reduce and traffic queues on Churchill Avenue would not extend up to El Camino Real during the after school and commute PM peak hours.

Although the analysis showed that reducing the green time on Alma Street in order to allocate additional green time to Churchill Avenue would result in an increase in delays for the southbound traffic on Alma (see Tables 2, 3 and 4), the proposed improvements/modifications to the traffic signal operations in conjunction with the railroad crossing improvements would decrease the delays for the eastbound Churchill traffic significantly resulting in a lower average intersection delay compared to the baseline existing conditions.

Optional Improvements

In order to provide an even larger waiting space for pedestrians and bicyclists in the northwest quadrant, to the east of the tracks, Hexagon analyzed the option of eliminating the southbound

right-turn lane on Alma Street (see Figure 3). Traffic volumes for the southbound right-turn movement on Alma Street are relatively low, and due to the short storage length (approximately 100 feet), field observations showed that the turn pocket was frequently blocked by southbound through traffic on Alma during the PM peak hours. An analysis of elimination of the right-turn pocket showed that the average delay would increase under all three time periods. The increase in delay would be higher during the AM peak hour compared to the after school and commute PM peak periods, as the southbound right-turn volume is relatively higher during the AM peak hour (see Table 1). During preemption, when Alma Street through traffic receives a green light, a vehicle on southbound Alma wanting to turn right would block through traffic in the outer through lane. This would increase the delay for the southbound approach on Alma Street. However, compared to existing conditions, the overall intersection delay would be lower during the AM and PM peak hours and only marginally higher during the after school peak hour.

Table 2
Alma and Churchill Intersection Queue Delays – Existing Conditions (AM Peak)

AM Peak Hour - Queue Delay (seconds)					
Intersection	Lane	Existing [1]	Existing + Safety Improvement [2]	Existing + Safety + Signal Improvement [3]	Existing + Safety + Signal Improvement + No Right-Turn Lane [4]
Alma Street and Churchill Avenue	NBL	287	282	94	79
	NBT	27	25	32	31
	NBTR	27	25	33	33
	WBLTR	379	393	75	72
	SBL	136	141	**186**	**201**
	SBT1	35	35	**48**	**70**
	SBT2	38	38	**53**	**98**
	SBR	14	15	27	-
	EBLT	81	**115**	66	67
	EBR	22	**129**	30	31

Notes:

Avg Delay = Average Delay in seconds; LOS = Level of Service;

XXX - Bold indicated Where queue delay exceeds 25% of the queue delay under baseline conditions.

[1] Existing traffic conditions were analyzed based on pre COVID traffic volumes which reflect normal school operations. A total of 8 trains were assumed to operate during the weekday AM and PM commute peak hours and a total of 2 tranis were assumed to operate during the school PM peak hour.

[2] Safety improvements consists of relocation of the stop line on eastbound Churchill Avenue from east of the tracks to west of the tracks. The eastbound right-turn traffic would not be allowed to turn on red.

[3] Analysis assumes relocation of the stop line on eastbound Churchill Avenue to the west of the tracks and an overlap phasing for the eastbound right-turn traffic. Also assumes modifications to the signal timings that would allow a lag phasing for the northbound left-turn movement on Alma Street, the eastbound phase to be called before the westbound phase on Churchill Avenue, and increasing the green time for the westbound approach.

[4] Analysis includes elimination of the southbound right-turn lane on Alma to provide a larger waiting space for pedestrians on the northwest corner of the intersection.

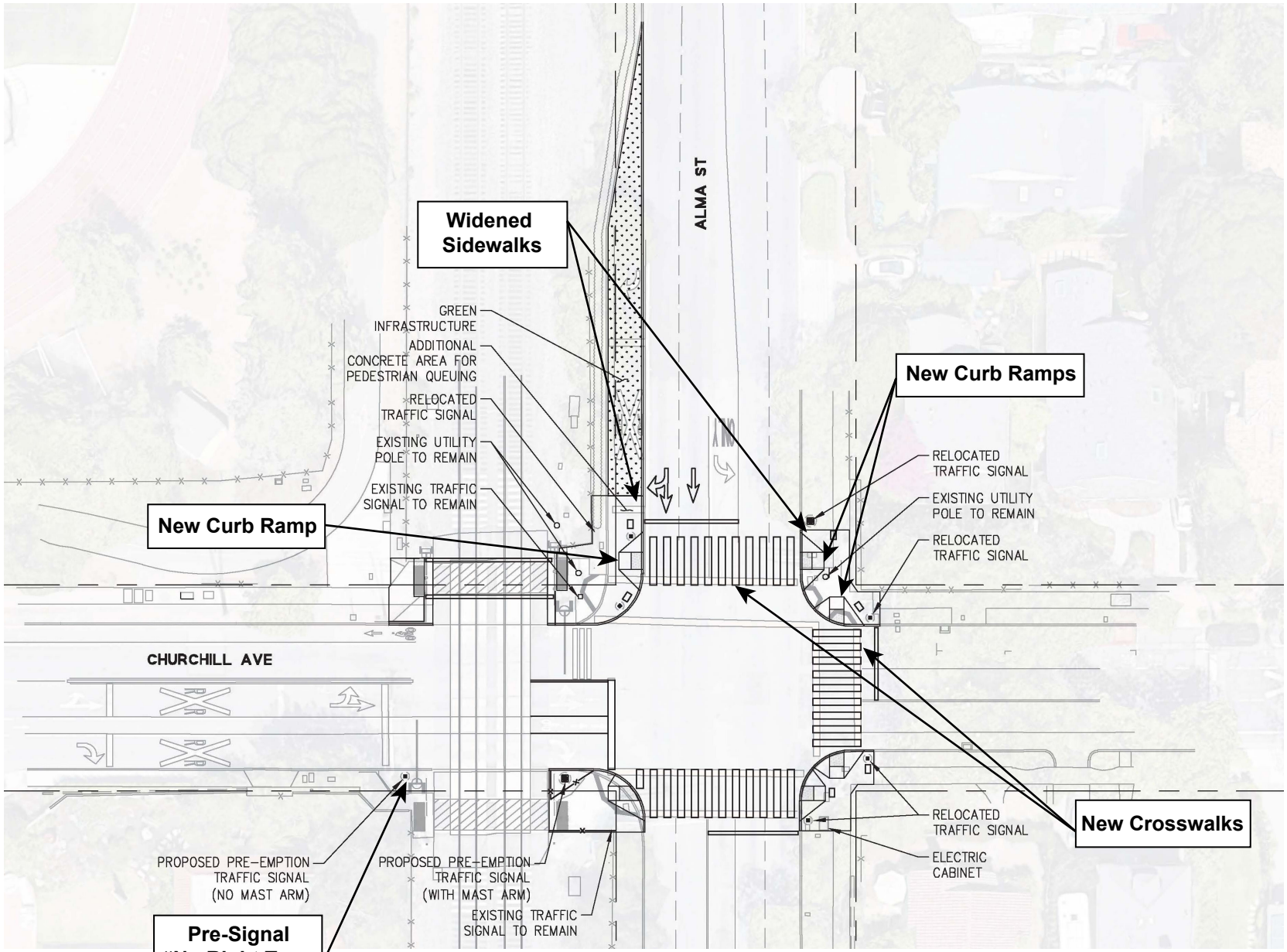

Figure 3
Proposed Railroad Crossing Improvements (Alternative 2)

NORTH
Not to Scale

Table 3
Alma and Churchill Intersection Queue Delays – Existing Conditions (After School)

After School - Queue Delay (Seconds)					
Intersection	Lane	Existing [1]	Existing + Safety Improvement [2]	Existing + Safety + Signal Improvement [3]	Existing + Safety + Signal Improvement + No Right-Turn Lane [4]
Alma Street and Churchill Avenue	NBL	119	136	77	78
	NBT	17	17	21	21
	NBTR	17	19	24	23
	WBLTR	86	83	91	92
	SBL	146	142	**184**	**183**
	SBT1	40	39	**49**	**50**
	SBT2	42	41	**52**	**62**
	SBR	21	22	**32**	-
	EBLT	184	**417**	84	83
	EBR	108	**422**	51	51

Notes:

Avg Delay = Average Delay in seconds; LOS = Level of Service;

XXX - Bold indicated Where queue delay exceeds 25% of the queue delay under baseline conditions.

[1] Existing traffic conditions were analyzed based on pre COVID traffic volumes which reflect normal school operations. A total of 8 trains were assumed to operate during the weekday AM and PM commute peak hours and a total of 2 tranis were assumed to operate during the school PM peak hour.

[2] Safety improvements consists of relocation of the stop line on eastbound Churchill Avenue from east of the tracks to west of the tracks. The eastbound right-turn traffic would not be allowed to turn on red.

[3] Analysis assumes relocation of the stop line on eastbound Churchill Avenue to the west of the tracks and an overlap phasing for the eastbound right-turn traffic. Also assumes modifications to the signal timings that would allow a lag phasing for the northbound left-turn movement on Alma Street, the eastbound phase to be called before the westbound phase on Churchill Avenue, and increasing the green time for the westbound approach.

[4] Analysis includes elimination of the southbound right-turn lane on Alma to provide a larger waiting space for pedestrians on the northwest corner of the intersection.

Table 4
Alma and Churchill Intersection Queue Delays – Existing Conditions (PM Peak)

PM Peak Hour - Queue Delay (Seconds)					
Intersection	Lane	Existing [1]	Existing + Safety Improvement [2]	Existing + Safety + Signal Improvement [3]	Existing + Safety + Signal Improvement + No Right-Turn Lane [4]
Alma Street and Churchill Avenue	NBL	120	120	96	95
	NBT	20	19	20	20
	NBTR	20	19	20	20
	WBLTR	101	101	106	106
	SBL	157	157	**206**	**210**
	SBT1	37	35	40	40
	SBT2	38	37	42	**50**
	SBR	26	26	29	-
	EBLT	260	**566**	173	173
	EBR	187	**586**	136	136

Notes:

Avg Delay = Average Delay in seconds; LOS = Level of Service;

XXX - Bold indicated Where queue delay exceeds 25% of the queue delay under baseline conditions.

[1] Existing traffic conditions were analyzed based on pre COVID traffic volumes which reflect normal school operations. A total of 8 trains were assumed to operate during the weekday AM and PM commute peak hours and a total of 2 tranis were assumed to operate during the school PM peak hour.

[2] Safety improvements consists of relocation of the stop line on eastbound Churchill Avenue from east of the tracks to west of the tracks. The eastbound right-turn traffic would not be allowed to turn on red.

[3] Analysis assumes relocation of the stop line on eastbound Churchill Avenue to the west of the tracks and an overlap phasing for the eastbound right-turn traffic. Also assumes modifications to the signal timings that would allow a lag phasing for the northbound left-turn movement on Alma Street, the eastbound phase to be called before the westbound phase on Churchill Avenue, and increasing the green time for the westbound approach.

[4] Analysis includes elimination of the southbound right-turn lane on Alma to provide a larger waiting space for pedestrians on the northwest corner of the intersection.

Caltrain Electrification

This analysis scenario describes the impact of electrification on existing traffic conditions and with the proposed railroad safety improvements at Alma Street and Churchill Avenue. As Caltrain begins to modernize, it is expected that the number of trains will increase from 8 trains to 12 trains during both the AM and PM peak hours (based on the Caltrain Electrification EIR). This calculates to one train every five minutes. During the after school peak hour, it is assumed that the number of trains will increase from 2 trains under existing conditions to 4 trains (2 trains in each direction) with the electrification. Table 5 below summarizes AM, after school, and commute PM peak hour intersection delays and levels of service at the Alma Street and Churchill Avenue intersection with electrification and with the proposed railroad safety improvements with Caltrain electrification.

Table 5
Alma and Churchill Intersection Delay and Levels of Service – Caltrain Electrification Conditions

Intersection		Electrification [1]		Electrification + Safety Improvement [2]		Electrification + Safety + Signal Improvement [3]		Electrification + Safety + Signal Improvement + No Right-Turn Lane [4]	
		Avg. Delay	LOS	Avg. Delay	LOS	Avg. Delay	LOS	Avg. Delay	LOS
Alma Street and Churchill Avenue	AM	127.33	F	148.31	F	60.36	E	65.52	E
	After School	68.44	E	115.58	F	55.53	E	57.79	E
	PM	92.78	F	103.96	F	86.16	F	86.48	F

Notes:

Avg Delay = Average Delay in seconds; LOS = Level of Service;

[1] Elecrification conditions were analyzed with existing traffic volumes based on pre COVID conditions which reflect normal school operations. A total of 12 trains were assumed to operate during the weekday AM and PM commute peak hours and a total of 4 tranis were assumed to operate during the school PM peak hour.

[2] Safety improvements consists of relocation of the stop line on eastbound Churchill Avenue from east of the tracks to west of the tracks. The eastbound right-turn traffic would not be allowed to turn on red.

[3] Analysis assumes relocation of the stop line on eastbound Churchill Avenue to the west of the tracks and an overlap phasing for the eastbound right-turn traffic. Also assumes modifications to the signal timings that would allow a lag phasing for the northbound left-turn movement on Alma Street, the eastbound phase to be called before the westbound phase on Churchill Avenue, and increasing the green time for the westbound approach.

[4] Analysis includes elimination of the southbound right-turn lane on Alma to provide a larger waiting space for pedestrians on the northwest corner of the intersection.

As shown in Table 5, the analysis showed that the average intersection delay would increase significantly with electrification and the intersection would operate at unacceptable LOS F during the AM and PM peak hours and LOS E during after school peak. With the proposed safety improvements that include a pre-signal on eastbound Churchill Avenue that would restrict right turns on red, the analysis showed that vehicular traffic operations would further degrade, and the intersection would operate at unacceptable LOS F during all three time periods. With the recommended signal timing improvements/modifications described above under existing conditions, the analysis showed that the adverse effects of the pre-signal would be fully mitigated, and the intersection traffic operations would improve to better than the baseline electrification conditions. Tables 6, 7 and 8 show the queue delays for the through lanes and the turn lanes at the Alma/Churchill intersection during the AM peak, after school and PM peak hours with electrification. Although the analysis showed that reducing the green time on Alma Street in order to allocate additional green time to Churchill Avenue would result in an increase in delays for the southbound traffic on Alma, the proposed improvements/modifications to the traffic signal operations in conjunction with the railroad crossing improvements would decrease the delays for the eastbound Churchill traffic significantly resulting in a lower average intersection delay compared to the baseline electrification conditions.

Table 6
Alma and Churchill Intersection Queue Delays – Electrification Conditions (AM Peak)

AM Peak Hour - Queue Delay (seconds)					
Intersection	Lane	Electrification [1]	Electrification + Safety Improvement [2]	Electrification + Safety + Signal Improvement [3]	Electrification + Safety + Signal Improvement + No Right-Turn Lane [4]
Alma Street and Churchill Avenue	NBL	675	718	90	83
	NBT	69	74	29	28
	NBTR	71	76	30	30
	WBLTR	422	418	136	130
	SBL	147	147	**198**	**199**
	SBT1	30	29	**45**	**58**
	SBT2	33	31	**50**	**79**
	SBR	13	14	26	-
	EBLT	92	**217**	69	70
	EBR	28	**239**	32	33

Notes:

Avg Delay = Average Delay in seconds; LOS = Level of Service;

XXX - Bold indicated Where queue delay exceeds 25% of the queue delay under baseline conditions.

[1] Elecrification conditions were analyzed with existing traffic volumes based on pre COVID conditions which reflect normal school operations. A total of 12 trains were assumed to operate during the weekday AM and PM commute peak hours and a total of 4 tranis were assumed to operate during the school PM peak hour.

[2] Safety improvements consists of relocation of the stop line on eastbound Churchill Avenue from east of the tracks to west of the tracks. The eastbound right-turn traffic would not be allowed to turn on red.

[3] Analysis assumes relocation of the stop line on eastbound Churchill Avenue to the west of the tracks and an overlap phasing for the eastbound right-turn traffic. Also assumes modifications to the signal timings that would allow a lag phasing for the northbound left-turn movement on Alma Street, the eastbound phase to be called before the westbound phase on Churchill Avenue, and increasing the green time for the westbound approach.

[4] Analysis includes elimination of the southbound right-turn lane on Alma to provide a larger waiting space for pedestrians on the northwest corner of the intersection.

Table 7
Alma and Churchill Intersection Queue Delays – Electrification Conditions (After School)

After School - Queue Delay (Seconds)					
Intersection	Lane	Electrification [1]	Electrification + Safety Improvement [2]	Electrification + Safety + Signal Improvement [3]	Electrification + Safety + Signal Improvement + No Right-Turn Lane [4]
Alma Street and Churchill Avenue	NBL	168	185	83	83
	NBT	18	17	20	20
	NBTR	17	18	23	23
	WBLTR	87	84	108	108
	SBL	157	157	**198**	**208**
	SBT1	38	38	**47**	**49**
	SBT2	40	38	**49**	**58**
	SBR	21	21	30	-
	EBLT	260	**474**	89	87
	EBR	184	**485**	58	56

Notes:

Avg Delay = Average Delay in seconds; LOS = Level of Service;

XXX - Bold indicated Where queue delay exceeds 25% of the queue delay under baseline conditions.

[1] Elecrification conditions were analyzed with existing traffic volumes based on pre COVID conditions which reflect normal school operations. A total of 12 trains were assumed to operate during the weekday AM and PM commute peak hours and a total of 4 tranis were assumed to operate during the school PM peak hour.

[2] Safety improvements consists of relocation of the stop line on eastbound Churchill Avenue from east of the tracks to west of the tracks. The eastbound right-turn traffic would not be allowed to turn on red.

[3] Analysis assumes relocation of the stop line on eastbound Churchill Avenue to the west of the tracks and an overlap phasing for the eastbound right-turn traffic. Also assumes modifications to the signal timings that would allow a lag phasing for the northbound left-turn movement on Alma Street, the eastbound phase to be called before the westbound phase on Churchill Avenue, and increasing the green time for the westbound approach.

[4] Analysis includes elimination of the southbound right-turn lane on Alma to provide a larger waiting space for pedestrians on the northwest corner of the intersection.

Table 8
Alma and Churchill Intersection Queue Delays – Electrification Conditions (PM Peak)

PM Peak Hour - Queue Delay (Seconds)					
Intersection	Lane	Electrification [1]	Electrification + Safety Improvement [2]	Electrification + Safety + Signal Improvement [3]	Electrification + Safety + Signal Improvement + No Right-Turn Lane [4]
Alma Street and Churchill Avenue	NBL	187	187	100	99
	NBT	18	17	16	16
	NBTR	18	17	16	16
	WBLTR	171	173	**223**	**225**
	SBL	197	198	**246**	**248**
	SBT1	34	32	31	30
	SBT2	35	33	32	37
	SBR	28	27	22	-
	EBLT	572	**902**	495	478
	EBR	487	**938**	459	441

Notes:

Avg Delay = Average Delay in seconds; LOS = Level of Service;

XXX - Bold indicated Where queue delay exceeds 25% of the queue delay under baseline conditions.

[1] Elecrification conditions were analyzed with existing traffic volumes based on pre COVID conditions which reflect normal school operations. A total of 12 trains were assumed to operate during the weekday AM and PM commute peak hours and a total of 4 tranis were assumed to operate during the school PM peak hour.

[2] Safety improvements consists of relocation of the stop line on eastbound Churchill Avenue from east of the tracks to west of the tracks. The eastbound right-turn traffic would not be allowed to turn on red.

[3] Analysis assumes relocation of the stop line on eastbound Churchill Avenue to the west of the tracks and an overlap phasing for the eastbound right-turn traffic. Also assumes modifications to the signal timings that would allow a lag phasing for the northbound left-turn movement on Alma Street, the eastbound phase to be called before the westbound phase on Churchill Avenue, and increasing the green time for the westbound approach.

[4] Analysis includes elimination of the southbound right-turn lane on Alma to provide a larger waiting space for pedestrians on the northwest corner of the intersection.

Analysis of the optional improvement with electrification, which would require the elimination of the southbound right-turn lane on Alma Street in order to provide a larger waiting area for pedestrians and bicycles on the northwest corner of the Alma/Churchill Avenue intersection, showed that the average delay for the southbound approach on Alma Street would increase as all right turns would occur from the outer through lane on southbound Alma Street. However, with the implementation of the identified improvements/modifications to the traffic signal operations, the overall intersection delay during the three peak hour periods would be less than the average intersection delay under baseline electrification conditions.

CALA

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Educate
Live+Work
Connect
Sustain

February 8, 2021

Meeting Summary
Alma/ Churchill Safety Improvements
RE: Community Meeting #1
Date: January 21, 2021
Time: 6:30 p.m. to 7:45 p.m.

Attendees:

City of Palo Alto (City):

Ruchika Aggarwal	ruchika.aggarwal@cityofpaloalto.org
Philip Kamhi	philip.kamhi@cityofpaloalto.org
Rafael Rius	rafael.rius@cityofpaloalto.org
Ripon Bhatia	ripon.bhatia@cityofpaloalto.org
Sarah Wilson	sarah.wilson@cityofpaloalto.org

BKF Engineers (BKF):

Jason Yee	jyee@bkf.com
Jason Mansfield	jmansfield@bkf.com
Jonathon Centofranchi	jcentofranchi@bkf.com

Hexagon Transportation Consultants (HT):

Trisha Dudala	tdudala@hextrans.com

Callander Associates (CA):

Marie Mai	mmai@callanderassociates.com
Melinda Wang	mwang@callanderassociates.com

Community Members: 28 total

The purpose of this virtual meeting was to introduce the project, present existing conditions, and receive feedback from the public on preliminary designs. A formal presentation was followed by a question-and-answer session during which attendees could share their questions and comments verbally or through the Q&A panel in Zoom. Polls were conducted to better understand how attendees currently use the intersection and which of the two preliminary designs they preferred.

Poll Results Summary
Based on the results from Poll #1, nearly half of the respondents live within 3 blocks of the Alma Street /Churchill Avenue intersection. All of the respondents pass through this intersection, but only 1/4th of respondents use the intersection specifically to get to school or work. Forty-seven percent (47%) of respondents typically use multiple modes of transportation when traveling through this intersection, 42% typically only drive through this intersection, and the remaining 11% typically only bike through this intersection.

Results from Poll #2 indicate a slight preference for Concept #1, which proposes to retain the dedicated right-turn pocket on southbound Alma Street.

Group Discussion Summary
Attendees expressed a desire for pedestrian and bicycle safety improvements at this intersection. Some attendees were concerned that Concept 2 would prevent motorists from turning right from Alma Street southbound onto westbound Churchill Avenue. It was clarified that Concept 2 retains the ability for motorists to make a southbound right turn by providing a shared through/right turn lane. Some attendees expressed concerns about the impacts of the Churchill Avenue pre-signal creating a traffic backup for eastbound Churchill Avenue to El Camino Real. It was noted that based on the traffic analysis, the net effect of the pre-signal in conjunction with various signal phasing and timing changes would be a significant potential decrease in overall delay at the intersection. Attendees also had questions and comments regarding how the proposed changes will impact traffic within the intersection and along corridors adjacent to the intersection, documented below.

Questions and Comments Received (responses in non-italicized text)

<u>Questions</u>

- *Why is this project being considered if [the grade separation project] could completely change the Churchill crossing? What is the status of the grade separation project?*
    - This project attempts to address some of the immediate safety concerns. The proposed improvements are considered interim and can be completed over the next two or so years. The XCAP grade separation project will address the overall circulation and multimodal challenges of this intersection in a more comprehensive way, but it will require more time and major funding. Council is in the process of reviewing alternatives.
- *Will Concept 2 remove the right-turn movement from southbound Alma Street to westbound Churchill Avenue?*
    - Concept 2 will retain the ability for motorists to turn right from southbound Alma Street to westbound Churchill Avenue. The dedicated right-turn pocket would be removed, but motorists would be able to turn right using the proposed through/right turn lane.
- *How will the [pre-signal] on Churchill Avenue impact the traffic on El Camino Real (ECR)? Eliminating the right-turn on red option for eastbound Churchill Avenue to southbound Alma Street will cause significant back-up on Churchill Avenue.*
    - The introduction of the pre-signal alone would result in a backup for motorists heading eastbound on Churchill Avenue. However, signal timing and phasing modifications are proposed in conjunction with the pre-signal to mitigate the adverse effects of the pre-signal. When the northbound left turn lane on Alma Street receives a green light, the eastbound right turn on Churchill Avenue will also receive a green. There will also be more green time allocated to eastbound Churchill Avenue.
- *What will happen to the current encroachment into the Caltrain right-of-way (ROW) with Concept 2?*
    - Concept 2 will slightly reduce the existing 1' encroachment into Caltrain ROW.

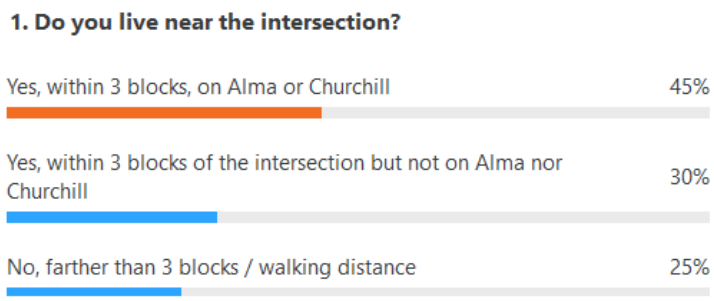
- *In the afternoon, if you are on Churchill Avenue heading west towards Stanford, each time a train passes the signal cycle restarts, giving right-of-way to motorists on Alma Street and motorists on Churchill Avenue may need to wait multiple cycles. Are there any proposed changes to the signal timing?*
    - Signal timing modifications would reduce the green time on Alma Street and reallocate it to eastbound and westbound Churchill Avenue. The sequence of the signal phasing would not change in order to give priority to traffic on Alma Street where there is more congestion during commute hours.
- *Can we ban cars on Churchill Avenue from Emerson Street to Alma Street so that bicyclists may use the whole lane and add a traffic light at Alma Street and Lowell Avenue to address diverted traffic from Churchill Avenue?*
    - The Churchill Avenue closure proposed in the XCAP grade separation project does not fully eliminate vehicular access to Churchill in order to retain access to adjacent residences. Multiple alternatives are being studied and the design is being further refined, but new concepts (such as full closure) are not being considered at this time.
- *Can a right turn lane be created in front of 25 Churchill Avenue or an entrance be provided off of ECR so that Palo Alto Unified School District traffic doesn't have to enter via Churchill Avenue?*
    - A right turn lane and extension of a bike slot are proposed at the intersection of Churchill Avenue/ECR as a part of the Churchill Avenue Enhanced Bikeways Project, and the right turn lane would start just west of the 25 Churchill Avenue driveway. No new driveways or modifications to existing driveways are proposed.

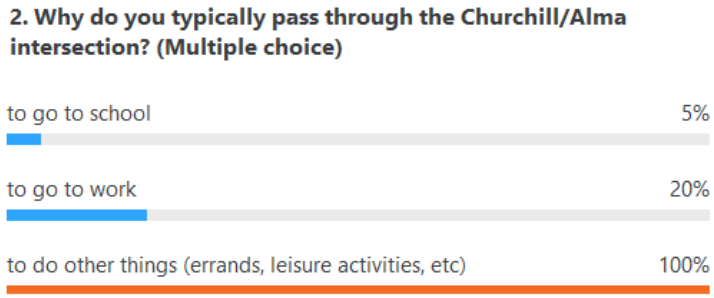
<u>Comments</u>

- *In Concept 2 when the railroad gates are down, a single car in the through right lane on southbound Alma Street will block one of the two through traffic lanes available.*
    - Motorists headed south on Alma Street in the through/right lane would need to wait if there is a driver who wants to turn right and head onto westbound Churchill Avenue, but the existing through movement at peak hours already frequently blocks the right turn queue. With the proposed design, there is no anticipated delay during off peak hours when there are fewer cars. There is an overall reduced delay in the intersection as a whole with the proposed signal modifications.
- *Proposed enhancements to queue space do not address the morning back-up of bicyclists at location C and the afternoon movement from Paly HS towards location Z.*
    - This project focuses on pedestrian improvements, and the future XCAP project will address bicycle circulation improvements.
- Enforce the morning through restriction (Left Turn Only, 7:45 AM to 8:30AM) for westbound Churchill Avenue to southbound Alma Street. This would allow bicyclists to get to school more safely.
    - City staff has previously informed the Police Department of this issue and will notify them again.
- *Consider green bike lanes on Churchill Avenue to increase the visibility of (bicyclists and) bike lanes.*

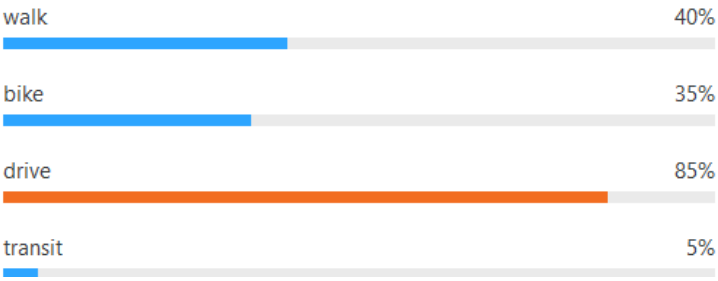
    - The Churchill Avenue Enhanced Bikeway Project proposes green bike lanes at conflict points between the school entrance on Churchill Avenue to Alma Street.
- *Someone was killed on the tracks today. It would be worth the cost if the proposed improvements could have prevented the incident.*
    - The Federal Railroad Administration (FRA) and Caltrans identified this crossing as one in need of safety improvements and the pre-signal is a specific feature identified to improve safety. The project and this community meeting are a part of the City's effort to improve the safety of this intersection.
- *The intersection needs to be improved because many pedestrians and bicyclists get caught in front of the railroad gates at the intersection.*
- *Pause the XCAP grade separation project until after these adjustments are made. In support of this project.*
- *Retain clear access from the intersection to the Embarcadero Bike Path.*
    - This project does not propose any changes to access to the bike path.
- *Consider adding a signal (pedestrian hybrid beacon) or a crossing guard at the Churchill Avenue entrance to Paly HS to improve safety.*

Poll #1
Responses received for Poll #1: 19





3. How do you typically travel through the intersection? (Multiple choice)

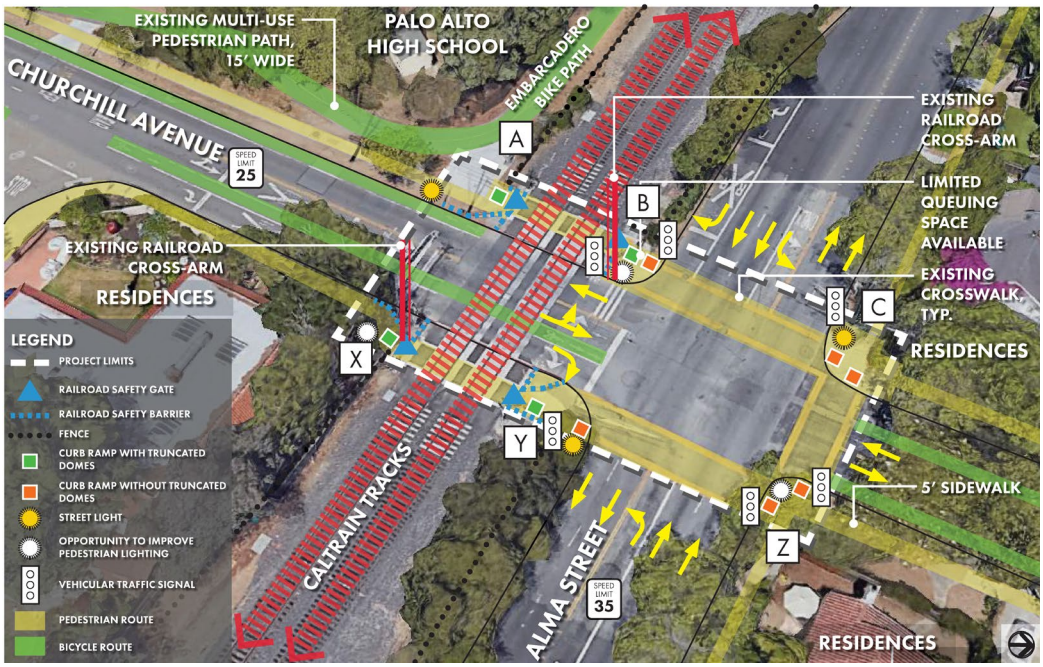


Poll #2

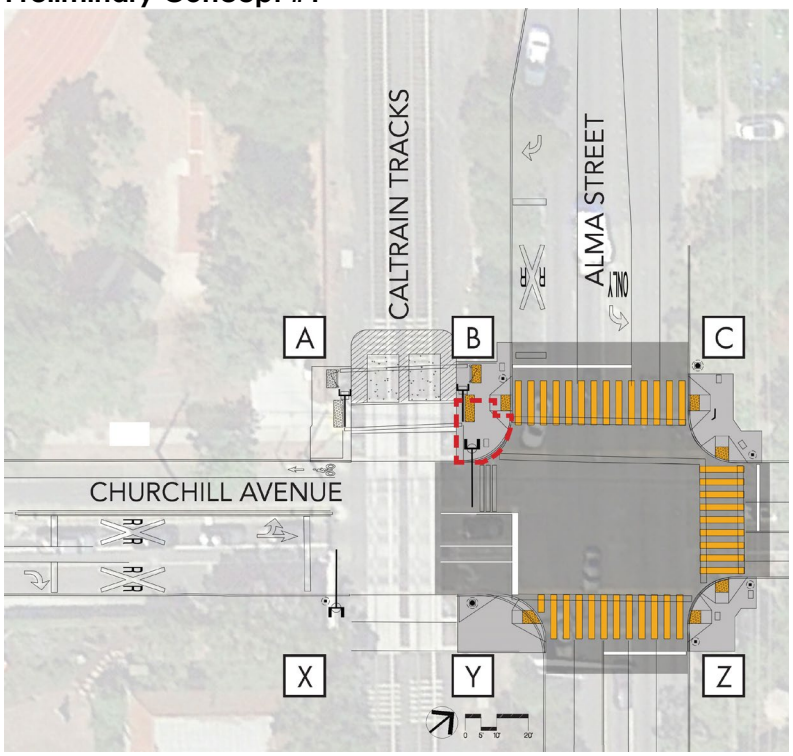
Responses received for Poll #2: 10

1. Which option do you prefer?

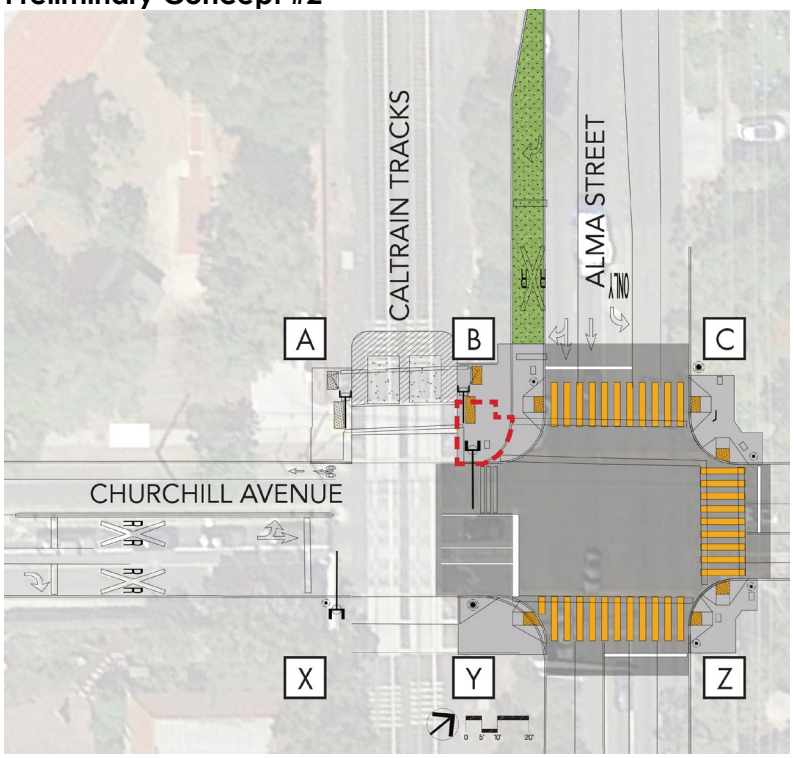
Opportunities and Constraints Diagram



Preliminary Concept #1



Preliminary Concept #2



The information above is Callander Associates' understanding of items discussed and decisions reached at the meeting. Callander Associates is proceeding with the project based on this understanding.

Submitted by:

Melinda Wang
Callander Associates

cc: All attendees

CALA

www.callanderassociates.com

Recreate
Educate
Live+Work
Connect
Sustain

February 19, 2021

Meeting Summary
Alma/ Churchill Safety Improvements
RE: PABAC Meeting #1
Date: February 2, 2021
Time: 6:15 p.m. to 8:00 p.m.

Attendees:

City of Palo Alto (City):

Ruchika Aggarwal	ruchika.aggarwal@cityofpaloalto.org
Rafael Rius	rafael.rius@cityofpaloalto.org
Ripon Bhatia	ripon.bhatia@cityofpaloalto.org
Joanna Chan	Joanna.chan@cityofpaloalto.org
Sylvia Star-Lack	sylvia.star-lack@cityofpaloalto.org

City of Palo Alto Pedestrian and Bicycle Advisory Committee (PABAC):

Ken Joye	Robert Neff
Cedric de la Beaujardiere	Cathy Durham
Eric Nordman	Rob Robinson
Stephen Rock	Art Liberman
Kathy Durham	

Not present: Arnout Boelens, Nicole Zoeller Boelens, Bill Courington, Penny Ellson, Paul Goldstein, Jane Rothstein, Richard Swent, Alan Wachtel, Bill Zauman

BKF Engineers (BKF):

Jason Mansfield	jmansfield@bkf.com
Jonathon Centofranchi	jcentofranchi@bkf.com

Callander Associates (CA):

Marie Mai	mmai@callanderassociates.com

The purpose of this virtual meeting was to introduce the project, present existing conditions, and receive feedback from the Pedestrian and Bicycle Advisory Committee (PABAC) on preliminary designs. A formal presentation was followed by an opportunity for PABAC members to share their questions and comments. Due to time constraints not every committee member was able to verbally share their feedback. Instead, they were encouraged to submit follow-up questions via e-mail to staff. Items noted below were discussed and/or decided upon in our meeting.

Item	***Response***
1. Can the connection between westbound Churchill Avenue to northbound Embarcadero trail/bike path be improved? Can the train horn frequency be reduced?	Opportunities to improve the path connection will be evaluated. The horn frequency is a federal requirement so cannot be changed.
2. One person felt the "B to Z" bike movement is unsafe and not addressed, while another felt the opposite because of the very few cars and the larger volume of bicyclists	Noted
3. Bicyclists are uncomfortable or simply cannot make the Churchill crossing at Paly driveway/Castilleja Avenue because of the large volume of cars with many different turning movements.	Noted
4. The XCAP project is still a few years away from being implemented, so these project improvements would be beneficial to the community. Committee member supported the concept with the stormwater component (ie. Concept 2).	Noted
5. Many students end up on the "wrong" side of Churchill Avenue when heading eastbound because they're coming from the Embarcadero bike path. Can a pedestrian/bike only or scramble phase be considered at this intersection?	A scramble phase would cause significant delay because of the train pre-emption so would not be feasible at this intersection.
6. Evaluate afternoon signal phasing to encourage "proper" bicycle circulation. Can the Y to Z crosswalk have priority over the B to C crosswalk?	Phasing will be evaluated.
7. Consider a bike box between the railway and Alma Street to give bicyclists more space.	Bike box and other enhancements will be evaluated.
8. Consider restricting right turns on westbound Churchill Avenue during	Right-turn restriction to be evaluated.

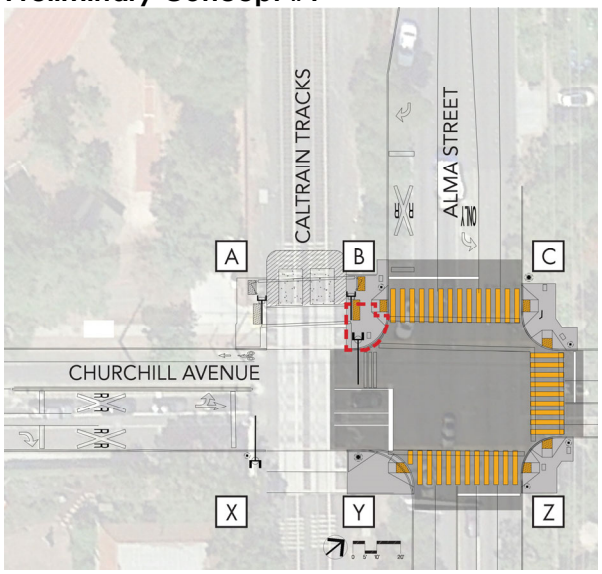
morning hours in addition to the existing morning through-restriction.

9. Will Caltrain fence locations be modified at locations A and B to align with the new crosswalk?

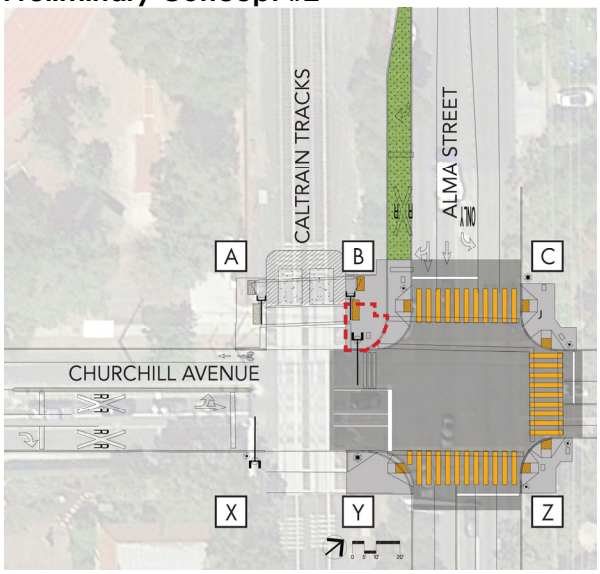
   Fence locations will be evaluated.

10. Committee member supports the larger queuing space, particularly as shown in Concept #2. Continue evaluating ways to improve pedestrian/bike circulation.

Preliminary Concept #1



Preliminary Concept #2



The information above is Callander Associates' understanding of items discussed and decisions reached at the meeting. Callander Associates is proceeding with the project based on this understanding.

Submitted by:

Melinda Wang
Callander Associates

cc: All attendees

LIMITS OF CHURCHILL AVE PAVEMENT IMPROVEMENTS

ASPHALT PAVING

5'-WIDE SMOOTH ASPHALT TRANSITIONS TO CONCRETE PANEL GRADE CROSSING

10' ASPHALT TAPER

ALMA ST

CHURCHILL AVE

MARIPOSA AVE

CASTILLEJA AVE

CLEAR

118'-5 3/4"

STOP

29+50

30+00

30+50

C20 C21 C22 C23

BC STA. 29+18.54, 19.35' L BEGIN FLUSH ACCESS

STA. 29+18.39, 29.14' L END AC PATH

STA. 29+22.25, 37.17' L MATCH EX. AC

STA. 29+27.89, 37.14' L END FLUSH ACCESS

STA. 29+27.94, 33.47' L END CURB & SIDEWALK

EC

STA. 29+66.48, 37.15 BEGIN FLUSH ACCESS

STA. 29+84.03, 37.23' L END SIDEWALK & PATH

STA. 29+80.15, 18.77' L BEGIN FLUSH ACCESS

STA. 29+41.12, 62.96' R MATCH EX. CURB END CURB

STA. 29+41.12, 42.04' R 2' CURB PERFORATION

STA. 29+41.12, 60.16' R END SIDEWALK

STA. 29+29.16, 48.05' R SIDEWALK TRENCH

STA. 29+63.35, 63.04' R MATCH EX. CURB BEGIN CURB

STA. 29+76.86, 63.07' R BEGIN SIDEWALK

STA. 29+69.17, 56.32' R 20" TREE

STA. 29+65.35, 45.18' R BC

STA. 29+69.02, 31.59' R CENTER LINE OF ACCESSIBLE RAMP

STA. 29+79.64, 21.35' R CENTER LINE OF ACCESSIBLE RAMP

STA. 29+92.35, 18.18' R EC

STA. 30+18.10, 28.86' R END SIDEWALK

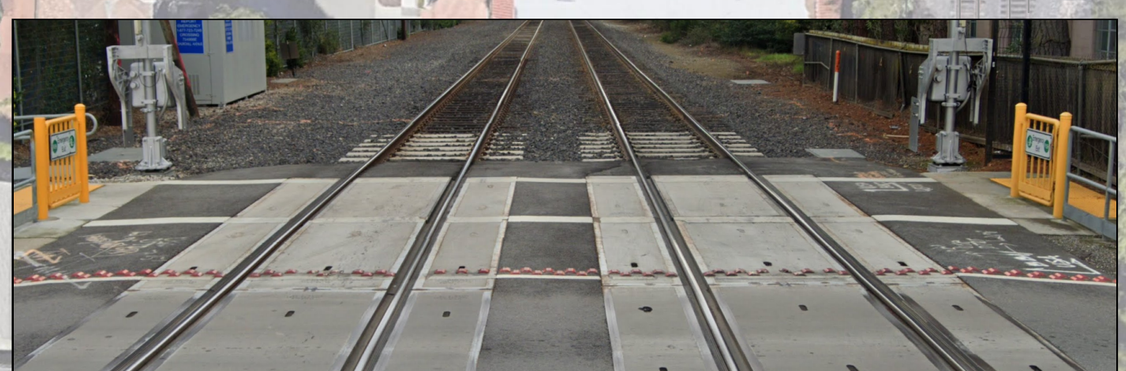
STA. 30+18.09, 18.18' R MATCH EX. CURB END CURB

CONCRETE, CITY

CONCRETE. JPB

ASPHALT, CITY

ASPHALT, JPB



GRAPHIC SCALE
20 0 20 40

255 SHORELINE DRIVE
SUITE 200
REDWOOD CITY, CA 94065
(650) 482-6300
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ALMA ST CHURCHILL AVE INTERSECTION IMPROVEMENT PROJECT
CONCEPTUAL PAVING LIMITS

SANTA CLARA COUNTY CALIFORNIA

PALO ALTO

No.	Revisions

Date 3/10/2021
Scale AS SHOWN
Design JC
Drawn JC
Approved JM
Job No 2019112

Sheet Number:
FIG1
1 OF 1

DRAWING NAME: K:\2019\191912_PaloAlto_ChurchillAve\ENG\EXHIBITS\Proposed_Plan_Alternatives_Exhibit\Paving_Limits_Exhibit.dwg
PLOT DATE: 03-11-21 PLOTTED BY: yeej

PALO ALTO
HIGH SCHOOL

BOL BOL BOL

SD

S-BUS-40
AASHTO 2011 (US)

ONLY

ALMA STREET

SSCO

HCR

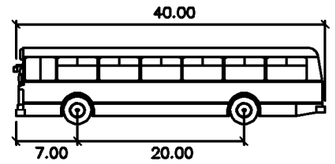
~R13'

~R19.5'

RR

RR

CHURCHILL AVENUE



S-BUS-40
feet

Width	: 8.00
Track	: 8.00
Lock to Lock Time	: 6.0
Steering Angle	: 34.4

GRAPHIC SCALE

20 0 20 40

SCHOOL BUS TURNING MOVEMENT

RAILROAD CROSSING SAFETY
IMPROVEMENT PLAN - EXISTING
ALMA STREET & CHURCHILL AVENUE
APRIL 2021

PREPARED BY

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JOB NO. 20191912

SHEET 1 OF 3 SHEETS

Plot Apr 07, 2021 at 10:38am

TurningMovement.dwg

PALO ALTO
HIGH SCHOOL

ALMA STREET

ONLY

CHURCHILL AVENUE

S-BUS-40
AASHTO 2011 (US)

R15'

R20'

CLEAR

KEEP

RR

SD

BOL

SSCO

40.00

7.00

20.00

S-BUS-40
feet

Width	: 8.00
Track	: 8.00
Lock to Lock Time	: 6.0
Steering Angle	: 34.4

GRAPHIC SCALE

20 0 20 40

SCHOOL BUS TURNING MOVEMENT

RAILROAD CROSSING SAFETY
IMPROVEMENT PLAN - ALTERNATIVE 1
ALMA STREET & CHURCHILL AVENUE
APRIL 2021

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JOB NO. 20191912

Plot Apr 07, 2021 at 10:38am

TurningMovement.dwg

PALO ALTO
HIGH SCHOOL

BOL BOL BOL

SD

S-BUS-40
AASHTO 2011 (US)

ONLY

ALMA STREET

SSCO

SSCO

R20'

R20'

CLEAR

KEEP

KEEP

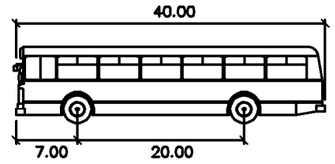
CLEAR

CHURCHILL AVENUE

S-BUS-40
AASHTO 2011 (US)

S-BUS-40
AASHTO 2011 (US)

S-BUS-40
AASHTO 2011 (US)



S-BUS-40
feet

Width	: 8.00
Track	: 8.00
Lock to Lock Time	: 6.0
Steering Angle	: 34.4

GRAPHIC SCALE

20 0 20 40

SCHOOL BUS TURNING MOVEMENT

RAILROAD CROSSING SAFETY
IMPROVEMENT PLAN - ALTERNATIVE 2
ALMA STREET & CHURCHILL AVENUE
APRIL 2021

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BKF ENGINEERS
255 SHORELINE DRIVE
SUITE 200
REDWOOD CITY, CA 94065
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SHEET 3 OF 3 SHEETS

Plot Apr 07, 2021 at 10:38am

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