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AECOM

Ravenswood Avenue Railroad Crossing Project

City Contract No. 1854
Project Study Report

City of Menlo Park

March 2019

FINAL

Project Study Report (PSR)

To

Request Approval to Proceed to the Project Approval and Environmental Document Phase

On Ravenswood Avenue in the City of Menlo Park, CA

Between El Camino Real and Noel Drive

Figure 1. Vicinity Map

1. Executive Summary

Ravenswood Avenue, Oak Grove Avenue, Glenwood Avenue and Encinal Avenue are the four Caltrain rail crossings, all at-grade, in the City of Menlo Park. Ravenswood Avenue is considered the most critical of the four crossings due to its higher traffic volumes than the other crossings along the Caltrain corridor.

This report describes and evaluates two Build alternatives for a grade separation that eliminates, at a minimum, the Ravenswood Avenue at-grade crossing. Three design alternatives were initially evaluated and two alternatives, Alternative A – Underpass; Railroad At-Grade and Lower Roadway (Ravenswood Avenue only and leave Oak Grove, Glenwood, and Encinal Avenues open as existing), and Alternative C – Hybrid; Partially Elevate Railroad and Partially Lower Three (3) Roadways (Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue and leave Encinal Avenue open as existing), were chosen by City Council in April 2017 for final evaluation. At the same council meeting, City Council voted in favor of including a reconfigured station with a center boarding platform and an outside passing track, if required in the future, into the study alternatives.

In May 2018, a comparison of the alternatives was made to the community and City Council based on project issues and concerns such as construction costs, right of way impacts and impacts to the adjacent properties. City Council voted in favor of Alternative A and also requested additional studies be prepared; these are currently being initiated and will be prepared as a supplemental document to this PSR.

In January 2019, City Council heard additional public comments regarding community preference of Alternative C and opposition to Alternative A and voiced their support for Alternative C as the preferred alternative to complete the PSR. On January 31, 2019, the City Council Rail Subcommittee directed staff to return to City Council with the preferred alternative selection of Alternative C. Formal approval was made subsequently at the City Council meeting on March 5, 2019.

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This project study report has been prepared under the direction of the following registered civil engineer. The registered civil engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based.

3/6/2019

REGISTERED CIVIL ENGINEER *DATE*

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3. Introduction

The City of Menlo Park, in cooperation with the San Mateo County Transportation Authority (SMCTA), and Caltrain, which is governed by the Peninsula Corridor Joint Powers Board (JPB), proposes to grade separate the Ravenswood Avenue railroad crossing (Milepost 28.98) in the City of Menlo Park.

Table 1. Project Summary

Project Limits	*On Ravenswood Avenue between El Camino Real to Noel Drive. On the Caltrain corridor between Encinal Avenue and San Francisquito Creek (See Figure 1)*
Number of Alternatives	*Two Build and One No-Build*
Current Capital Outlay Support Estimate for PA&ED	*$33.5M-$57.6M**
Current Capital Outlay Construction Cost Range	*$90.2M-$150.6M**
Current Capital Outlay Right-of-Way Cost Range	*$21.8M-$60.8M**
Funding Source	*Federal, State and Local (SMCTA Measure A)*
Type of Facility	*Ravenswood Avenue – "Avenue – Mixed Use" classification, # of lanes vary from 4 to 6 within project limits*
Number of Structures	*Two (for Alternative A) – Caltrain Underpass at Ravenswood Avenue and Alma Street Undercrossing* *Three (for Alternative C) – Caltrain Underpasses at Ravenswood, Oak Grove and Glenwood Avenues*
Anticipated Environmental Determination or Document	*CEQA Statutory Exemption (SE) and NEPA Categorical Exemptions (CEs) or an EA to support approval of a FONSI (See Section 11)*

* Cost range includes both Build alternatives.

4. Background

4.1 Existing Conditions

The Caltrain commuter rail runs north and south from San Francisco to Gilroy. The Peninsula Corridor Joint Powers Board (JPB) manages the Caltrain commuter rail operations on the San Francisco Peninsula corridor. As of 2018, Caltrain currently operates 92 passenger trains every weekday (both directions combined), 36 every Saturday and 36 every Sunday. When the Peninsula Corridor Electrification Project (PCEP) is complete, which is expected by 2022, the weekday train volume is projected to be 114 passenger trains. The weekday train volume is expected to more than double the current volume in 2030 after high speed rail trains go into service as part of the corridor's blended system.

In addition to Caltrain service, Union Pacific Railroad (UPRR) operates freight trains in the corridor. Approximately six UPRR freight trains run daily for five days per week and generally operate at night when Caltrain is not in operation, but they also run at other times of the day when Caltrain can accommodate them.

Within the City of Menlo Park, the Caltrain rail traverses east of and parallel to El Camino Real stopping at the Menlo Park Transportation Center, located near the intersection of El Camino Real and Santa Cruz Avenue. There are four at-grade railroad crossings in the City of Menlo Park (Ravenswood Avenue, Oak Grove Avenue, Glenwood Avenue, and Encinal Avenue).

The Ravenswood Avenue crossing experiences the highest traffic congestion conditions of the four at-grade crossings. Ravenswood Avenue is located in the center of Menlo Park and serves as a main east-west connector between US 101 and El Camino Real, as well as providing local access to the City's Civic Center, Burgess Park, numerous local businesses and services, and Menlo-Atherton High School. This crossing accommodates high vehicular traffic volumes; approximately 24,000 daily. It also has a large volume of bicycle and pedestrian traffic due to its proximity to the Menlo Park Caltrain Station and Transit Center; and is within walking and bicycling distance to many employment centers and local schools. Additionally, many local residents use this crossing location to travel between their homes, schools, shopping, and recreational venues.

In the existing condition, two railroad tracks cross Ravenswood Avenue. The existing at-grade crossing is currently protected by gates with flashing lights and warning bells, a separate gate for pedestrians, and a cantilever signal facing eastbound traffic. The center island gates are protected by a raised median.

Within the vicinity of the railroad crossing, Ravenswood Avenue has four lanes; two eastbound (EB) and two westbound (WB). See Figure 2. The two westbound lanes transition to four lanes as they approach El Camino Real.

In the westbound direction, Ravenswood Avenue contains a Class III bike route between Noel Drive and El Camino Real. In the eastbound direction, there is a Class II bike lane between El Camino Real and the tracks. East of the tracks, eastbound Ravenswood Avenue contains a Class III bike route. The existing roadway through the project limits has sidewalks on each side and a variable width median island.

Figure 2. Ravenswood Avenue Rail Crossing, facing East

The intersection of Alma Street with Ravenswood Avenue is immediately east of the rail crossing and has a high pedestrian volume due to trips from/to the rail station and to/from the nearby Menlo Park Library, City Hall, Arrillaga Family Recreation Center, and Burgess Park southeast of the intersection.

Ravenswood Avenue intersects with Alma Lane and Noel Drive at unsignalized T-intersections at approximately 220 feet and 370 feet respectively, east of the railroad crossing. Ravenswood Avenue intersects with Merrill Street at an unsignalized T-intersection approximately 140 feet west of the railroad crossing.

Approximately 370 feet west of the railroad crossing, Ravenswood Avenue intersects with El Camino Real at a signalized intersection. East of the intersection, Ravenswood Avenue contains two WB left turn lanes, one WB through, one WB right turn, and two EB through lanes. West of the intersection, Ravenswood

Avenue becomes Menlo Avenue and contains one WB through lane, one EB through/left turn, and one EB through/right turn lane. Just east of the tracks at Noel Drive, the two EB lanes merge into one lane.

At Laurel Street, both directions of Ravenswood Avenue contain a single left turn lane, one through lane, and a Class II bike lane.

4.2 Previous Studies

While numerous past efforts exploring grade separation of the railroad crossings have been prepared, this summary focuses on the prior efforts completed by the City of Menlo Park over the past 15 years. The studies described below are listed in chronological order highlighting the natural progression of these grade separation studies.

In June 2003, BKF Engineers (BKF) completed a preliminary grade separation study for this corridor of the Caltrain railroad tracks and roadways in Menlo Park. The report investigated four alternatives for grade separating the crossings:

- Alternative 1: Trench – Keep roads at their present elevation and lower the tracks
- Alternative 2: Overpass – Keep the tracks at their present elevation and raise the roads
- Alternative 3: Underpass – Keep the tracks at their present elevation and lower the roads
- Alternative 4: Split – Partially lower the roads and partially raise the tracks

The study included preliminary information regarding the general impact of the alternatives. In 2003, City Council affirmed the City staff's recommendation of the Split option as the preferred alternative. The council also requested that the Underpass Option be studied further; and to consider the practicality of closing Encinal Avenue and Glenwood Avenue.

In September 2004, a Feasibility Study Supplement was prepared by BKF. The following is a summary of the findings of the 2003-2004 studies:

- Trench Alternative
  - A fully-depressed trench not possible if work must be contained within the City's limits; this translates into a Split/Hybrid-like option
  - Not aesthetically-pleasing, a tall security fence would be required along the rail corridor
  - Drainage/flooding and long-term maintenance concerns of the tracks
  - Impact on the train station; station platforms must be constructed to a new elevation
- Road Overpass Alternative
  - Least impact to the railroad, no temporary (shoofly) track needed
  - Largest footprint, major visual impacts
  - Greatest community impacts, such as:
    - Disruptions to existing roadway network (for example, Alma Lane may no longer be directly connected to Ravenswood Avenue)
    - Disruptions to existing private driveway accesses
    - Greatest number of property impacts and acquisitions
- Road Underpass Alternative
  - Road/driveway connection impacts, but less (in quantity and magnitude) than the Road Overpass Alternative

  - Tall retaining walls would create an undesirable “tunnel effect”
  - Temporary (shoofly) tracks would be needed
  - Challenging construction staging
  - Property acquisitions are required, but less than the Road Overpass Alternative
- Split/Hybrid (Rail over Road) Alternative
  - Maintains the most existing road/driveway connections compared to other alternatives
  - Requires raised track embankment
  - Some visual impact due to the elevated rail, but the overall height of the proposed infrastructure is lower than the Road Overpass Alternative
  - Less impact to adjacent properties, compared to the Road Overpass and Road Underpass Alternatives
  - Impact on the train station; station platforms must be constructed to a new elevation

In 2013, the City was awarded a $750,000 grant from the San Mateo County Transportation Authority (SMCTA) Call for Grade Separation Projects to complete a project study report (PSR) for Ravenswood Avenue. The report process was scoped to include preparation of conceptual designs, assessment of local circulation and property impacts, community engagement, and identification of a preferred alternative.

At the time of grant award, the California High Speed Rail Authority (HSR) was considering a number of passing track alternatives, one of which included adding a third track through Menlo Park (Long Middle option). In order to account for this possible future scenario, the grant required that the project consider alternatives that would not preclude the addition of a third track through Menlo Park, but would not require the project to construct the infrastructure for a third track. In spring 2017, HSR removed from the current environmental analysis of the passing track option that would install a third track through Menlo Park. In late 2017, the HSR Authority announced its preliminary preferred passing track option to add two tracks (for a total of four tracks) between San Mateo and approximately Whipple Avenue in Redwood City, which would not include the addition of a third track in Menlo Park. Caltrain has not yet concurred with this preferred alternative and the HSR Authority is expected to finalize this decision through the environmental review of the San Jose to San Francisco segment in the coming years. The PSR reflects the original grant requirement.

In 2015, the City Council provided direction on two potential alternatives that should be evaluated as part of the project study report: 1) Undercrossing alternative: maintain the existing Caltrain tracks, and lower Ravenswood Avenue to pass under the tracks and 2) Hybrid or split alternative: partially raise the Caltrain tracks and partially lower the roadways under the tracks considering all four Menlo Park crossings for potential impacts. This report summarizes the results of this study.

5. Purpose and Need

There are operational and safety needs for grade separations at all four of Menlo Park’s Caltrain rail crossings, and especially at Ravenswood Avenue.

Of the City’s four at-grade railroad crossings, the Ravenswood Avenue crossing experiences the highest traffic congestion. Ravenswood Avenue is designated as an east-west truck route, accommodates several SamTrans bus lines, and provides access to key destinations including the Menlo Park Caltrain Station, downtown Menlo Park, Burgess Park, Civic Center, and Menlo-Atherton High School. Ravenswood Avenue also serves as a key multi-modal, east-west connection between US 101 and El Camino Real via Willow Road and Middlefield Road.

Congestion at the rail crossings at Ravenswood Avenue and the City's other east-west connections (Oak Grove, Glenwood, and Encinal Avenues) is expected to increase in the future as rail service increases. An evaluation of the traffic conditions is discussed in more detail in Section 8 of this PSR.

Ravenswood Avenue has the highest traffic volume and it also has the highest frequency of rail incidents of the four crossings in Menlo Park. The incident history at the Ravenswood Avenue rail crossing provided by the Federal Railroad Administration (FRA), shows that three incidents occurred over a 10-year period from August 2003 to August 2013.

Of these incidents, one resulted in a pedestrian fatality and one resulted in injuries to a single occupant inside a vehicle. The remaining incident involved a stalled vehicle on the tracks. The driver was able to exit the vehicle to avoid injury by the oncoming train.

Table 2 below is a summary of the accidents in the FRA database that have occurred at the four at-grade crossings within Menlo Park for the 10-year period between August 2003 and August 2013.

Table 2. Rail Accident Summary

At-Grade Crossing Intersection	Total	Fatalities	Injuries	No Injuries	Accidents Involving Pedestrians
Ravenswood Avenue	3	1	1	1	1
Oak Grove Avenue	0	0	0	0	0
Glenwood Avenue	1	1	0	0	1
Encinal Avenue	2	0	0	2	0

Based on collision data from the FRA, between August 2013 and January 2019, four additional collisions occurred at the four crossings, including a fatality of a pedestrian at Encinal Avenue and three incidents at Ravenswood Avenue; one non-injury accident, one injury accident and a fatality of a driver on westbound Ravenswood Avenue stopped in the traffic queue waiting for the signal at El Camino Real.

The purpose of the grade separation proposed at the Ravenswood Avenue railroad crossing is to:

- Remove the at-grade crossing and replace it with a grade separation structure, which will increase the safety of pedestrians, bicyclists, and motor vehicles by eliminating the conflict with the trains.
- Improve traffic operations, reduce queuing and thus, reduce the overall travel times, and improve east/west connectivity in the City.
- Reduce overall traffic congestion and stop-and-go movements, which will result in a reduction of motor vehicle emissions.
- Improve access to/from local destinations including the residential and business communities within the project area.

6. Corridor and System Coordination

The project has not yet been programmed in the Federal Transportation Improvement Program (FTIP). The project would be programmed into FTIP in the next phase, Project Approval & Environmental Document (PA&ED phase).

The proposed project is consistent with the City of Menlo Park Rail Policy which was modified on May 5, 2015 to allow consideration of an elevated rail option as part of the City's Ravenswood Avenue Grade Separation Project. The project is also consistent with the most recent update of the City's Rail policy in May 2018, which updated the policy to reflect updates to the current High Speed Rail proposals and presentation information. In addition, the project is consistent with the following local planning documents

which support a railroad grade separation and bicycle facilities at Ravenswood Avenue:

- City of Menlo Park General Plan Circulation Element, adopted by Council on November 29, 2016.
- El Camino Real and Downtown Specific Plan, dated July 12, 2012.
- City of Menlo Park Sidewalk Master Plan, dated January 28, 2009.
- Menlo Park Comprehensive Bicycle Development Plan, dated January 2005.

The project is also being coordinated closely with the City's Transportation Master Plan, currently in development. The project is also consistent with the JPB and High Speed Rail blended system operation. The California High Speed Rail Authority (HSR Authority) is currently preparing environmental documents for the San Jose to San Francisco segment. According to the HSR Authority's Revised Business Plan (dated June 1, 2018), environmental completion of all segments is expected by 2022 and a Record of Decision for the San Jose to San Francisco segment is scheduled for completion in 2020. One of the items being evaluated is the length and location of potential passing track options. At the time this grade separation study began in 2016, the HSR Authority and Caltrain were considering a potential passing track (a third track) running through Menlo Park. As such, and as required by the funding requirements of the grant received to conduct this study, this project evaluated alternatives that were consistent with the proposals for blended system operations, with a potential passing track running continuously within Menlo Park (city limit to city limit).

In late 2017, the HSR Authority announced its preliminary preferred passing track option to add two tracks (for a total of four tracks) between San Mateo and approximately Whipple Avenue in Redwood City, which would not include the addition of a third track in Menlo Park. Caltrain has not yet concurred with this preferred alternative and the HSR Authority is expected to finalize this decision through the environmental review of the San Jose to San Francisco segment in the coming years.

The grade separation project would not be required to construct any such third (passing) track, only to not preclude its future construction. With Council's approval and as required by this study's funding to not preclude to third track within Menlo Park, the City has decided to move forward with the option that includes two mainline tracks and a center-loading station platform, with the future ability to add a passing track to the east (Alma Street) side of the station.

Additional right-of-way acquisition would be necessary to accommodate a third (passing) track on the east side of the station. As the next phases of design and environmental review are completed for this grade separation project, the following evaluations may be considered to respond to the needs of the City, HSR Authority, and Caltrain:

- Remove the proposed third track from the grade separation designs, with the possible impact that any structures built with grade separation may need to be modified or reconstructed to accommodate a third track. This could cause duplicative costs and additional construction impacts if a third track is ever deemed necessary in the future.

- Accommodate space within the existing Caltrain right-of-way, but not construct a third track within the project area. This would reduce future costs and construction impacts if a third track were to be added in the future. However, this would have greater right-of-way impacts (to build the shoofly, for example) and up-front costs that would be a throw-away if the passing track were never built.

- Placement of the station platforms, outboard or center-boarding, may also be reconsidered at that time.

The project has also coordinated with the proposed bicycle/pedestrian grade-separation structure at Middle Avenue, near the 500 El Camino Real Development Project in the City of Menlo Park, currently in

the study and conceptual design phase.

7. Alternatives

Two Build alternatives and the No-Build were evaluated for the grade separation to determine conformance with the project's purpose and need. See Attachments A and B for the preliminary plans of the Build alternatives. Engineering design features, construction staging, right-of-way, and utilities associated with the Build alternatives are discussed in this section.

7.1 Roadway Design Criteria

The roadway design criteria (lane widths, shoulder widths, sidewalk widths, taper lengths, stopping sight distance, etc.) for the project's alternatives was based on the 6th Edition of the Caltrans' Highway Design Manual (HDM**),** updated July 2, 2018.

The only exception is for the design of the sag vertical curves. Instead of designing for headlight sight distance, the sag vertical curves were designed for passenger comfort based on the following formula on page 3-160 in the 2011 (6th Edition) American Association of State Highway Transportation Official (AASHTO) Green Book, "A Policy on Geometric Design of Highways and Streets". This criteria for sag vertical curves reduces the overall project footprint, which eliminates direct impacts to the El Camino Real intersection. This criteria is very commonly used for roadway underpasses and since lighting will be provided, drivers will not have to rely on their headlights at night to see objects ahead on the sag curve.

Minimum Length of Sag Vertical Curve = AV^2 / 46.5 where A is the algebraic difference in grades (in percent). For example, for A_1 = -5% and A_2 = +5%, and a design speed of 25 mph:

$L_{(minimum)} = |-5 – 5| * (25)^2 / 46.5 = 134.4$ feet

The following assumptions were included in the design of the Build Alternatives:

- Through Lane Width = 12 feet
- Turning Pocket Lane Width = 11 feet (Minimum)
- Right Shoulder/Bike Lane Width = 5 feet (Minimum)
- Sidewalk Width = 6 feet (Minimum)
- Crosswalk Width = 10 feet
- Minimum Vertical Clearance over Roadway or Shoulder = 15'-6"
- Minimum Vertical Clearance over Sidewalk = 9'-0"
- Minimum Vertical Curve Length = 50 feet
- The length of the crest vertical curves was based on a stopping sight distance of 150 feet (design speed of 25 mph).
- Roadway profile grade = 5% (Maximum, preferred) ; 10% (Maximum) (See Note)
- Railroad structure depth: 0.11 * Span Length

Note: To avoid direct impacts to the El Camino Real intersection, the Ravenswood Avenue profile, for Alternative A, exceeds 5%, but the sidewalks were designed on a separate profile from the roadway, and a maximum grade of 5% was used for the sidewalks. See Attachment A.

7.2 Railroad Design Criteria

Railroad design assumptions were based on Caltrain's Design Criteria (dated September 30, 2011) and the California High-Speed Train Project technical memorandums TM 1.1.21 – Typical Cross Sections for 15% Design, and TM 2.1.2 – Alignment Design Standards for High-Speed Train Operation. The horizontal track geometry is designed for 90 mph and FRA Class 5 track standards. The Railroad Design Criteria for this project was reviewed and approved by Caltrain staff in July 2016. Since that time, Caltrain has begun updating their standards and the next phase of the project will incorporate any necessary criteria such as horizontal track geometry being designed for 110 mph and FRA Class 6 track standards.

The maximum continuous profile (vertical) grade along the main line track is 1%. Grades exceeding 1% would be a design exception and may be approved by Caltrain on a case-by-case basis. In order to identify mitigations for any operational and maintenance impacts, the design exception review process may require additional supporting studies, such as power simulations. Depending on the complexity of the design exception request, the design exception request process can take anywhere from 3 to 12 months and still may result in design exception rejection.

At the proposed Menlo Park Station (with a 1,000 foot long platform), no vertical curves are permitted within the limits of the platform. The platform must fall within a single vertical tangent (maximum grade of 1%) on the rail profile. A 0% grade along the platform is preferred by Caltrain.

Vertical curves of the rail were governed by the 60 mph design speed for freight.

7.3 No-Build Alternative

The No-Build alternative proposes no improvements within the project limits. The at-grade railroad crossing would remain as it exists today. However, if the No-Build is ultimately chosen or if there is a significant delay in the project, the City will consider near-term improvements, such as:

- A traffic signal with railroad preemption at the Ravenswood Avenue/Alma Street intersection.
- A four quadrant (quad) gate system. This system would have gate mechanisms on both sides of the tracks in both directions of Ravenswood Avenue. This would deter drivers from illegally driving their vehicles around lowered gates to cross the tracks before the train arrives.
- Quiet zone designation application. Based on federal rule, local government agencies may acquire a quiet zone designation that would restrict the usage of train horns at railroad crossings which meet specified criteria.

7.4 Viable Alternatives

7.4.1 Alternative A: Underpass - Railroad At-Grade and Lower Roadway

7.4.1.1 Road and Rail Geometry

Alternative A (see Attachment A) proposes to maintain the railroad at its existing grade (elevation) and construct one grade separation by lowering Ravenswood Avenue to a maximum excavation depth of approximately 22 feet. The profile of Ravenswood Avenue would be modified/lowered for a total length of 740 feet. The maximum grade on Ravenswood Avenue would be 10%.

The proposed, two-track railroad structure over Ravenswood Avenue would be comprised of four spans with a total length of approximately 160 feet. Retaining walls would be constructed on each side of Ravenswood Avenue to minimize/avoid impact to adjacent roads, properties and buildings.

Sidewalks are proposed on each side of Ravenswood Avenue and would be on a separate profile from Ravenswood Avenue, elevated slightly above the roadway, and would have a maximum grade of 5%.

Pedestrian ramps and stairways are proposed on each side of Ravenswood Avenue to allow direct access to the Caltrain station platform above Ravenswood Avenue.

Except for the sidewalks and addition of bike facilities, the modified/lowered Ravenswood Avenue would have cross section dimensions very similar to the existing conditions. Ravenswood Avenue would be comprised of two westbound lanes, two eastbound lanes, a variable-width curbed median, and an 8-foot wide shoulder in each direction. The shared-use sidewalks on each side of the roadway will be 10-feet wide on the approach to the underpass, then widen out to a maximum of 34 feet under the railroad structure. Bicyclists can use the roadway shoulder, or the shared-use sidewalk to pass under the railroad structure.

Alma Street would maintain its existing elevation to allow Ravenswood Avenue to pass under it via a two-span structure. The Ravenswood Avenue/Alma Street grade separation would remove the direct vehicular connection between the two streets, and thus would change vehicular travel patterns. This will require a right-turn pocket on eastbound Ravenswood Avenue, approaching Laurel Street. This is discussed in more detail in Section 8 (Evaluation of Traffic Conditions).

Pedestrian and bicycle connectivity between Ravenswood Avenue and Alma Street would be maintained via shared-use ramps on each side of Ravenswood Avenue. For example, bicyclists travelling northbound on Alma Street from Burgess Park can access the south side of Ravenswood Avenue by descending on a shared-use path just west of the library.

Due to the roadway excavation required to lower Ravenswood Avenue and the depth of the sidewalk (elevated above the lowered Ravenswood Avenue), direct vehicular access to Merrill Street and Alma Lane on the north side of Ravenswood Avenue would be removed. Similarly, direct access to the Cornerstone Research driveway on the south side of Ravenswood Avenue would be removed. Access to/from Axis Personal Trainers would be maintained from/to Alma Street.

Oak Grove Avenue, Glenwood Avenue, and Encinal Avenue would maintain their existing at-grade crossing condition except that the crossings would have to be modified slightly during construction to accommodate a temporary (shoofly) track alignment. Each crossing would stay open during and after construction. No current CPUC, Caltrain, or HSR policy would require closure of any of these crossings due to the train frequency/speeds expected in the future. However, an increase in train frequency in the future will increase gate downtime and traffic congestion on these three streets.

See Attachment A for plan, profile and typical section exhibits and Attachment E for 3D renderings of Alternative A. At the time the 3D renderings for Alternative A were completed in late 2016, the alternative's station configuration consisted of outboard platforms. In April 2017, City Council selected a center-boarding platform as the preferred configuration; however, in order to be efficient with the project budget, the 3D renderings were not reconstructed for Alternative A. The exhibits included in Attachment A show a center-boarding platform.

7.4.1.2 Station Configuration and Future Passing Track

The Caltrain Station between Oak Grove and Ravenswood Avenues would also be modified and include the following improvements:

- A 1,000-foot long platform to accommodate longer Caltrain (10-car) trains in the future.
- A 32-foot wide, center-boarding passenger platform area to meet current Caltrain standards.
- A center-boarding platform would allow entry/exit of either train from a single platform.

Although a center-boarding platform was chosen as the City Council's preference at the April 4, 2017, City Council meeting, the platform configuration will be re-evaluated and can be revised during the next phase of the project (environmental studies and design).

The parking lot on the west side of the tracks would have to be modified as a result of the platform reconfiguration. A stairway and ramps and/or elevator would be placed from at least one box structure under the tracks and platform to allow for access to/from a center platform from/to either side of the tracks; from/to Alma Street or from/to the parking lot adjacent to Merrill Street. A layout of the entire station would be determined in the next phase of the project.

A passing track, if constructed in the future, could be accommodated by widening the railroad structure to the east towards Alma Street. The gap between the outside face of the concrete barrier of the future widening and the outside face of the concrete barrier of the Alma Street Undercrossing would be slightly more than 4 feet. Constructability of the widening would have to be evaluated during final design.

7.4.1.3 Opportunities and Constraints

Opportunities presented under this alternative include:

- A grade separation at the City's highest priority crossing location.
- Little/no change in the visual and noise impacts, compared to Alternative C.

  Note: Noise impacts will be evaluated in detail in the next phase of work, with strategies to mitigate impacts during the environmental review process.
- Grade separation of Alma Street improves north/south pedestrian and bicycle connectivity and safety on Alma Street.
- Restoration of the vehicular through movement on Alma Street at Ravenswood Avenue.
- Lesser construction impacts compared to Alternative C.
- Least costly Build alternative.

The constraints of this alternative include:

- Limitation of future grade separation options at the City's other rail crossings in this corridor.
- Elimination of direct access from/to Ravenswood Avenue to/from Alma Street.
- Restriction of access from/to Ravenswood Avenue to/from Alma Lane and Merrill Street.
- Greatest impact to Ravenswood Avenue and access to adjacent properties due to the excavation depth required.
- 10% roadway grade on Ravenswood Avenue. This grade avoids impact to the El Camino Real intersection, and still allows motor vehicles to navigate the roadway comfortably. However, a 10% grade can be challenging for bicyclists, so the shared sidewalk will likely be used by the casual bicyclist.

7.4.2 Alternative C: Hybrid - Partially Elevate Railroad and Partially Lower Roadways

7.4.2.1 Road and Rail Geometry

Under Alternative C (see Attachment B), grade separation structures would be constructed at three crossings: Ravenswood Avenue, Oak Grove Avenue, and Glenwood Avenue. This alternative partially elevates the railroad approximately 10 feet (maximum) above existing rail elevation at Ravenswood and Oak Grove Avenues, and approximately 5 feet at Glenwood Avenue as it transitions back to existing grade before reaching Encinal Avenue.

As in Alternative A, the Encinal Avenue crossing would stay open during and after construction. No current CPUC, Caltrain, or HSR policy would require closure of this crossing due to the train frequency/speeds expected in the future. However, an increase in train frequency in the future will

increase gate downtime and traffic congestion on Encinal Avenue. Other alternatives could be considered in the future for Encinal Avenue, such as a closure or a conversion to a pedestrian/bicycle only crossing (closed to vehicles).

The roadways would be lowered partially, by approximately 12 feet (maximum) at Ravenswood Avenue, by approximately 11 feet (maximum) at Oak Grove Avenue, and by approximately 15 feet (maximum) at Glenwood Avenue. The aforementioned dimensions are measured at the rail crossing. All road profiles would have a maximum grade of 7%.

The Ravenswood Avenue profile would be modified/lowered for a length of approximately 630 feet, Oak Grove Avenue would be modified/lowered for a length of approximately 510 feet and Glenwood Avenue would be modified/lowered for a length of approximately 590 feet.

The railroad profile would be modified/raised for a length of approximately 5,800 feet (1.1 miles) from just south of Encinal Ave to just north of San Francisquito Creek at the border with the City of Palo Alto. The maximum grade of the railroad would be 1%.

Similar to Alternative A, the two-track railroad structure over Ravenswood Avenue would be comprised of four spans with a total length of approximately 160 feet. The two-track railroad structures over Oak Grove Avenue and Glenwood Avenue would be comprised of two spans with a total length of approximately 80 feet. An intermediate column/bent would be placed in the median of each roadway. Retaining walls would be constructed on each side of the railroad and on each side of the roadways, where feasible, to minimize impacts to adjacent roads, properties and buildings. See Attachment B for plan, profile and typical section exhibits and Attachment E for 3D renderings of Alternative C.

There are several differences at Ravenswood Avenue when compared to Alternative A:

- Alma Street would be lowered to match the elevation of a lowered Ravenswood Avenue, resulting in an intersection that resembles the existing Ravenswood Avenue/Alma Street intersection, providing the ability to restore full vehicular access (i.e., left-turns and through movements for all approaches).
- Merrill Street would also be lowered to tie into the elevation of a lowered Ravenswood Avenue.
- The adjacent sidewalks would follow the roadway profiles (not elevated above the roadway).

Except for the sidewalks and addition of bike facilities, the modified/lowered roadways would have cross section dimensions very similar to the existing conditions. Ravenswood Avenue would be comprised of two westbound lanes, two eastbound lanes, a variable-width curbed median, and an 8-foot wide shoulder in each direction. The shared-use sidewalks on each side of the roadway would be 10-feet wide on the approach to the underpass, then widen out to a maximum of 34 feet under the railroad structure. Bicyclists can use the roadway shoulder, or the shared-use sidewalk to pass under the railroad structure.

Pedestrian ramps and stairways would be placed on each side of Ravenswood Avenue to allow direct access to the Caltrain station platform above Ravenswood Avenue.

Oak Grove Avenue and Glenwood Avenue would be comprised of one lane in each direction, a variable-width median, an 8-foot wide shoulder or Class II bike lane in each direction and a 10-foot wide sidewalk on each side of the roadway. Similar to Ravenswood Avenue, bicyclists can use the bike lane or sidewalk to pass under the railroad structure.

Merrill Street and Alma Street would be modified/lowered to match the lowered profile for Ravenswood and Oak Grove Avenues. Garwood Way, San Antonio Street, and Mills Court would be modified/lowered to match the lowered profile of Glenwood Avenue. Driveways and entrances to fronting properties would be modified in coordination with property owners, where feasible, to match the elevation of the adjoining roadway.

7.4.2.2 Station Configuration and Future Passing Track

Similar to Alternative A, the Caltrain Station between Oak Grove and Ravenswood Avenues would be modified and include the following improvements:

- A 1,000-foot long platform to accommodate longer Caltrain (10-car) trains in the future.
- A 32-foot wide, center-boarding passenger platform area to meet current Caltrain standards.
- A center-boarding platform would allow entry/exit of either train from a single platform.

The parking lot on the west side of the tracks would have to be modified as a result of the platform reconfiguration. A stairway and ramps and/or elevator would be placed from at least one box structure under the tracks and platform to allow for access to/from a center platform from/to either side of the tracks, from/to Alma Street or from/to the parking lot adjacent to Merrill Street. A layout of the entire station will be determined in the next phase of the project.

A passing track, if constructed in the future, could be accommodated on the east side of the rail alignment.

7.4.2.3 Opportunities and Constraints

The opportunities presented with this alternative include:

- Grade separations for three of the four road crossings within the City's limits, which would improve east/west mobility across the City and decrease three rail conflict points.
- Additional grade separations without a substantial additional amount of construction time (54 to 66 months, compared to 42 to 48 months for Alternative A).
- Maintenance of access for all travel modes at the intersections of Ravenswood Avenue with Alma Street, Alma Lane and Merrill Street.
- Better local street connectivity including the ability to restore full access at the intersection of Ravenswood Avenue and Alma Street.
- Maximum grades on roadways are less than Alternative A due to a reduction in the roadway excavation depth.

The constraints of this alternative include:

- Funding could be more challenging; Alternative C is more costly than Alternative A.
- More overall impacts than Alternative A; to roadways, properties, and utilities; however impacts at Ravenswood Avenue are less severe.
- Longer construction duration and greater disruption during construction (more public utilities need to be relocated).
- Greater visual impacts, compared to Alternative A.

  Note: Both alternatives incorporate strategies to minimize such visual impacts (an open plaza under the railroad structure at Ravenswood, for example, and there is a potential for other visual enhancements in the station area that will be evaluated during final design.
- Potential increase in noise due to the elevated tracks. However, noise impacts will be evaluated in the next phase of work, with strategies to mitigate impacts during the environmental review process.

7.5 Rejected Alternatives

7.5.1 Alternative B: Partially Elevate Railroad and Partially Lower Roadway

Alternative B is a modified version of Alternative C, the hybrid alternative that would partially elevate the railroad tracks and lower the crossing roadways. Instead of grade separating three roadways, this alternative proposes grade separation of two roadways (Ravenswood and Oak Grove Avenues), while maintaining at-grade crossings at Encinal and Glenwood Avenues.

This alternative proposed to lower Ravenswood Avenue by approximately 8 feet and lower Oak Grove Avenue by approximately 15 feet below existing ground. In order to maximize an elevation gain at Ravenswood Avenue for this alternative, the rail profile was placed on a constant grade of 0.75% through the 1,000-foot long station between Oak Grove Avenue and Ravenswood Avenue. This introduced an apex (the point of maximum elevation) of the railroad profile about 800 feet south of Ravenswood Avenue near the Arrillaga Family Gymnasium to 17 feet maximum above existing rail elevation,. Figure 3 below shows a comparison of the proposed railroad profile for Alternatives A, B and C. Point (a) on the figure is the location of the aforementioned apex, which is about 7 feet higher than the highest elevation for Alternative C.

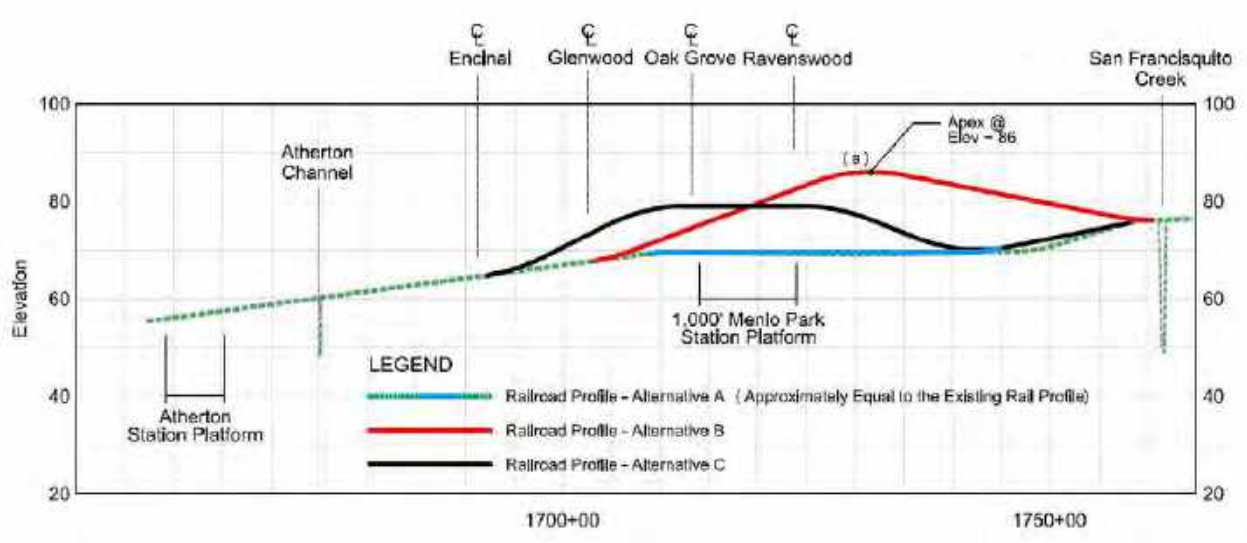


Figure 3. Rail Profiles for the Build Alternatives

The rail tracks would be raised approximately 14 feet from the existing rail elevation at Ravenswood Avenue and approximately 6 feet at Oak Grove Avenue. The railroad would be raised for a length of approximately 5,400 feet (1 mile) from just south of Glenwood Avenue to just north of San Francisquito Creek. Ravenswood Avenue would be modified/lowered for a length of approximately 460 feet and Oak Grove Avenue would be modified/lowered for a length of approximately 600 feet.

Similar to Alternative C, the roads joining Ravenswood Avenue and Oak Grove Avenue would be lowered to match the elevation of Ravenswood and Oak Grove Avenues.

The opportunities presented with this alternative include:

- Grade separations at the two rail crossings with the highest traffic volumes.
- The ability to maintain access between Ravenswood Avenue and Alma Street, Alma Lane, and Merrill Street.
- The least impact to Ravenswood Avenue, compared to Alternatives A & C.

The constraints of this alternative include:

- The highest railroad elevation of the Build alternatives (approximately 17 feet above existing rail elevation just north of Arrillaga Family Gymnasium); thus introducing potentially greater noise and visual impacts. As noted for Alternatives A and C, a noise study will be conducted during the next phase of the project when the environmental studies will be completed.

Due to general concerns about the maximum height of the railroad and a desire to maximize the number of street crossings addressed with the hybrid option, on April 4, 2017, City Council directed staff to advance Alternative C (over Alternative B) as the chosen hybrid option. Thus, Alternative B was dropped from further consideration. The vote was 3-1-1; three (3) in favor of Alternative C, one (1) in favor of Alternative B, and one (1) councilmember abstained. In addition to the aforementioned Council meeting, several community outreach meetings were held describing the proposed Build alternatives. See Section 9 (Community Involvement) for more information.

7.6 Construction Staging

To minimize disruption to rail and vehicular traffic during construction, either of the Build alternatives would be constructed in several stages. Construction of the railroad structures and new track alignment would require temporary (shoofly) tracks around the limits of the work zone in order to maintain train service at all times, except during weekend closures, when needed.

Shoofly alignments were considered on both sides of the rail corridor. A westerly alignment along Garwood Way, the existing Caltrain parking lot, and Merrill Street is likely the most feasible option because it occurs primarily on public right-of-way and avoids direct impact to Alma Street and the private residences north of Oak Grove Avenue.

A temporary station with 12-foot wide outboard platforms would be provided while the new platform and tracks are being constructed. See Figure 3 below for a typical section of the temporary platforms. The shoofly tracks would impact the existing parking lot. Details of the temporary station will be finalized during the next phase of the project and replacement parking will be included to the greatest extent feasible and mutually agreed upon by the City and Caltrain.

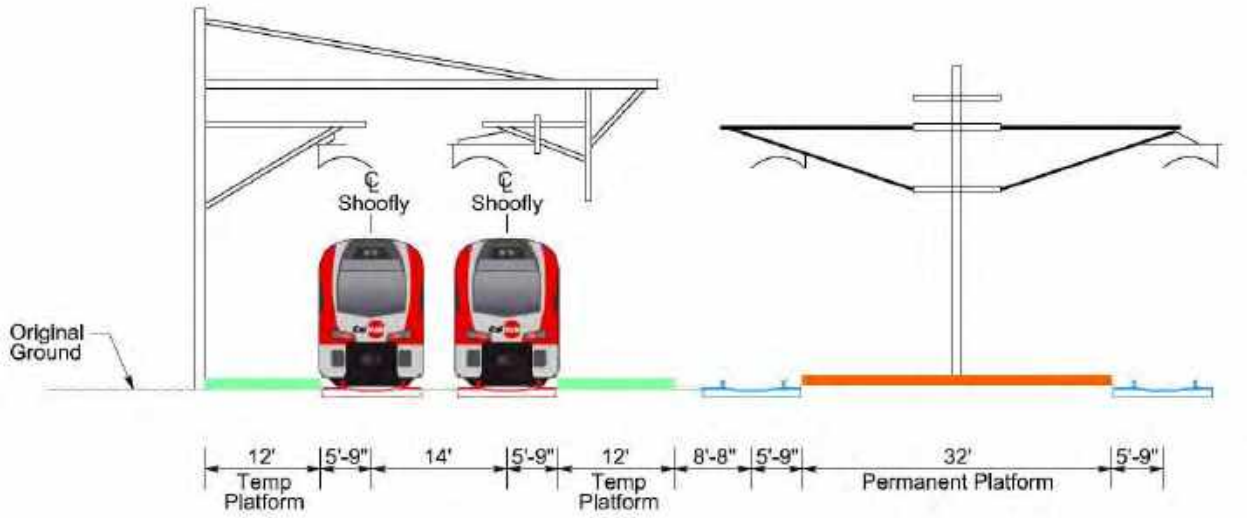


Figure 4. Typical Section of Temporary Platforms

Retaining walls and/or temporary shoring will be used, where required, to allow for construction activity adjacent to the shoofly tracks.

Traffic handling of vehicular traffic on Ravenswood Avenue and other local streets will be evaluated in more detail during the next phase of the project (preliminary design and environmental review). Existing turning movements and access to existing properties will be considered and maintained, wherever

feasible. However, short-term closures of the streets will be required; for example, Ravenswood Avenue would be closed over a single weekend while the shoofly tracks and temporary gates are placed across the road. This is noted in Stage 2 below.

One method to reduce the duration of local street closures is to construct a temporary bridge for the railroad on the shoofly alignment at Ravenswood Avenue. This provides the benefit of a shorter duration of closure of Ravenswood Avenue.

The following is a conceptual construction staging plan for Alternative A. A similar concept could be applied to Alternative C. The estimated duration of construction for Alternative A is 42 to 48 months. Alternative C, due to its additional scope of work (more utility work, grade separations and an elevated rail alignment), would require approximately an additional 12 to 18 months to complete. Given the early stage of engineering design completed at this stage in the project, these estimates are meant to be conservative and provide an order-of-magnitude duration of construction stages. As the project advances through design and other future stages, every effort would be made to reduce the length of construction and consider strategies to mitigate construction impacts.

During the community engagement efforts for this study, participants generally favored considering greater impacts to shorten the overall construction timeline. The construction strategy would continue to be refined as the next phases of the project continue.

Stage 1 Traffic Handling:

- Vehicular traffic maintained on existing roads
- Rail traffic maintained on existing tracks

Stage 1 Construction:

- Relocate utilities
- Construct temporary pavement for a detour on the south side of Ravenswood Avenue
- Begin construction of shoofly tracks

Estimated Duration of Stage 1:

9 to 10 months

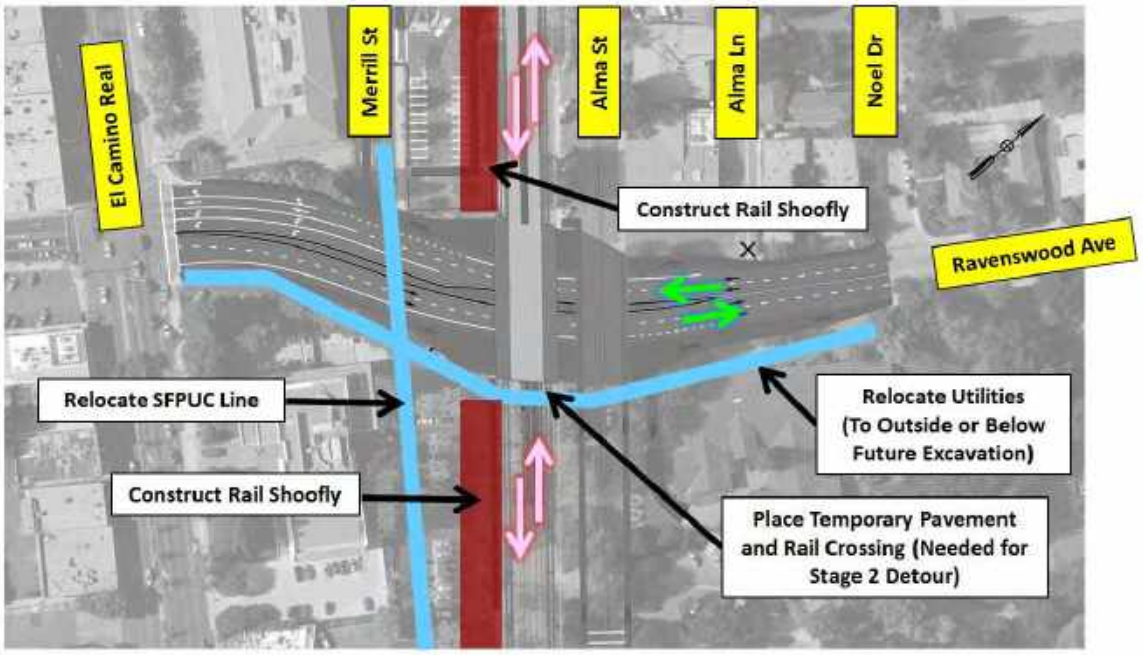


Figure 5. Schematic of Stage 1

Stage 2 Traffic Handling:

- Vehicular traffic shifted onto south side of Ravenswood Avenue

  Note: Temporary closure of Alma Street would commence when excavation of Ravenswood Avenue (at Alma Street) begins.

- Rail traffic maintained on existing tracks

Stage 2 Construction:

- Install temporary shoring to prepare for Stage 3 excavation
- Complete shoofly track work across Ravenswood Avenue
- Install temporary at-grade crossing on the south side of Ravenswood Avenue

Estimated Duration of Stage 2:

4 months

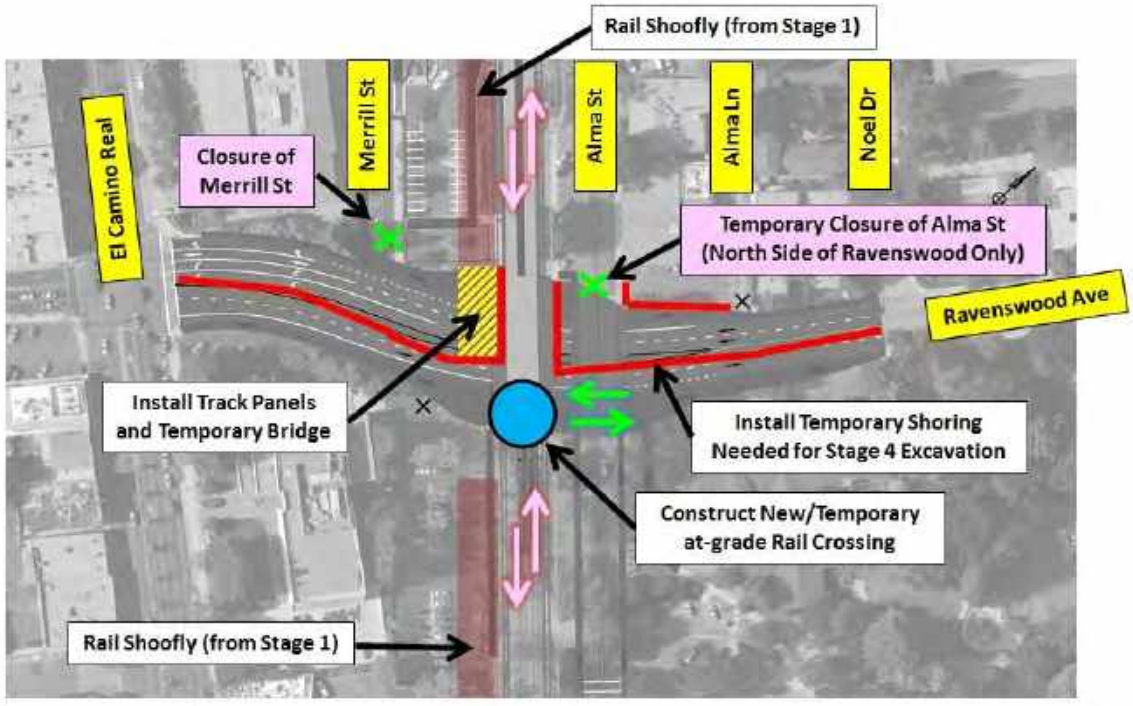


Figure 6. Schematic of Stage 2

Stage 3 Traffic Handling:

- Ravenswood Avenue temporarily closed
- Rail traffic maintained on existing tracks

Stage 3 Construction:

- Place temporary rail crossing and gates on Ravenswood Avenue

Estimated Duration of Stage 3:

One weekend

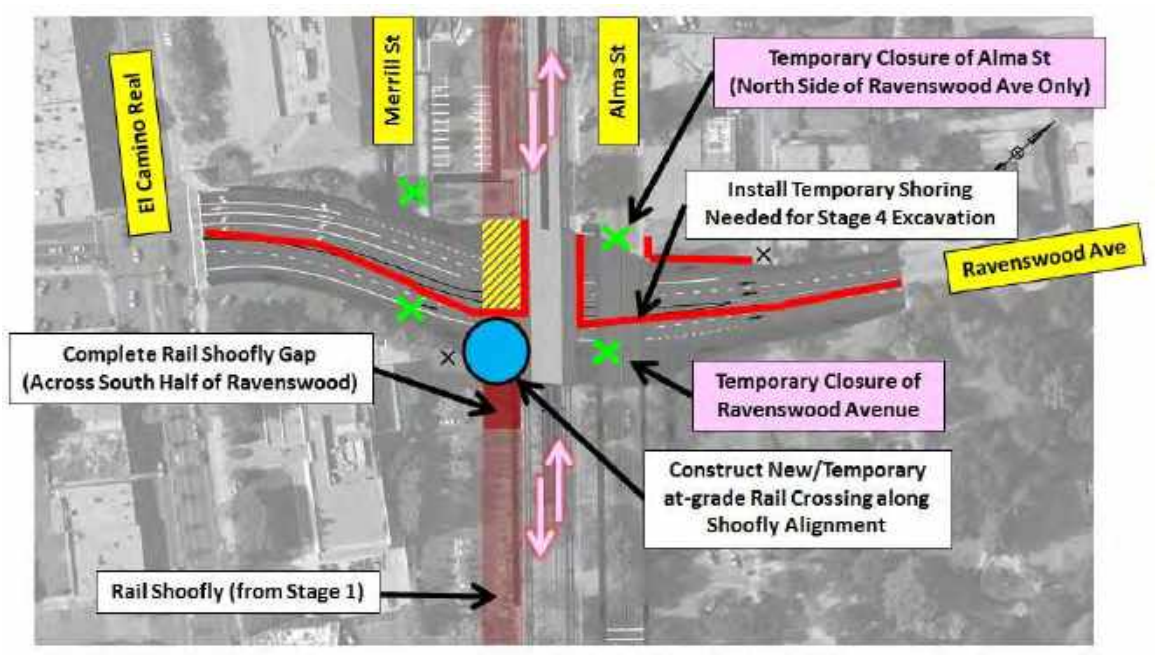


Figure 7. Schematic of Stage 3

Stage 4 Traffic Handling:

- Shift rail traffic onto shoofly tracks (with temporary platforms at the Menlo Park Station)
- Place vehicular traffic back onto the south side of Ravenswood Avenue

Stage 4 Construction:

- Begin roadway excavation on the north side of Ravenswood Avenue
- Construct foundations for both structures (railroad and Alma Street)
- Begin permanent track work
- Begin construction of new Menlo Park Caltrain station

Estimated Duration of Stage 4:

5 to 6 months

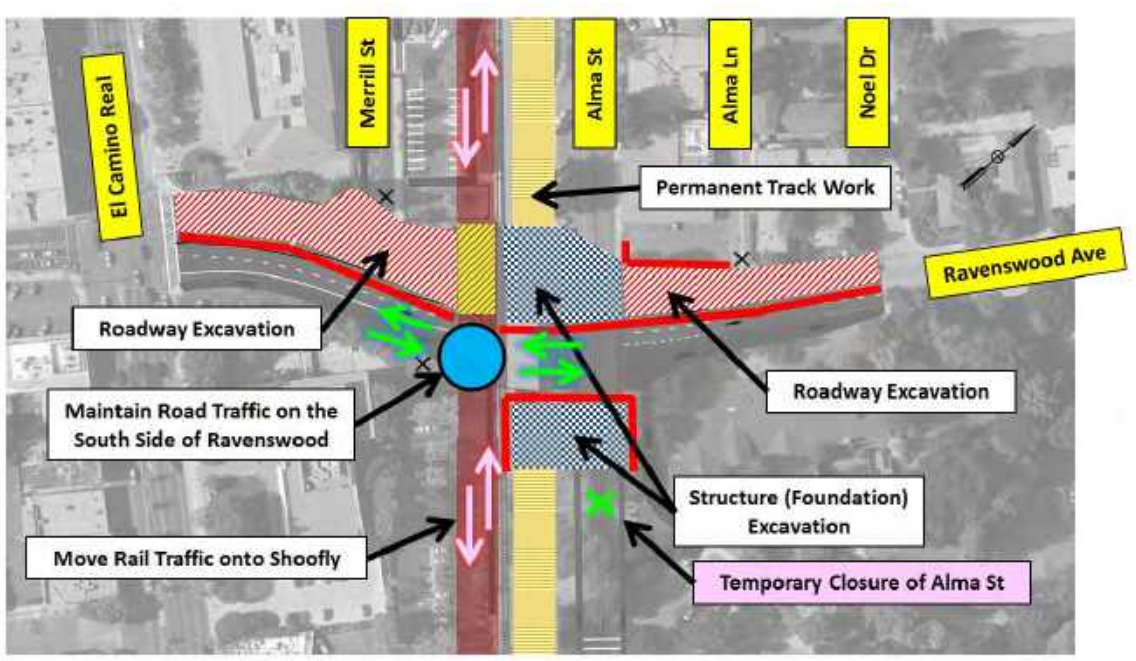


Figure 8. Schematic of Stage 4

FINAL

Stage 5 Traffic Handling:

- Maintain rail traffic on the shoofly track alignment
- Maintain vehicular traffic on the south side of Ravenswood Avenue

Stage 5 Construction:

- Complete north half of the railroad and Alma Street bridges

Estimated Duration of Stage 5:

3 to 4 months

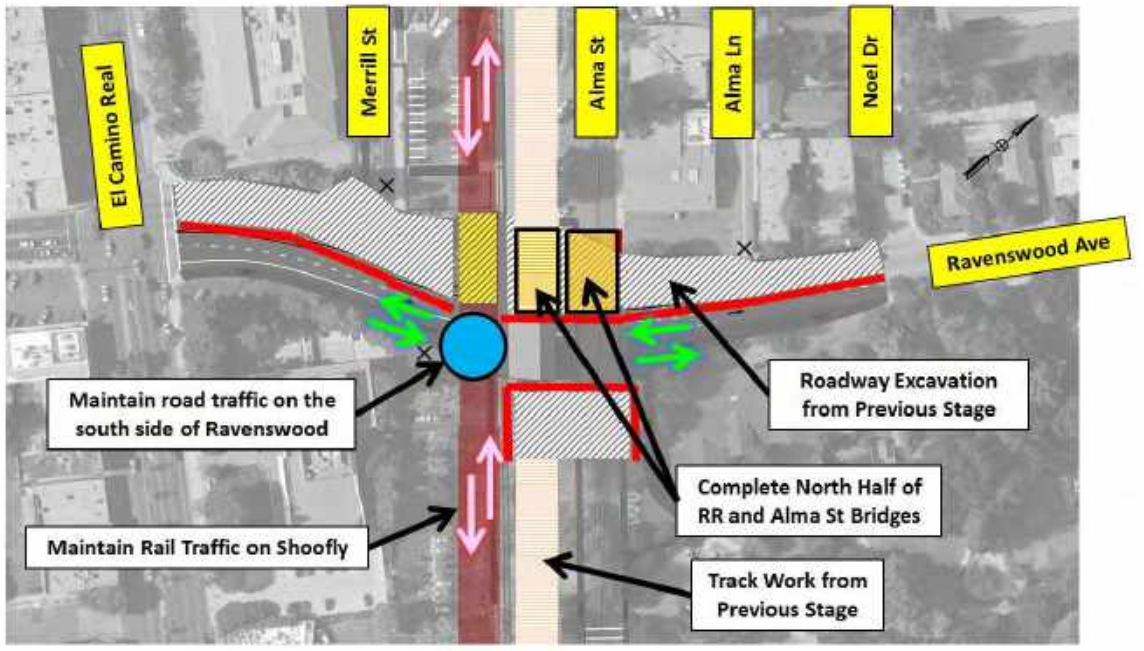


Figure 9. Schematic of Stage 5

Stage 6 Traffic Handling:

- Maintain rail traffic on the shoofly track alignment
- Vehicular traffic shifted onto the north side of Ravenswood Avenue

Stage 6 Construction:

- Complete south half of railroad and Alma Street bridges
- Complete permanent track work

Estimated Duration of Stage 6:

3 to 4 months

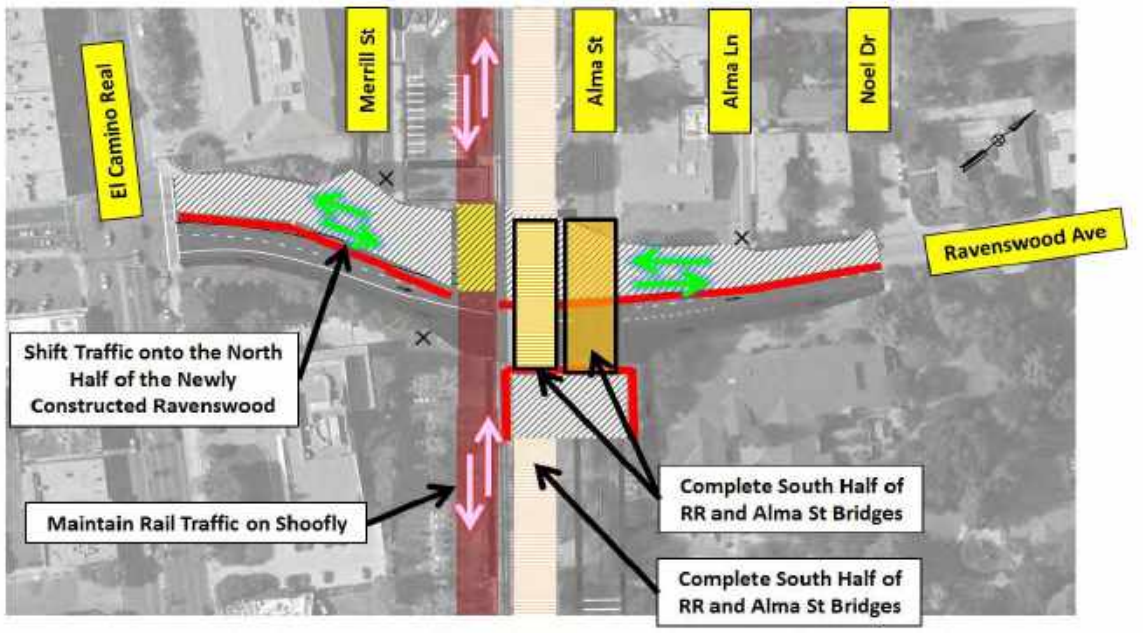


Figure 10. Schematic of Stage 6

Stage 7 Traffic Handling:

- Shift rail traffic onto permanent track alignment
- Open Alma Street bridge to vehicular traffic
- Vehicular traffic maintained on the north side of Ravenswood Avenue
- Remove shoofly tracks and temporary railroad structure

Stage 7 Construction:

- Complete roadway excavation and retaining walls on the south side of Ravenswood Avenue
- Complete new station
- Complete final paving and striping

Estimated Duration of Stage 7:

18 to 20 months

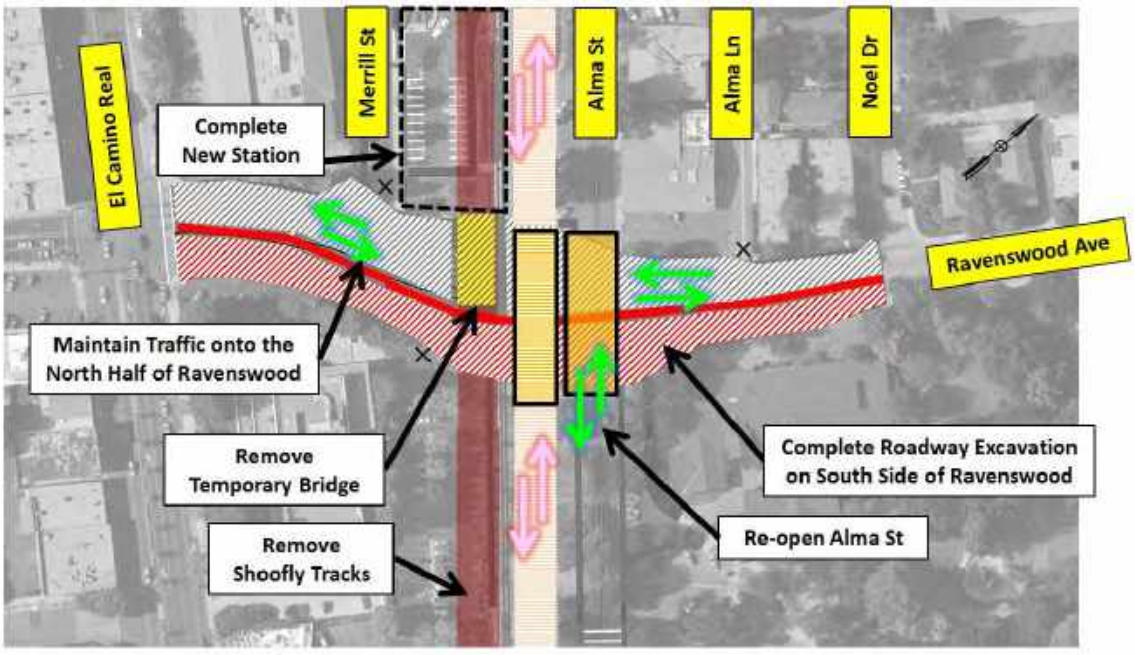


Figure 11. Schematic of Stage 7

7.7 Right of Way Needs

The right-of-way impacts for roadways, pedestrians, and bicycles vary with each alternative. The degree of each impact can vary from a minor driveway modification to a complete driveway/entrance reconstruction to some form of parcel acquisition. Both Build alternatives require permanent property acquisitions, mostly partial sliver acquisitions, and temporary construction easements.

Alternative A would require partial acquisitions of approximately four parcels fronting Ravenswood Avenue adjacent to the crossing to allow for installation of retaining walls and associated structures required to lower Ravenswood Avenue and for bicycle and pedestrian facilities. The temporary (shoofly) tracks would create temporary impacts to parcels fronting the west side of the Caltrain right-of-way. See Figure 12 below for a typical section of the shoofly tracks. Alternative C is shown, but Alternative A is similar.

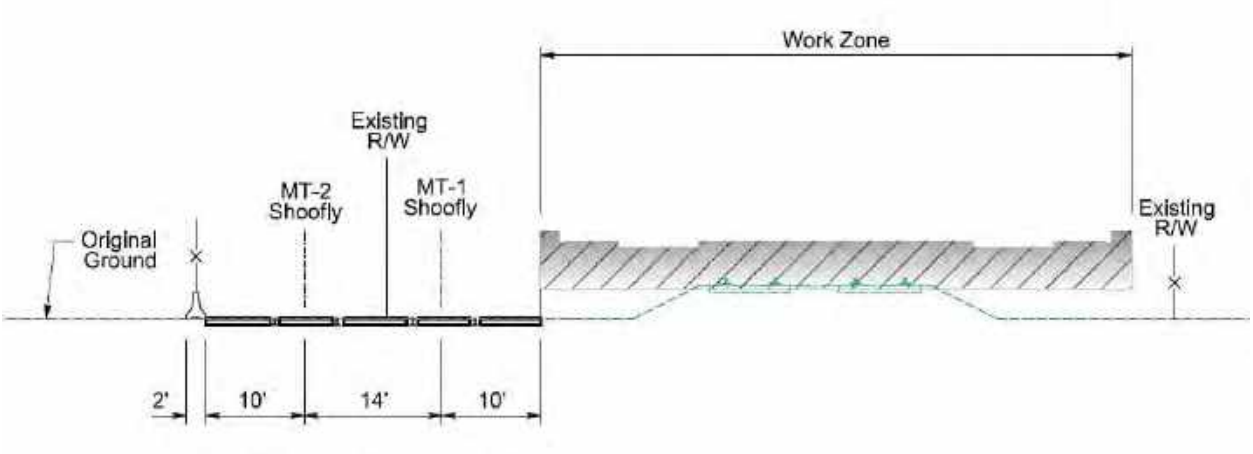


Figure 12. Typical Section of Shoofly Tracks (Looking North)

Alternative C would have similar impacts to the aforementioned parcels impacted by Alternative A. However, Alternative C would also impact parcels along the segments of Oak Grove and Glenwood Avenues, which would also be lowered to create a grade separation at those crossings. Parcels adjacent to the lowered intersections of Oak Grove and Glenwood Avenues may also be impacted including Merrill Street, Alma Street, San Antonio Street, Mills Street, and Mills Court. The temporary (shoofly) track impacts would be similar to Alternative A.

In general, properties and their access to City streets will be impacted more significantly the closer they are to the railroad crossing locations because the local roads must be lowered (below current elevation) most greatly under the railroad to establish enough elevation difference for a grade separation structure. Conversely, properties and driveways further away from the railroad would be impacted less severely. Vehicular and pedestrian access to properties will be modified where feasible and property acquisitions will be minimized as much as possible as the project progresses into the next phase of design and environmental studies.

All potentially affected property owners have been contacted by the City during this phase of the project to discuss strategies to minimize impacts and keep each owner’s circumstances, and future needs under consideration. Outreach to all potentially affected property owners will continue throughout the project process.

The access impacts are shown with X marks in Attachments A and B. The access impacts are the predominant cause of right-of-way impacts. The estimated right-of-way costs for Alternative A are $15.2M and for Alternative C, $41.6M.

7.8 Utilities

Depending on the Build alternative, the following utilities may be impacted:

- 36-inch Water (SFPUC)
- 8-inch Water (California Water Service Co.)
- 6-inch Water (California Water Service Co.)
- Wave Broadband TV
- Comcast Overhead Cable
- Comcast TV Underground
- Comcast Overhead Fiber Optic
- 12 kV PG&E Overhead Electrical
- PG&E Underground Electrical
- PG&E Gas
- Verizon and Sprint Underground Telecommunication and Fiber Optic Lines
- AT&T Cable

The San Francisco Public Utilities Commission (SFPUC) has listed the replacement of the Palo Alto water distribution line on their 10-year capital improvement program. This 36-inch line was built in 1937 and runs parallel to the Caltrain corridor, between the railroad and El Camino Real within the project limits.

The SFPUC's current plan is to replace this line due to its age and condition. The SFPUC is anticipating to begin the design work in 2022 and to start construction between 2026 and 2028. The current budget for the replacement is $90M. During the next phase of the project, the project team will coordinate with the SFPUC about the design of this line.

For the purpose of this study and to estimate potential future costs, it is assumed this line will be replaced in its current alignment. The cost for its replacement is included in the overall cost of this project.

Utility location (potholing) will be conducted during the next phase to determine the exact location of the utilities. A summary of utility relocations and costs are included under Attachment C.

8. Evaluation of Traffic Conditions

For the traffic operational analysis, two Build alternatives were considered: Alternatives A and C.

Alternatives A and C, as described below, were analyzed for the existing and future 2040 No-Build and Build conditions. The 2040 conditions include all planned development as proposed within the El Camino Real/Downtown Specific Plan area, as well as the Bayfront area as re-zoned under the Connect Menlo General Plan update.

A more detailed traffic analysis and operations report will be developed during the next phase of the project (preliminary engineering and environmental review), and will include any additional development projects (through amendments to the Downtown Specific Plan or the City's General Plan).

Each of the Build alternatives were evaluated for the future year (2040) conditions. A summary of the conclusions of the traffic operational analyses for each Build alternative is presented below. The full Traffic Analysis Technical Memorandum can be found in Attachment F.

Alternative A

1. **Alma Street and Ravenswood Avenue** - Since Alma Street would be grade separated, no vehicular movement was assumed between Alma Street and Ravenswood Avenue. Therefore, traffic from Ravenswood Avenue to Alma Street and vice-versa was re-routed via Laurel Street for the traffic operational analysis.

2. **Laurel Street and Ravenswood Avenue** - The eastbound approach at the intersection of Laurel Street and Ravenswood Avenue is modified to include a 300 foot-long right turn lane between Noel Street and Laurel Street. Signal timing modifications would be proposed as a result of the re-routing traffic from Alma Street.

As a result of the above changes, the intersections along Ravenswood Avenue would operate at acceptable levels (level of service [LOS] D or better) compared to the No-Build conditions. In addition, the proposed changes would reduce the delay and the travel time for vehicles traveling along Ravenswood Avenue between El Camino Real and Middlefield Road. See Attachment F for more information.

Alternative C:

1. **Alma Street and Ravenswood Avenue** – This intersection is proposed to be a full-access intersection under this alternative with the following modifications along each approach. See Figure 11 below:

    - ***Eastbound & westbound approaches (Ravenswood Avenue) -*** Modification from a single through, shared through/right lane to a single left-turn pocket, single through lane, and single shared through/right lane on both the eastbound and westbound (Ravenswood Avenue) approaches.

      Note: If the lane configuration on Ravenswood Avenue noted above were implemented, the road and bridge geometry shown in Attachment B would have to be altered slightly to accommodate the additional lane.
    - ***Northbound approach & southbound approach (Alma Street) –*** Modification from a single right-in/right-out only approach to a single shared left/through/right approach on both the northbound and southbound (Alma Street) approaches.
    - ***Signalization of the intersection.***

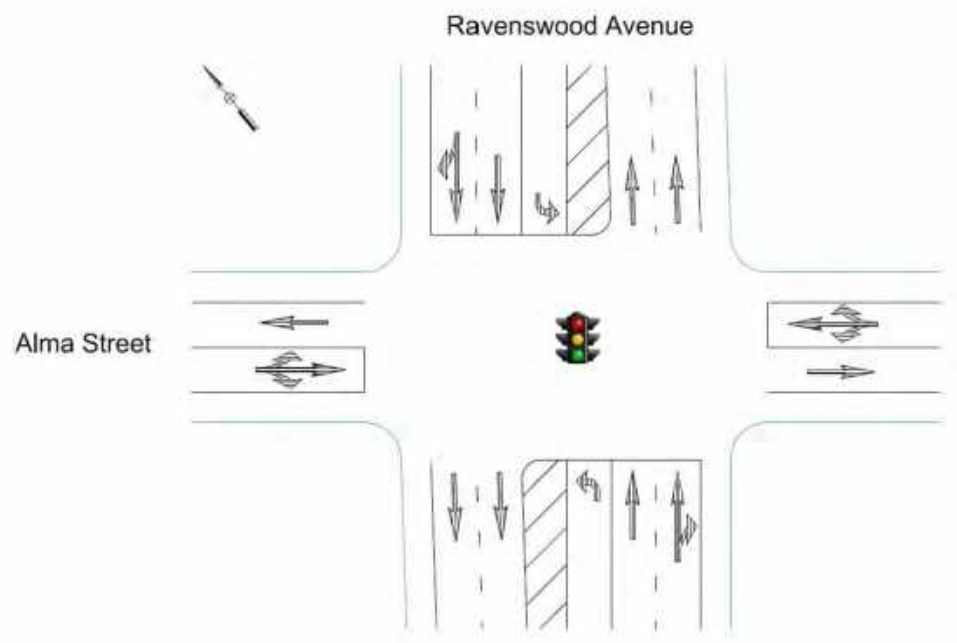


Figure 13. Alma Street/Ravenswood Avenue Signalized Intersection Configuration (Alternative C)

2. **Laurel Street and Glenwood Avenue** – In future 2040 conditions, this intersection operates unacceptably with the current control (All-Way Stop Control) and is anticipated to meet the peak hour traffic signal warrants. Therefore, a signal is proposed at this intersection. This intersection is within the Town of Atherton's jurisdiction, therefore concurrence from the Town would be required and the project will continue to coordinate with the Town on this item as the project progresses.

3. **Middlefield Road and Glenwood Avenue** – In future 2040 conditions, this intersection operates unacceptably with the current control (Two-Way Stop Control) and is anticipated to meet the peak hour traffic signal warrants. Therefore, a signal is proposed at this intersection. This intersection is within the Town of Atherton's jurisdiction, therefore concurrence from the Town would be required and the project will continue to coordinate with the Town on this item as the project progresses.

As a result of the above changes, the intersections along Ravenswood, Oak Grove, and Glenwood Avenues that were operating at unacceptable levels under the No-Build conditions would operate at acceptable levels under the Build conditions with the recommended improvements. In addition, the proposed changes would reduce the delay and travel time for vehicles traveling along Ravenswood Avenue, Oak Grove Avenue, and Glenwood Avenue between El Camino Real and Middlefield Road.

No-Build Alternative:

The future year (2040) No Build alternative was also evaluated. The average delay at each of the study intersections is expected to increase in 2040, when compared to the existing (2018) conditions. In addition, travel times along Ravenswood Avenue, in both the eastbound and westbound directions; between El Camino Real and Middlefield Road, are expected to increase in 2040.

9. Community Involvement

Multiple public meetings and stakeholder meetings have been held to present the project and receive feedback from the community. The outreach included three community workshops, eight City Council meetings, seven Commission meetings, and more than 30 stakeholder meetings with local property owners, Police Department, Fire District, and developer representatives. A summary of all outreach

events is described in this section. Details from the various public outreach activities, including presentations and handout materials, can be found on the Menlo Park City webpage for the project (www.menlopark.org/ravenswood).

Three community workshops were held for the project. On May 2, 2016, the first Community Meeting was held at the Arrillaga Family Recreation Center. The project team presented the purpose of the project, existing conditions, and information regarding railroad crossing options and potential aesthetic treatments. The meeting's purpose was to hear from the community about their preferences and concerns prior to the start of the initial engineering. The questions and feedback received at that meeting is documented in a Meeting Summary that is available on the City's project webpage along with all presentation materials.

On October 4, 2016, the second Community Meeting was held at the Menlo Church Social Hall in downtown Menlo Park. The purpose of this meeting was to present the three Build alternatives (Alternatives A, B, and C) described above and receive additional feedback on preferences and concerns. A presentation was given by the project team covering background information, how the community input from the first meeting was incorporated into the project, and details of the three Build alternatives. After a question and answer period, attendees were invited to visit the four stations and provide specific feedback. A meeting summary was prepared to document this feedback and can be found along with all presented materials on the City's project webpage.

On June 7, 2017, the third Community Meeting was held in the Arrillaga Family Recreation Center. During this meeting, the community reviewed Alternatives A and C in greater detail. The following was presented at the meeting:

- Three-dimensional (3D), CAD-generated animations and renderings for each alternative. These were presented both as videos and at a virtual reality station. See Attachment E.
- Exhibits showing various details for each alternative, including temporary (shoofly) track layouts, typical sections, lane configurations, project footprints and construction impacts.

In addition, a handout was provided to the community members to enable them to provide their general feedback of the alternatives. Over 85% of those attending expressed their support for Alternative C due to the increase of east-west connectivity from the three grade separations. They also cited more grade separations would be better long-term and expressed a desire to keep full access at the Alma Street/Ravenswood Avenue intersection.

Those in favor of Alternative A expressed a desire to not have the rail elevated (concern about noise) and its construction would not be as impactful to the community. There was also support for the lower construction cost and grade separating at the crossing with the highest volumes of all travel modes.

City Council Rail Subcommittee information meetings were held on the following dates. The City Council's Rail Subcommittee is comprised of two City Councilmembers. From 2015 through 2018, Councilmembers Richard Cline and Kirsten Keith served on the Rail Subcommittee. Starting in December 2018, Councilmembers Drew Combs and Ray Mueller served on the Rail Subcommittee:

- October 26, 2016
- March 20, 2017
- April 14, 2018
- January 31, 2019

Other community outreach performed as part of the study includes:

- Informational presentation by staff at Parks and Recreation Commission, May 25, 2016
- Informational presentation by staff at Library Commission, June 13, 2016
- Meeting with Fire District and Police Department representatives, September 27, 2016
- Presentation to Chamber of Commerce, Business and Transportation Issues Committee

meeting, September 29, 2016
- Transportation Commission meeting presentation on November 9, 2016
- Bicycle Commission meeting presentation on November 14, 2016
- Planning Commission meeting presentation on December 5, 2016
- Planning Commission meeting presentation on September 11, 2017
- Complete Streets Commission meeting presentation on September 13, 2017
- More than 30 meetings with individual stakeholders including local schools, local residential neighborhoods and adjacent property and business owners

The following are some of the key comments and questions received at the Commission meetings:

- On September 11, 2017, the Planning Commission approved a motion to support Alternative A.
- On September 13, 2017, the Complete Streets Commission approved a motion to support Alternative C.
- An open plaza area or breezeway is welcomed and could be used for community events.
- Avoid a “Berlin wall” look.
- Can Ravenswood Avenue be grade separated from El Camino Real also?
- Be open to other options (viaduct and tunnel, for example) and recommend studying them further.
- Provide renderings of the various options.
- More grade separations are preferred, and consider grade separating Encinal Avenue.
- Bicycle and pedestrian access should be given high priority.
- Vehicular/pedestrian access and safety at the Alma Street/Ravenswood Avenue intersection should be given priority.

Recurring themes of the community feedback at all outreach events included the following:

- More Grade Separations
- Minimize Height of the Railroad
- Improve Pedestrian & Bicycle Access and Safety
- Improve Connectivity between Alma Street & Ravenswood Avenue
- Coordinate with other Projects
- Minimize Driveway Impacts
- Inform owners about Property Impacts
- Station Configuration
- Aesthetics

The project was on the Menlo Park City Council agenda on the following dates:

- February 7, 2017, Study Session
- April 4, 2017, Study Session
- October 10, 2017, Regular Business
- January 16, 2018, Informational Item (no presentation made)
- May 8, 2018, Regular Business
- December 4, 2018, Informational Item (no presentation made)
- January 15, 2019, Study Session
- March 5, 2019, Consent Item

At the April 4, 2017 meeting, City Council voted in favor of Alternative C (over Alternative B) to be studied further (with Alternative A); and also voted in favor of including a reconfigured station with a center boarding platform and an outside passing track, if required in the future, into this study (for Alternatives A and C).

On May 8, 2018, City Council voted in support of Alternative A as the preferred alternative. Although, Alternative C provides more long-term benefits, there was concern about moving forward with an

alternative that was more costly and would have impacts to the community and the travelling public at more locations during construction. The motion to move forward with Alternative A passed 3-1-1 (with one councilmember dissenting, and one councilmember abstaining).

In addition, City Council directed staff to draft letters to Palo Alto, Atherton, Redwood City, Mountain View, and Sunnyvale to request consideration of a multi-city trench or tunnel; and to draft a letter to Caltrain to request a bicycle/pedestrian path adjacent to the rail within Caltrain right-of-way. City Council also requested an additional scope of work and appropriation request to prepare (1) Financial assessment of a trench/tunnel and; (2) Conceptual design, noise, tree, and a visual impact assessment of a fully elevated alternative.

On January 15, 2019, staff requested City Council direction on finalizing the Project Study Report and advancing the additional scope of work requested by the Council in May 2018. At that time, the Council directed staff to return with a revised Project Study Report and generally voiced support of Alternative C as the preferred alternative, citing concerns about eliminating direct access between Alma Street and Ravenswood Avenue (proposed in Alternative A); and the difficulty in grade separating other streets (Oak Grove Avenue, etc.) in the future. The Council also directed staff to bring back the scope amendment at a future meeting, to follow approval of the Project Study Report.

Following the City Council direction, the City Council Rail Subcommittee held a public meeting on January 31, 2019 to consider two actions: a recommendation to the City Council on a preferred alternative necessary to finalize the Project Study Report; and consideration of the additional scope items described above. The Rail Subcommittee directed staff to return to City Council with the preferred alternative selection of Alternative C and revisions to this document to reflect that direction. They also provided direction to staff to outline the next steps and process for consideration of the additional scope of work and further analysis of other alternatives to follow the adoption of the Project Study Report.

City Council approved a motion (5-0-0) to move forward with Alternative C as the preferred alternative at the City Council meeting on March 5, 2019.

10. Evaluation

Alternatives A and C were evaluated based on potential benefits and impacts including rail/vehicle conflict, traffic and local street connectivity, pedestrian/bicycle access, anticipated changes in train horn noise, visual impacts, property/driveway impacts, disruption during construction, estimated construction costs, and traffic operations. These criteria were established based on feedback received during the community engagement process conducted as part of this study, as summarized in Section 9 above.

An impact matrix was developed and utilized a color-coded rating system based on qualitative and quantitative assessment of the specific impact. The color-coded system is shown below.

Impact Matrix Color Coding System

The results were presented at the May 8, 2018, Menlo Park City Council meeting and are displayed in the following matrix (See Figure 12).

Alternative A would grade separate the City's most heavily-traveled, east-west connector (Ravenswood Avenue), have the least overall impact to the community (shorter construction duration, fewer utility relocations and property impacts compared to Alternative C), and is estimated at a lower cost ($160 to $200 million for Alternative A, versus $310 to $380 million for Alternative C).

Alternative C would have higher short-term impacts (construction cost, disruption during construction, permanent and temporary right of way impacts), but it also would provide greater long-term improvements (east/west connectivity for three streets, pedestrian/bicycle access, less potential rail/vehicle conflicts, less potential horn and gate noise, maintaining Ravenswood Avenue/Alma Street connectivity).

	A	C	
Alternatives →			**Notes**
Reduce Potential Rail/Vehicle Conflict			Three grade separations for Alt C vs. one for Alt A
Improve East/West Connectivity			More grade separations, better east/west mobility across town
Improve East/West Ped/Bike Access			Increased safety and connectivity for Alt C
Reduce Potential Horn & Gate Noise			With elimination of at-grade crossings, horn or gate noise will potentially be reduced
Maintain Alma St/Ravenswood Ave Connection			No direct access to/from Ravenswood from/to Alma St for Alt A
Increase Visual Impacts			Railroad profile remains at current elevation for Alt A
Minimize Property/Driveway Impacts			More impacts to properties with 3 grade separations, Alt C
Minimize Disruption During Construction			Fewer roads and properties impacted during construction for Alt A
Improve Traffic Pattern Predictability			Improved traffic circulation for Alt C
Order of Magnitude Cost	$160-200M*	$310-380M*	Lower overall cost for Alt A

*** Preliminary (Subject to Change)**

Figure 14. Alternative Matrix

11. Environmental Determination/Document

Grade separation projects are generally exempt from the requirements of the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA). A CEQA Statutory Exemption typically applies to railroad grade separation projects that eliminate or reconstruct an existing at-grade crossing (California Public Resources Code Section 21080.13 and Title 14 California Code of Regulations Section 15282(g)). This Statutory Exemption was enacted by the State and became effective in 2016. Unlike categorical exemptions, statutory exemptions are not subject to any exceptions that might require environmental review. Statutory exemptions are absolute; the exemption applies if the project fits within the language of the exemption. This proposed project squarely fits within the statutory exemption. The proposed project appears to meet the definition of this Statutory Exemption, making it exempt from CEQA. Caltrain, as the owner of the rail facility and right-of-way, will likely be the lead agency for this approval.

If the project involves federal transportation funding, NEPA includes Categorical Exclusions (CEs) that also may apply. Caltrain or the Federal Railroad Administration would function as the NEPA Lead Agency

and would determine and approve the appropriate documentation. A CE defined under Title 23 Code of Federal Regulations (CFR) Section 771.117(c)(28) is "Bridge rehabilitation, reconstruction, or replacement or the construction of grade separation to replace existing at-grade railroad crossings." Restrictions on the use of this CE category are outlined in 23 CFR 771.117(e) and include the acquisition of more than a minor amount of right-of-way or residential or non-residential displacements.

If Ravenswood Avenue is lowered substantially, the design would require retaining walls and/or right-of-way acquisition to accommodate the slopes and supporting embankments, or retaining wall structures, depending on the alternative and design. If a NEPA CE under 23 CFR 771.117(c)(28) is not applicable, a CE under 23 CFR 771.117(d) could be considered, but use of this CE would require additional environmental review and documentation (technical studies or memos) to demonstrate that no substantial or significant impacts would occur. If the project does not qualify for a CE, the next appropriate environmental document would be an Environmental Assessment (EA) to support approval of a Finding of No Significant Impact (FONSI).

Key environmental studies to support a NEPA CE or EA for this project would likely involve technical reports for cultural resources, biological resources, hazardous materials, noise, visual/aesthetics, and community impacts.

12. Funding

The current PSR level phase of the project is funded through San Mateo County Transportation Authority's Measure A (voter-approved half-cent sales tax for countywide transportation projects and programs) and a contribution provided from local City funds. The City intends to request additional Measure A, regional, State and federal grade separation funds in future programming years for subsequent milestones.

12.1 Capital Outlay Project and Support Estimate

Table 1 summarizes order of magnitude construction, right-of-way and support cost estimates for each Build Alternative. Capital outlay project cost estimates for each alternative are included in Attachment D.

Table 3. Capital Outlay Project and Support Estimate

Cost Estimate (Values shown in Millions)					
Alternative	**Construction**	**R/W & Utility**	**Support**	**Escalation^**	**Range #**
A	$90.2	$21.8	$33.5	$33.4	$160 to $210
C	$150.6	$60.8	$57.6	$61.8	$310 to $380

^ Escalation to estimated mid-point of construction (2025)
# Range is based on +/- 10%, rounded up to the nearest $10M.

The level of detail available to develop these capital outlay project estimates is only accurate to within the above ranges and is useful for long-range planning purposes only.

12.2 Potential Funding Sources

Funding for transportation and other major infrastructure projects has been increasingly difficult to obtain due to limited availability of funds as well as the greater demand and competition for the funding that is available. Moreover, the funding environment is highly volatile, and changes in administration priorities and the economy can affect the type and availability of funds. For instance, changes in energy prices can

alter gasoline-tax funded opportunities, while changes in administration priorities can change project selection criteria for existing funds. Additionally, many funding partners will only evaluate “shovel ready” projects for funding consideration. Together these factors recommend proceeding with project design and environmental compliance completion as the project’s capital funding strategy is developed, refined and implemented.

There are three major categories of potential project funding sources:

12.2.1 Federal

The Highway Safety Improvement Program (HSIP) is a federal aid program under the FAST Act. The California apportionment of over $200 million is administered by the Caltrans Division of Local Assistance through a competitive call for projects every two years. The maximum federal reimbursement amount per project is $10 million and may be used for preliminary engineering, right-of-way and construction. The ninth and most recent call for projects was announced on April 30, 2018, with a submission deadline of August 30 2018. A small percentage of the HSIP funds are set aside for the Railway-Highway Crossing (Section 130) Program specifically for use in grade crossing projects. California apportionment of the Section 130 Program is approximately $16 million per year and the maximum federal reimbursement level may be up to 100% of project work to eliminate the identified hazards at an eligible crossing. It is administered by the Caltrans Division of Rail and CPUC, and requires CPUC Priority and FSTIP listings. Obtaining the CPUC Priority and FTIP listings are important next steps for the project. Caltrans prepares the FSTIP every two years in cooperation with the regional transportation agencies. Applications for the Draft 2021 FSTIP occur in 2020 and authorized by December 2020.

California apportionment of federal funds from the Surface Transportation Program (STP) / Congestion Mitigation and Air Quality Improvement Program (CMAQ) and other FAST Act Programs are now distributed across the nine Bay Area Counties through the One Bay Area Grant Program (OBAG).

On November 18, 2015, the Metropolitan Transportation Commission (MTC) adopted the funding and policy framework for the second round of the OBAG program. Known as OBAG 2 for short, the OBAG 2 County Program of Projects was approved by the MTC Commission at the end of 2017 with $386 million in federal funds earmarked for 180 transportation projects located in 95 jurisdictions within Bay Area region’s nine counties. However, the majority of OBAG 2 funds are for active transportation projects oriented to bicycle access and walkability, but also include streetscape improvements, road diets, or transit elements. The City received funding for repaving parts of Santa Cruz Avenue and Middle Avenue, with an expected completion in the summer 2020.

Other potential federal contribution to project funding can be expected to be limited and from highly competitive grants. Until recently the Transportation Investment Generating Economic Recovery (TIGER) grant program provided an annual opportunity for transportation projects to compete for federal grant funding. Another similar federal grant program Fostering Advancements in Shipping and Transportation for the Long-Term Achievement of National Efficiencies (FASTLANE) was however more focused on providing financial assistance (both in the form of grants or credit assistance) to nationally and regionally significant freight and highway projects. While those grants were highly selective, grade separation projects have been successful in securing funding through these mechanisms under the previous TIGER programs.

Recently the federal government has discontinued and in effect replaced those grant programs with its Infrastructure for Rebuilding America (INFRA) and Better Utilizing Investments to Leverage Development (BUILD) grants programs. These are nationally competitive grants and are expected to offer an annual call for applications. The INFRA grant program has completed two rounds of funding and awarded both large ($45 million for a City of Seattle) and small ($5 million for Tukwila, WA) grants for their grade separation and railroad safety projects. The INFRA program is specifically focused on projects where the local sponsor is majorly invested and well-positioned for the project’s construction and completion. The last INFRA funding opportunity submission deadline was November 2, 2017. Although no announcement for a FY 2018 round has occurred it is expected that additional future opportunities for INFRA program funding will be likely.

Similar to its predecessor TIGER, the BUILD Transportation grant program awards grant funding on a competitive basis for projects that have a significant or local regional impact. The BUILD program incorporates many of the TIGER criteria and requirements but has a greater focus on infrastructure that will make a positive impact on the country and also gives special consideration to projects located in rural areas. The maximum grant award under the BUILD program is $25 million and the submission deadline for its first funding round was July 19, 2018. Although no formal commitments have been made, it is considered likely that there will additional opportunities for BUILD program funding in the future.

Generally, the maximum federal reimbursement ratio for projects in non-rural areas is 80%, although it can be lower. Non-federal funding is required to cover the other 10% or more of the development cost for the project. If a project uses multiple counter measures which have different maximum federal reimbursement ratios, the lowest ratio applies. Among the various federal funds identified for this project, the maximum reimbursement ratio is 80%, and as such state and/or regional funding will be required and is identified below. Furthermore, the federal government increasingly favors projects that leverage financial support from other agencies and/or the private sectors.

The federal government also offers two loan assistance programs for transportation projects similar to the Ravenswood Avenue Railroad Crossing Project. The DOT sponsored Transportation Infrastructure Finance and Innovation Act (TIFIA) provides low cost credit assistance for qualified projects of regional and national significance in the form of direct loans, loan guarantees, and standby lines of credit. However, given the requirements to qualify and restrictions in use of the loan funding, TIFIA lending is best suited in conjunction with other funding mechanisms that can obtain investment grade ratings (e.g. from dedicated sales revenues).

The Railroad Rehabilitation & Improvement Financing (RRIF) program, established by the Transportation Equity Act for the 21st Century can be used to obtain federal loans to refinance debt for railroad projects. However, loan recipients must be able to secure the loan to offset the loan default risk. RRIF also favors projects that result in economic revitalization and safety improvements. It also provides a limited number of large loans (averaging $165 million) for major railroad redevelopment projects.

12.2.2 State

Successful project development will require obtaining substantial state funding to supplement the federal contribution. Section 190 Streets and Highway Code, required Caltrans to include $15 million in each budget for grade separation projects on state highways and local streets and roads. This Grade Separation Program is jointly administered by Caltrans and CPUC. CPUC develops the priority list of projects that would be eligible for funding, which receive funding allocations from Caltrans. The application will be completed when the project approaches the latter stages of the final design phase.

In addition to the Grade Separation Program (Section 190) funds, a potential state funding is the California High Speed Rail Authority (through Prop 1A), which has made substantial funding contributions to key grade separation projects and has committed up to 50% of total project funds for other grade separation projects in San Mateo County. However, the lack of passing track or other project-related changes at the location requiring grade separation for its operations makes an Authority funding contribution unlikely.

The State Road Repair and Accountability Act (SB 1) was passed in 2017 and provides funding for numerous transportation programs and purposes. The project may be expected to be best-aligned with the Road Maintenance and Rehabilitation Program through its Local Street & Road Funding Program. Its 2018-2019 Program has $1.1 Billion in funding and its initial list of Eligible Cities and Counties was adopted in June 2018 with project applications due August 2018. However, future funding cycles are anticipated.

12.2.3 Regional/Local

Significant regional and local funding contribution will also be necessary. San Mateo County Transportation Authority's Measure A Grade Separation Program has been identified as a key funding source for the project. The fund has $235 million pending commitment and will be allocated to grade

separation projects throughout the county on a rolling basis, and may be used to fund pre-construction and construction related activities.

In addition, the City of Menlo Park will also likely need to contribute to the project's design and construction either from general or other local funds. Coordination with the City's Transportation Master Plan and Fee Program Update is ongoing and will incorporate the findings of this PSR. Potential contributions to the project may also be obtained from future development projects that may create additional traffic impacts on the rail crossing(s). To supplement City General Funds and other local contributions, it could be worthwhile to investigate the potential for some limited project funding support from innovative funding mechanisms, including transportation impact fees and value capture funding if future project related development (e.g. transportation oriented residential or retail development) can be expected to occur.

Other tax based potential local funding sources (e.g. increased parcel, add-on sales or transient occupancy taxes) would require city-wide voter approval. Further analysis of the applicable funding program requirements, their funding potential and likelihood of success will be necessary to develop and implement an effective funding strategy to obtain capital funding required for future project development.

Funding contributions from Caltrain may also offer some potential funding opportunities particularly if the agency is successful in future efforts to obtain the necessary voter, county, and city approvals for a future ballot measure for up to a one-eight-cent dedicated funding sales tax increase in San Francisco, San Mateo and Santa Clara counties. If successful, the Caltrain sales tax initiative could raise more than $100 million in annual revenues that would exceed its annual operations and maintenance costs. In which case, some capital funding for grade separation projects such as the Ravenswood Avenue Railroad Crossing Project may be possible.

13. Schedule

Table 4. Milestone Schedule

Project Milestones	Estimated Scheduled Delivery Date (Month Year)
Draft PSR	December 2018
Final PSR	March 2019
*Preliminary Engineering and Environmental Review	March 2021
*PS&E (Final Design)	June 2023
*Begin Construction	October 2023
*End Construction	September 2027

*Assuming funding is available/secured

14. Caltrain Coordination

All railroad involvement will be coordinated with Caltrain. Caltrain staff has attended monthly project meetings and has participated in the three public outreach workshops as well as reviewed the design criteria and the PSR.

15. Project Reviews

Caltrain: Melissa Reggiardo, Hok Lai & Bin Zhang — Date: October 2018
City of Menlo Park: Angela Obeso & Nicole Nagaya — Date: August 2018

16. Project Personnel

Nicole Nagaya, Assistant Public Works Director, City of Menlo Park	(650) 330-6770
Angela Obeso, Project Manager, City of Menlo Park	(650) 330-6739
Melissa Reggiardo, Caltrain, Principal Planner	(650) 508-6283
Etty Mercurio, Project Manager, AECOM	(510) 874-1773
Millette Litzinger, Deputy Project Manager, AECOM	(408) 961-8417
Peter DeStefano, Project Engineer, AECOM	(510) 874-3143

17. Attachments

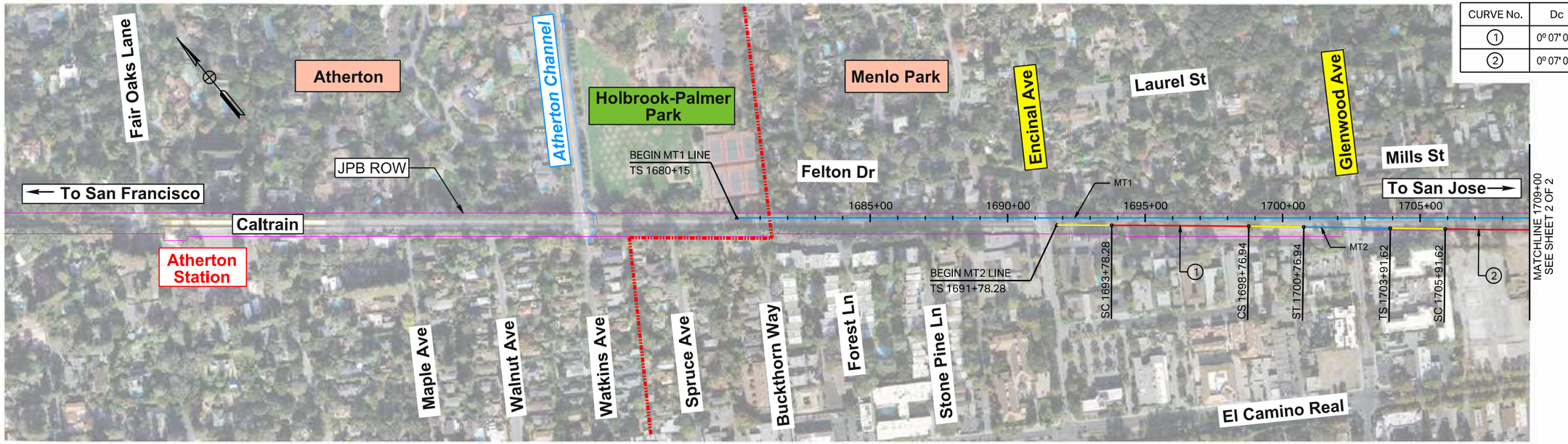
A. Alternative A – Preliminary Plans, Profiles and Typical Sections
B. Alternative C – Preliminary Plans, Profiles and Typical Sections
C. Preliminary Utility Plans and Relocation Costs
D. Preliminary Project Cost Estimates
E. 3D Renderings
F. Traffic Analysis Technical Memorandum

ATTACHMENT A

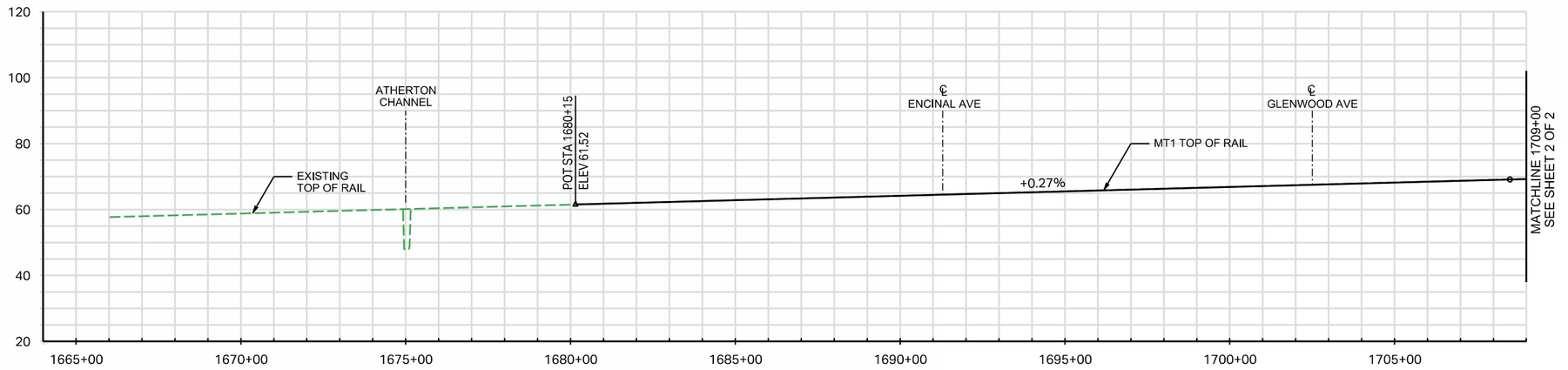
Alternative A – Preliminary Plans, Profiles and Typical Sections

CURVE DATA

CURVE No.	Dc	R	L
1	0° 07' 00"	49,110.66'	498.66'
2	0° 07' 00"	49,110.66'	500.00'



PLAN



PROFILE

MENLO PARK RAILROAD CROSSING

Caltrain

SAN MATEO COUNTY Transportation Authority

AECOM

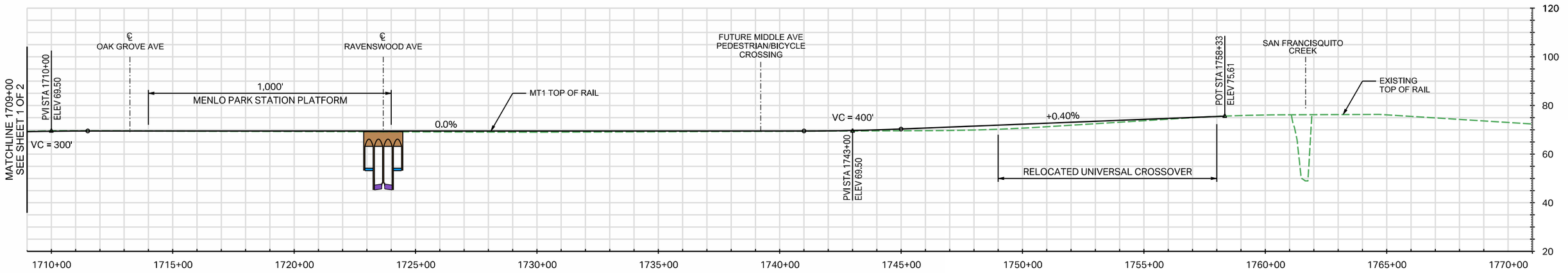
Ravenswood Avenue Railroad Crossing Project

Alternative A

Track Plan and Profile

Sheet 1 of 2

PLAN



PROFILE

MENLO PARK RAILROAD CROSSING

Caltrain

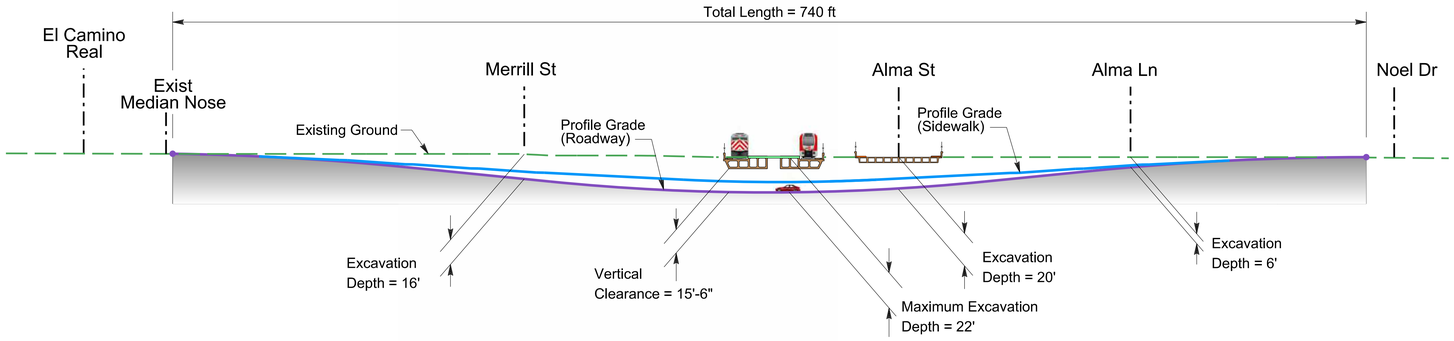
SAN MATEO COUNTY Transportation Authority

AECOM

Ravenswood Avenue Railroad Crossing Project

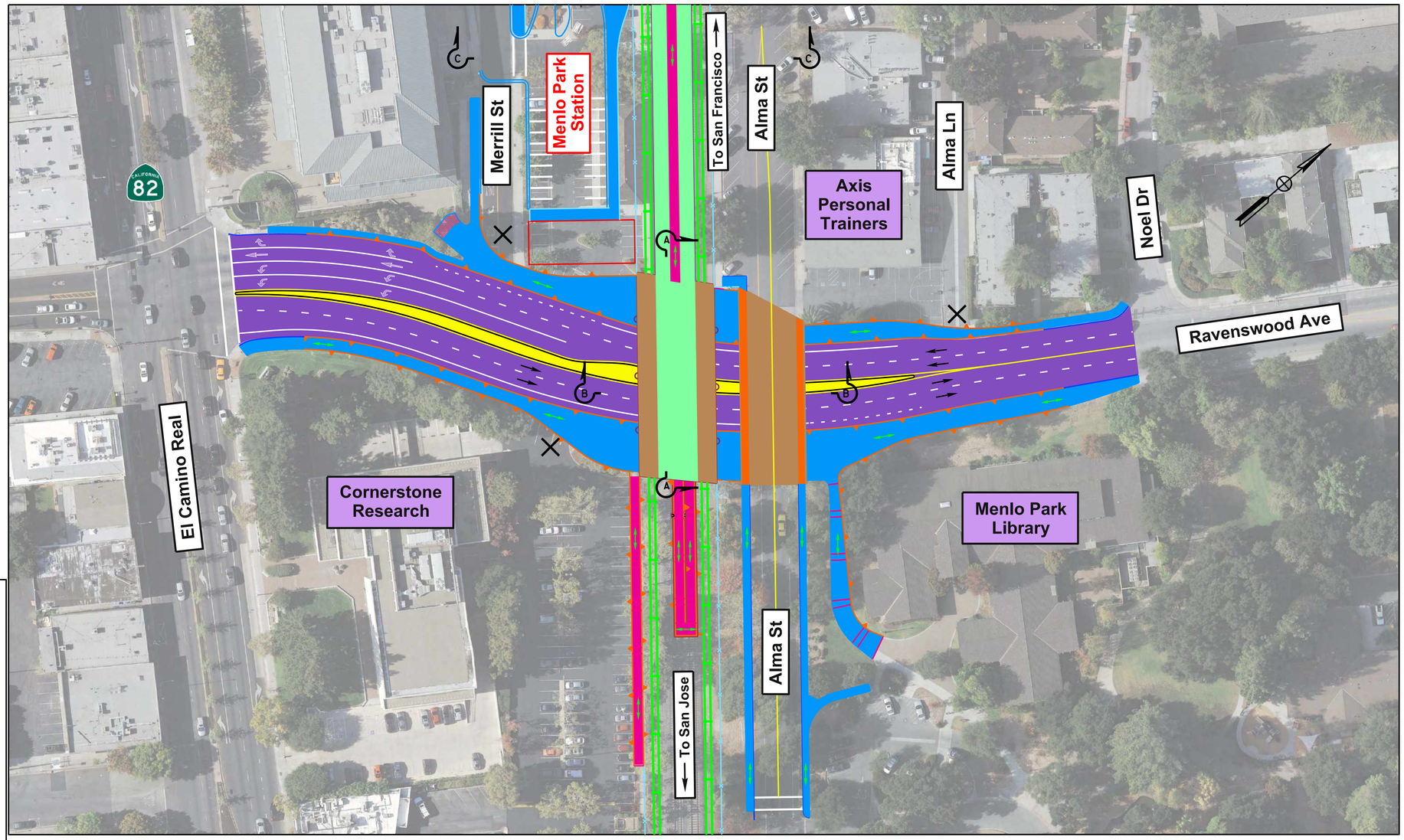
Alternative A

Track Plan and Profile
Sheet 2 of 2



RAVENSWOOD AVENUE

PROFILE



PLAN

LEGEND:

- Track
- Retaining Wall
- Structure
- Driveway Access
- Limits of Roadway Modifications
- Median / Curbed Island
- Sidewalk Modifications
- Sidewalk on Structure
- Station Platform
- Pedestrian Ramps (ADA Compliant)
- Access Modification or Restriction

Plan & Profile - Ravenswood Avenue (Alternative A)

0ft 40 80 ft

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
June 7, 2017

ALTERNATIVE A: UNDERPASS (RAVENSWOOD ONLY)

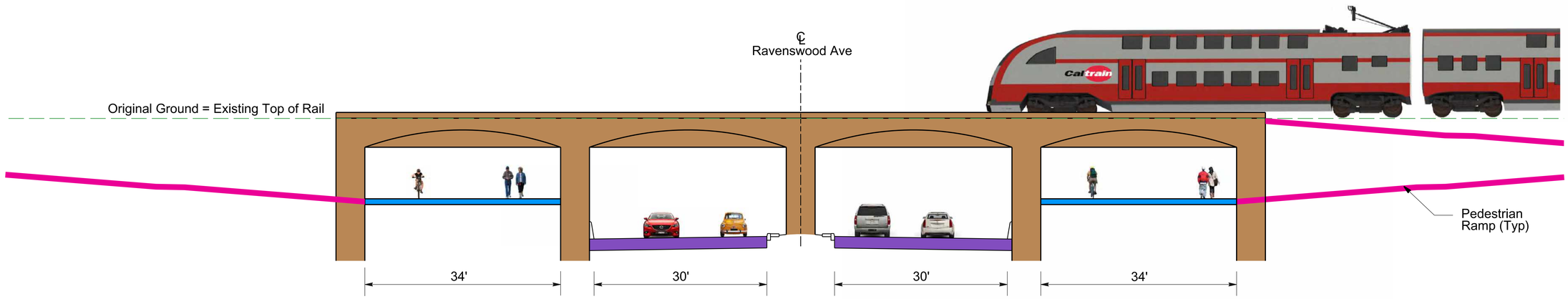
Ravenswood Avenue Railroad Crossing Project

MENLO PARK RAILROAD CROSSING

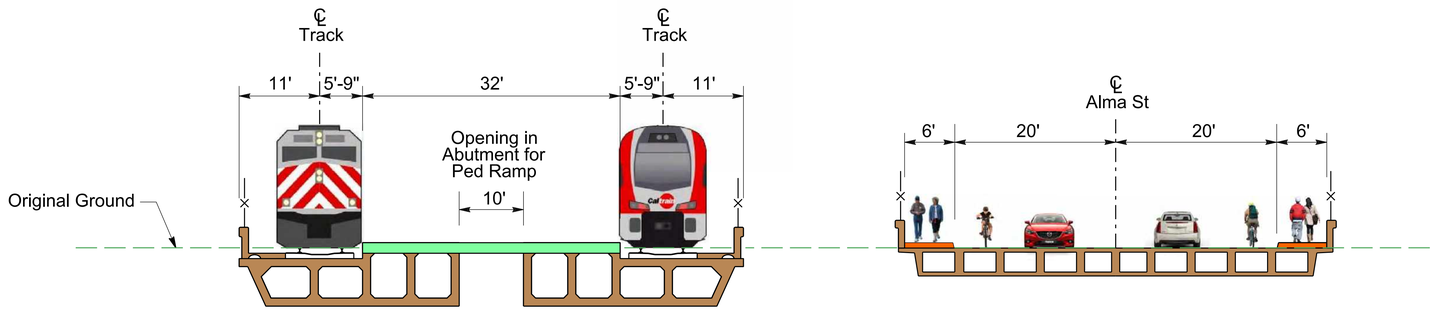
Caltrain

SAN MATEO COUNTY Transportation Authority

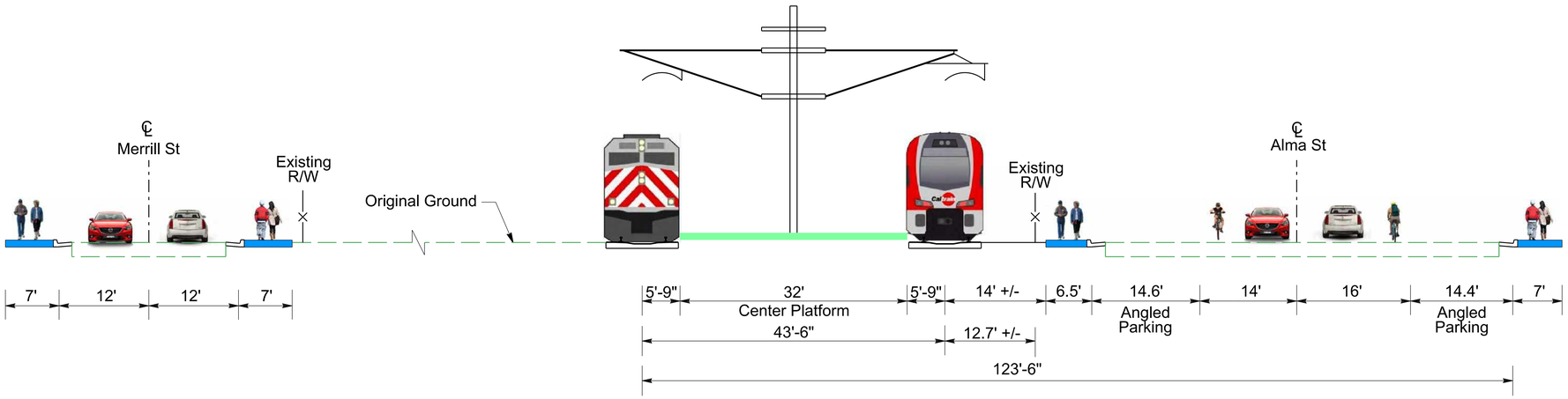
AECOM



Typical Section - Ravenswood Avenue
(Section A-A)



Typical Section - Bridges over Ravenswood
(Section B-B)



Typical Section - Merrill St and Menlo Park Station and Alma St
(Section C-C)

Typical Sections - Ravenswood Avenue (Alternative A)

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
June 7, 2017

ALTERNATIVE A: UNDERPASS
(RAVENSWOOD ONLY)

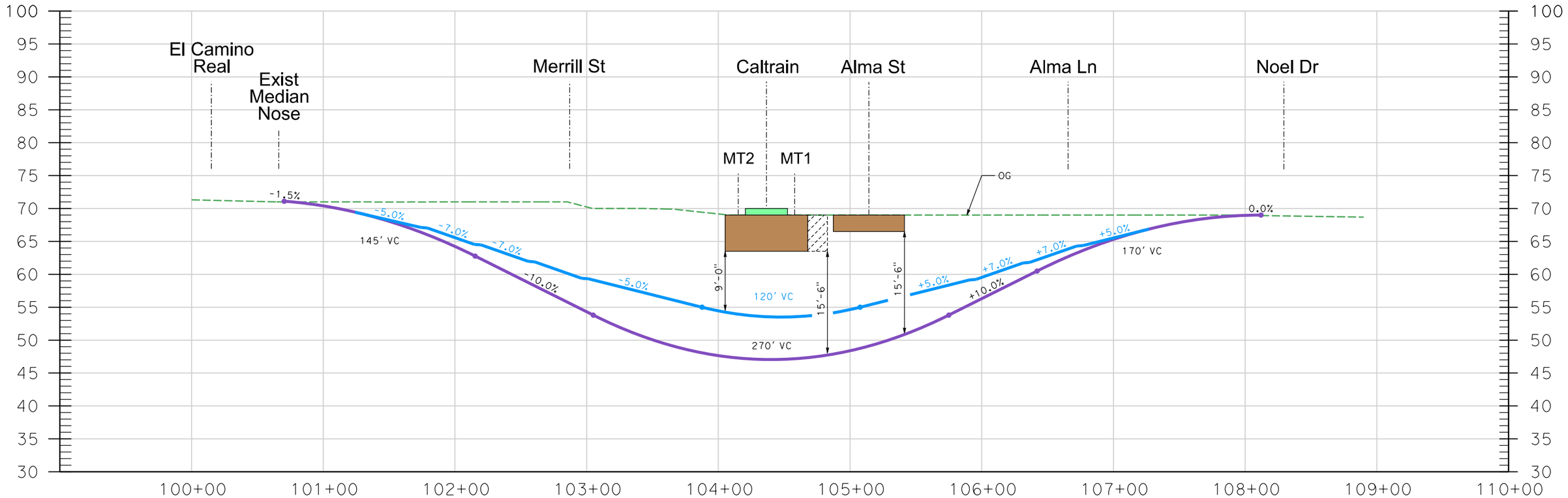
Ravenswood Avenue Railroad Crossing Project

MENLO PARK RAILROAD CROSSING

Caltrain

SAN MATEO COUNTY Transportation Authority

AECOM



Roadway Profile:
Crest curves based on 25 mph design speed (Sight Distance = 150 feet)
Sag curve based on passenger comfort for 25 mph

Sidewalk Profile:
Sag curve based on passenger comfort for 20 mph
Meets ADA Requirements

Legend:

- Grade Separation Structure
- Station Platform
- Sidewalk Profile
- Roadway Profile
- Widening for Future Passing Track

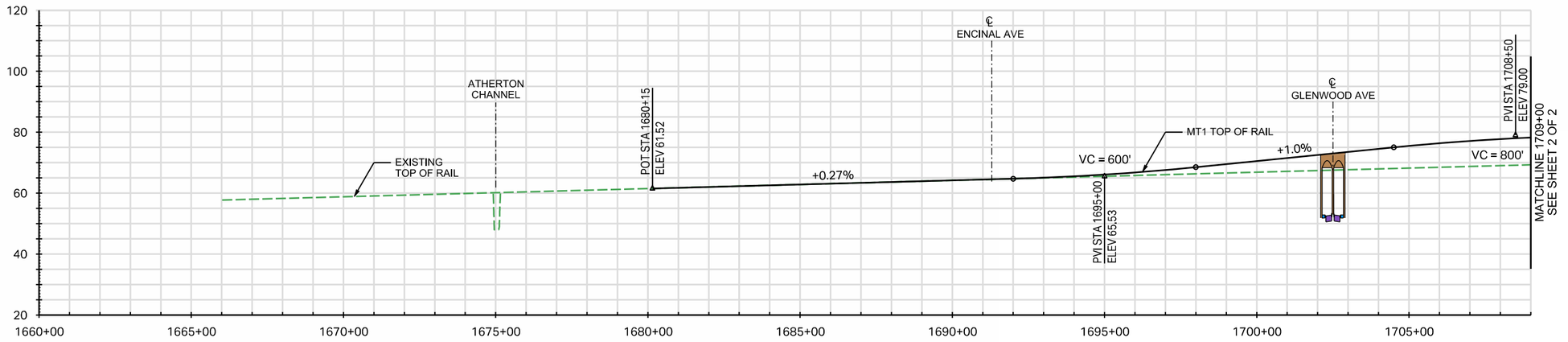
Ravenswood Avenue Profile - Alternative A

ATTACHMENT B

Alternative C – Preliminary Plans, Profiles and Typical Sections

Note: For horizontal alignment data, see Alternative A.

PLAN



PROFILE

MENLO PARK RAILROAD CROSSING

Caltrain

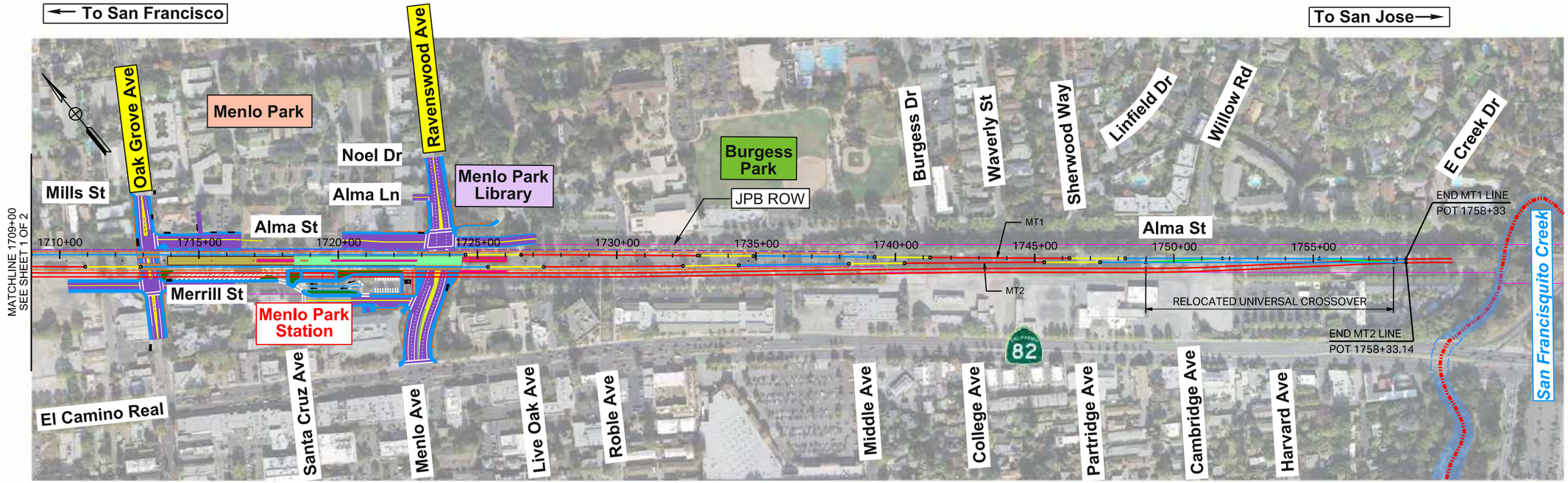
SAN MATEO COUNTY Transportation Authority

AECOM

Ravenswood Avenue Railroad Crossing Project

Alternative C

Track Plan and Profile
Sheet 1 of 2



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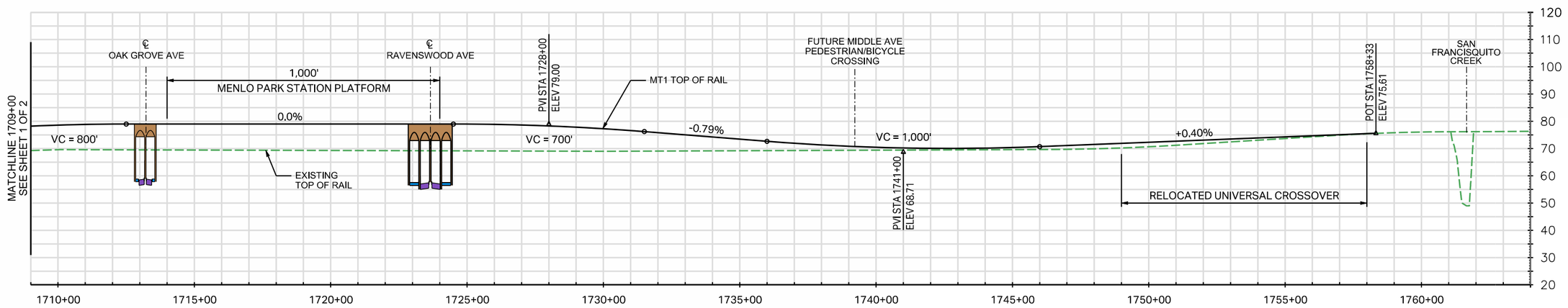


PROFILE

MENLO PARK RAILROAD CROSSING

Caltrain

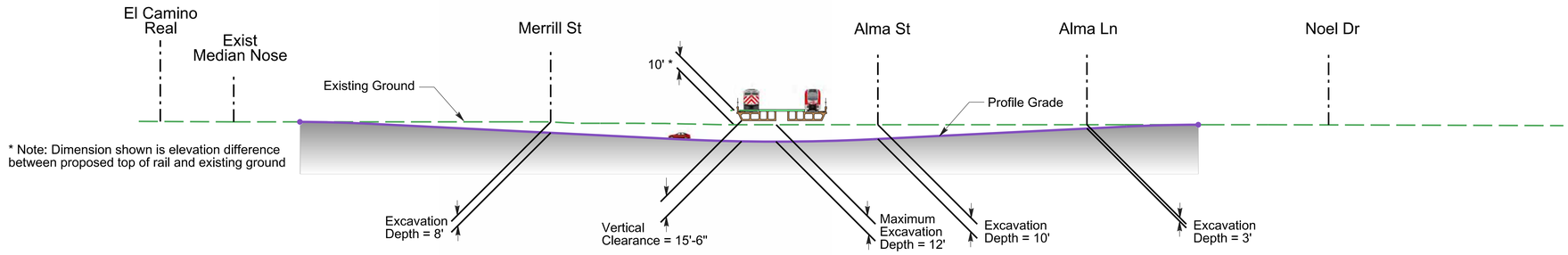
SAN MATEO COUNTY Transportation Authority

AECOM

Ravenswood Avenue Railroad Crossing Project

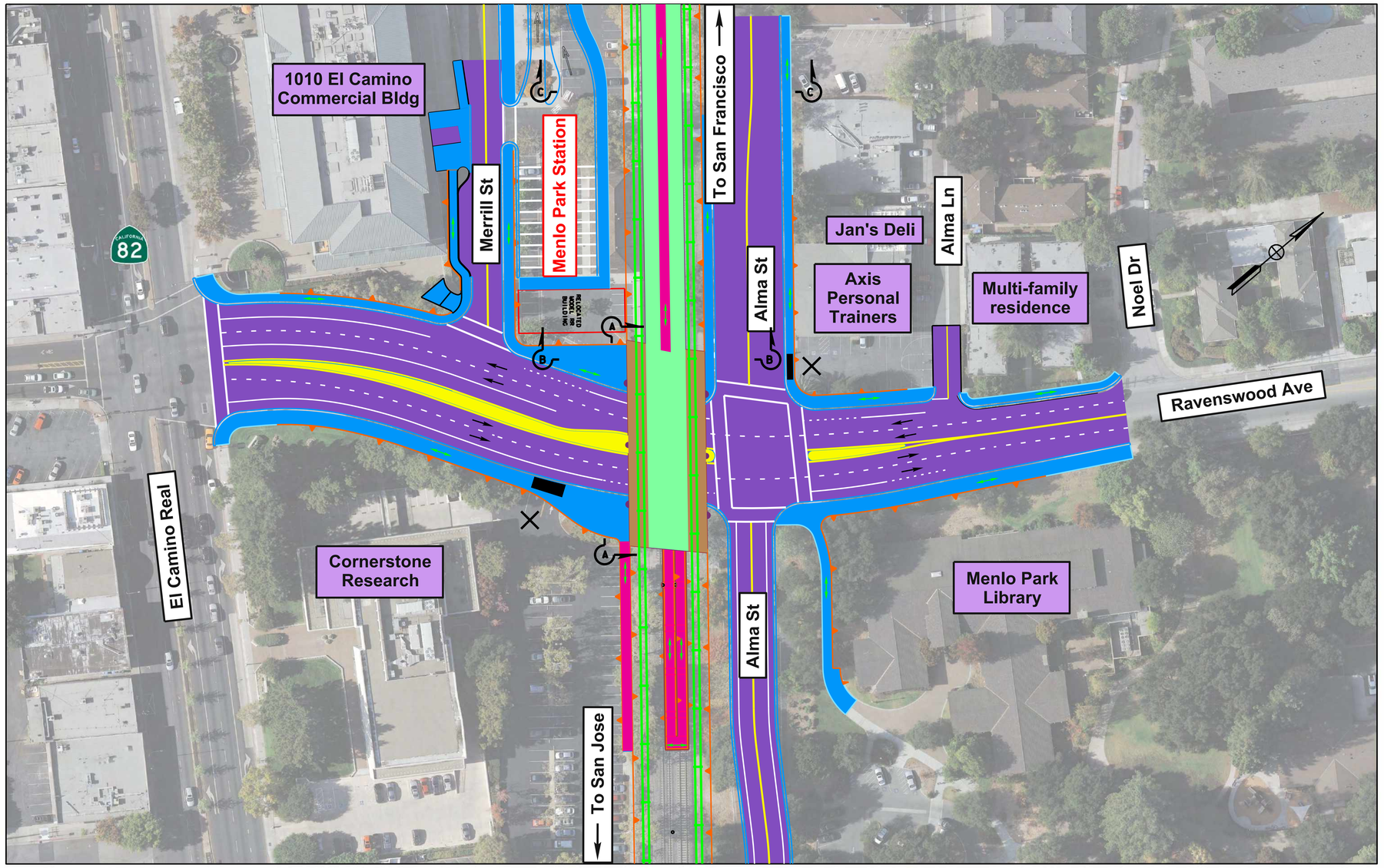
Alternative C

Track Plan and Profile
Sheet 2 of 2



RAVENSWOOD AVE

PROFILE



PLAN

LEGEND:

- Track
- Retaining Wall
- Structure
- Driveway Access
- Limits of Roadway Modifications
- Median / Curbed Island
- Sidewalk Modifications
- Station Platform
- Pedestrian Ramps (ADA Compliant)
- Access Modification or Restriction

Plan & Profile - Ravenswood Avenue (Alternative C)

0ft 40 80 ft

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
June 7, 2017

ALTERNATIVE C: HYBRID
(RAVENSWOOD, OAK GROVE, & GLENWOOD)

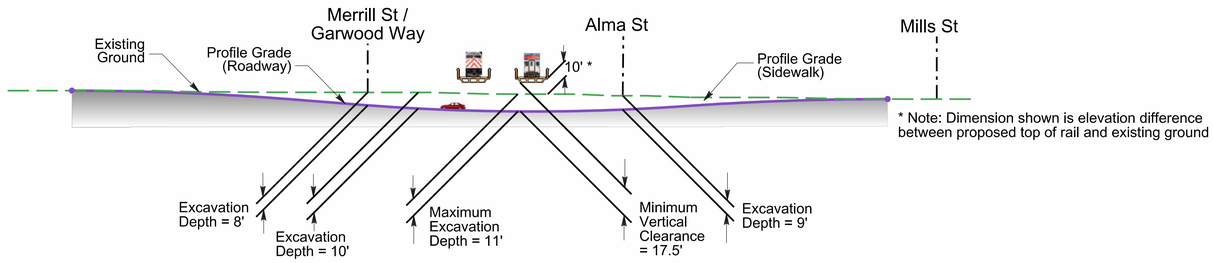
Ravenswood Avenue Railroad Crossing Project

MENLO PARK RAILROAD CROSSING

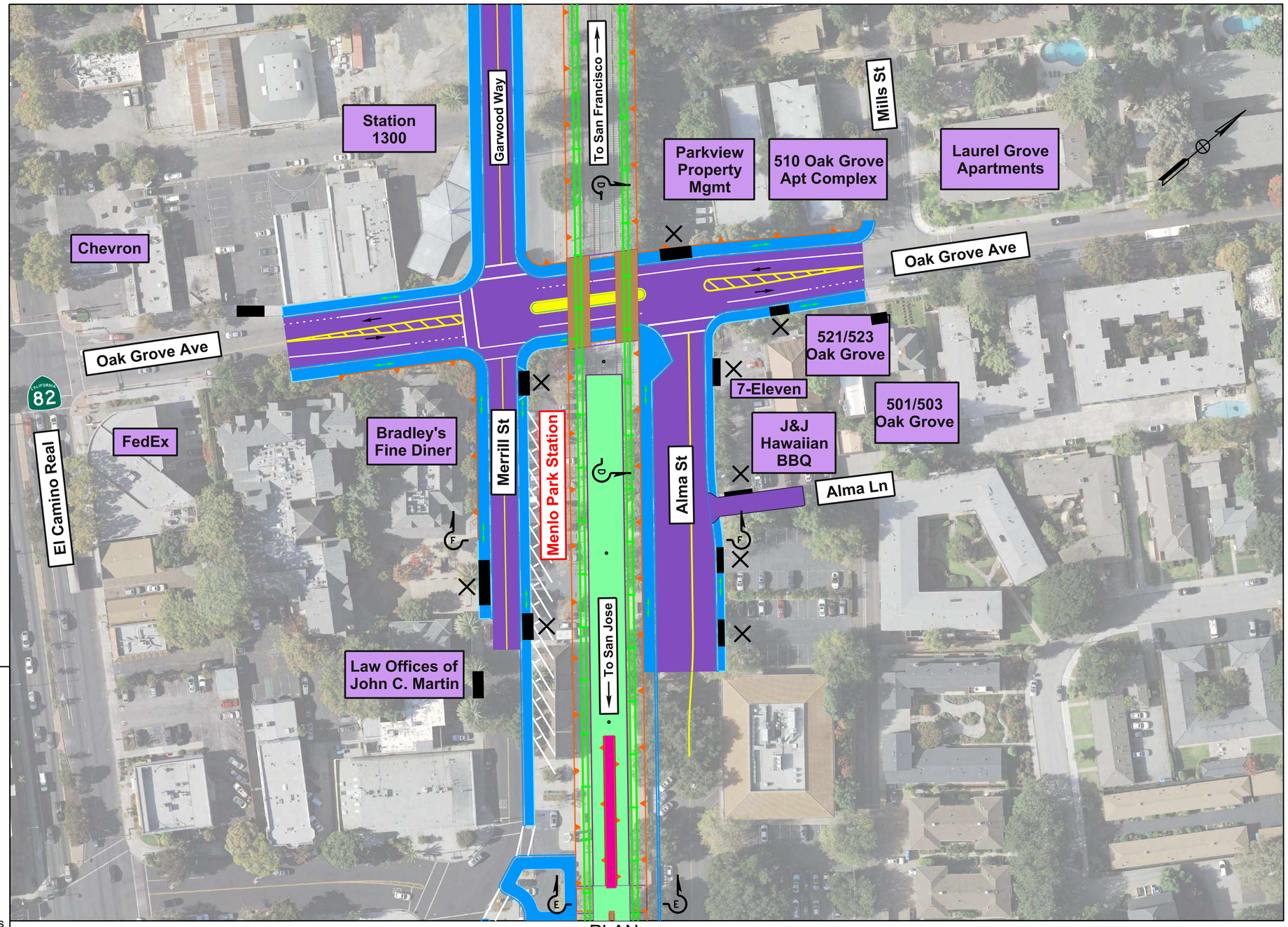
Caltrain

SAN MATEO COUNTY Transportation Authority

AECOM



OAK GROVE
PROFILE



PLAN

LEGEND:

- Track
- Retaining Wall
- Structure
- Driveway Access
- Limits of Roadway Modifications
- Median / Curbed Island
- Sidewalk Modifications
- Station Platform
- Pedestrian Ramps (ADA Compliant)
- Access Modification or Restriction

0ft 40 80 ft

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
June 7, 2017

Plan & Profile - Oak Grove Avenue (Alternative C)

ALTERNATIVE C: HYBRID
(RAVENSWOOD, OAK GROVE, & GLENWOOD)

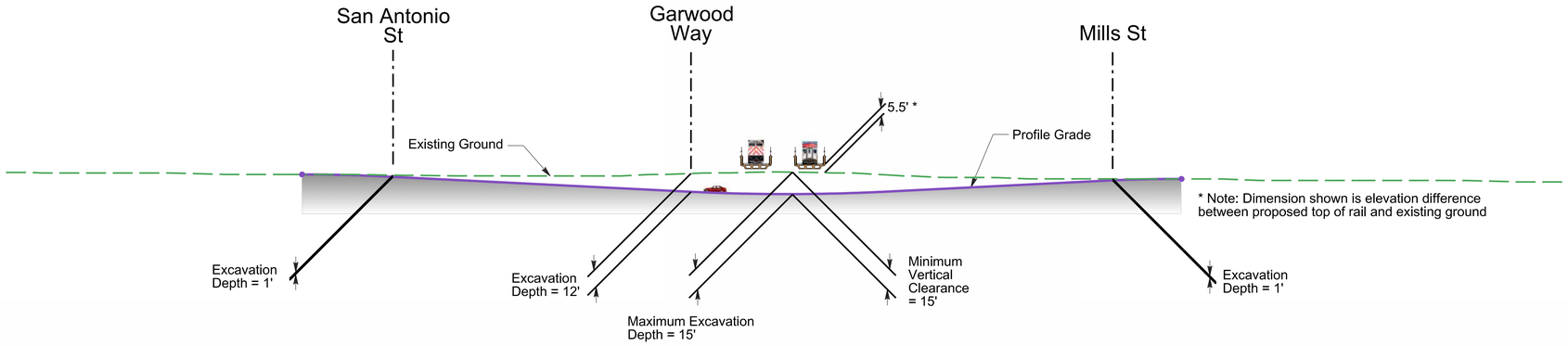
Ravenswood Avenue Railroad Crossing Project

MENLO PARK RAILROAD CROSSING

Caltrain

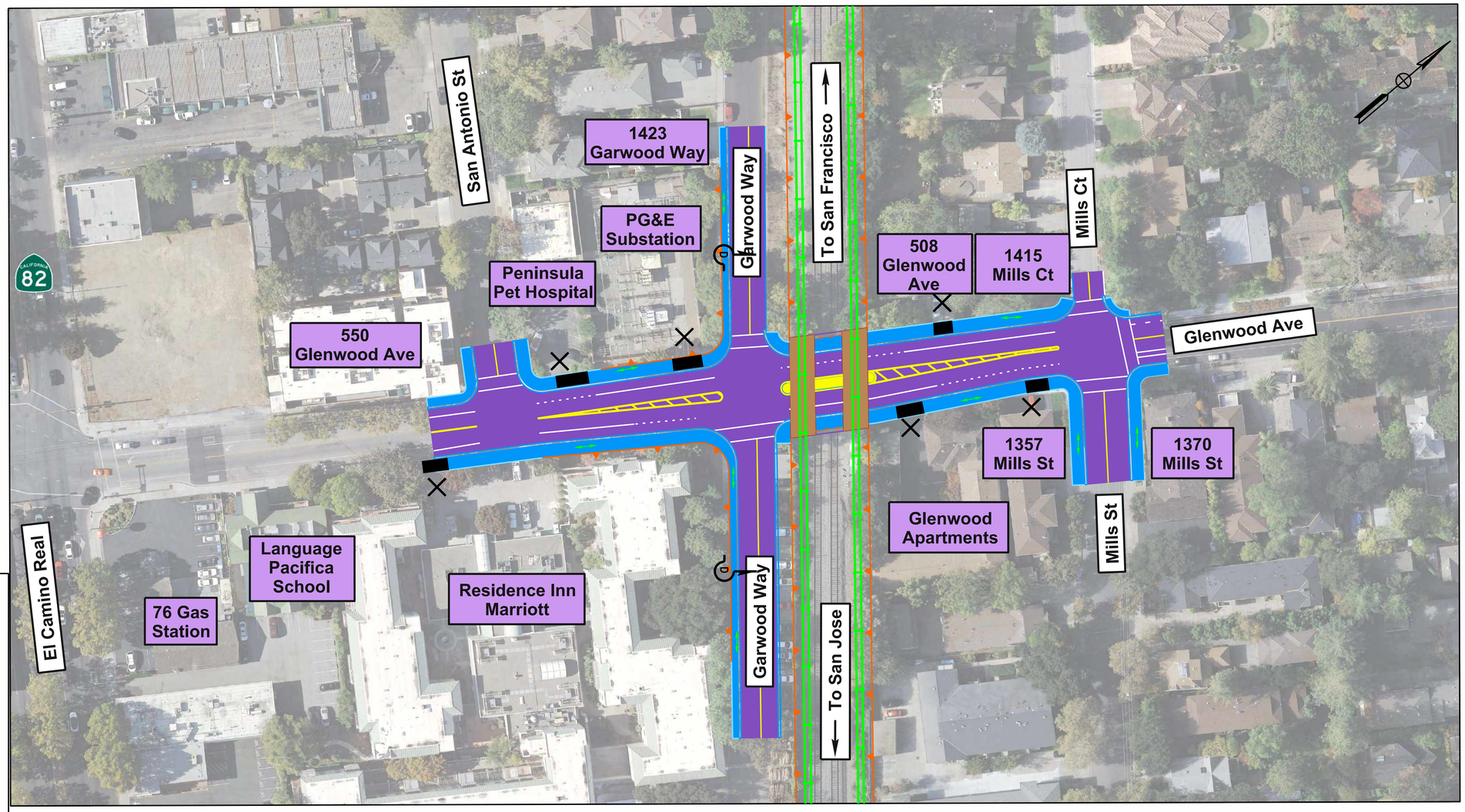
SAN MATEO COUNTY Transportation Authority

AECOM



GLENWOOD AVE

PROFILE



PLAN

LEGEND:

- Track
- Retaining Wall
- Structure
- Driveway Access
- Limits of Roadway Modifications
- Median / Curbed Island
- Sidewalk Modifications
- Station Platform
- Pedestrian Ramps (ADA Compliant)
- Access Modification or Restriction

0ft 40 80 ft

Plan & Profile - Glenwood Avenue (Alternative C)

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
June 7, 2017

ALTERNATIVE C: HYBRID
(RAVENSWOOD, OAK GROVE, & GLENWOOD)

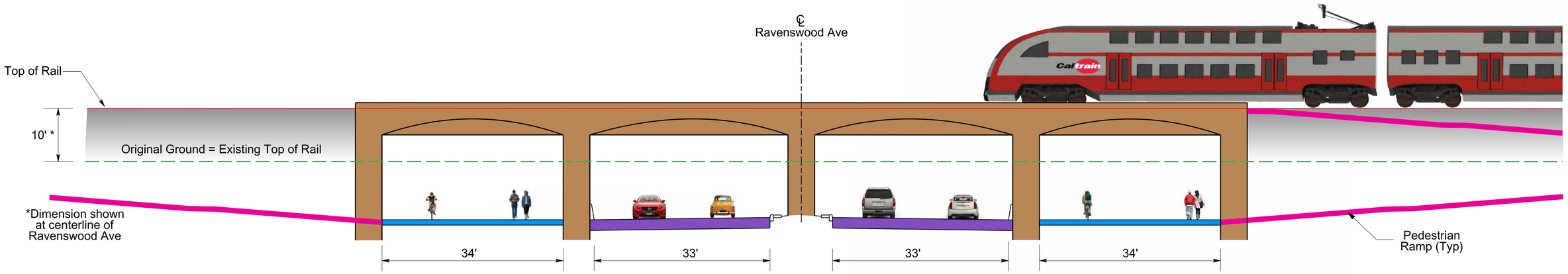
Ravenswood Avenue Railroad Crossing Project

MENLO PARK RAILROAD CROSSING

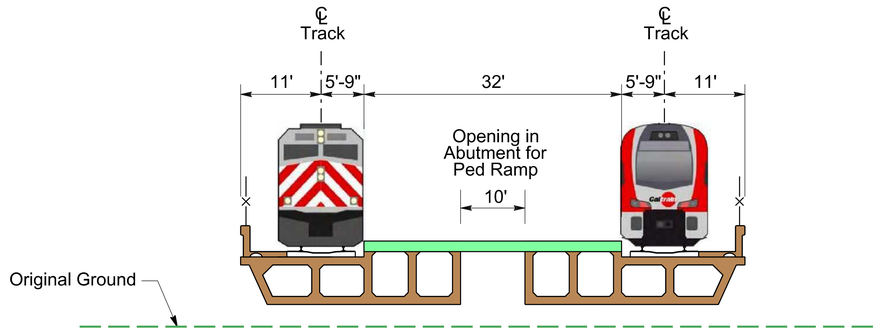
Caltrain

SAN MATEO COUNTY Transportation Authority

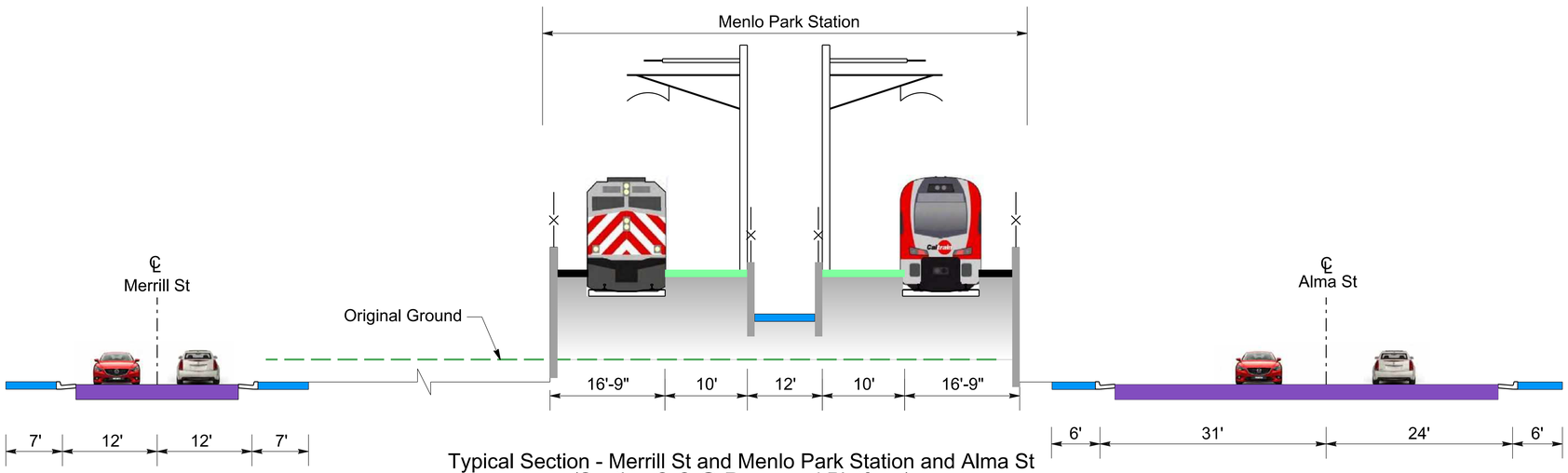
AECOM



Typical Section - Ravenswood Avenue
(Section A-A)



Typical Section - Menlo Park Station
(Section B-B @ Abutment)



Typical Section - Merrill St and Menlo Park Station and Alma St
(Section C-C @ Ramp and Platform)

Typical Sections - Alternative C

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
June 7, 2017

ALTERNATIVE C: HYBRID
(RAVENSWOOD, OAK GROVE, & GLENWOOD)

Ravenswood Avenue Railroad Crossing Project

MENLO PARK RAILROAD CROSSING

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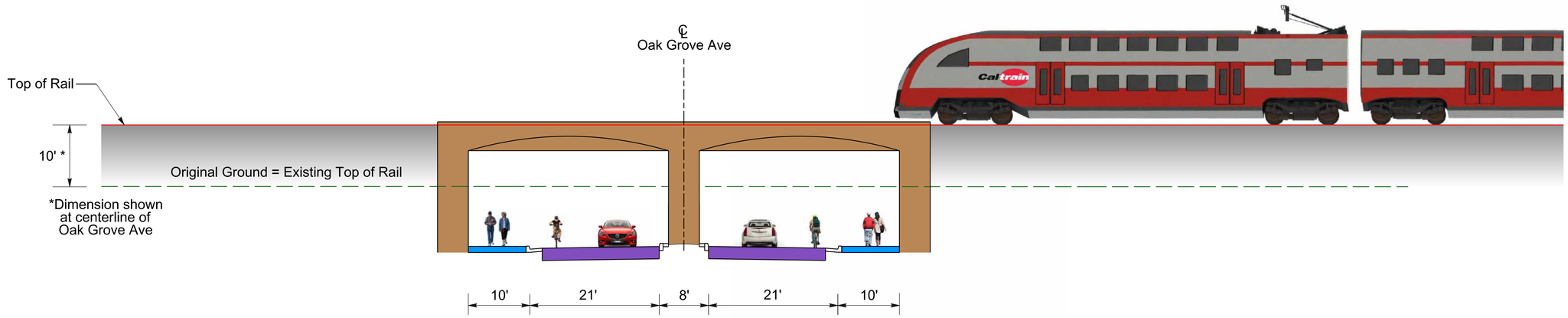
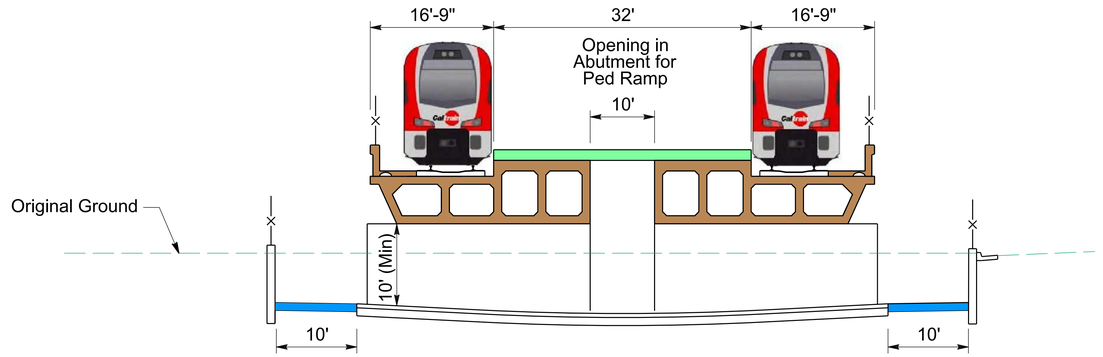
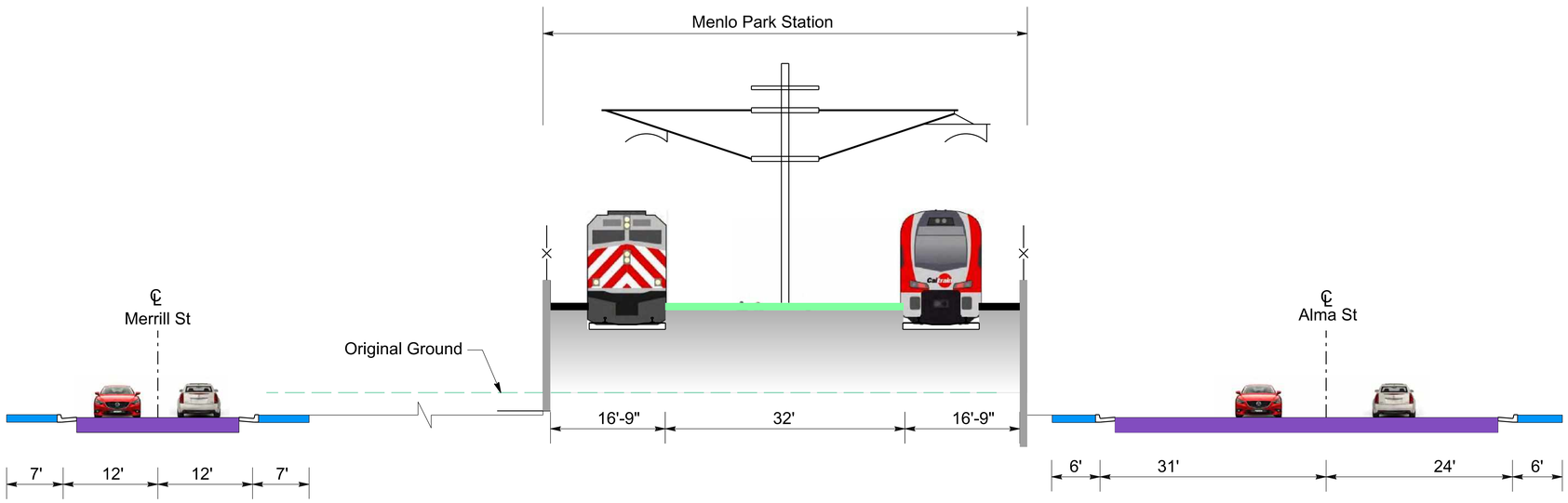


Typical Section - Oak Grove Avenue and Glenwood Avenue
(Section D-D)



Typical Section - Menlo Park Station
(Section E-E @ Pedestrian Undercrossing)



Typical Section - Menlo Park Station
(Section F-F @ Platform)

Typical Sections - Alternative C

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
June 7, 2017

ALTERNATIVE C: HYBRID
(RAVENSWOOD, OAK GROVE, & GLENWOOD)

Ravenswood Avenue Railroad Crossing Project

MENLO PARK RAILROAD CROSSING

Caltrain

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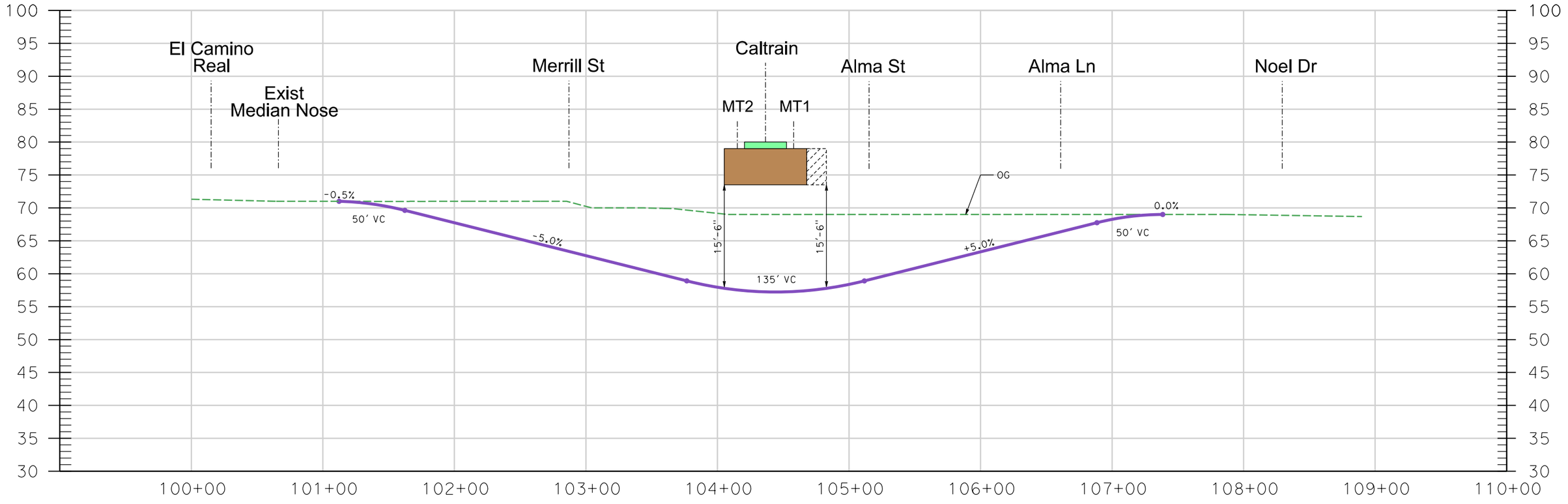
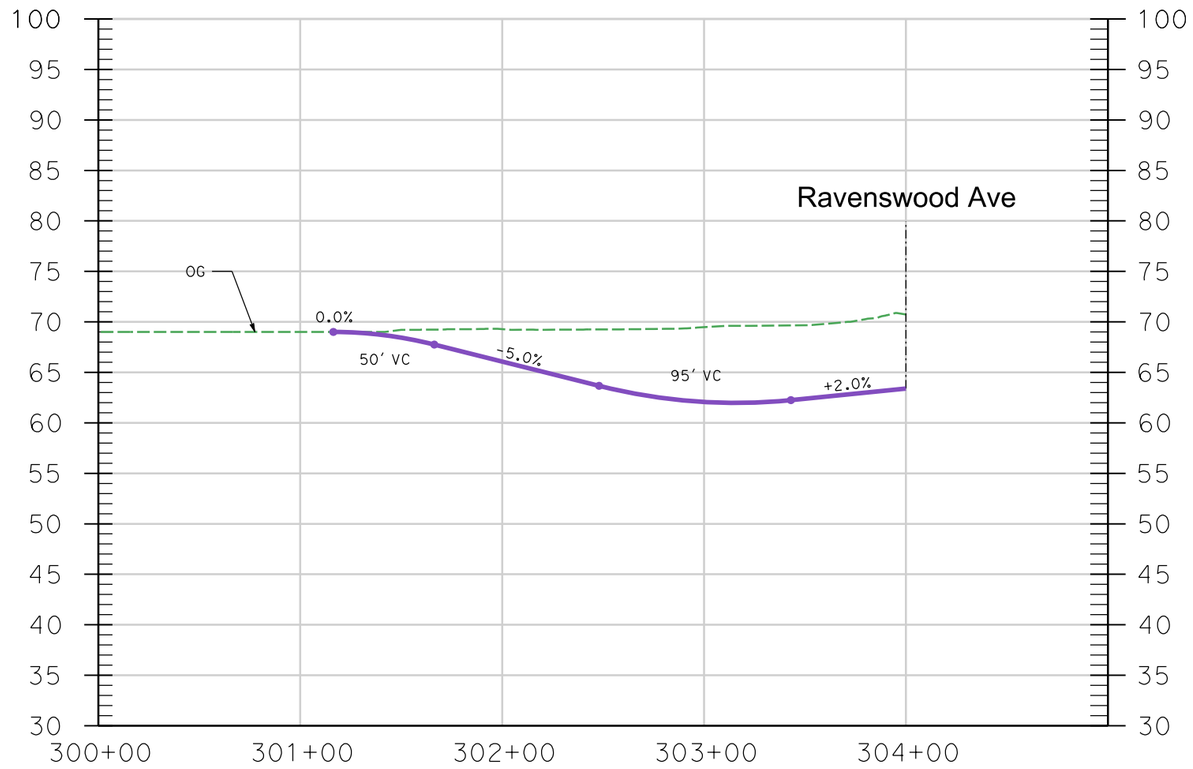


Roadway Profile:
Crest curves based on 25 mph design speed (Sight Distance = 150 feet)
Sag curve based on passenger comfort for 25 mph

Legend:

- Grade Separation Structure
- Station Platform
- Roadway Profile
- Widening for Future Passing Track

Ravenswood Avenue Profile - Alternative C

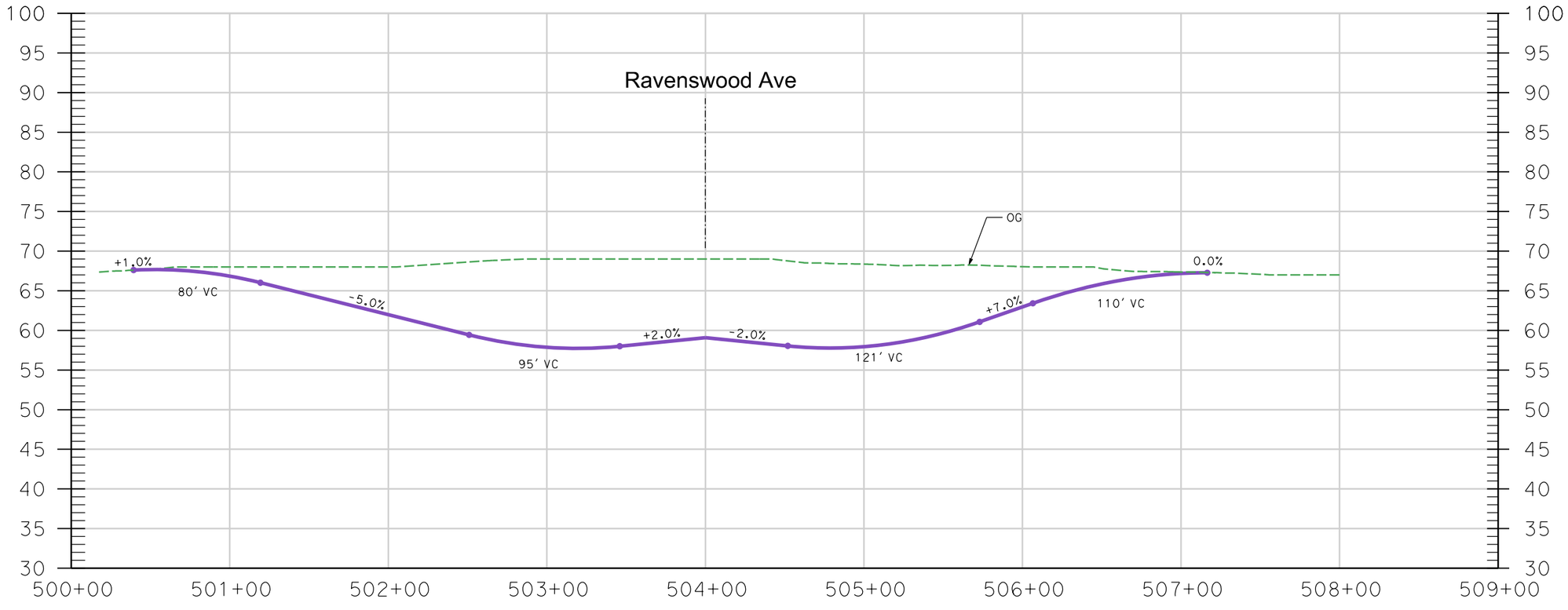


Roadway Profile:
Crest curves based on 25 mph design speed (Sight Distance = 150 feet)
Sag curve based on passenger comfort for 25 mph

Legend:

Roadway Profile

Merrill Street Profile (at Ravenswood Avenue)
Alternative C

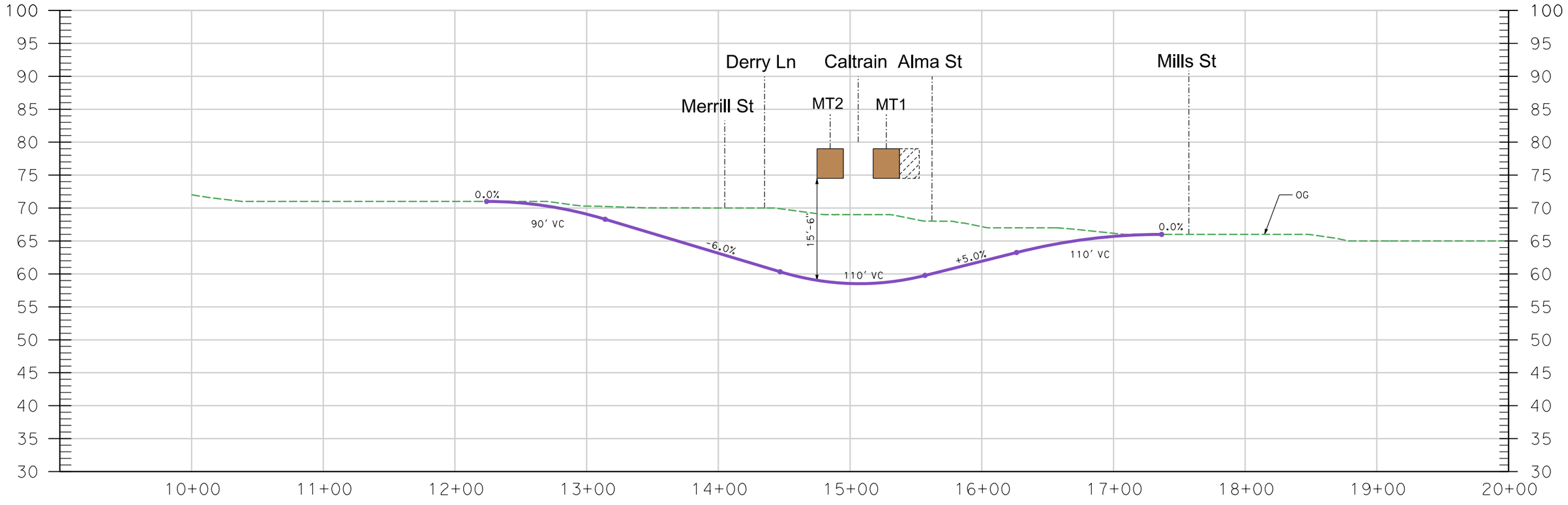


Roadway Profile:
Crest curves based on 25 mph design speed (Sight Distance = 150 feet)
Sag curve based on passenger comfort for 25 mph

Legend:

Roadway Profile

Alma Street Profile (at Ravenswood Avenue)
Alternative C

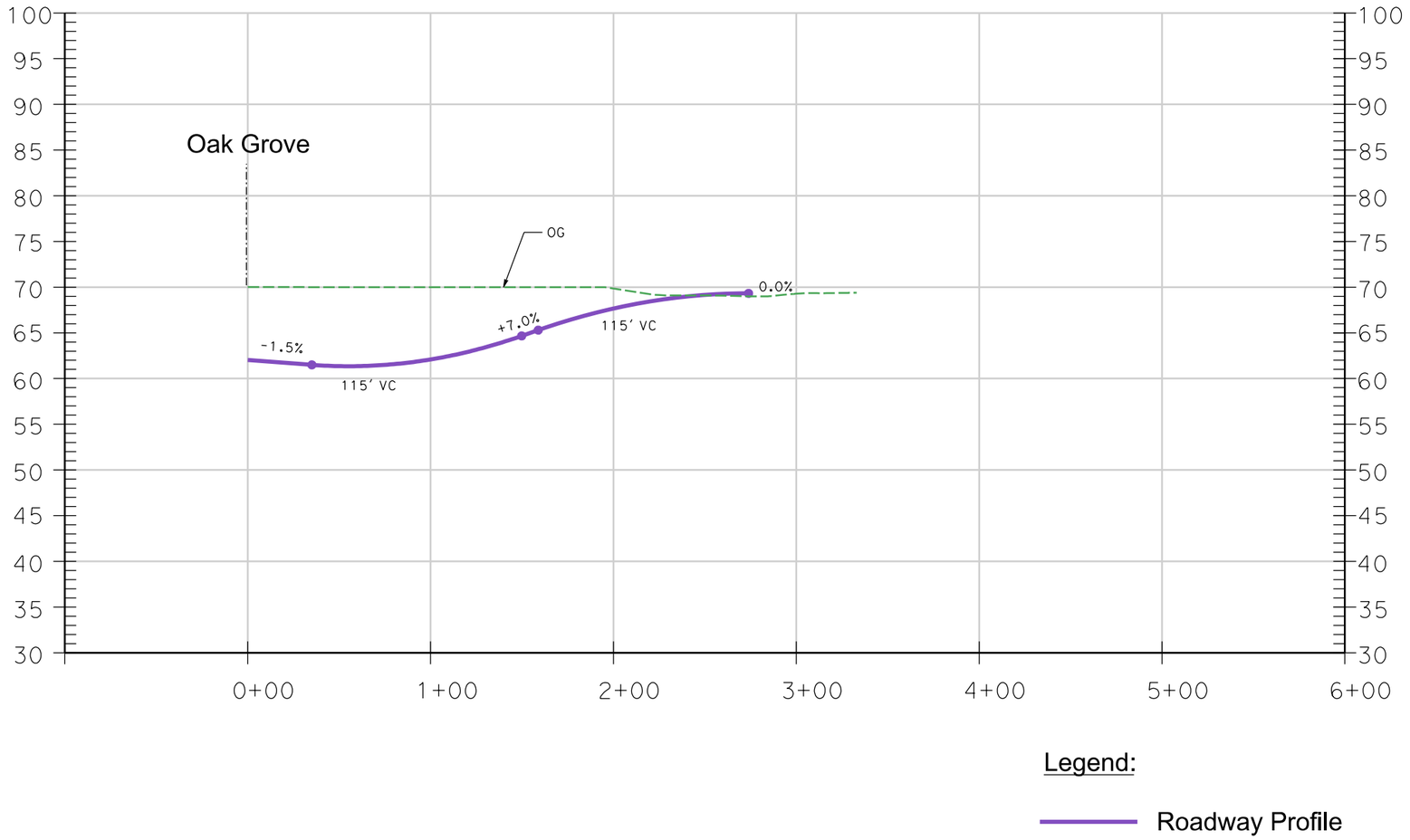


Roadway Profile:
Crest curves based on 25 mph design speed (Sight Distance = 150 feet)
Sag curve based on passenger comfort for 25 mph

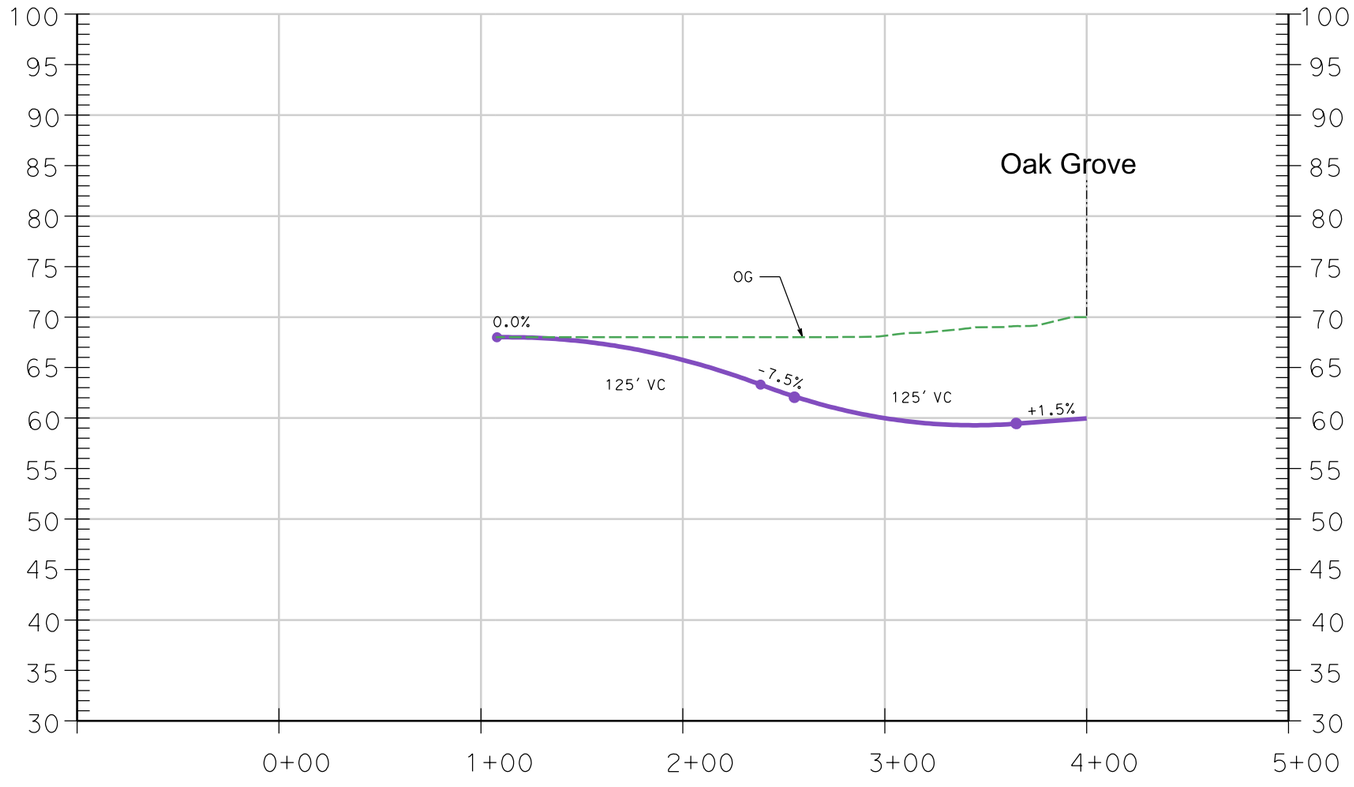
Legend:

- Grade Separation Structure
- Roadway Profile
- Widening for Future Passing Track

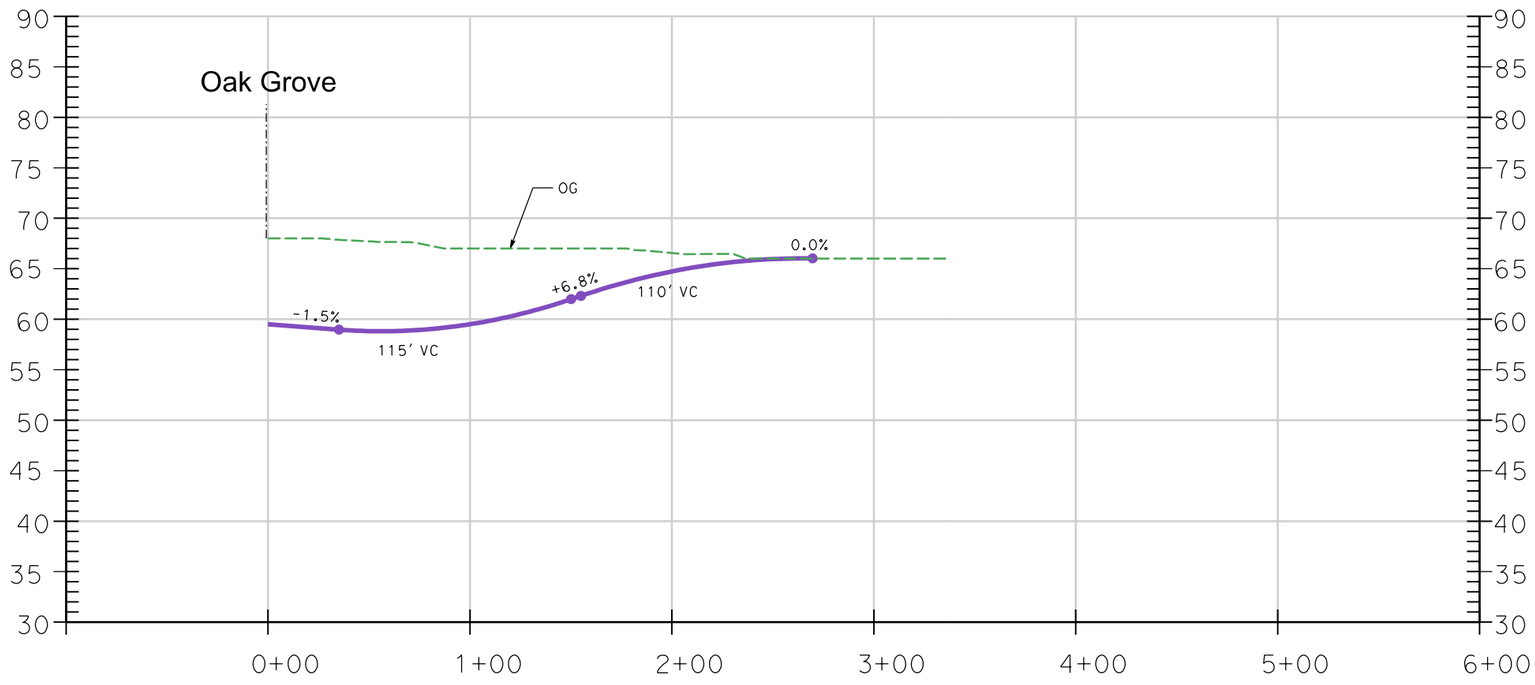
Oak Grove Avenue Profile - Alternative C



Merrill Street Profile (at Oak Grove Avenue)
Alternative C



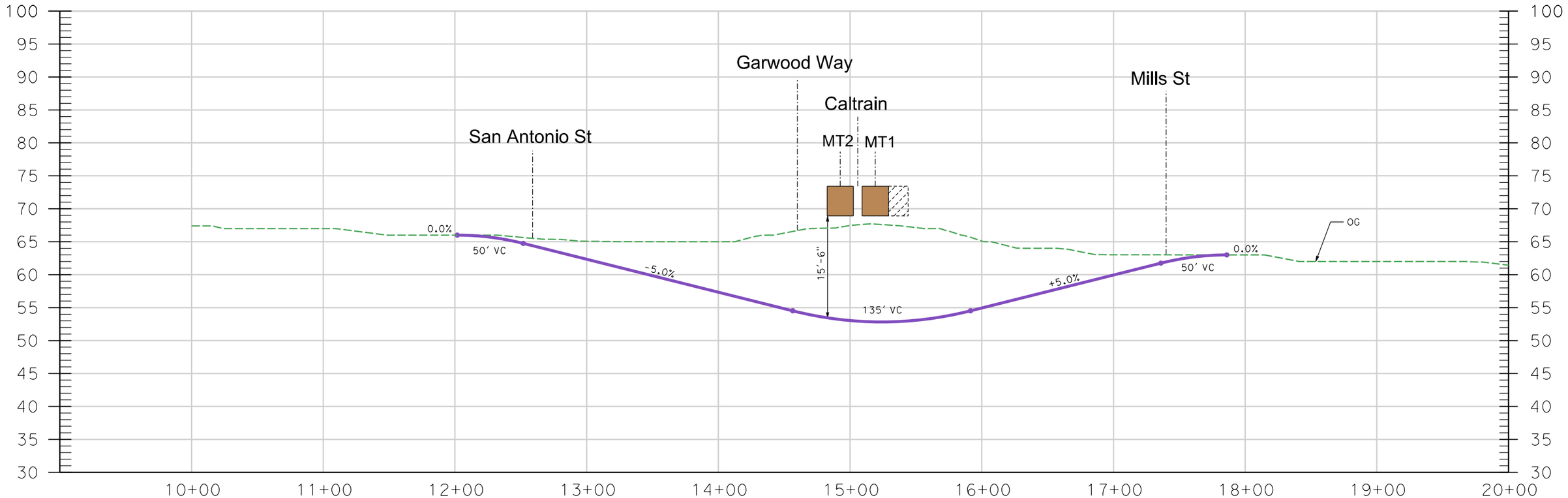
Derry Lane Profile - Alternative C



Legend:

Roadway Profile

Alma Street Profile (at Oak Grove Avenue)
Alternative C

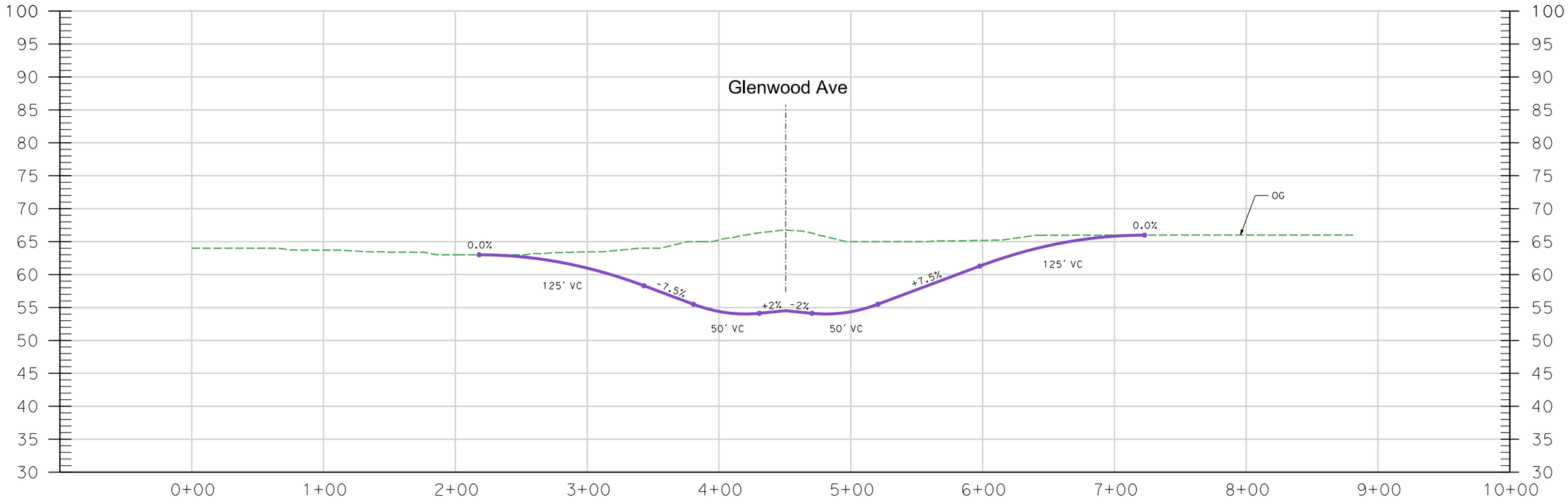


Roadway Profile:
Crest curves based on 25 mph design speed (Sight Distance = 150 feet)
Sag curve based on passenger comfort for 25 mph

Legend:

- Grade Separation Structure
- Roadway Profile
- Widening for Future Passing Track

Glenwood Avenue Profile - Alternative C



Roadway Profile:
Crest curves based on 25 mph design speed (Sight Distance = 150 feet)

Legend:

Roadway Profile

Garwood Way Profile - Alternative C

ATTACHMENT C

Preliminary Utility Plans and Relocation Costs

Utility Relocation Summary - Alternative A Ravenswood				
Utility Description	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
36" Water	1,000	LF	$ 850	$ 850,000
54" Casing (for 36" pipe)	180	LF	$ 2,500	$ 450,000
8" Water	600	LF	$ 600	$ 360,000
6" Water	600	LF	$ 600	$ 360,000
2" Water	100	LF	$ 300	$ 30,000
12 kV Electrical OH (Joint Pole) Relocation	2	EA	$ 100,000	$ 200,000
Underground Electric	2,500	LF	$ 500	$ 1,250,000
Gas	800	LF	$ 600	$ 480,000
UG Joint Fiber Line	600	LF	$ 600	$ 360,000
			Subtotal	$ 4,340,000
		50%	Contingency	$ 2,170,000
			Grand Total*	**$ 6,600,000**

Note: Unit costs include minor appurtenances such as manholes, valves, etc.

* Rounded up to the nearest $100k

Utility Relocation Summary - Alternative C Ravenswood				
Utility Description	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
36" Water	250	LF	$ 850	$ 212,500
54" Casing (for 36" pipe)	180	LF	$ 2,500	$ 450,000
8" Water	600	LF	$ 600	$ 360,000
6" Water	800	LF	$ 600	$ 480,000
2" Water	250	LF	$ 300	$ 75,000
12 kV Electrical OH (Joint Pole) Relocation	2	EA	$ 100,000	$ 200,000
Underground Electric	3,000	LF	$ 500	$ 1,500,000
Gas	900	LF	$ 600	$ 540,000
UG Joint Fiber Line	600	LF	$ 600	$ 360,000
			Subtotal	$ 4,177,500
			50% Contingency	$ 2,088,750
			Grand Total*	**$ 6,300,000**

Utility Relocation Summary - Alternative C Oak Grove Ave				
Utility Description	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
36" Water #	950	LF	$ 850	$ 807,500
54" Casing (for 36" pipe)	160	LF	$ 2,500	$ 400,000
8" Water	300	LF	$ 600	$ 180,000
6" Water	900	LF	$ 600	$ 540,000
4" Water	250	LF	$ 400	$ 100,000
Sanitary Sewer	600	LF	$ 400	$ 240,000
12 kV Electrical OH (Joint Pole) Relocation	7	EA	$ 100,000	$ 700,000
Underground Electric	300	LF	$ 500	$ 150,000
Gas	1,200	LF	$ 600	$ 720,000
UG Joint Fiber Line	600	LF	$ 600	$ 360,000
Overhead Joint Communications	500	LF	$ 300	$ 150,000
			Subtotal	$ 4,347,500
# Includes 750 LF between Glenwood and Oak Grove to accommodate shoofly				
			50% Contingency	$ 2,173,750
			Grand Total*	**$ 6,600,000**

Utility Relocation Summary - Alternative C Glenwood Ave				
Utility Description	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
36" Water	500	LF	$ 850	$ 425,000
54" Casing (for 36" pipe)	160	LF	$ 2,500	$ 400,000
6" Water	900	LF	$ 600	$ 540,000
Sanitary Sewer	1,000	LF	$ 400	$ 400,000
12 kV Electrical OH (Joint Pole) Relocation	10	EA	$ 100,000	$ 1,000,000
Gas	1,500	LF	$ 500	$ 750,000
UG Joint Fiber Line	600	LF	$ 600	$ 360,000
Overhead Joint Communications	1,000	LF	$ 300	$ 300,000
			Subtotal	$ 4,175,000
			50% Contingency	$ 2,087,500
			Grand Total*	**$ 6,300,000**

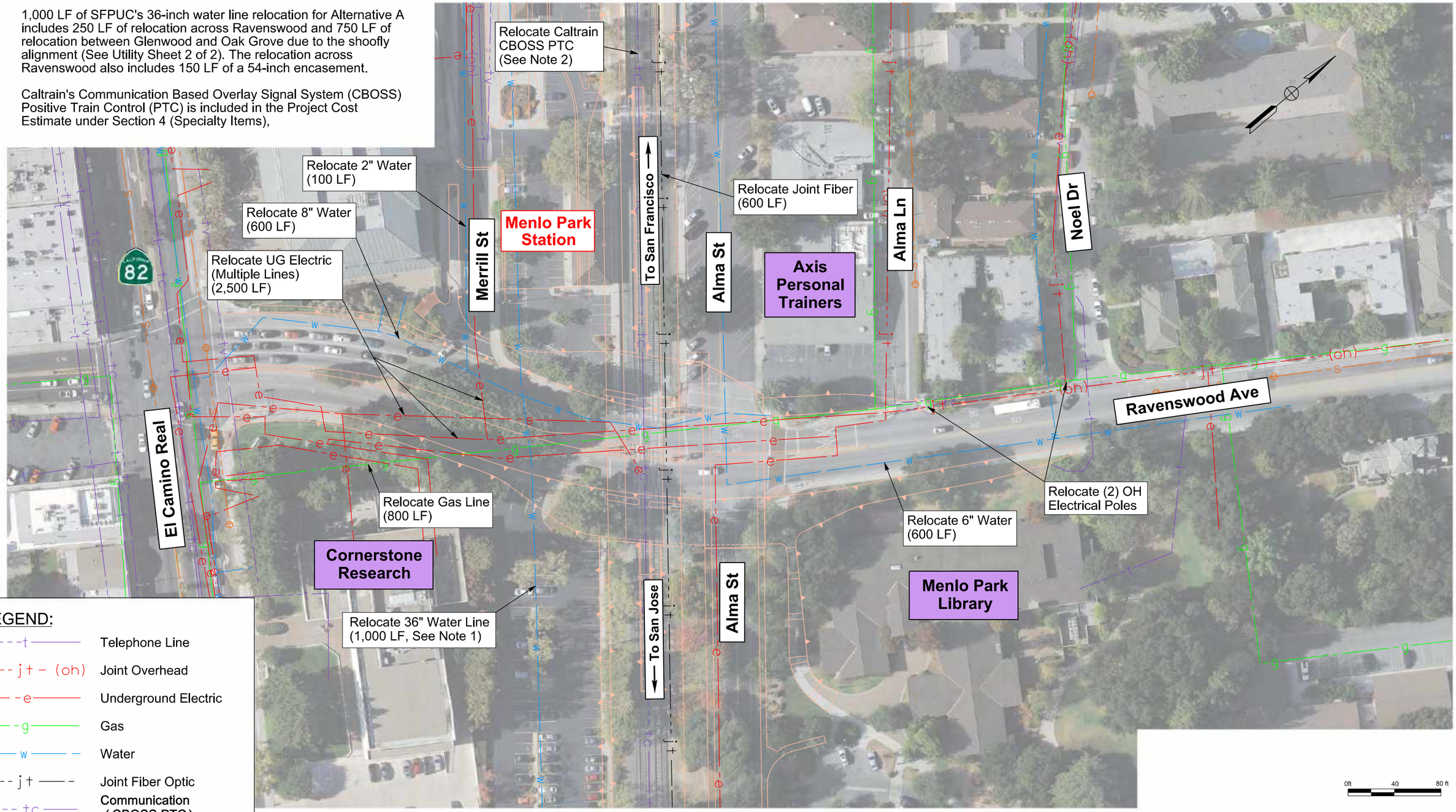
Note: Unit costs include minor appurtenances such as manholes, valves, etc.
* Rounded up to the nearest $100k

TOTAL for Alt C = $ 19,200,000

Notes:

1. 1,000 LF of SFPUC's 36-inch water line relocation for Alternative A includes 250 LF of relocation across Ravenswood and 750 LF of relocation between Glenwood and Oak Grove due to the shoofly alignment (See Utility Sheet 2 of 2). The relocation across Ravenswood also includes 150 LF of a 54-inch encasement.

2. Caltrain's Communication Based Overlay Signal System (CBOSS) Positive Train Control (PTC) is included in the Project Cost Estimate under Section 4 (Specialty Items),



LEGEND:

- Telephone Line
- Joint Overhead
- Underground Electric
- Gas
- Water
- Joint Fiber Optic
- Communication (CBOSS PTC)
- Sanitary Sewer

PLAN

MENLO PARK RAILROAD CROSSING

Caltrain

SAN MATEO COUNTY Transportation Authority

AECOM

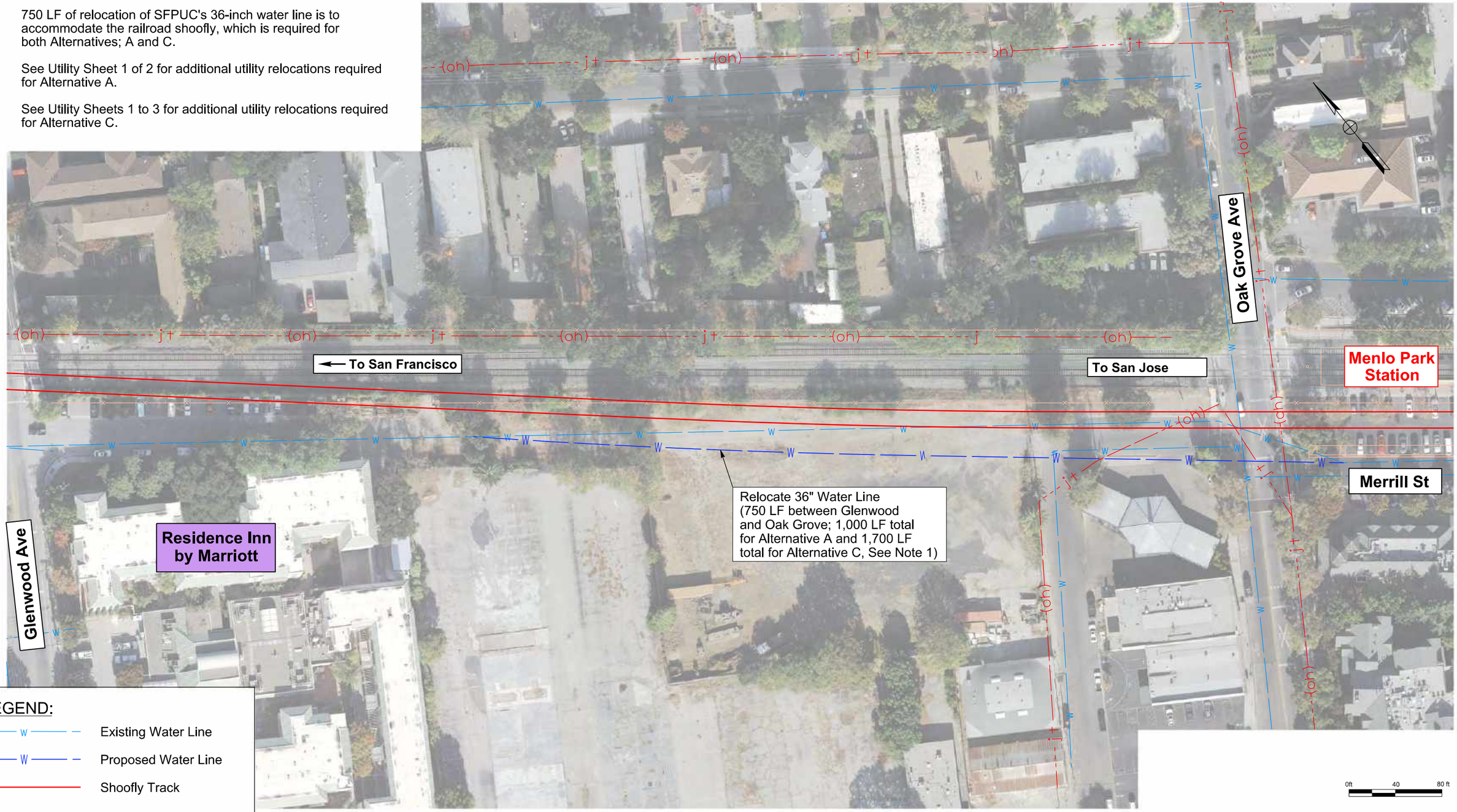
Ravenswood Avenue Railroad Crossing Project

Utility Relocations

Alternative A
Sheet 1 of 2

Notes:

1. 750 LF of relocation of SFPUC's 36-inch water line is to accommodate the railroad shoofly, which is required for both Alternatives; A and C.
2. See Utility Sheet 1 of 2 for additional utility relocations required for Alternative A.
3. See Utility Sheets 1 to 3 for additional utility relocations required for Alternative C.



LEGEND:

- Existing Water Line
- Proposed Water Line
- Shoofly Track

PLAN

MENLO PARK RAILROAD CROSSING | Caltrain | SAN MATEO COUNTY Transportation Authority | AECOM

Ravenswood Avenue Railroad Crossing Project

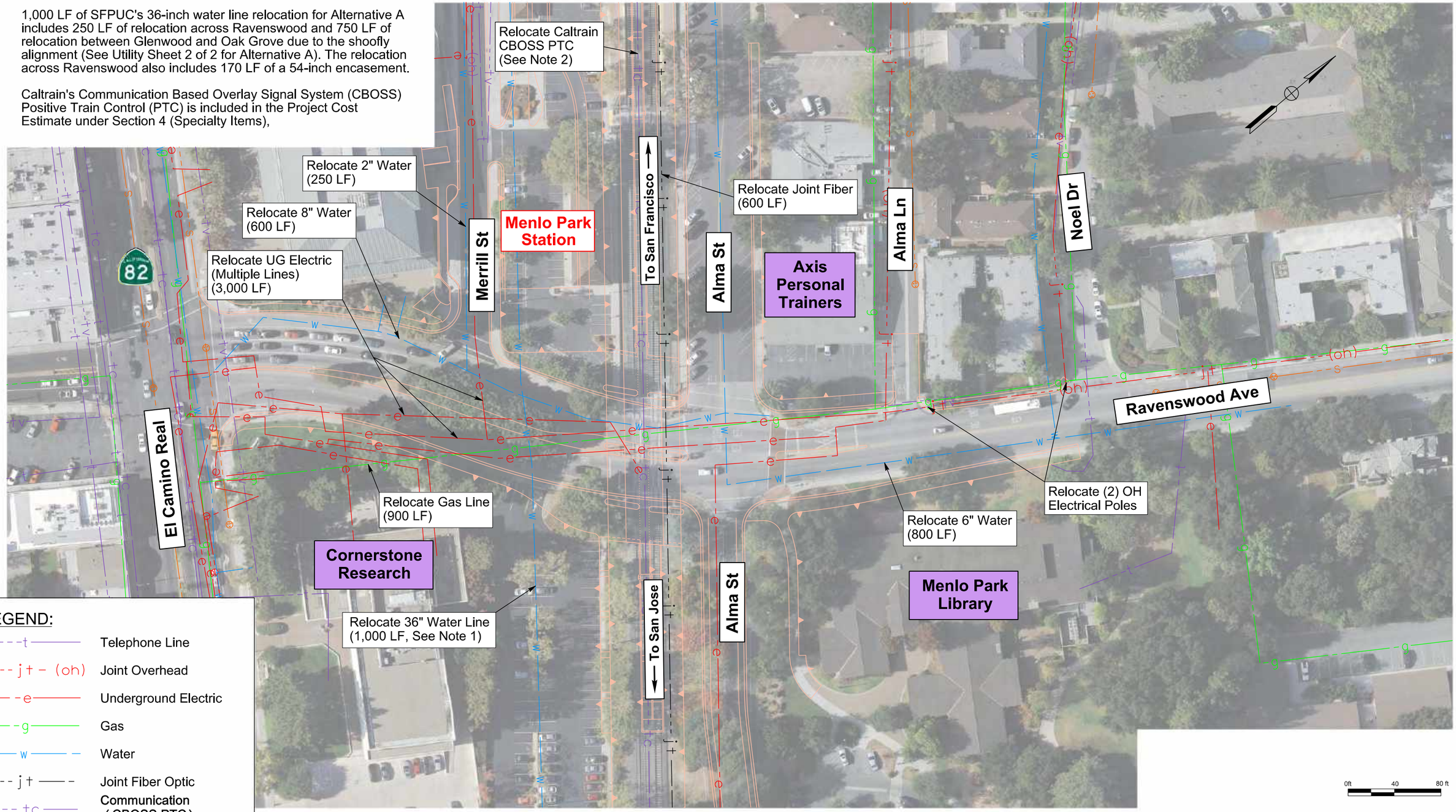
Utility Relocations

Alternative A
Sheet 2 of 2

Notes:

1. 1,000 LF of SFPUC's 36-inch water line relocation for Alternative A includes 250 LF of relocation across Ravenswood and 750 LF of relocation between Glenwood and Oak Grove due to the shoofly alignment (See Utility Sheet 2 of 2 for Alternative A). The relocation across Ravenswood also includes 170 LF of a 54-inch encasement.

2. Caltrain's Communication Based Overlay Signal System (CBOSS) Positive Train Control (PTC) is included in the Project Cost Estimate under Section 4 (Specialty Items),



LEGEND:

- Telephone Line
- Joint Overhead
- Underground Electric
- Gas
- Water
- Joint Fiber Optic
- Communication (CBOSS PTC)
- Sanitary Sewer

PLAN

MENLO PARK RAILROAD CROSSING

Caltrain

SAN MATEO COUNTY Transportation Authority

AECOM

Ravenswood Avenue Railroad Crossing Project

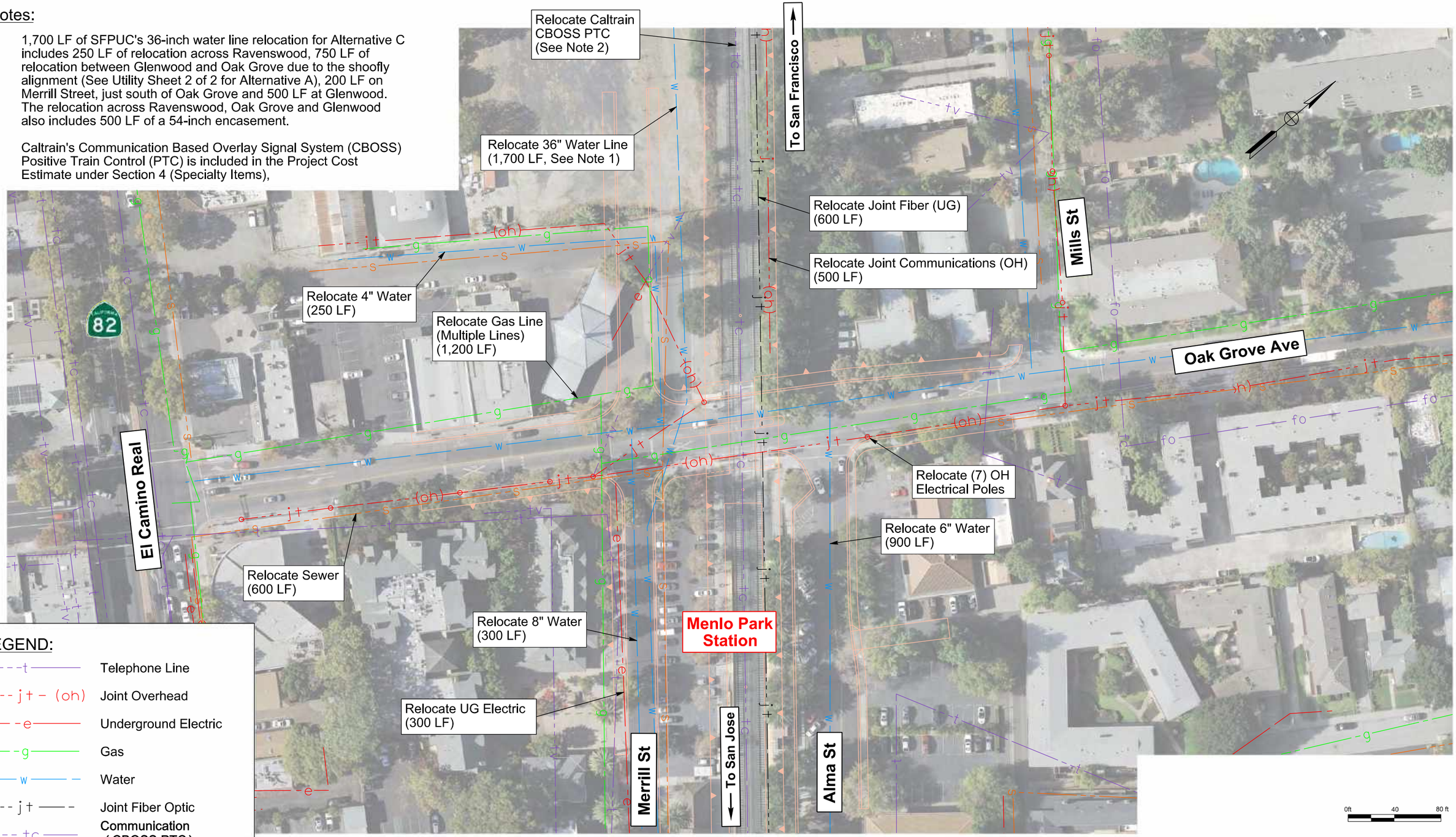
Utility Relocations

Alternative C
Sheet 1 of 3

Notes:

1. 1,700 LF of SFPUC's 36-inch water line relocation for Alternative C includes 250 LF of relocation across Ravenswood, 750 LF of relocation between Glenwood and Oak Grove due to the shoofly alignment (See Utility Sheet 2 of 2 for Alternative A), 200 LF on Merrill Street, just south of Oak Grove and 500 LF at Glenwood. The relocation across Ravenswood, Oak Grove and Glenwood also includes 500 LF of a 54-inch encasement.

2. Caltrain's Communication Based Overlay Signal System (CBOSS) Positive Train Control (PTC) is included in the Project Cost Estimate under Section 4 (Specialty Items),



PLAN

LEGEND:

- Telephone Line
- Joint Overhead
- Underground Electric
- Gas
- Water
- Joint Fiber Optic
- Communication (CBOSS PTC)
- Sanitary Sewer

MENLO PARK RAILROAD CROSSING | Caltrain | SAN MATEO COUNTY Transportation Authority | AECOM

Ravenswood Avenue Railroad Crossing Project

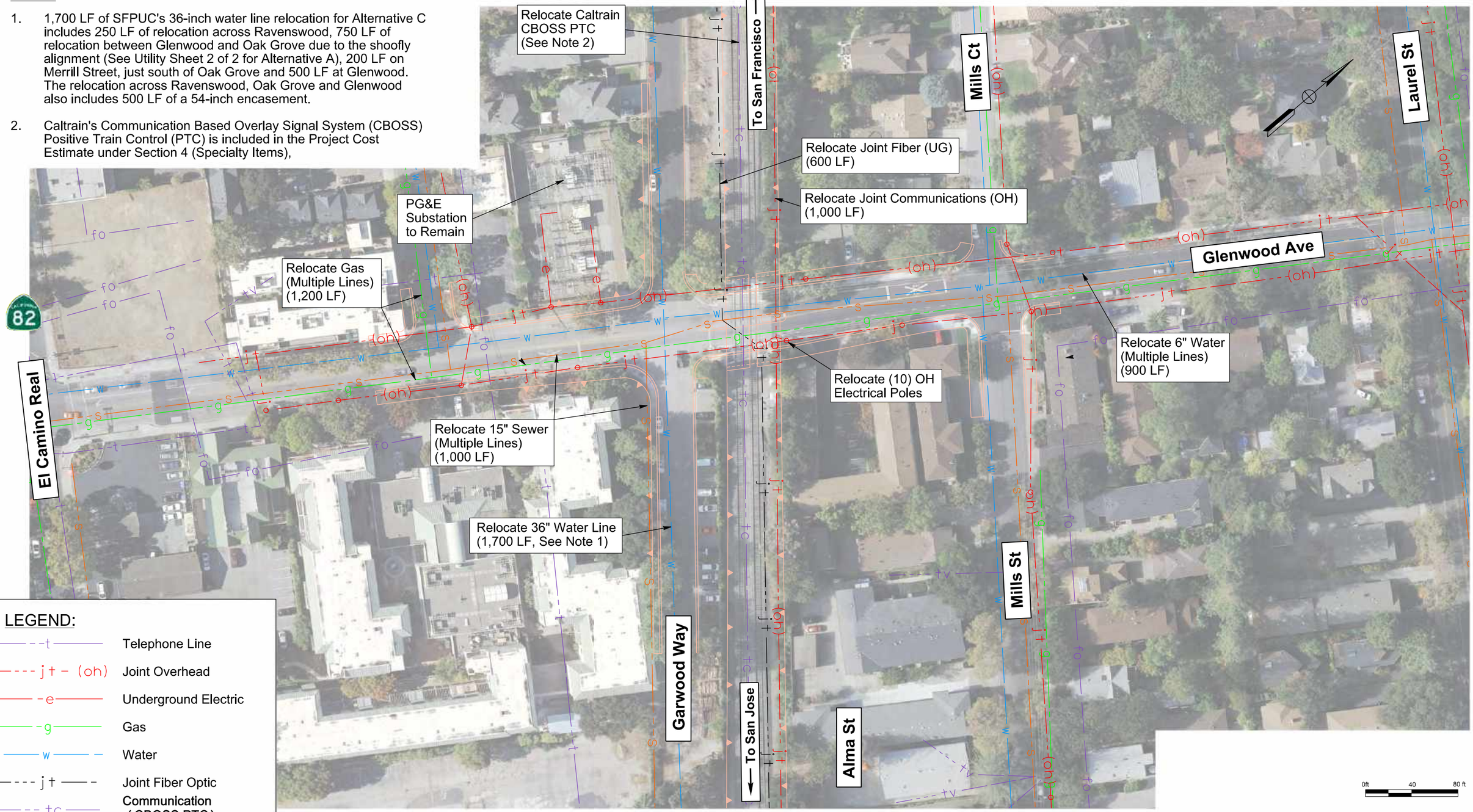
Utility Relocations

Alternative C
Sheet 2 of 3

Notes:

1. 1,700 LF of SFPUC's 36-inch water line relocation for Alternative C includes 250 LF of relocation across Ravenswood, 750 LF of relocation between Glenwood and Oak Grove due to the shoofly alignment (See Utility Sheet 2 of 2 for Alternative A), 200 LF on Merrill Street, just south of Oak Grove and 500 LF at Glenwood. The relocation across Ravenswood, Oak Grove and Glenwood also includes 500 LF of a 54-inch encasement.

2. Caltrain's Communication Based Overlay Signal System (CBOSS) Positive Train Control (PTC) is included in the Project Cost Estimate under Section 4 (Specialty Items),



LEGEND:

- Telephone Line
- Joint Overhead
- Underground Electric
- Gas
- Water
- Joint Fiber Optic
- Communication (CBOSS PTC)
- Sanitary Sewer

PLAN

MENLO PARK RAILROAD CROSSING

Caltrain

SAN MATEO COUNTY Transportation Authority

AECOM

Ravenswood Avenue Railroad Crossing Project

Utility Relocations

Alternative C
Sheet 3 of 3

ATTACHMENT D

Preliminary Project Cost Estimates

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

Type of Estimate: PSR

Project Description: Ravenswood Avenue Grade Separation Project - Alternative A

Limits: On Ravenswood Ave from El Camino Real to Noel Drive

Proposed Improvement (Scope): Grade separate Ravenswood Ave by depressing roadway and keeping railroad at grade

CONSTRUCTION PHASE		
TOTAL ROADWAY & RAILROAD ITEMS		$72,696,000
TOTAL STRUCTURE ITEMS		$17,468,000
TOTAL CONSTRUCTION COSTS		**$90,200,000**
TOTAL RIGHT OF WAY & UTILITY		$21,800,000
TOTAL CAPITAL COST		**$112,000,000**
ENGINEERING SERVICES (PA&ED)	4.5%	$4,059,000
ENGINEERING SERVICES (PS&E)	9.0%	$8,118,000
FLAGGING (TASI)	7.0%	$6,314,000
R/W SERVICES	10.0% ^	$1,524,000
CONSTRUCTION ADMINISTRATION	15.0%	$13,530,000
TOTAL SUPPORT COST		**$33,500,000**
SUBTOTAL (CAPITAL + SUPPORT)		**$145,500,000**
ESCALATION* (TO 2025)		**$33,400,000**
TOTAL PROJECT COST		**$179,000,000**

^ 10% of "Total Right of Way & Utility" minus Utility Relocation Costs

* Escalation to mid-point of construction (3% per year)

Reviewed by Project Engineer	Peter DeStefano, P.E	(510) 874-3143	11/09/18
Approved by Deputy Project Manager	Millette Litzinger, P.E.	(408) 961-8417 (Phone)	11/09/18 (Date)

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

	Quantity	Unit	Unit Price	Unit Cost	Section Cost
Section 1 - Earthwork					
Imported Borrow	0	CY	$30	$0	
Excavation	110,000	CY	$25	$2,750,000	
Clearing & Grubbing	1	LS	$400,000	$400,000	
Develop Water Supply	1	LS	$25,000	$25,000	
Remove Unsuitable Materials	1	LS	$800,000	$800,000	
				Total Earthwork	$3,975,000
Section 2 - Structural Section *					
HMA (Type A)	1,900	TON	$135	$257,000	
Aggregate Base (Cl 2)	2,400	CY	$75	$180,000	
Aggregate Subbase (Cl 4)	1,800	CY	$40	$72,000	
PCC	750	CY	$400	$300,000	
				Total Structural Section	$809,000
Section 3 - Drainage					
Project Drainage ^	1	LS	$1,000,000	$1,000,000	
				Total Drainage	$1,000,000

^ Includes cost for pump station

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

Section 4 - Specialty Items	Quantity	Unit	Unit Price	Unit Cost	Section Cost
Retaining Wall	37,400	SF	$110	$4,114,000	
Prepare SWPPP	1	LS	$30,000	$30,000	
Water Pollution Control	1	LS	$1,400,000	$1,400,000	
Permanent Treatment BMPs and Hydromodification	1	LS	$2,000,000	$2,000,000	
Dewatering	1	LS	$800,000	$800,000	
Temporary Creek Diversion (Not Required)			$0	$0	
Escalator	1	LS	$300,000	$300,000	
Ravenswood Train Station	1	LS	$10,000,000	$10,000,000	
Railroad Track**	16,300	TF	$400	$6,520,000	
Overhead Contact System (OCS)	8,150	RF	$300	$2,445,000	
No. 20 Crossover	1	EA	$800,000	$800,000	
Temporary Shoofly Track**	10,900	TF	$550	$5,995,000	
Temporary OCS	5,450	RF	$400	$2,180,000	
Impacts to CBOSS/PTC	1	LS	$1,700,000	$1,700,000	
Temporary Shoring (Roadway)	10,000	SF	$40	$400,000	
Temporary Shoring (Railroad)	0	SF	$40	$0	

** Unit price based on a single track. Unit cost for shoofly track includes $150/TF for removal.

Total Specialty Items $38,684,000

Section 5 - Traffic Items					
Lighting	1	LS	$250,000	$250,000	
Signals (No New Traffic Signals)				$0	
Traffic Control System	1	LS	$1,000,000	$1,000,000	
Signing and Striping	1	LS	$70,000	$70,000	
TMP (Inc. COZEEP, CMS etc.)	1	LS	$1,000,000	$1,000,000	

Total Traffic Items $2,320,000

Section 6 - Planting and Irrigation					
Planting	1	LS	$600,000	$600,000	
Irrigation	1	LS	$300,000	$300,000	

Total Planting & Irrigation Items $900,000

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

	Quantity	Unit		Unit Price	Unit Cost	Section Cost
Section 7 - Roadside Management & Safety						
Erosion Control	1	LS		$60,000	$60,000	
					Total Roadside Management & Safety	$60,000
					SUBTOTAL SECTIONS 1 - 7:	$47,748,000
Section 8 - Minor Items						
Subtotal Sections 1 - 7		$47,748,000	X	5%	$2,387,400	
					TOTAL MINOR ITEMS:	$2,387,000
Section 9 - Mobilization						
Subtotal Sections 1 - 7		$47,748,000				
Minor Items		$2,387,000				
	Sum	$50,135,000	X	10%	$5,013,500	
					TOTAL MOBILIZATION	$5,014,000
Section 10 - Additions						
Supplemental						
Subtotal Sections 1 - 7		$47,748,000				
Minor Items		$2,387,000				
	Sum	$50,135,000	X	5%	$2,506,750	
Contingencies						
Subtotal Sections 1 - 7		$47,748,000				
Minor Items		$2,387,000				
	Sum	$50,135,000	X	30%	$15,040,500	
					TOTAL ADDITIONS	$17,547,000
					TOTAL ROADWAY & RAILROAD ITEMS (Total of Sections 1 - 10)	$72,696,000

Estimate Prepared By:	Peter DeStefano, P.E	(510) 874-3143	11/09/18
	(Print Name)	(Phone)	(Date)

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

II. STRUCTURES ITEMS	#1 ^	#2	#3	#3
Bridge Name	Temp Rail Structure	Rail Structure	Alma St Underpass	Ped Undercrossing
Structure Type	PC/PS Girder	PC/PS Girder	PC/PS Girder	PC/PS Girder
Width (ft) - out to out	36.00	65.50	52.00	20.00
Span Length (ft)	60	157	146	32
Total Area (SqFt)	2,160	10,254	7,596	640
Footing Type (pile/spread)	Pile	Pile	Pile	Pile
Cost per Sq. Ft.	$1,200	$1,200	$300	$300
Including:				
Mobilization: 10%				
Contingency: 25%				
Bridge Removal	$100,000			
Total Cost For Structure	$2,692,000	$12,304,800	$2,278,800	$192,000

^ Includes temporary structure for the shoofly tracks at Ravenswood Ave.

SUBTOTAL THIS PAGE $17,467,600

TOTAL STRUCTURES ITEMS $17,468,000

Railroad Related Costs

COMMENTS:

Estimate Prepared By:	Peter DeStefano, P.E.	(510) 874-3143	11/09/18
	(Print Name)	(Phone)	(Date)

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

III. RIGHT OF WAY & UTILITY

	Current Values (Future Use)	Escalation Rate (%/yr)	Escalated Value (2018)
Acquisition, including excess lands TCE and damages to remainders	$15,200,000	0.00%	$15,200,000
Utility Relocation ^	$6,600,000	0.00%	$6,600,000
Clearance / Demolition	$0	0.00%	$0
RAP	$0	0.00%	$0
R/W Services - Title and Escrow Fees	$40,000	0.00%	$40,000
CONSTRUCTION CONTRACT WORK			$0
SB1210		0.00%	$0
Section 83 Transfers		0.00%	$0
		0.00%	$0
TOTAL RIGHT OF WAY (CURRENT VALUE)	$21,840,000	TOTAL ESCALATED RIGHT OF WAY	$21,840,000

^ See Attachment D for details.

Estimate prepared by:	Peter DeStefano, P.E	(510) 874-3143	11/09/18
	(Print Name)	(Phone)	(Date)

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

Type of Estimate: PSR

Project Description: Ravenswood Avenue Grade Separation Project - Alternative C

Limits: On Ravenswood Ave from El Camino Real to Noel Drive
On Oak Grove Ave from El Camino Real to Mills St
On Glenwood Ave from El Camino Real to Mills Ct

Proposed Improvement (Scope): Grade separate Ravenswood Ave, Oak Grove Ave, and Glenwood Ave by depressing roadway and elevating railroad

CONSTRUCTION PHASE		
TOTAL ROADWAY & RAILROAD ITEMS		$126,559,000
TOTAL STRUCTURE ITEMS		$24,029,000
TOTAL CONSTRUCTION COSTS		**$150,600,000**
TOTAL RIGHT OF WAY & UTILITY		$60,800,000
TOTAL CAPITAL COST		**$211,400,000**
ENGINEERING SERVICES (PA&ED)	4.5%	$6,777,000
ENGINEERING SERVICES (PS&E)	9.0%	$13,554,000
FLAGGING (TASI)	7.0%	$10,542,000
R/W SERVICES	10.0% ^	$4,164,000
CONSTRUCTION ADMINISTRATION	15.0%	$22,590,000
TOTAL SUPPORT COST		**$57,600,000**
SUBTOTAL (CAPITAL + SUPPORT)		**$269,000,000**
ESCALATION* (TO 2025)		**$61,800,000**
TOTAL PROJECT COST		**$331,000,000**

^ 10% of "Total Right of Way & Utility" minus Utility Relocation Costs
* Escalation to mid-point of construction (3% per year)

Reviewed by Project Engineer	Peter DeStefano, P.E	(510) 874-3143	11/02/18
Approved by Deputy Project Manager	Millette Litzinger, P.E.	(408) 961-8417 (Phone)	11/02/18 (Date)

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

	Quantity	Unit	Unit Price	Unit Cost	Section Cost
Section 1 - Earthwork					
Imported Borrow	0	CY	$30	$0	
Excavation	330,000	CY	$18	$5,940,000	
Clearing & Grubbing	1	LS	$400,000	$400,000	
Develop Water Supply	1	LS	$25,000	$25,000	
Remove Unsuitable Materials	1	LS	$2,200,000	$2,200,000	
				Total Earthwork	$8,565,000
Section 2 - Structural Section *					
HMA (Type A)	7,500	TON	$100	$750,000	
Aggregate Base (Cl 2)	7,600	CY	$45	$342,000	
Aggregate Subbase (Cl 4)	6,900	CY	$40	$276,000	
PCC	1,020	CY	$400	$408,000	
				Total Structural Section	$1,776,000
Section 3 - Drainage					
Project Drainage ^	1	LS	$2,900,000	$2,900,000	
				Total Drainage	$2,900,000

^ Includes cost for pump station

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

Section 4 - Specialty Items	Quantity	Unit	Unit Price	Unit Cost	Section Cost
Retaining Wall	144,000	SF	$110	$15,840,000	
Prepare SWPPP	1	LS	$60,000	$60,000	
Water Pollution Control	1	LS	$1,900,000	$1,900,000	
Permanent Treatment BMPs and Hydromodification	1	LS	$2,800,000	$2,800,000	
Dewatering	1	LS	$1,300,000	$1,300,000	
Temporary Creek Diversion (Not Required)			$0	$0	
Escalator	1	LS	$300,000	$300,000	
Ravenswood Train Station	1	LS	$15,000,000	$15,000,000	
Railroad Track**	19,100	TF	$400	$7,640,000	
Overhead Contact System (OCS)	9,550	RF	$300	$2,865,000	
No. 20 Crossover	1	EA	$800,000	$800,000	
Temporary Shoofly Track**	16,200	TF	$550	$8,910,000	
Temporary OCS	8,100	RF	$400	$3,240,000	
Impacts to CBOSS/PTC	1	LS	$1,900,000	$1,900,000	
Temporary Shoring (Roadway)	20,000	SF	$40	$800,000	
Temporary Shoring (Railroad)	0	SF	$40	$0	

** Unit price based on a single track. Unit cost for shoofly track includes $150/TF for removal.

Total Specialty Items $63,355,000

Section 5 - Traffic Items					
Lighting	1	LS	$750,000	$750,000	
Signals (No New Traffic Signals)	3	EA	$270,000	$810,000	
Traffic Control System	1	LS	$1,500,000	$1,500,000	
Signing and Striping	1	LS	$150,000	$150,000	
TMP (Inc. COZEEP, CMS etc.)	1	LS	$1,400,000	$1,400,000	

Total Traffic Items $4,610,000

Section 6 - Planting and Irrigation					
Planting	1	LS	$1,200,000	$1,200,000	
Irrigation	1	LS	$600,000	$600,000	

Total Planting & Irrigation Items $1,800,000

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

	Quantity	Unit		Unit Price		Unit Cost	Section Cost
Section 7 - Roadside Management & Safety							
Erosion Control	1	LS		$120,000		$120,000	
					Total Roadside Management & Safety		$120,000
					SUBTOTAL SECTIONS 1 - 7:		$83,126,000
Section 8 - Minor Items							
Subtotal Sections 1 - 7		$83,126,000	X	5%		$4,156,300	
					TOTAL MINOR ITEMS:		$4,156,000
Section 9 - Mobilization							
Subtotal Sections 1 - 7		$83,126,000					
Minor Items		$4,156,000					
	Sum	$87,282,000	X	10%		$8,728,200	
					TOTAL MOBILIZATION		$8,728,000
Section 10 - Additions							
Supplemental							
Subtotal Sections 1 - 7		$83,126,000					
Minor Items		$4,156,000					
	Sum	$87,282,000	X	5%		$4,364,100	
Contingencies							
Subtotal Sections 1 - 7		$83,126,000					
Minor Items		$4,156,000					
	Sum	$87,282,000	X	30%		$26,184,600	
					TOTAL ADDITIONS		$30,549,000
					TOTAL ROADWAY & RAILROAD ITEMS (Total of Sections 1 - 10)		$126,559,000

Estimate Prepared By:	Peter DeStefano, P.E	(510) 874-3143	11/02/18
	(Print Name)	(Phone)	(Date)

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

	Ravenswood		Oak Grove	
II. STRUCTURES ITEMS	#1 ^	#2	#3	#4
Bridge Name	Temp Rail Structures	Rail Structure	SB Rail Structure	NB Rail Structure
Structure Type	PC/PS Girder	PC/PS Girder	PC/PS Girder	PC/PS Girder
Width (ft) - out to out	36.00	65.50	22.00	22.00
Span Length (ft)	160	157	74	74
Total Area (SqFt)	5,760	10,254	1,620	1,620
Footing Type (pile/spread)	Pile	Pile	Pile	Pile
Cost per Sq. Ft.	$600	$1,200	$1,200	$1,200
Including:				
Mobilization: 10%				
Contingency: 25%				
Bridge Removal	$300,000			
Total Cost For Structure	$3,756,000	$12,304,800	$1,944,000	$1,944,000

SUBTOTAL THIS PAGE	$24,028,800
TOTAL STRUCTURES ITEMS	$24,029,000

^ Includes temporary structures for the shoofly tracks at all three street crossings (Ravenswood, Oak Grove and Glenwood).

Railroad Related Costs

COMMENTS:

Estimate Prepared By:	Peter DeStefano, P.E.	(510) 874-3143	11/02/18
	(Print Name)	(Phone)	(Date)

PRELIMINARY PROJECT COST ESTIMATE SUMMARY

III. RIGHT OF WAY & UTILITY

	Current Values (Future Use)	Escalation Rate (%/yr)	Escalated Value (2018)
Acquisition, including excess lands TCE and damages to remainders	$41,600,000	0.00%	$41,600,000
Utility Relocation ^	$19,200,000	0.00%	$19,200,000
Clearance / Demolition	$0	0.00%	$0
RAP	$0	0.00%	$0
R/W Services - Title and Escrow Fees	$40,000	0.00%	$40,000
CONSTRUCTION CONTRACT WORK			$0
SB1210		0.00%	$0
Section 83 Transfers		0.00%	$0
		0.00%	$0
TOTAL RIGHT OF WAY (CURRENT VALUE)	$60,840,000	TOTAL ESCALATED RIGHT OF WAY	$60,840,000

^ See Attachment D for details.

Estimate prepared by:	Peter DeStefano, P.E	(510) 874-3143	11/02/18
	(Print Name)	(Phone)	(Date)

ATTACHMENT E

3D Renderings

Figure 1 - Alternative A - Looking West from Alma St (~700 feet south of Ravenswood)

Figure 2 - Alternative C - Looking West from Alma St (~700 feet south of Ravenswood)

Figure 3 - Alternative A, Ravenswood Avenue, Looking East from El Camino Real

Figure 4 - Alternative C, Ravenswood Avenue, Looking East from El Camino Real

Figure 5 - Alternative A, Looking North towards Ravenswood Avenue and the Caltrain Station

Figure 6 - Alternative C, Looking North towards Ravenswood Avenue and the Caltrain Station

Figure 7 - Alternative A, Ravenswood Avenue, Looking West from Noel Drive

Figure 8 - Alternative C, Ravenswood Avenue, Looking West from Noel Drive

Figure 9 - Alternative C, Looking North at Oak Grove Avenue

Figure 10 - Alternative C, Looking NE at Glenwood Avenue

ATTACHMENT F

Traffic Analysis Technical Memorandum

TO: Nicole H Nagaya, City of Menlo Park
Angela R Obeso, City of Menlo Park

CC: Millette Litzinger, AECOM
Rabindra Puttagunta, AECOM

FROM: Aswini Rajagopalan, AECOM
Swathi Korpu, AECOM

DATE: November 2018

RE: Ravenswood Avenue Railroad Crossing Project
Proposed Alternatives - Traffic Analysis Technical Memorandum

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Introduction

This memorandum discusses the traffic operational analysis conducted to evaluate the existing conditions and future (2040) conditions for the Ravenswood Avenue Railroad Crossing Project. This memorandum also describes the methodology that AECOM used, in coordination with the City/County Association of Governments (C/CAG) models, to forecast future traffic volumes to be used in this study. The project proposes grade separations at Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue from the at-grade railroad crossings of the Caltrain line, to help alleviate traffic congestion and to improve the overall vehicular traffic, pedestrian and bicycle safety and circulation. The traffic analysis evaluates project Future (or Design) Year (2040) conditions with and without the proposed project.

Background and Study Area

Within the City of Menlo Park, the Caltrain rail traverses east of and parallel to El Camino Real, stopping at the Menlo Park Transportation Center located near the intersection of El Camino Real and Santa Cruz Avenue. There are four at-grade railroad crossings in the City of Menlo Park: Ravenswood Avenue, Oak Grove Avenue, Glenwood Avenue and Encinal Avenue.

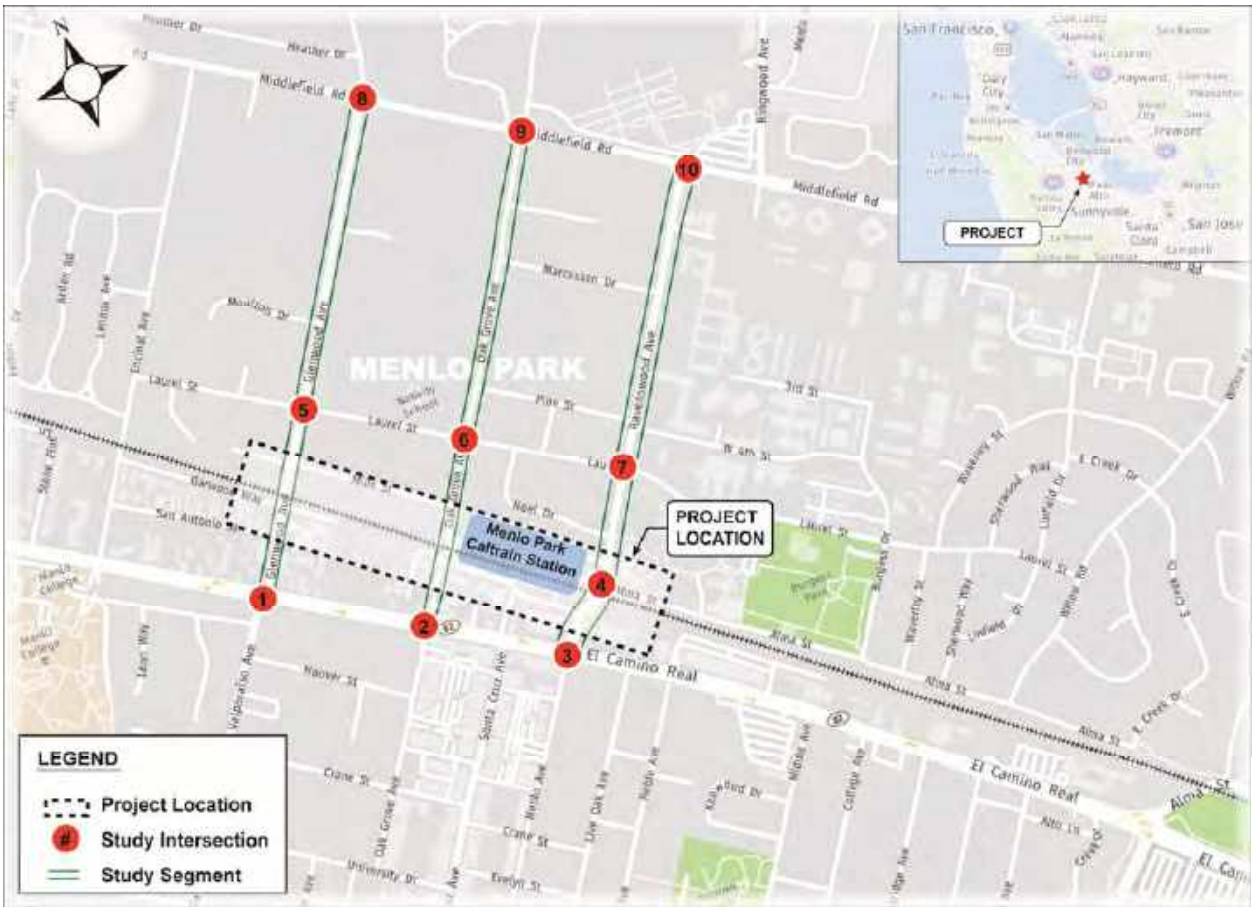
Though there are four at-grade railroad crossings, this project proposes grade separations at Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue; however the number of grade separations varies by alternative. Encinal Avenue will continue to have the at-grade railroad crossing. The project study area spans along each of the above three corridors between El Camino Real to the west and Middlefield Road to the east. Project location map is presented in ***Figure 1***.

Purpose and Need

Working collaboratively with the City of Menlo Park staff, residents and other key stakeholders, the priorities and key functional objectives of this project were identified:

- **Improve traffic circulation and mobility** by reducing traffic delays, alleviating traffic congestion, and increasing traffic flow across the railroad crossing.
- **Increase public safety for vehicles, bicycles, and pedestrians** by eliminating the conflict with the train and improving access to/from local destinations

Figure 1 – Project Location and Study Network Map



Alternatives Considered

Based on the identified objectives, the project team proposed the following alternatives for further evaluation.

No-Build Alternative

Under this alternative, there will be no change to the at-grade crossings at Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue. In addition, there will be no change to the lane configurations and the capacity of the roadways under consideration.

Alternative A

Under this alternative, Ravenswood Avenue is "depressed" from the current elevation in the vicinity of the railroad tracks. In other words, Ravenswood Avenue will pass under the tracks (underpass). This modification is proposed only to Ravenswood Avenue. No changes are proposed to the other at-grade crossings at Oak Grove Avenue and Glenwood Avenue.

The depressed design of Ravenswood Avenue under this alternative requires Alma Street to be grade separated due to design constraints. Hence, per the proposed design, Alma Street is grade separated and the through movements are maintained to facilitate the north/south connectivity.

Since the at-grade crossing at Ravenswood Avenue experiences the highest traffic congestion, compared to the other at-grade railroad crossings, it is the highest priority location within the City for consideration of a grade separation. In addition, the railroad crossing at Ravenswood Avenue is immediately adjacent to the Menlo Park Caltrain station and transit center. The railroad crossing is also within walking distance to many employment centers and residential land uses. For the above reasons, the City Council decided to pursue Alternative A. The Study Area and conceptual design plans for this option are included in the PSR-PDS report.

Alternative B

Under this alternative, Ravenswood Avenue and Oak Grove Avenue are partially "depressed" and the Caltrain tracks are partially "elevated" from the current elevation. This alternative is referred as "Hybrid" since it involves partial depression as well as partial elevation. Based on the input from the City Council, this alternative was dropped from further consideration. The conceptual design plans for this option are included in the PSR-PDS report..

Alternative C

Under this alternative, Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue are partially "depressed" and the Caltrain tracks are partially "elevated" from the current elevation. This alternative is referred as "Hybrid" since it involves partial depression as well as partial elevation. Overall, this alternative would provide better safety and improve circulation for pedestrians, cyclists and autos compared to Alternative A and B since the improvements are proposed for a larger study area. In addition, it would help alleviate the traffic congestion in the study area. For the above reasons, the City Council also decided to pursue Alternative C. The conceptual design plans for this option are included in the PSR-PDS report.

Study Network and Traffic Volumes

To address the traffic circulation issues, ten intersections and three roadway segments were identified for analysis. The following section presents the details of the study network and traffic data used.

Study Intersections

Intersection operating conditions were analyzed at the following locations within the Study Area:

Ravenswood Avenue

- El Camino Real & Menlo Avenue/ Ravenswood Avenue
- Alma Street & Ravenswood Avenue
- Laurel Street & Ravenswood Avenue
- Middlefield Road & Ravenswood Avenue

Oak Grove Avenue

- El Camino Real & Oak Grove Avenue
- Laurel Street & Oak Grove Avenue
- Middlefield Road & Oak Grove Avenue

Glenwood Avenue

- El Camino Real & Valparaiso Avenue/ Glenwood Avenue
- Laurel Street & Glenwood Avenue
- Middlefield Road & Glenwood Avenue

Study Segments

The operating conditions of the following segments were analyzed within the Study Area:

- Ravenswood Avenue: Segment between El Camino Real and Middlefield Road
- Oak Grove Avenue: Segment between El Camino Real and Middlefield Road
- Glenwood Avenue: Segment between El Camino Real and Middlefield Road

While analyzing Alternatives A and C, the segments were divided into two sections in order to better understand the traffic impacts due to the proposed project:

- Section 1 - El Camino Real and Laurel Street
- Section 2 - Laurel Street and Middlefield Road

Figure 1 presents the study intersections and the study segments.

Traffic Data Collection

To properly assess the existing constraints and opportunities within the study area, the following data was obtained from the City of Menlo Park. The time period during which the traffic data was collected ranges between December 2015 and June 2016.

- Weekday vehicle turning movement counts at the study intersections (AM and PM peak periods);
- Weekday bicycle and pedestrian counts at the study intersections (AM and PM peak periods); and
- Weekday daily (24-hour) traffic volumes at selected locations;

Development of Forecast Volumes

The approved VTA-C/CAG Forecast Traffic Models for 2013 and 2040 were used to determine the no-build forecast volumes for the year 2040. Link volumes for the intersections were obtained from the VTA-C/CAG models and the corresponding growth in link volumes was applied to the existing link volumes counts. Using the Furness method and existing turning movement volumes, future turning movement volumes were determined.

Traffic volumes for existing and future no build and build scenarios are provided in ***Appendix A.***

Traffic Operations Methodology

Intersection operating conditions and level of service (LOS) were evaluated for the AM and PM peak hour. Peak hour is chosen as the hour that has four consecutive 15-minute periods with the highest overall traffic throughput from the weekday AM (7:00 AM to 9:00 AM), and weekday PM (4:00 PM to 6:00 PM) peak periods. LOS was evaluated for the existing conditions, future year 2040 no-build conditions and build conditions. In addition to the LOS evaluation, arterial analysis was conducted for the identified study roadway segments under existing conditions and future year conditions as explained earlier. The future no-build condition serves as a base for comparison, which assumes the traffic patterns continue to be the same as that of the existing conditions with an increase in the traffic projected by the VTA/C-CAG model.

Intersection Measure of Effectiveness

Synchro/Sim-Traffic version 9 software package was used in the evaluation of the intersection. Synchro utilizes the 2000 *Highway Capacity Manual* (2000 HCM) methodology in calculating intersection LOS and vehicle delay. The following measure of effectiveness (MOEs) was calculated based on 2000 HCM methodology and was considered in the evaluation of intersection operations and performance:

- Vehicle delay (measured in seconds per vehicle)

Vehicle Delay

Vehicle (control) delay is the primary measure of performance in the HCM. It includes the time lost due to acceleration and deceleration of a vehicle, in addition to the stopped time of a vehicle due to a traffic control device. The delay-based operations analysis uses various intersection characteristics (e.g., traffic volumes, lane geometry, signal control, and signal phasing / timing) to estimate the average control delay experienced by motorists at an intersection. The HCM methodology qualitatively characterizes traffic conditions based on the delay value, ranging from LOS A to LOS F. LOS A indicates free-flow traffic conditions with little or no delay experienced by motorists and LOS F indicates congested conditions where traffic flows exceed design capacity and may result in long delays.

For signalized intersections, the methodology determines the capacity of each lane group approaching the intersection and calculates an average delay (in seconds per vehicle) for each of

the various movements at the intersection. A combined weighted delay and LOS are presented for each intersection. For unsignalized intersections with one-way, or two-way stop control, intersection LOS and delay are typically reported for the worst stop-controlled approach (or yield movement) and for all-way stop control, the average intersection delay is reported.

For this traffic operational analysis, LOS D or better is considered to be acceptable and LOS E or worse is considered unacceptable.

Intersection LOS criteria for signalized and unsignalized intersections are summarized in **Table 1**.

Table 1: Intersection Level of Service Criteria – Vehicle Delay

Level of Service	Average Delay (seconds / vehicle)		Description
	Signalized	Unsignalized	
A	≤ 10.0	≤ 10.0	Little or no traffic delay
B	> 10.0 and ≤ 20.0	> 10.0 and ≤ 15.0	Minimal traffic delay
C	> 20.0 and ≤ 35.0	> 15.0 and ≤ 25.0	Average traffic delay
D	> 35.0 and ≤ 55.0	> 25.0 and ≤ 35.0	Long traffic delay
E	> 55.0 and ≤ 80.0	> 35.0 and ≤ 50.0	Very long traffic delay
F	> 80.0	> 50.0	Extreme traffic delay

Source: Transportation Research Board, *Highway Capacity Manual*, 2000.

Arterial Measure of Effectiveness

As this project proposes grade separation and improvements to traffic circulation, arterial analysis was conducted in order to gauge the corridor-wise benefit of the project. Therefore, arterial analysis was conducted for each of the study roadway segments. SimTraffic was used for the evaluation of the arterial segments. The arterial results summarized in this report were based on multi-run Sim-Traffic simulation. The following measures of effectiveness (MOEs) were calculated and considered in the evaluation of intersection operations and performance:

- Vehicle delay (measured in seconds per vehicle) – Delay experienced by the vehicle while traversing the arterial;
- Travel Time (measured in seconds) – Time taken by the vehicle to travel the arterial; and
- Speed (measured in miles per hour) – Average speed taken by the vehicle to traverse the arterial.

Arterial travel time is directly proportional to delay experienced by the vehicles and inversely proportional to the arterial speed. Therefore, the longer the travel times are, the higher the delays and lower the speeds.

Existing Conditions

Existing intersection lane configurations, signal timings and turning movement volumes were used to calculate the LOS for the study intersections during the AM and PM peak hour. The results of the LOS analysis for existing conditions are presented in **Table 2**.

Table 2: Intersection Level of Service – Existing Conditions

ID	Intersection		Control	Existing Conditions			
	North/South	East/West		AM Peak		PM Peak	
				LOS	Delay	LOS	Delay
1	El Camino Real	Glenwood Ave	Signal	D	48.7	D	38.1
2	El Camino Real	Oak Grove Ave	Signal	D	37.7	D	37.4
3	El Camino Real	Ravenswood Ave	Signal	D	41.5	D	51.7
4	Alma St	Ravenswood Ave	*TWSC*	B	12.9	C	15.4
5	Laurel St	Glenwood Ave	AWSC	C	17.3	B	11.5
6	Laurel St	Oak Grove Ave	Signal	B	14.7	B	10.8
7	Laurel St	Ravenswood Ave	Signal	D	53.6	D	48.5
8	Middlefield Rd	Glenwood Ave	*TWSC*	**F**	**>50**	**F**	**>50**
9	Middlefield Rd	Oak Grove Ave	Signal	B	15.2	B	11.7
10	Middlefield Rd	Ravenswood Ave	Signal	D	54.7	D	53.1

Source: AECOM 2016
Notes:
1. AM = morning peak hour, PM = evening peak hour
2. Whole intersection weighted average control delay expressed in second per vehicle for signalized intersections and all-way stop controlled intersections. Total control delay for the worst movement is presented for side-street stop controlled intersections.
Bold text indicates deficient intersection operations.

The results of the existing conditions indicate that all of the study intersections operate at acceptable LOS of D or better with the exception of the intersection of Middlefield Road and Glenwood Avenue. This intersection operates at an unacceptable LOS F during both the AM and PM peak hours.

Table 3 presents the summary of the arterial analysis under existing conditions along the eastbound and westbound direction for each of the study roadway segment during both the AM and PM peak hour. As mentioned above, the limits for each of the study segment included El Camino Real to the west and Middlefield Road to the east. The study segments were measured for the delay, travel time and speed.

Table 3: Arterial Analysis Results – Existing Conditions
Between El Camino Real and Middlefield Road

Direction	Street Name	AM Peak Hour			PM Peak Hour		
		Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)	Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)
Eastbound	*Ravenswood Avenue*	110.4	206.4	22.0	172.3	271.9	18.0
	Oak Grove Avenue	45.0	126.4	35.0	47.3	135.8	32.0
	Glenwood Avenue	60.3	144.0	31.0	54.6	138.6	33.0
Westbound	*Ravenswood Avenue*	63.7	136.5	34.0	80.7	167.4	27.0
	Oak Grove Avenue	105.4	188.0	28.0	79.9	159.4	32.0
	Glenwood Avenue	83.0	166.3	30.0	79.0	134.2	61.0

Source: AECOM 2016
Notes:
1. AM = morning peak hour PM = evening peak hour
2. The arterial delay is measured in terms of seconds per vehicle, the arterial travel time is measured in terms of seconds, and the arterial speed is measured in terms of miles per hour.

In the eastbound direction, it took between 3 and 5 minutes to travel along Ravenswood Avenue between El Camino Real and Middlefield Road during both AM and PM peak hours and between 2 and 3 minutes to travel along Oak Grove Avenue and Glenwood Avenue between El Camino Real and Middlefield Road. Hence, it can be concluded that it took longer to travel along Ravenswood Avenue compared to the other two segments. In the westbound direction, it took between 2 and 3 minutes to travel along Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue during both AM and PM peak hours.

Design Year 2040 Conditions

Future year 2040 conditions were evaluated under the no-build alternative conditions and build alternative conditions (i.e. grade separation). The analysis results are presented in the following sections along with improvement measures to bring the intersection LOS to acceptable levels (LOS D or better).

No Build Alternative

This section summarizes the 2040 no-build operating conditions for the AM and PM peak hour. The turning movement volumes at the study intersections are presented in the ***Appendix A***

Table 4 presents the 2040 LOS along with Existing conditions LOS for comparison.

Table 4: Intersection Level of Service – No-Build (2040) Conditions

ID	Intersection		Control	Existing Conditions				No-Build (2040) Conditions			
	North/South	East/West		AM Peak		PM Peak		AM Peak		PM Peak	
				LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
1	El Camino Real	Glenwood Ave	Signal	D	48.7	D	38.1	**E**	**65.5**	D	51.8
2	El Camino Real	Oak Grove Ave	Signal	D	37.7	D	37.4	D	38.1	D	46.9
3	El Camino Real	Ravenswood Ave	Signal	D	41.5	D	51.7	D	45.9	**E**	**75.5**
4	Alma St	Ravenswood Ave	*TWSC*	B	12.9	C	15.4	C	15.2	C	15.4
5	Laurel St	Glenwood Ave	AWSC	C	17.3	B	11.5	D	32.4	D	27.4
6	Laurel St	Oak Grove Ave	Signal	B	14.7	B	10.8	D	39.1	B	17.2
7	Laurel St	Ravenswood Ave	Signal	D	53.6	D	48.5	**E**	**61.4**	**E**	**60.4**
8	Middlefield Rd	Glenwood Ave	*TWSC*	**F**	**>50**	**F**	**>50**	**F**	**>50**	**F**	**>50**
9	Middlefield Rd	Oak Grove Ave	Signal	B	15.2	B	11.7	B	15.6	B	15.2
10	Middlefield Rd	Ravenswood Ave	Signal	D	54.7	D	53.1	**E**	**57.9**	**F**	**>80**

Source: AECOM 2016
Notes:
1. AM = morning peak hour, PM = evening peak hour
2. Whole intersection weighted average control delay expressed in second per vehicle for signalized intersections and all-way stop controlled intersections. Total control delay for the worst movement is presented for side-street stop controlled intersections.
Bold text indicates deficient intersection operations.

The corresponding LOS calculation sheets are included in ***Appendix B***

During the AM peak hour, the intersections of El Camino Real and Glenwood Avenue, Laurel Street and Ravenswood Avenue, Middlefield Road and Ravenswood Avenue operate at LOS E. In addition, the intersection of Middlefield Road and Glenwood Avenue continues (from existing conditions) to operate at LOS F under the no-build 2040 conditions.

During the PM peak hour, the intersections of El Camino Real and Ravenswood Avenue, and Laurel Street and Ravenswood Avenue operate at LOS E and the intersection of Middlefield Road and Ravenswood Avenue operates at an unacceptable LOS F. In addition, the intersection of Middlefield Road and Glenwood Avenue continues (from existing conditions) to operate at LOS F under the no-build 2040 conditions

Table 5 presents the summary of the 2040 no-build conditions arterial analysis along the eastbound and westbound direction for each of the study segment roadway during both the AM and PM peak hour. As mentioned above, the limits for each of the study segment included El Camino Real to the west and Middlefield Road to the east. The study segments were measured for the delay, travel time and speed.

Table 5: Arterial Analysis Results – No-Build 2040 Conditions Between El Camino Real and Middlefield Road

Direction	Street Name	AM Peak Hour			PM Peak Hour		
		Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)	Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)
Eastbound	*Ravenswood Avenue*	290.0	413.0	6.0	237.9	379.4	7.0
	Oak Grove Avenue	97.3	182.5	12.0	79.1	163.1	14.0
	Glenwood Avenue	91.6	181.1	12.0	322.0	405.8	5.0
Westbound	*Ravenswood Avenue*	99.6	165.3	13.0	110.6	178.8	13.0
	Oak Grove Avenue	294.3	373.7	6.0	97.1	171.0	13.0
	Glenwood Avenue	221.5	361.7	7.0	92.8	168.9	13.0

Source: AECOM 2016
Notes:
1. AM = morning peak hour, PM = evening peak hour
2. The arterial delay is measured in terms of seconds per vehicle, the arterial travel time is measured in terms of seconds, and the arterial speed is measured in terms of miles per hour.

In the westbound direction, it took approximately between 3 and 7 minutes to travel along Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue, between El Camino Real and Middlefield Road, during both AM and PM peak hours. In the westbound direction, it took approximately between 3 and 6 minutes to travel along Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue between El Camino Real and Middlefield Road during both AM and PM peak hours. It can be inferred that the travel times have increased compared to the existing conditions in all the study roadway segments. Increase in travel times also signifies increase in delays and reduction in speed compared to the existing conditions.

Alternative A

Under Alternative A, as mentioned above, Ravenswood Avenue is "depressed" from the current elevation in the vicinity of the railroad tracks. This modification is proposed only to Ravenswood Avenue. In addition, due to design constraints, a grade separation of Alma Street to improve north/south connectivity would be required, thereby maintaining the through movement on Alma Street. As a result, no vehicular movement would be allowed between Alma Street and Ravenswood Avenue. The traffic from Ravenswood Avenue to Alma Street and vice-versa would be re-routed to Laurel Street. Initially, this alternative was analyzed with no lane configuration and signal timing changes at the intersection of Laurel Street and Ravenswood Avenue. However, the analysis results indicated that the intersection would fail due to the additional traffic. Therefore, in order to improve the intersection operations to an acceptable LOS D or better, the following modification is proposed:

1. The eastbound approach at the intersection of Laurel Street and Ravenswood Avenue should be modified to include a 300 –foot right trap lane. Corresponding signal timing changes should be implemented to accommodate the modified lane geometry and additional traffic due to traffic re-routing.

No changes are proposed to the other at-grade crossings at Oak Grove Avenue and Glenwood Avenue. The turning movement volumes at the study intersections are presented in the ***Appendix A***. The results of the LOS analysis for Alternative A are presented in **Table 6**. The results presented in **Table 6** compare the traffic operational results between no-build (No project) conditions; build Alternative A with existing lane configuration and build Alternative A with proposed modifications as discussed above.

From **Table 6**, it can be seen that the LOS at the intersection of Laurel Street and Ravenswood Avenue deteriorates from an unacceptable LOS E in the no-build conditions to an unacceptable LOS F in the PM peak hour with the project if the intersection configuration remains unchanged. However, the LOS would improve to an acceptable LOS C with proposed modifications. All other intersections either improve or continue to operate at the same LOS under both the Alternative A with existing configuration and Alternative A with proposed modifications compared to the no-build conditions.

Table 7 presents summary of the Alternative A arterial analysis of Ravenswood Avenue between El Camino Real and Laurel Street along the eastbound and westbound direction during both the AM and PM peak hour. The results for this segment show that this segment would be impacted the most as a result of the grade separation of Alma Street. It should be noted that the results presented in **Table 7** compare the arterial analysis results between no-build (No project) conditions, build Alternative A with existing lane configuration and build Alternative A with proposed modifications as discussed above. The results indicate that Alternative A with proposed modifications would reduce the delay and travel time for vehicles traveling along Ravenswood Avenue between El Camino Real and Middlefield Road. The corresponding LOS calculation sheets are included in ***Appendix B***

Table 6: Intersection Level of Service – Alternative A Build (2040) Conditions

ID	Intersection		Control	No-Build (2040) Conditions				Alternative A Existing Configuration (2040)				Alternative A Proposed Modifications (2040)			
	North/South	East/West		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
				LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
1	El Camino Real	Glenwood Ave	Signal	**E**	**65.5**	D	51.8	**E**	**65.5**	D	52.3	**E**	**65.5**	D	52.1
2	El Camino Real	Oak Grove Ave	Signal	D	38.1	D	46.9	D	37.9	D	42.5	D	37.9	D	42.4
3	El Camino Real	Ravenswood Ave	Signal	D	45.9	**E**	**75.5**	D	43.9	**E**	**55.5**	D	45.1	**E**	**57.7**
4*	Alma St	Ravenswood Ave	*TWSC/Signal*	C	15.2	C	15.4	Removed under this Alternative				Removed under this Alternative			
5*	Laurel St	Glenwood Ave	AWSC/Signal	D	32.4	D	27.4	D	32.4	D	27.4	D	32.4	D	27.4
6	Laurel St	Oak Grove Ave	Signal	D	39.1	B	17.2	D	39.1	B	17.2	D	39.1	B	17.2
7	Laurel St	Ravenswood Ave	Signal	**E**	**61.4**	**E**	**60.4**	**D**	**45.9**	**F**	**>80**	**C**	**25.7**	**C**	**31.7**
8*	Middlefield Rd	Glenwood Ave	*TWSC/Signal*	**F**	**>50**	**F**	**>50**	**F**	**>50**	**F**	**>50**	**F**	**>50**	**F**	**>50**
9	Middlefield Rd	Oak Grove Ave	Signal	B	15.6	B	15.2	B	15.6	B	15.2	B	15.6	B	15.2
10	Middlefield Rd	Ravenswood Ave	Signal	**E**	**57.9**	**F**	**>80**	**D**	**49.1**	**E**	**73.2**	**D**	**49.1**	**E**	**73.2**

Source: AECOM 2016
Notes:
1. AM = morning peak hour, PM = evening peak hour
2. Whole intersection weighted average control delay expressed in second per vehicle for signalized intersections and all-way stop controlled intersections. Total control delay for the worst movement is presented for side-street stop controlled intersections.
Bold text indicates deficient intersection operations.
* Due to the proposed improvements within the project limits, the control was changed from a stop to a signal under the Build conditions.
Green indicates improvement in LOS from the no-build conditions. **Red** indicates deterioration in LOS from the no-build conditions.

Table 7: Arterial Analysis Results – Alternative A Build (2040) Conditions

Direction	Scenario	AM Peak Hour			PM Peak Hour		
		Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)	Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)
No-Build Configuration							
Eastbound	*Ravenswood Avenue*	290.0	413.0	6.0	237.9	379.4	7.0
Westbound	*Ravenswood Avenue*	37.9	67.0	13.0	53.4	85.4	10.0
Alternative A - Existing Configuration							
Eastbound	*Ravenswood Avenue*	182.3	219.4	4.0	250.0	509.5	3.0
Westbound	*Ravenswood Avenue*	37.9	67.0	13.0	53.4	85.4	10.0
Alternative A - Proposed Modification with Right Trap Lane							
Eastbound	*Ravenswood Avenue*	39.5	73.7	11.0	149.9	284.8	5.0
Westbound	*Ravenswood Avenue*	35.2	64.4	13.0	65.3	98.0	9.0

Source: AECOM 2016
Notes:
1. AM = morning peak hour, PM = evening peak hour
2. The arterial delay is measured in terms of seconds per vehicle, the arterial travel time is measured in terms of seconds, and the arterial speed is measured in terms of miles per hour.

Alternative C

Under Alternative C, as mentioned above, Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue are partially "depressed" and the Caltrain tracks are partially "elevated" respectively from the current elevation. This alternative is referred as "Hybrid" since it involves partial depression as well as partial elevation.

Initially, this alternative was analyzed with no lane configuration and signal timing changes at the study intersections on Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue. However, the analysis results indicated that some intersections would fail due to the design year 2040 traffic volumes. Therefore, in order to improve the intersection operations to an acceptable LOS D or better, the several modifications are proposed. Overall, this alternative would provide better safety, alleviate traffic congestion and improve circulation for pedestrians, cyclists and autos.

1. **Alma Street and Ravenswood Avenue** – This intersection is proposed to be a full-access intersection under this alternative. The following lists the modifications along each approach.

   - ***Eastbound approach & westbound approach (Ravenswood Avenue)*** - Modification from a single through, shared through/right lane to a single left-turn pocket, single through lane and single shared through/right lane on both the eastbound and westbound (Ravenswood Avenue) approaches.
   - ***Northbound approach & southbound approach (Alma Street)*** – Modification from a single right-in/right-out only approach to a single shared left/through/right approach on both the northbound and southbound (Alma Street) approaches.

- Signalization of the intersection.

2. **Laurel Street and Glenwood Avenue** – This intersection operates unacceptably with the current control (All-Way Stop Control) and meets the peak hour signal warrants for the year 2040. Therefore, a signal is proposed at this intersection. This intersection is within the Town of Atherton's jurisdiction, therefore concurrence from the Town would be required and the project will continue to coordinate with the Town on this item as the project progresses.
3. **Middlefield Road and Glenwood Avenue** – This intersection operates unacceptably with the current control (Two-Way Stop Control) and meets the peak hour signal warrants for the year 2040. Therefore, a signal is proposed at this intersection. This intersection is within the Town of Atherton's jurisdiction, therefore concurrence from the Town would be required and the project will continue to coordinate with the Town on this item as the project progresses.

The turning movement volumes at the study intersections are presented in the ***Appendix A***. The results of the LOS analysis for Alternative C are presented in **Table 8**. The results presented in **Table 8** compare the traffic operational results between no-build (No project) conditions; build Alternative C with existing lane configuration and build Alternative C with proposed modifications as discussed above. The results presented in **Table 8** are summarized as follow:

- The intersection of Alma Street and Ravenswood Avenue deteriorates from an acceptable LOS C in the no-build conditions to an unacceptable LOS F under the Alternative C with existing configuration. In order to improve the LOS, the above discussed modifications were proposed at this intersection. As a result, the LOS improved from an unacceptable LOS F in the Alternative C with existing configuration to an acceptable LOS B in the build with proposed modifications during both the AM and PM peak hours.
- Though the intersection of Laurel Street and Glenwood Avenue with the project (unchanged intersection configuration) is expected to operate at similar LOS to the no-build conditions (LOS D), road users are anticipated to experience longer delays due to the stop control. In addition, this intersection warrants a signal in the peak hour based on the design year 2040 traffic volumes. The project recommends a signal at this location. As a result of the proposed signal, the LOS improves from a LOS D under no-build conditions to LOS B or better under the Alternative C with proposed modifications.
- The intersection of Middlefield Road and Glenwood Avenue continues to operate at an unacceptable LOS F under both no-build conditions and Alternative C with existing configuration. A peak hour signal warrant analysis was conducted to determine if a signal is required. The results indicated that the peak hour signal warrants were met and thus a signal is proposed at this location. As a result, the LOS improved from an unacceptable LOS F under both the no-build conditions and Alternative C with existing configuration to an acceptable LOS B in the Alternative C with proposed modifications during both the AM and PM peak hours.

- All other intersections either operate similar or better than the no-build conditions due to the proposed changes at the above intersections.

In order to measure the project impacts more accurately, the arterial operations along Glenwood Avenue was divided into two sections for analysis. **Table 9a** presents the arterial analysis results for Glenwood Avenue between El Camino Real and Laurel Street and **Table 9b** presents the arterial analysis results for Glenwood Avenue between Laurel Street and Middlefield Road. In both **Table 9a** and **Table 9b**, the arterial results for the following four scenarios are presented:

- No-build conditions,
- Alternative C with existing configuration,
- Alternative C with proposed signal only at Laurel Street and Glenwood Avenue and
- Alternative C with proposed signals at both Laurel Street/Glenwood Avenue and Middlefield Road/Glenwood Avenue.

The results indicate that the signalization of both the intersections would provide the lowest travel time, and lowest delay along Glenwood Avenue in the year 2040.

Table 10 summarizes the Alternative C arterial analysis along the eastbound and westbound direction for Ravenswood Avenue and Oak Grove Avenue between El Camino Real and Middlefield Road during both the AM and PM peak hours. The results indicate that Alternative C with proposed modifications would provide the lowest travel time, and lowest delay to travel along Glenwood Avenue in the year 2040. The corresponding LOS calculation sheets are included in ***Appendix B***

Table 8: Intersection Level of Service – Alternative C Build (2040) Conditions

ID	Intersection		Control	No-Build (2040) Conditions				Alternative C Existing Configuration (2040)				Alternative C Proposed Modifications (2040)			
	North/South	East/West		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
				LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
1	El Camino Real	Glenwood Ave	Signal	**E**	**65.5**	D	51.8	**E**	**65.5**	D	51.8	**E**	**65.5**	D	51.8
2	El Camino Real	Oak Grove Ave	Signal	D	38.1	D	46.9	D	38.1	D	46.8	D	38.0	D	46.8
3	El Camino Real	Ravenswood Ave	Signal	D	45.9	**E**	**75.5**	D	46.4	**E**	**61.7**	D	45.2	**E**	**61.7**
4*	Alma St	Ravenswood Ave	*TWSC/Signal*	C	15.2	C	15.4	**F**	**>80**	**F**	**>80**	**B**	**11.0**	**B**	**11.7**
5*	Laurel St	Glenwood Ave	AWSC/Signal	D	32.4	D	27.4	D	32.4	D	27.4	**A**	**8.9**	**B**	**10.3**
6	Laurel St	Oak Grove Ave	Signal	D	39.1	B	17.2	D	40.8	B	17.4	D	40.8	B	17.4
7	Laurel St	Ravenswood Ave	Signal	**E**	**61.4**	**E**	**60.4**	**D**	**38.5**	**D**	**48.2**	**C**	**26.1**	**D**	**39.7**
8*	Middlefield Rd	Glenwood Ave	*TWSC/Signal*	**F**	**>50**	**F**	**>50**	**F**	**>50**	**F**	**>50**	**B**	**11.3**	**B**	**13.8**
9	Middlefield Rd	Oak Grove Ave	Signal	B	15.6	B	15.2	B	15.9	B	15.2	B	15.9	B	15.2
10	Middlefield Rd	Ravenswood Ave	Signal	**E**	**57.9**	**F**	**>80**	**D**	**51.4**	**E**	**78.6**	**D**	**51.3**	**E**	**78.6**

Source: AECOM 2016
Notes:
1. AM = morning peak hour, PM = evening peak hour
2. Whole intersection weighted average control delay expressed in second per vehicle for signalized intersections and all-way stop controlled intersections. Total control delay for the worst movement is presented for side-street stop controlled intersections.
Bold text indicates deficient intersection operations.

* Due to the proposed improvements within the project limits, the control was changed from a stop to a signal under the Build conditions.
Green indicates improvement in LOS from the no-build conditions. **Red** indicates deterioration in LOS from the no-build conditions.

Table 9a: Arterial Analysis Results – Alternative C –Glenwood Avenue Segment between El Camino Real and Laurel Street

Direction	Scenario	AM Peak Hour			PM Peak Hour		
		Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)	Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)
No-Build Configuration							
Eastbound	*Glenwood Avenue*	25.2	59.0	14.0	42.5	76.1	11.0
Westbound	*Glenwood Avenue*	200.7	296.1	4.0	82.0	111.8	7.0
Alternative C - Existing Configuration							
Eastbound	*Glenwood Avenue*	19.5	53.5	15.0	14.7	48.0	17.0
Westbound	*Glenwood Avenue*	175.9	402.8	4.0	55.8	85.5	10.0
Alternative C - Signal at Glenwood Ave/ Laurel Street only							
Eastbound	*Glenwood Avenue*	13.1	46.3	18.0	10.4	43.7	19.0
Westbound	*Glenwood Avenue*	136.7	231.6	5.0	57.0	86.7	10.0
Alternative C - Signal at Glenwood Ave/ Laurel Street and Glenwood Ave/ Middlefield Rd							
Eastbound	*Glenwood Avenue*	13.7	47.3	17.0	12.2	45.3	18.0
Westbound	*Glenwood Avenue*	113.7	193.2	6.0	54.4	84.4	10.0

Table 9b: Arterial Analysis Results – Alternative C –Glenwood Avenue Segment between Laurel Street and Middlefield Road

Direction	Scenario	AM Peak Hour			PM Peak Hour		
		Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)	Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)
No-Build Configuration							
Eastbound	*Glenwood Avenue*	66.4	122.1	11.0	279.5	329.7	4.0
Westbound	*Glenwood Avenue*	20.8	65.6	21.0	10.8	57.1	24.0
Alternative C - Existing Configuration							
Eastbound	*Glenwood Avenue*	63.5	114.2	12.0	300.0	334.2	4.0
Westbound	*Glenwood Avenue*	17.9	64.6	21.0	9.6	52.5	26.0
Alternative C - Signal at Glenwood Ave/ Laurel St only							
Eastbound	*Glenwood Avenue*	70.0	126.6	11.0	256.5	309.1	4.0
Westbound	*Glenwood Avenue*	9.9	56.0	25.0	10.8	62.7	22.0
Alternative C - Signal at Glenwood Ave/ Laurel St and Glenwood Ave/ Middlefield Rd							
Eastbound	*Glenwood Avenue*	24.3	74.4	19.0	38.6	95.6	14.0
Westbound	*Glenwood Avenue*	8.6	51.1	27.0	12.8	61.3	22.0

Source: AECOM 2016
Notes:
1. AM = morning peak hour, PM = evening peak hour
2. The arterial delay is measured in terms of seconds per vehicle, the arterial travel time is measured in terms of seconds, and the arterial speed is measured in terms of miles per hour.

Table 10: Arterial Analysis Results–Alternative C–Ravenswood Avenue and Oak Grove Avenue
Segment Between El Camino Real and Middlefield Road

Direction	Scenario	AM Peak Hour			PM Peak Hour		
		Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)	Delay (s/veh)	Travel Time (s)	Arterial Speed (mph)
No-Build Configuration							
Eastbound	*Ravenswood Avenue*	290.0	413.0	6.0	237.9	379.4	7.0
	Oak Grove Avenue	97.3	182.5	12.0	79.1	163.1	14.0
Westbound	*Ravenswood Avenue*	99.6	165.3	13.0	110.6	178.8	13.0
	Oak Grove Avenue	294.3	373.7	6.0	97.1	171.0	13.0
Alternative C - Existing Configuration							
Eastbound	*Ravenswood Avenue*	143.8	378.1	10.0	208.4	326.2	4.0
	Oak Grove Avenue	38.1	119.0	19.0	42.4	126.3	18.0
Westbound	*Ravenswood Avenue*	62.4	137.5	16.0	70.2	102.4	9.0
	Oak Grove Avenue	93.3	177.0	13.0	86.4	159.6	14.0
Alternative C - Proposed Modifications							
Eastbound	*Ravenswood Avenue*	91.6	183.1	12.0	114.6	208.1	11.0
	Oak Grove Avenue	38.1	119.0	19.0	42.4	126.3	18.0
Westbound	*Ravenswood Avenue*	56.9	137.9	16.0	110.5	197.3	11.0
	Oak Grove Avenue	93.3	177.0	13.0	86.4	159.6	14.0

Source: AECOM 2016
Notes:
1. AM = morning peak hour, PM = evening peak hour
2. The arterial delay is measured in terms of seconds per vehicle, the arterial travel time is measured in terms of seconds, and the arterial speed is measured in terms of miles per hour.

Conclusions

The project proposes grade separations at Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue from the at-grade railroad crossings of the Caltrain line. This is to help alleviate traffic congestion, improve the overall vehicular, pedestrian and bicycle safety and circulation.

For the traffic operational analysis, three build alternatives were considered: Alternative A, Alternative B and Alternative C. Based on the input from the City Council, Alternative B was dropped from further evaluation. The other two alternatives were analyzed for the existing and future 2040 no build and build conditions. The summary of Alternative A and Alternative C are presented below:

Alternative A:

1. Since Alma Street will be grade separated, no vehicular movement was assumed between Alma Street and Ravenswood Avenue. Therefore, traffic from Ravenswood Avenue to Alma Street and vice-versa was re-routed via Laurel Street for the traffic operational analysis.
2. The eastbound approach at the intersection of Laurel Street and Ravenswood Avenue is modified to include a 300 feet right trap lane between Noel Street and Laurel Street. Signal timing modifications are proposed as a result of the re-routing traffic from Alma Street.

As a result of the above changes, the intersections along Ravenswood Avenue would operate at acceptable LOS of level D or better compared to the no-build conditions. In addition, the proposed changes would reduce the delay and the travel time for vehicles traveling along Ravenswood Avenue between El Camino Real and Middlefield Road.

Alternative C:

1. **Alma Street and Ravenswood Avenue** – This intersection is proposed to be a full-access intersection under this alternative with the following modifications along each approach:
   - ***Eastbound approach & westbound approach (Ravenswood Avenue)*** - Modification from a single through, shared through/right lane to a single left-turn pocket, single through lane and single shared through/right lane on both the eastbound and westbound (Ravenswood Avenue) approaches.
   - ***Northbound approach & southbound approach (Alma Street)*** – Modification from a single right-in/right-out only approach to a single shared left/through/right approach on both the northbound and southbound (Alma Street) approaches.

- Signalization of the intersection.

2. **Laurel Street and Glenwood Avenue** – This intersection operates unacceptably with the current control (All-Way Stop Control), but meets the peak hour signal warrants for the year 2040. Therefore, a signal is proposed at this intersection
3. **Middlefield Road and Glenwood Avenue** – This intersection operates unacceptably with the current control (Two-Way Stop Control), but meets the peak hour signal warrants for the year 2040. Therefore, a signal is proposed at this intersection.

As a result of the above changes, the intersections along Ravenswood Avenue, Oak Grove and Glenwood Avenue that were operating at unacceptable LOS under the no-build conditions would operate at acceptable LOS of level D or better under the Build conditions. In addition, the proposed changes would reduce the delay and travel time for vehicles traveling along Ravenswood Avenue, Oak Grove Avenue and Glenwood Avenue between El Camino Real and Middlefield Road.

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