Caltrain Grade Separation in Palo Alto
Churchill Crossing: An Alternative
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There has been much discussion about how to achieve grade separation at the Caltrain crossing at Churchill Avenue in Palo Alto. The city has presented a number of options in past years, but all have met with significant resistance. This proposal is an attempt to address the concerns of residents while meeting the requirements of Caltrain.

The goal of this proposal is to preserve as much of the access provided by the Churchill/Alma intersection as possible.

Churchill Grade Crossing Options To Date

Close Churchill Avenue

Not a true grade separation alternative, closing Churchill and adding a bike/pedestrian tunnel for crossing Alma is probably the least expensive option. It also insulates bikes and pedestrians from cars. However, there is widespread concern about traffic impacts on El Camino, Embarcadero and Oregon Expressway if current Churchill traffic – approximately 9500 cars per average weekday – is diverted. Based on a survey conducted in July 2019, it also appears that a majority of Southgate residents are opposed to closing Churchill Avenue.

Churchill-only Viaduct

Many residents whose properties are adjacent to the tracks oppose a viaduct because they fear that having an elevated structure so close to their homes will materially affect their privacy, their views, and other aspects of their quality of life. In addition, there are widespread fears that an elevated train would too-radically transform the Palo Alto visual landscape and cause train noise to be distributed more widely. Raising, then lowering, the tracks for at-grade train stations may also concern Caltrain, which may wish to avoid frequent height changes.

Hybrid Design

In the most common version of this option, the train is raised halfway and the roads are lowered halfway. By reducing the height of the train relative to grade, a hybrid mitigates some of the concerns about the Viaduct, but in most versions involves significant property takings.
Underground Options – Tunnel or Trench

Lowering the grade for train traffic below ground has a number of aesthetic and functional advantages very appealing to residents. However, both underground options are by far the most expensive designs and require the longest construction time, with accompanying disruption of traffic along Alma. They also involve significant property takings, as the temporary tracks would need to be placed along Alma, preventing residents from accessing their properties during construction.

Design Objectives

Analysis of previous options and their drawbacks leads to the following objectives for the Churchill Avenue crossing:

1. Separate Caltrain tracks from Churchill Avenue
2. Take no private properties
3. Allow vehicular access to Alma from Churchill Avenue
4. Improve bike and pedestrian safety while crossing Alma
5. Avoid rapid grade changes along the tracks (don’t convert Caltrain into a roller coaster)

Design Features of This Proposal

1. Separates Caltrain from Churchill Avenue
2. Requires no property takings
3. Partially closes Churchill Avenue, but preserves access to Alma – and therefore downtown and south Palo Alto – for Southgate and other residents west of Alma.
4. Prevents use of Churchill as a cut-through to Embarcadero, thereby reducing traffic congestion on Churchill east of Alma (Churchill East).
5. Keeps Caltrain at grade level – i.e., no raising or lowering of tracks
6. Separates bicycle and pedestrian traffic crossing Alma from car traffic
7. Provides a bridge over Churchill Avenue to the bike trail next to Palo Alto High School
8. All infrastructure is at or below grade level, so it doesn’t create an eyesore like that of a viaduct
The Proposal - A Modified Underpass

This proposal achieves these goals by creating a modified underpass at the Alma/Churchill intersection. It requires lowering both Churchill and Alma about 21 feet to allow West Churchill to pass underneath the Caltrain tracks, while keeping East Churchill at grade and closing it to through traffic from West Churchill. While a full underpass would preserve all traffic, bike, and pedestrian access between Churchill and Alma, it would also require the taking of many private properties. This proposal sacrifices some movement of traffic but avoids takings by stopping the underpass at East Churchill while preserving one lane at existing grade on both Alma and Churchill to allow access to properties on those streets. The underpass depth and road slope/grade is copied from the Jefferson Street underpass in Redwood City.

The most significant traffic-flow change is that no through traffic is allowed on Churchill across Alma. The table below summarizes traffic movement at the Alma/Churchill intersection.

For cars on Alma approaching the Churchill intersection:

<table>
<thead>
<tr>
<th></th>
<th>Left onto Churchill</th>
<th>Right onto Churchill</th>
<th>Straight through</th>
</tr>
</thead>
<tbody>
<tr>
<td>southbound on Alma</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>northbound on Alma</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

For cars on Churchill approaching the Alma intersection:

<table>
<thead>
<tr>
<th></th>
<th>Left onto Alma</th>
<th>Right onto Alma</th>
<th>Straight through</th>
</tr>
</thead>
<tbody>
<tr>
<td>eastbound on Churchill</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>westbound on Churchill</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
</tr>
</tbody>
</table>

All pedestrian and bike access is preserved and separated from car traffic on Alma and Churchill.

Eastbound Churchill Traffic

From studies published by the City of Palo Alto, it appears that eastbound Churchill Ave. traffic is split in three relatively equal ways: south on Alma, north on Alma, and continuing east of Churchill, most of which is likely heading for Embarcadero.
Overhead View (looking straight down) of the Intersection

The above illustration is a bird’s-eye view of the Alma/Churchill intersection. Traffic on West Churchill from El Camino and much of Southgate enters from the bottom. There are two lanes on Churchill as it approaches Alma: one for turning left and one for turning right. No traffic can cross Alma to the other side. Traffic heading west on Churchill from the east side of Alma (entering from the top) can only turn right on Alma, heading north. There is no access to southbound Alma or the other side of Churchill from East Churchill.
Alma Traffic
Cars heading north on Alma have three choices:

• Stay at grade in the right lane and turn right onto Churchill heading east
• Descend and continue north on Alma in the left lane
• Merge into the left turn lane to head west on Churchill

Cars heading south on Alma have no access to Churchill East (no left turn), but can

• Turn right onto Churchill heading west using the right-turn lane
• Continue south in the other two lanes

(Note: The existing right-turn lane is shown in these illustrations, but it would be possible to eliminate it with this design, since right-turning traffic would no longer need to queue due to preemption by the train.)

Churchill Traffic
Cars heading east on Churchill from Southgate or El Camino can

• Descend and turn left or right onto Alma
• Stay at grade in the right-hand lane and turn right onto Mariposa.

Cars heading west on Churchill from Alma have the same access to Mariposa as they have today (no left turn onto Mariposa is currently permitted).

Cars heading west on Churchill from east of Alma can only turn right onto Alma to head north. There is no access to Alma southbound or to the other side of Churchill.

Preserving Private Property
The right turn lane onto Mariposa allows access to Mariposa from Churchill, but also allows those houses along Churchill to have access to their driveways even though Churchill is descending below grade.

Similarly, the right-hand lane on northbound Alma remains at grade, allowing access to driveways along Alma while also providing access to Churchill heading east.
This is how an underpass at Churchill is possible without taking private property. There may be some disruption during construction, however.

**Bike and Pedestrian**
Bicyclists and pedestrians cross Alma on an overpass (at grade level since Alma is lowered) then pass underneath Caltrain in a tunnel, emerging along Churchill.

**References**
In this document, the portion of Churchill east of Alma is referred to as East Churchill. The portion west of Alma (between Alma and El Camino) is referred to as West Churchill.
Overview of the Intersection

The illustration below is a perspective view looking down at the intersection from the northeast.

Most of Alma drops down to the Churchill underpass. West Churchill goes under the Caltrain tracks which remain at grade level. East Churchill also remains at grade and connects to one northbound lane of Alma. Bikes and pedestrians cross Alma on a bridge, then follow the ramps to a tunnel under Caltrain. The bike trail crosses Churchill on a bridge.

The intersection will need a traffic light, to allow left turns off Alma and to allow Churchill traffic to turn onto Alma.
Below is a perspective view of the intersection looking south along Alma.

This illustration shows the intersection and underpass at Churchill, about 21 feet below grade level. The right hand northbound Alma lane (on the left side of the illustration above) continues at grade level providing access to East Churchill and the properties along Alma. Southbound lanes move right to provide space for a northbound left turn lane. The lanes today also move slightly right to make room for the left turn lane at Churchill, but that turn has been eliminated. The right turn lane has also been eliminated, since no cars need to queue for a right turn.

Bikes and pedestrians cross Alma using the overpass bridge.
This illustration is a perspective view looking north along Alma toward the Alma/Churchill intersection.

Both southbound lanes and one northbound lane are lowered to allow connection to the Churchill Ave underpass. The right-hand northbound lane stays at grade level to provide access for the driveways along Alma and to East Churchill Avenue.
This illustration is a perspective view looking east along West Churchill toward the Alma/Churchill intersection.

Traffic heading east on West Churchill enters one of two lanes, turning either left or right onto Alma. There is no through route to East Churchill. The right most lane provides driveway access for the properties along Churchill and to Mariposa Ave. All bike and pedestrian traffic is diverted to the bike trail and sidewalk on the left side of Churchill, which connect to the tunnel under the Caltrain tracks and the bridge over Alma.
This illustration is a perspective view looking down at the Alma/Churchill intersection from above East Churchill.

This shows East Churchill and the right-hand northbound lane of Alma. Only right turns are permitted. A traffic light will be needed to allow pedestrians and bikes to cross over to the bridge and enter Caltrain tunnel.
**West Churchill**

To the right is an overhead view (looking straight down) of West Churchill showing the Castilleja and Mariposa intersections. East is up.

The road layout is unchanged between El Camino and Castilleja. The traffic lane veers left and splits into left and right turns lanes for Alma. Churchill traffic can only turn left (north) or right (south) at Alma.

Cars wanting access to Mariposa move to the right and proceed to the intersection with Mariposa. This lane also provides access to the properties along Churchill that would otherwise be inaccessible because of the lowering of Churchill.

Cars on Mariposa heading to Churchill or Alma must use Miramonte and Castilleja.

No right turn off Churchill onto Mariposa for cars heading west is possible, but that turn is now prohibited.

Eastbound bikes have two options:

a) they can stay right, proceed up past Mariposa and cross Churchill on the bridge to access the bike trail.

b) they can cross Churchill at Castilleja and travel up to the entrance to the bike/pedestrian tunnel under Caltrain, and proceed to East Churchill.

There is no bike access to Alma from Churchill.
East Churchill

Below is an overhead view (looking straight down) of East Churchill and the Alma intersection. East (ish) is up.

There is no southbound Alma access to East Churchill (no left turn from southbound Alma). There is no access to southbound Alma for traffic traveling west on East Churchill.

The right hand lane of northbound Alma continues at grade allowing access from the properties along Alma near the Churchill intersection, between Coleridge and Kellogg Avenues. Access to these properties is only from northbound Alma. Cars exiting these driveways must turn north on Alma.

Pedestrians and bikes cross the single northbound Alma lane and then over the rest of Alma on a bridge. A crossing light will be needed at Churchill.
This illustration is a perspective view of the Alma/Churchill intersection looking down from above the Palo Alto High school.

The bike trail along the High School continues to a bridge over Churchill and connects to Mariposa. The trail also continues along Churchill to the Palo Alto High School entrance at Castilleja. The bike and pedestrian bridge over Alma enters the tunnel under the Caltrain via a ramp and reemerges on the other side of the tracks with a ramp connecting to the bike trail.
Bike and Pedestrian Access.

One goal was to eliminate the need for bikes and pedestrians to cross Alma. This is mostly achieved with the tunnel under the tracks and a bridge over Alma, although there is still a need to cross the right-hand northbound lane of Alma.

The bridge over the Alma/Churchill intersection connects with a ramp leading to a tunnel under the Caltrain tracks and then emerges along Churchill.

The tunnel appears in the illustration to the right, which shows the East Churchill bridge over Alma and the ramps down to the tunnel.

The curve in the tunnel serve two purposes:

a) it make bike transit easier (no sharp turns)

b) it eliminates corners for someone to lurk behind (to enhance safety)
Implementation Issues

There are three issues that have to be addressed for this to proceed:

1. Will Caltrain permit the encroachment onto their right-of-way for the ramp leading to the tunnel under the tracks?

2. Splitting the lanes on Alma to prevent taking properties introduces some safety issues, such as an abutment between the two lanes that could be a hazard. This needs to be investigated, but there are mitigations for the safety issues. There are many examples of this configuration elsewhere in California.

3. The bike/pedestrian ramp will extend onto the Palo Alto High School property on the Alma side. The high school will need to be consulted.

Thanks to Susan Newman and Mike Dixon for contributions to this proposal.