Summary of Evaluation

CITY OF PALO ALTO

Meadow-Charleston Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Trench	Hybrid	Viaduct	Underpass
A	Facilitate movement across the corridor for all modes of transportation	- ▨▨▨▨■■■ + Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.	- ▨▨▨▨■■■ + Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open.	- ▨▨▨▨■■■ + Meadow Drive and Charleston Road will be grade separated from the railroad for all modes and will remain open. Viaduct provides opportunities for additional crossings for all modes.	- ▨▨▨▨■■▨ + East/West (through) traffic on Meadow Drive and Charleston Road will be grade separated from the railroad and Alma Street for all modes. Turning movements from Meadow Drive to southbound Alma Street will be prohibited. Turning movements from northbound Alma Street will require a U-turn at Alma Village Circle. All turning movements on Charleston Road to/from Alma Street will be permitted; however, some movements will be facilitated via a roundabout approximately 600 feet east of Alma Street, resulting in longer routes for all modes compared to the Trench, Hybrid, and Viaduct alternatives.
B	Reduce delay and congestion for vehicular traffic at rail crossings	- ▨▨▨▨■■▨ + With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by the railroad crossing gates.	- ▨▨▨▨■■▨ + With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by the railroad crossing gates.	- ▨▨▨▨■■▨ + With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by the railroad crossing gates.	- ▨▨▨▨■■■ + With construction of the grade separation, the railroad crossing gates and warning lights at Meadow Drive and Charleston Road will be removed. Thus, the traffic will not be interrupted by the railroad crossing gates. Pedestrian and cyclist mode separation will also help reduce intersection congestion. Some turning movements will be prohibited at the Alma/Meadow intersection and thus would use the Charleston Road intersection or the new signal at Alma Village Circle. At the Alma/Charleston intersection, some turning movements will increase overall delays due to the circuitous nature of the movements, as vehicles would need to use the Charleston roundabout and return to the Alma intersection to complete the movements (e.g. eastbound left-turns to Alma, northbound left-turns and southbound right-turns to Charleston).
C	Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles	- ▨▨▨▨■■▨ + Pedestrians/cyclists will be separated from train traffic. Conflicts between pedestrians/cyclists and motor vehicles will remain at the Alma intersections. Bike lanes will be added to Meadow Drive and Charleston Road intersections. Additional pedestrian/cyclist separations routes can be explored in the next phase of design.	- ▨▨▨▨■■▨ + Pedestrians/cyclists will be separated from train traffic. Conflicts between pedestrians/cyclists and motor vehicles will remain at the Alma intersections. Bike lanes will be added to Meadow Drive and Charleston Road intersections. Additional pedestrian/cyclist separations routes can be explored in the next phase of design.	- ▨▨▨▨■■▨ + Pedestrians/cyclists will be separated from train traffic. Conflicts between pedestrians/cyclists and motor vehicles will remain at the Alma intersections. Bike lanes will be added to Meadow Drive and Charleston Road intersections. Additional pedestrian/cyclist separations routes can be explored in the next phase of design.	- ▨▨▨▨■■■ + Pedestrians and cyclists traveling east/west will be completely separated from train and vehicular traffic on Alma Street. Full pedestrian and cyclist movement is maintained. Pedestrians and cyclists will have more circuitous routes traveling east/west across the corridor because the pedestrian/bike path is located on one side of the street only: on the south side of Meadow Drive and on the north side of Charleston Road. For example, cyclists traveling eastbound on Charleston Road near Ruthelma Street will have to cross Charleston Road to get onto the north side of the road, then cross Charleston Road again at the roundabout near Mumford Place to get back onto the right/south side of the road.

Impact ⟷ Improvement

Most Impact	- ■■■▨▨▨▨ +
Moderate Impact	- ▨■■▨▨▨▨ +
Some Impact	- ▨▨■▨▨▨▨ +
Neutral (No Impact or Improvement)	- ▨▨▨■▨▨▨ +
Some Improvement	- ▨▨▨▨■▨▨ +
Moderate Improvement	- ▨▨▨▨■■▨ +
Most Improvement	- ▨▨▨▨■■■ +

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Meadow-Charleston Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Trench	Hybrid	Viaduct	Underpass
D	Support continued rail operations and Caltrain service improvements	- ■ ■ ■ + A temporary railroad track will be required, and a crossover track located north of the San Antonio Caltrain Station will be relocated. With the pump stations, there will be potential risks to train operations from flooding.	- ■ ■ ■ + A temporary railroad track will be required, and a crossover track located north of the San Antonio Caltrain Station will be relocated.	- ■ ■ ■ + A temporary railroad track will be required, and a crossover track located north of the San Antonio Caltrain Station will be relocated.	- ■ ■ ■ + A temporary railroad track is likely to be required unless an alternate construction methodology and sequencing is acceptable to Caltrain.
E	Finance with feasible funding sources (order of magnitude cost)	- ■ ■ ■ + The trench will require greater levels of local funding in the form of fees, taxes or special assessments, the feasibility of which are still being studied in the context of overall citywide infrastructure funding needs.	- ■ ■ ■ + The hybrid would require lower levels of local funding, with a substantial portion of capital costs covered by Regional, State and Federal sources.	- ■ ■ ■ + The viaduct would require substantial local funding resources more than the hybrid alternative, but less than the trench and viaduct alternatives.	- ■ ■ ■ + The underpass will require substantial local funding resources more than the hybrid alternative, but less than the trench and viaduct alternatives.
F	Minimize right-of-way acquisition (Private property only)	- ■ ■ ■ + Subsurface acquisition will be required for the ground anchors for the trench retaining walls and private properties will be required for creek diversion pump station.	- ■ ■ ■ + No acquisition of private properties is required; however, driveway modifications will be required.	- ■ ■ ■ + No acquisition of private properties is required.	- ■ ■ ■ + Five (5) full private property acquisitions are required in multiple locations (two at Meadow Drive and three at Charleston Road). Multiple driveway modifications will be also required. Partial acquisition of residential properties and removal of trees will be required at various locations and summarized below: At Meadow Drive: • Six (6) front yard acquisitions on both sides of Meadow between 2nd Street and Park Boulevard. • One (1) side yard acquisition on the north side of Meadow, just west of Emerson Street. • Five (5) backyard acquisitions on the south side of Meadow between Alma Street and Emerson Street. At Charleston Road: • On both sides of Charleston between Ruthelma Avenue and Park Boulevard. Seven (7) front yard acquisitions; two (2) on the north side, five (5) on the south side of Charleston. • One (1) side yard acquisition on the south side of Charleston between Park Boulevard and the railroad tracks. • Eight (8) property acquisitions on both sides of Charleston between Alma St and Wright Place; six (6) backyard acquisitions on the north side of Charleston, and two (2) front yard acquisitions on the south side of Charleston (closest to Alma). • Eight (8) acquisitions between Wright Place and Mumford Place; six (6) backyard acquisitions on the north side of Charleston and two (2) front yard acquisitions on the south side of Charleston. • Six (6) property acquisitions along Alma Street between Charleston Road and Ely Place; five (5) backyard acquisitions, and one side yard acquisition (closest to Ely Place).

Impact ◄► Improvement

- Most Impact
- Moderate Impact
- Some Impact
- Neutral (No Impact or Improvement)
- Some Improvement
- Moderate Improvement
- Most Improvement

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Meadow-Charleston Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Trench	Hybrid	Viaduct	Underpass
G1	Reduce rail noise and vibration	- ▫▫▫▫■▫▫+ Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing EMU trains instead of diesel locomotives will also reduce noise. Trains operating in trench will reduce noise in neighborhoods. Acoustically treated trench walls will eliminate acoustical reflections. There would be a slight reduction to vibration levels at nearby receptors.	- ▫▫▫▫■▫▫+ Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing EMU trains instead of diesel engines will also reduce noise. Six-foot high parapet sound barriers will help reduce propulsion and wheel/rail noise. There would be a slight reduction to vibration levels at nearby receptors.	- ▫▫▫▫■▫▫+ Train horn noise and warning bells will be eliminated with the replacement of the at-grade crossings with grade separations. Utilizing EMU trains instead of diesel engines will also reduce noise. Six-foot high parapet sound barriers will help reduce propulsion and wheel/rail noise. There would be significant reduction to vibration levels at nearby receptors.	- ▫▫▫▫■▫▫+ Train horn noise and warning bells will be eliminated by the replacement of the at-grade crossings with grade separations. Utilizing EMU trains rather than diesel engines will also reduce noise. Modern rail bridge design will reduce excess structural noise. Sound barriers will also help to reduce propulsion and wheel/rail noise. There would be little to no change to vibration levels at nearby receptors. An optional 6-foot high noise barrier near the tracks and on the overpass structure could significantly reduce wheel/rail and propulsion noise.
G2	Sea Level Rise Susceptibility	- ■■■▫▫▫▫+ The low point of the track profile (Elevation 4 feet) for the trench alternative would be close to the projected sea level rise inundation zone for the year 2100 (a sea level rise of 3.42 feet). The trench's track profile is below the estimated groundwater (approximately between Elevation 20 and 25) for about 4,000 feet along the track. Increased groundwater elevations from sea level rise would further expose the trench to emergent groundwater by 2100. A pump station is proposed, but groundwater depletion and additional studies would be needed to further assess the feasibility of this alternative.	- ▫▫■▫▫▫▫+ The hybrid alternative would be outside of the projected sea level rise inundation zone for the year 2100. The low point of the proposed roadway for the Hybrid at Meadow (Elevation 30 feet) is about 9 feet higher than current groundwater (Elevation 21). The low point of the proposed roadway for the Hybrid at Charleston (Elevation 34 feet) is about 12 feet higher than current groundwater (Elevation 22). Increased groundwater elevations from sea level rise can damage a roadway from below, increasing the likelihood of cracks, potholes, and sinkholes.	- ▫▫▫■▫▫▫+ The viaduct structure is not anticipated to be affected by sea level rise or emergent groundwater.	- ▫■■▫▫▫▫+ The underpass alternative would be outside of the projected sea level rise inundation zone for the year 2100. The low point of the proposed roadway for the underpass at Meadow (Elevation 12 feet) is about 9 feet below current groundwater (Elevation 21). The low point of the proposed roadway for the underpass at Charleston (Elevation 16 feet) is about 6 feet below current groundwater (Elevation 22). Increased groundwater elevations from sea level rise would further expose the underpass alternative to emergent groundwater by 2100.
G3	Heat Island Effect	- ▫▫▫■▫▫▫+ Construction extents are limited to the existing railroad tracks. Negligible changes to heat island effects due to minimal changes to land use.	- ▫▫■▫▫▫▫+ The replacement of asphalt pavement for roadway grading results in some impact to heat island effects, because newer asphalt pavement surfaces have lower albedo ratings that will increase with age. Lower albedo ratings are less favorable because more light is absorbed, which heats up the surrounding air.	- ▫▫▫■▫▫▫+ Construction extents are limited to the existing railroad tracks. Negligible changes to heat island effects due to minimal changes to land use.	- ▫▫▫▫■▫▫+ As the alternative with the largest construction extents, the replacement of existing darker concrete with new concrete with higher albedo ratings results in some expected improvement to heat island effects. Higher albedo ratings are more favorable because more light is reflected, which can help cool the surrounding air.
G4	Stormwater Treatment	- ■■■▫▫▫▫+ Construction extents are limited to the existing railroad tracks. Significant changes to the amount of stormwater runoff generated from project area expected, due to changes in land use from existing railroad ballast to significantly more impervious concrete surfaces.	- ▫▫▫■▫▫▫+ Changes to land use and additional impervious areas (i.e., new underpass bridge) are minimal.	- ▫▫▫■▫▫▫+ Construction extents are limited to the existing railroad tracks. With the assumption that runoff from the raised viaduct can all be directed to the underlying vegetated areas, no net increase in runoff generation is expected.	- ▫■■▫▫▫▫+ As the alternative with the largest construction extents and changes to land use, especially with the conversion of existing vegetated areas to concrete and asphalt surfaces, a moderate impact to the amount of stormwater to be treated is expected.
H	Maintain access to neighborhoods, parks, and schools along the corridor, while reducing regional traffic on neighborhood streets	- ▫▫▫▫■■■+ No diversion of regional traffic with construction of grade separations.	- ▫▫▫▫■■■+ No diversion of regional traffic with construction of grade separations.	- ▫▫▫▫■■■+ No diversion of regional traffic with construction of grade separations.	- ▫■■▫▫▫▫+ Regional traffic will be diverted due to the restricted turning movements; however, travel in all directions will be possible, but may require a longer route and take more time. Turning movements at Ely Place will be limited to right turns on northbound Alma Street only. Pedestrian and cyclist access will improve due to mode separation.

Impact ◄► Improvement

- Most Impact: - ■■■▫▫▫▫+
- Moderate Impact: - ▫■■▫▫▫▫+
- Some Impact: - ▫▫■▫▫▫▫+
- Neutral (No Impact or Improvement): - ▫▫▫■▫▫▫+
- Some Improvement: - ▫▫▫▫■▫▫+
- Moderate Improvement: - ▫▫▫▫■■▫+
- Most Improvement: - ▫▫▫▫■■■+

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Meadow-Charleston Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Trench	Hybrid	Viaduct	Underpass
I	Minimize visual changes along the corridor	- ■ ■ ■ + Railroad tracks will be below grade with high fencing at grade. Landscaping options will be limited to plants with shallow roots in areas where ground anchors are required for the trench retaining walls.	- ■ ■ ■ + Railroad tracks will be approximately 15 feet above grade. Landscaping with trees will be incorporated for screening where feasible. During the winter, late afternoon (after 3 pm) shadows are significant on the east side of the structure as they extend to the west-facing, residential properties on the east side of Alma Street.	- ■ ■ ■ + Railroad tracks will be approximately 20 feet above grade. Landscaping with trees will be incorporated for screening where feasible. Shadows from the viaduct structure extend about 15 feet from each side of the structure in the mid-morning (9 am) and mid-afternoon (3 pm) hours during the summer solstice. During the winter, late afternoon (after 3 pm) shadows are significant on the east side of the structure as they extend to the west-facing, residential properties on the east side of Alma Street.	- ■ + Railroad tracks will remain at-grade. On Charleston Road, removal of the planting strip on both sides of the road will be required along with the planting strip on the east side of Alma Street between Charleston Road and Ely Place.
J	Minimize disruption and duration of construction	- ■ ■ ■ + Extended road closures at Meadow Drive and Charleston Road are required. Construction would last for approximately 6 years.	- ■ ■ ■ + Extended lane reductions at Alma Street, Meadow Drive, and Charleston Road will be required. Construction would last for approximately 4 years.	- ■ ■ ■ + Extended lane reductions along Alma Street are required. Construction would last for approximately 2.5 to 3 years.	- ■ ■ ■ + Lane reductions and temporary closures (nights/weekends only) on Alma Street, a closure of Meadow Drive between Emerson Street and Park Boulevard, and a closure of Charleston Road between Alma Street and Park Boulevard will be required for the majority of construction. The total duration of construction will be approximately 3.5 to 4 years; however the durations are subject to change depending on the construction methodologies used.
	Order of magnitude cost	TBD, likely between $1.5B and $2B*	$390M to $480M*	$790M to $980M*	$690M to $850M*

Meadow-Charleston Evaluation of Engineering Challenges

	Engineering Challenges	Trench	Hybrid	Viaduct	Underpass
L	Creek/Drainage Impacts	- ■ ■ ■ + • Requires diversion of Adobe and Barron creeks resulting in the need for pump stations. • Numerous regulatory agency approvals required for creek diversion. • Pump stations also required to dewater the trench. • Increased risk of flooding due to pump stations.	- ■ ■ + • Pump stations required for lowered roadways. • Increased risk of flooding due to pump stations.	- ■ + • No significant creek or drainage impacts.	- ■ ■ + • Pump station required for lowered roadways. • Increased risk of flooding due to pump station.

Impact ◄► Improvement

- Most Impact: - ■ ■ ■ +
- Moderate Impact: - ■ ■ +
- Some Impact: - ■ +
- Neutral (No Impact or Improvement): - ■ +
- Some Improvement: - ■ +
- Moderate Improvement: - ■ ■ +
- Most Improvement: - ■ ■ ■ +

* Total Preliminary Construction Cost for infrastructure of both railroad crossings in 2024 dollars, and includes escalation to 2031 (Subject to Change).

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Meadow-Charleston Evaluation of Engineering Challenges

	Engineering Challenges	Trench	Hybrid	Viaduct	Underpass
M	Long-Term Maintenance	- ■ ■ ■ ◪ ◪ ◪ ◪ + Increased maintenance costs due to: • Pump stations for creek diversions. • Pump stations for trench dewatering. • Below ground railroad alignment.	- ◪ ■ ■ ◪ ◪ ◪ ◪ + Increased maintenance costs due to: • Pump stations for roadway drainage. • Above ground railroad alignment with embankments and undercrossing structures.	- ◪ ◪ ■ ◪ ◪ ◪ ◪ + Increased maintenance costs due to: • Above ground railroad alignment with embankments and viaduct structures.	- ◪ ■ ■ ◪ ◪ ◪ ◪ + Increased maintenance cost due to: • Pump stations for underpass dewatering. • Above ground structures for both road and rail.
N	Utility Relocations	- ■ ■ ■ ◪ ◪ ◪ ◪ + • Major utility relocations for lowered railroad.	- ◪ ■ ■ ◪ ◪ ◪ ◪ + • Moderate amount of utility relocations for utility relocations for lowered roadways.	- ◪ ◪ ■ ◪ ◪ ◪ ◪ + • Some utility relocations required.	- ■ ■ ■ ◪ ◪ ◪ ◪ + • Major utility relocation due to the fully lowered roadway.
O	Railroad Operations Impacts during Construction	- ■ ■ ■ ◪ ◪ ◪ ◪ + • Temporary track (i.e., shoofly) is required.	- ◪ ■ ■ ◪ ◪ ◪ ◪ + • Temporary track (i.e., shoofly) is required, but a bit shorter than the trench shoofly.	- ◪ ◪ ■ ◪ ◪ ◪ ◪ + • Temporary track (i.e., shoofly) is required.	- ◪ ■ ■ ◪ ◪ ◪ ◪ + • Temporary track (i.e., shoofly) likely required unless an alternate construction methodology and sequencing is acceptable to Caltrain.
P	Local Street Circulation Impacts during Construction	- ◪ ■ ■ ◪ ◪ ◪ ◪ + • Removal of right turn lanes on Alma Street at Meadow Drive and Charleston Road; however, traffic will still be able to flow as needed despite lane reduction. • Closes Meadow Drive while Charleston Road roadway bridges are constructed and visa versa.	- ■ ■ ■ ◪ ◪ ◪ ◪ + • Removal of right turn lanes on Alma Street at Meadow Drive and Charleston Road; however, traffic will still be able to flow as needed despite lane reduction. • Alma Street, Charleston Road, and Meadow Drive reduced to 2 lanes (one lane each direction).	- ◪ ◪ ■ ◪ ◪ ◪ ◪ + • Reduced number of lanes on Alma Street. • Possible night time closures of Meadow Drive and Charleston Road.	- ■ ■ ■ ◪ ◪ ◪ ◪ + • Lane reduction on Alma Street during construction of the shoofly and bridge. • Closure of Meadow Drive and Charleston Road throughout excavation and construction of the undercrossing and related features.
Q	Caltrain right-of-way Impact (Probability of approval by Caltrain of permanent encroachment inside Caltrain's right-of-way is unknown at this time).	- ◪ ■ ■ ◪ ◪ ◪ ◪ + Permanent encroachment inside Caltrain's right-of-way is required to accommodate pump station(s).	- ◪ ◪ ◪ ■ ◪ ◪ ◪ + Permanent encroachment inside Caltrain's right of way is required to accommodate the southbound right turn lane from Alma Street.	- ◪ ◪ ■ ◪ ◪ ◪ ◪ + No permanent encroachment inside Caltrain's right-of-way is required. However, options of a linear park or dual use under the viaduct would require Caltrain approval.	- ◪ ◪ ◪ ■ ◪ ◪ ◪ + No permanent encroachment inside Caltrain's right-of-way is required.
R	Caltrain Design Exceptions Needed	2% grade on track required. Maximum grade allowed by Caltrain is 1%.	Temporary vertical clearance of 12 feet at undercrossing structures during construction. Minimum vertical clearance allowed by Caltrain is 16.5 feet.	1.4% grade on track required. Maximum grade allowed by Caltrain is 1%.	No Caltrain design exceptions required.

Impact ◄► Improvement

- Most Impact: - ■ ■ ■ ◪ ◪ ◪ ◪ +
- Moderate Impact: - ◪ ■ ■ ◪ ◪ ◪ ◪ +
- Some Impact: - ◪ ◪ ■ ◪ ◪ ◪ ◪ +
- Neutral (No Impact or Improvement): - ◪ ◪ ◪ ■ ◪ ◪ ◪ +
- Some Improvement: - ◪ ◪ ◪ ◪ ■ ◪ ◪ +
- Moderate Improvement: - ◪ ◪ ◪ ◪ ■ ■ ◪ +
- Most Improvement: - ◪ ◪ ◪ ◪ ■ ■ ■ +

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Churchill Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Closure with Mitigations	Partial Underpass
A	Facilitate movement across the corridor for all modes of transportation	- + Churchill Avenue will be closed to vehicles at the railroad tracks. Pedestrians and cyclists will be grade separated from the railroad in Option 1. For Option 2, pedestrians and cyclists will be grade separated from the railroad and vehicle traffic on Alma Street.	- + Churchill Avenue will be grade separated from the railroad for all modes and will remain open. Through traffic on Churchill Avenue is no longer possible, and some traffic will have to take alternate routes. Pedestrian/bike (only) traffic will be grade separated from the railroad and vehicle traffic on Alma Street via an undercrossing at Kellogg Avenue or Seale Avenue.
B	Reduce delay and congestion for vehicular traffic at rail crossings	- + With closure of Churchill Avenue, traffic will be diverted to Embarcadero and Page Mill Road and thus, nearby intersections will be impacted; however, operational improvements are proposed at the Embarcadero/Kingsley/Alma intersection, El Camino Real intersections at Embarcadero Road and Page Mill Road and Alma/Oregon Expressway interchange that would mitigate the traffic impacts.	+ With construction of the grade separation, the railroad crossing gates and warning lights at Churchill Avenue will be removed. Thus, the traffic will not be interrupted by the railroad crossing gates. Pedestrian undercrossing at Kellogg Avenue or Seale Avenue will also help reduce intersection congestion.
C	Provide clear, safe routes for pedestrians and cyclists crossing the rail corridor, separate from vehicles	+ Pedestrians/cyclists will be separated from train traffic and vehicles.	+ Pedestrians and cyclists will be completely separated from train and vehicular traffic. Full pedestrian and cyclist movement is maintained with a new undercrossing at Kellogg Avenue or Seale Avenue.
D	Support continued rail operations and Caltrain service improvements	- + A temporary railroad track will not be required.	- + A temporary railroad track is likely to be required unless an alternate construction methodology and sequencing is acceptable to Caltrain.
E	Finance with feasible funding sources (Order of magnitude cost)	- + The closure would require the lowest levels of local funding, with a substantial portion of capital costs covered by Regional, State and Federal sources.	- + The underpasses would require lower levels of local funding, with a substantial portion of capital costs covered by Regional, State, and Federal sources.
F	Minimize right-of-way acquisition (Private property only)	- + No acquisition of private properties is required; however, there will be impacts to the Palo Alto High School property. Loss of street parking and removal of the planter strip on both sides of Churchill Avenue, east of Alma Street, will be required for the pedestrian/bike undercrossing (Option 2 only).	- + A partial acquisition of the high school and/or residential property fronting Churchill Avenue on the west side of the tracks in the vicinity of Mariposa Avenue will be required. Driveway modifications, removal and relocation of planter strips, and fifteen (15) partial acquisitions of residential properties will be required due to widening of Alma Street between Melville Avenue and Lowell Avenue. For the pedestrian undercrossing at Kellogg Avenue (or Seale Avenue), loss of street parking and removal of the planter strip on both sides of the street will be required for approximately 250-300 feet from (east of) Alma Street. The number of properties to be affected are as follows: • For an undercrossing at Kellogg Avenue, four (4) on the north side and five (5) on the south side of Kellogg Avenue. In addition, a partial acquisition of the high school near the bleachers will be required. • For an undercrossing at Seale Avenue, four (4) on the north side and four (4) on the south side of Seale Avenue.
G1	Reduce rail noise and vibration	- + Train horn noise and warning bells will be eliminated with the removal of the at-grade crossings with roadway closure. Utilizing EMU trains instead of diesel engines will also reduce noise. There would be no change to vibration levels at nearby receptors. An optional 6-foot high noise barrier near the tracks could significantly reduce wheel/rail and propulsion noise.	- + Train horn noise and warning bells will be eliminated by the replacement of the at-grade crossings with grade separations. Utilizing EMU trains rather than diesel engines will also reduce noise and some road noise would be reduced. Modern rail bridge design will reduce excess structural noise. There would be little to no change to vibration levels at nearby receptors. An optional 6-foot high noise barrier near the tracks and on the overpass structure could significantly reduce wheel/rail and propulsion noise.
G2	Sea Level Rise Susceptibility	- + The closure alternative would be outside of the projected sea level rise inundation zone for the year 2100. The lowest pedestrian underpass elevations (27 feet at Kellogg, and 20 feet at Seale Avenue) would still be well above current groundwater levels (Elevation 8-11 feet).	- + The underpass alternative would be outside of the projected sea level rise inundation zone for the year 2100. The lowest elevations (27 feet for the pedestrian underpass at Kellogg, 25 feet for the roadway underpass at Churchill and 20 feet for the pedestrian underpass at Seale Avenue) would still be well above current groundwater levels (Elevation 8-11 feet). This alternative is not anticipated to be affected by sea level rise or emergent groundwater.

Impact ◄► Improvement

- Most Impact
- Moderate Impact
- Some Impact
- Neutral (No Impact or Improvement)
- Some Improvement
- Moderate Improvement
- Most Improvement

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Churchill Evaluation of City Council-Adopted Criteria

	Evaluation Criteria	Closure with Mitigations	Partial Underpass
G3	Heat Island Effect	- + The introduction of new vegetated areas, with higher albedo ratings than asphalt surfaces and increased provision of shading, southwest of the Alma St & Churchill Ave intersection results in an expected improvement to heat island effects. Higher albedo ratings are more favorable because more light is reflected, which can help cool the surrounding air.	- + The combination of replacing existing concrete with lighter albedo concrete and replacing existing asphalt with darker albedo asphalt pavements results in an expected neutral impact to heat island effects.
G4	Stormwater Treatment	- + The introduction of new vegetated areas, with lower runoff coefficients and higher expected perviousness, southwest of the Alma St & Churchill Ave intersection results in some expected reduction in stormwater generation.	- + Due to the large area of regraded (lowered) and replaced impervious surfaces the volume of runoff requiring treatment will increase substantially as compared to existing conditions.
H	Maintain access to neighborhoods, parks, and schools along the corridor, while reducing regional traffic on neighborhood streets	- + Vehicle access will be diverted and resultant regional traffic will be mitigated. Pedestrian and cyclist access will improve to mode separation.	- + Regional traffic will be diverted due to the restricted turning movements. Pedestrian and cyclist access will improve due to mode separation.
I	Minimize visual changes along the corridor	- + Railroad tracks remain at existing grade. Residual roadway areas from the closure provide opportunities for landscaping at Churchill between Mariposa Avenue and the tracks. Some tree removals will be required on both sides of Churchill for a length of approximately 250-300 feet east of Alma Street to accommodate a ped/bike ramp down the center of Churchill (Option 2 only).	- + The railroad tracks and the northbound lanes of Alma Street will remain at-grade, and the east side of Churchill Avenue will remain unchanged. Mature trees and overhead power poles within the Alma Street planting strip, from just north of Kellogg Avenue to just south of Coleridge Avenue, will be removed. Landscaping restoration is limited due to space constraints.
J	Minimize disruption and duration of construction	- + The closure will have minimal road closures (nights/weekends only). Construction would last for approximately 2 years.	- + Closure of Churchill Avenue between Alma Street and Mariposa Avenue will be required for the majority of construction. Alma Street will be one-way northbound for approximately 6+ months. Total duration of construction will be approximately 2.5 to 3 years; however the durations are subject to change depending on the construction methodologies used.
	Order of magnitude cost	$90M to $120M*	$260M to $320M*

Churchill Evaluation of Engineering Challenges

	Engineering Challenges	Closure with Mitigations	Partial Underpass
L	Creek/Drainage Impacts	-+ • Pump station required for lowered pedestrian/bike undercrossing. • Increased risk of flooding with pump stations. • Relocation of the pump house at Embarcadero Road required to accommodate widening of Alma Street.	-+ • Pump station required for lowered roadways. • Increased risk of flooding due to pump station.
M	Long-Term Maintenance	- + Increased maintenance costs due to: • Pump stations for undercrossing drainage.	- + Increased maintenance cost due to: • Pump stations for underpass drainage. • Above ground structures for both road and rail.

Impact ◄► Improvement

- Most Impact
- Moderate Impact
- Some Impact
- Neutral (No Impact or Improvement)
- Some Improvement
- Moderate Improvement
- Most Improvement

* Total Preliminary Construction Cost for infrastructure of the railroad crossing in 2024 dollars, and includes escalation to 2031 (Subject to Change).

The color of the matrix is comparative between each alternative at this location.

Summary of Evaluation

CITY OF PALO ALTO

Churchill Evaluation of Engineering Challenges

	Engineering Challenges	Closure with Mitigations	Partial Underpass
N	Utility Relocations	- ■ ■ + • Potential utility relocations in Alma Street and Churchill Avenue for pedestrian/bike undercrossing. • Minor utility relocations for Embarcadero Road/Alma Street improvements.	- ■ ■ + • Major utility relocations for lowered roadways.
O	Railroad Operations Impacts during Construction	- ■ + • No temporary track (i.e., shoofly) required, only single tracking during nights and weekends.	- ■ ■ + • Temporary track (i.e., shoofly) likely required unless alternate construction methodology and sequencing is acceptable to Caltrain.
P	Local Street Circulation Impacts during Construction	- ■ + • Path along Palo Alto High School will temporarily be impacted during construction. • Temporary night and weekend closure of lanes on Churchill Avenue, Alma Street, Embarcadero Road, El Camino Real, and Oregon Expressway.	- ■ ■ + • Lane reduction on Alma Street during construction of the shoofly and bridge. • Likely closure of Churchill Avenue throughout the excavation and construction of the undercrossing and related features. • Likely closure of Kellogg Avenue for the duration of the pedestrian underpass construction; driveway access from one direction only.
Q	Caltrain right-of-way Impact (Probability of approval by Caltrain of permanent encroachment inside Caltrain's right-of-way is unknown at this time).	- ■ ■ + Requires permanent longitudinal encroachment inside Caltrain's right-of-way for the pedestrian/bike ramps for undercrossing Option 1.	- ■ ■ + • Requires permanent longitudinal encroachment inside Caltrain's right-of-way for the pedestrian/bike ramps (to the undercrossing at Kellogg Avenue) and for the lanes/shoulders for southbound Alma Street. • No longitudinal encroachment inside Caltrain's right-of-way required for the pedestrian/bike underpass at Seale Avenue.
R	Caltrain Design Exceptions Needed	None required.	No Caltrain design exceptions needed.

Impact ◄► Improvement

- Most Impact
- Moderate Impact
- Some Impact
- Neutral (No Impact or Improvement)
- Some Improvement
- Moderate Improvement
- Most Improvement

The color of the matrix is comparative between each alternative at this location.