

Lawrence Expressway

Grade Separation Concept Study



Executive Summary
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Prepared by

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Lawrence Expressway Grade Separation Concept Study

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Executive Summary

Lawrence Expressway is part of the County Expressway System, a regional network of key thoroughfares operated and maintained by the County of Santa Clara. The expressways serve numerous functions, including regional connectivity, local access, and multi-modal circulation. The primary mission of the expressway system is to relieve local streets of through traffic and supplement the freeway system.

Lawrence Expressway is a vital regional artery that directly supports the expressway system's mission. It has 8 through lanes north of I-280, including high-occupancy vehicle (HOV) lanes between Stevens Creek Boulevard and US 101. It provides connectivity between three east-west freeways and access for the cities of Cupertino, San Jose, Santa Clara, Saratoga, and Sunnyvale. It serves over 80,000 vehicles per day between Reed Avenue/Monroe Street and US 101. The volume of traffic carried by this segment results in congestion and long delays, and creates a physical and visual barrier between the businesses and communities on either side of the expressway.

Past expressway planning efforts identified the section of Lawrence Expressway north of El Camino Real and south of US 101 as the busiest portion of Lawrence Expressway, and even the busiest portion of any expressway countywide. The 2003 Comprehensive County Expressway Planning Study identified the at-grade signalized intersections of Lawrence Expressway with Arques Avenue, Kifer Road, and Reed Avenue/Monroe Street as the most congested along Lawrence Expressway and in need of major capacity improvements. These findings were supported again in the 2008 Update to the Expressway Study.

Lawrence Expressway serves over 80,000 vehicles per day between US 101 and Reed Avenue/Monroe Street, resulting in congestion, long delays, and a physical and visual barrier within the community.

Grade separations have been historically implemented at various locations throughout the expressway network as a solution for congested intersections when all feasible at-grade solutions are not sufficient. Lawrence Expressway itself is grade separated at major crossings of both El Camino Real and Stevens Creek Boulevard. Grade separations have been long considered as potential improvements for the Arques Avenue, Kifer Road, and Reed Avenue/Monroe Street intersections, with some rough concepts dating back decades. Over the years, a number of at-grade improvements have been implemented at these locations, with the addition of travel lanes, turn lanes, and extensive signal operations optimizations along the corridor. With the congestion along Lawrence Expressway between US 101 and Reed Avenue/Monroe Street continuing to increase, and rising to the top of the areas of greatest need countywide, the County and its partners, the City of Santa Clara and the City of Sunnyvale, elected to embark on a study to better understand the type of solutions needed to improve the most congested section of Lawrence Expressway. With the identification of community-supported improvements, the right-of-way needed to implement those improvements can be preserved and accumulated as the area redevelops.

Project Purpose

The main purpose of the Lawrence Expressway Grade Separation Project is to identify potential improvements at the intersections of Reed Avenue/Monroe Street, Kifer Road, and Arques Avenue that will address existing and forecast traffic congestion in the study area. Identifying these improvements through this study will be critical to serving the long-term congestion problem by allowing for:

- Preservation of right-of-way needed for long-term improvements as the area redevelops;



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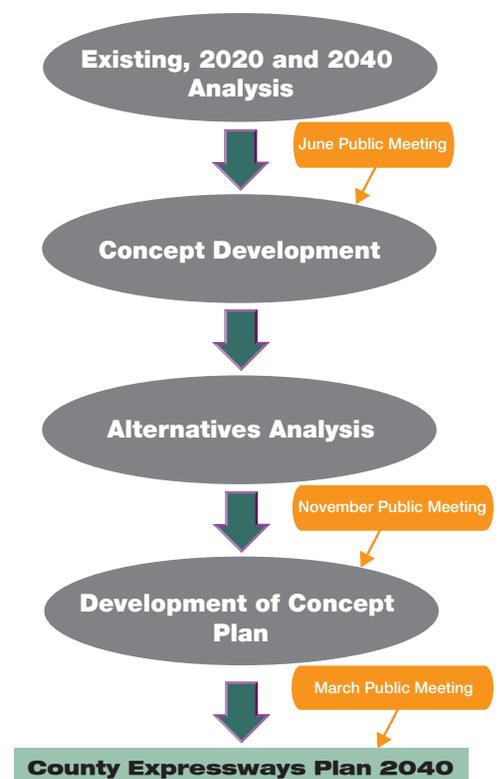
- Identification of project costs, supporting inclusion in traffic impact fee programs and in the ultimate preparation of a financing plan;
- Establishment of a basis for further preliminary engineering and environmental analysis, getting improvements closer to being shovel-ready to capitalize on financing opportunities as they arise; and
- Identification of a project and cost for inclusion in the Expressway Plan 2040 Study, the Valley Transportation Plan and the Regional Transportation Plan.

The study is focused on identifying improvements to the three intersections of Reed Avenue/Monroe Street, Kifer Road, and Arques Avenue; however, it also examines the associated effects over a wider area to ensure that solutions at those locations will not result in the problem shifting elsewhere. The study area consists of Lawrence Expressway and other major roadways included within the area bound by Oakmead Parkway to the north, Oakmead Parkway/Corvin Drive to the east, Commercial Street/Deguigne Drive to the west, and Cabrillo Avenue to the south. Central Expressway runs through the heart of the study area. Considerations were given to circulation to and from Central Expressway in the vicinity of Lawrence Expressway, although modifications to the existing square loops were not inherent to the study. The project study area is depicted on **Figure ES-2**.

The project process included the development of a range of potential solutions, testing and refinement of those solutions, extensive public and stakeholder input, and the identification of a proposed concept. The project was roughly divided into the following stages:

- Baseline analysis phase where the challenges within the corridor, such as right-of-way, traffic volumes, bicycle/pedestrian mobility impairments and others were identified through analysis and public input;
- Concept development where a range of potential solutions was developed and tested for their feasibility and effectiveness at addressing the project goals;
- Alternatives analysis where three solutions were analyzed in greater detail, and presented for public input, for their circulation benefits, design feasibility, and community context; and
- Proposed concept refinement where an identified solution was further refined and presented to the public and stakeholders.

Figure ES-1 - Project Flow Chart



The project process is summarized in **Figure ES-1** at right.

A key element of the project process was the inclusion of stakeholder and public involvement. Three sets of public meetings were held at key stages in the project process where public input was received and the project findings and recommendations were presented. The meetings were well attended, with an engaged mix of residents, commuters and business owners. Each meeting had interactive elements, both providing information about the project and eliciting input



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Figure ES-2 - Study Area Map



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and feedback from the attendees. Additionally, the project was presented to key advisory and decision making bodies of the three cooperating agencies (County of Santa Clara, City of Sunnyvale, and City of Santa Clara), presented at various stakeholder meetings (Chambers of Commerce, Silicon Valley Leadership Group), and discussed with elected officials. Project information was distributed through community newsletters, newspapers and e-blasts. A project e-mail list was maintained and utilized to distribute information regarding project milestones and opportunities for public input. The County maintained a project website, phone number, and e-mail address, providing additional opportunities for public input.

The project included three sets of public meetings, presentations to several key advisory and decision making bodies, and meetings with stakeholders and elected officials. Project information was posted to the project website and distributed via e-mail blasts.

Baseline Conditions and Challenges

Based on input from the project stakeholders and the public, the following set of goals, and associated baseline challenges, were identified for improvements to Lawrence Expressway.



The community meetings were well attended. Interactive elements helped solicit input from the engaged attendees.

- Reduce congestion along Lawrence Expressway: Long delays occur at the traffic signals along Lawrence Expressway, while signal operations have already been optimized as much as possible.
- Enhance bicycle and pedestrian connectivity across Lawrence Expressway: Currently bicyclists and pedestrians encounter long crossing distances and long waits to cross Lawrence Expressway.
- Maintain and enhance access to the Lawrence Caltrain Station: The current configuration of the local streets used to access the Lawrence Caltrain Station is difficult to navigate for automobiles and buses and difficult to access for bicyclists and pedestrians.
- Provide sufficient capacity along Lawrence Expressway so that commute traffic stays on Lawrence Expressway and off local streets: Traffic volumes have been increasing as the economy recovers and are forecast to continue to increase as the area redevelops, necessitating improvements that can increase capacity.
- Coordinate solutions with the ongoing Lawrence Station Area Plan (LSAP) efforts: Ensure that the Lawrence Expressway solution works harmoniously with the LSAP efforts in improving connectivity, providing for redevelopment and density, and enhancing the viability of the Lawrence Caltrain Station.
- Ensure that any solution fits the community context: Reduce or minimize the existing visual and perceived community barrier that is Lawrence Expressway and develop a solution that fits the varying character of adjacent land uses.
- Develop a cost effective solution with community support.

A few additional guiding principles were identified through the stakeholder and public process that would be used to



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evaluate and prioritize the identified improvements:

- Minimize right-of-way needs: Minimize encroachment upon any adjacent parcels and properties.
- Avoid shifting the entire problem to another choke point: Consider the effects of potential solutions on nearby streets and downstream on Lawrence Expressway.
- Maintain local access: Maintain access to businesses and the community from Lawrence Expressway.
- Consistency with environmental goals and policies: Reduce greenhouse gas emissions and other pollutants associated with vehicle idling and delays, and support the use of alternative modes in the corridor.

The over-arching goal of the project was to identify a cost-effective, community-supported, and constructible long-term solution for Lawrence Expressway within the study corridor to alleviate congestion and improve traffic flow. Additionally, the project will support the movement of bicyclists, pedestrians, and transit on both Lawrence Expressway and the local street network.

The project sought to identify a cost-effective, community-supported, and constructible long-term solution to alleviate congestion, improve traffic flow and support the movement of bicyclists, pedestrians, and transit within the study corridor.

The baseline analysis identified that both Kifer Road and Reed Avenue/Monroe Street are operating deficiently in current, Year 2013, conditions. The three focus intersections of Lawrence Expressway with Arques Avenue, Kifer Road and Monroe Street/Reed Avenue are all forecast to be deficient by Year 2020. Average delays at Reed Avenue/Monroe Street are forecast to exceed three minutes during the AM peak hour, and average delays at all three

intersections are forecast to exceed two minutes during the PM peak hour. By Year 2040, all three intersections are forecast to be at a deficient level of service F (excessive delays) in both the AM and PM peak hours, with average delays at Reed Avenue/Monroe Street exceeding five minutes during the AM peak hour. The free-flow speed on Lawrence Expressway is 50 miles per hour; however, without any improvements, the average speed on the section of Lawrence Expressway within the study area is projected to drop to 13 miles per hour by Year 2040. That will result in increased congestion on parallel roadways such as San Tomas Expressway, Bowers Avenue or Wolfe Road, and increased vehicle miles traveled as Lawrence Expressway users detour off of the expressway to avoid the congestion. In addition, local residents and businesses will experience decreased access, affecting economic growth.

The constraints along the corridors that create all of that congestion are the signalized intersections. At each signalized intersection, Lawrence Expressway traffic is stopped while cross-street traffic and pedestrians crossing Lawrence Expressway are served. Traffic signal coordination has been fine-tuned to the point where no further improvements are feasible strictly from timing modifications. There is just too much traffic on Lawrence Expressway to fit within the available green time. The baseline analysis demonstrated that some measure of significant capacity enhancement is needed in order to reduce congestion and improve circulation.

Without improvements, the average speed on Lawrence Expressway is forecast to drop to 13 miles per hour by Year 2040, with average delays exceeding 5 minutes at Reed Avenue/Monroe Street. This will shift congestion to parallel roadways and reduce mobility.

Concept Evaluation

The project team investigated the applicability of a wide variety of intersection geometric design treatments that would address the needs of the Lawrence Expressway project corridor as defined by the



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baseline analysis. These treatments included:

- Indirect Left Turns
- Hook Ramps
- Tight Diamond Urban Interchanges
- Single Point Urban Interchanges
- Roundabouts
- Frontage Roads
- Elevated Left Turns
- Jughandles/Square Loops

These treatments were considered for their applicability at each of the improvement intersections. Nine distinct concepts were developed based on various combinations of these improvements. The concepts were considered for their ability to handle near-term and horizon year projected traffic needs, bicycle and pedestrian mobility, enhance access to/from the Lawrence Caltrain Station, and design feasibility given right-of-way and other constraints. It was determined that roundabouts were not a feasible solution due to the very high turning movement volumes at each of the three improvement locations. Indirect left-turns and other at-grade treatments also did not provide the capacity needed to handle projected traffic flows. Based on the quantitative and qualitative evaluation, certain concepts were deemed most feasible for meeting the project goals.

Alternatives Analysis

Based on input from County of Santa Clara, City of Sunnyvale and City of Santa Clara staff, three corridor alternatives were chosen for further study. These alternatives were comprised of selected concepts from the concept evaluation phase of the project. Each alternative was developed at a conceptual level for analysis of traffic, multi-modal circulation, community context, cost and other design elements. The three alternatives are summarized below:

- Alternative 1 - Frontage Road Alternative: This alternative introduced one-directional frontage roads on either side of Lawrence Expressway. The expressway itself would be depressed below Arques Avenue, Kifer Road, the Caltrain tracks, and Reed Avenue/Monroe Street. Traffic would travel between the frontage roads and the expressway at either end of the frontage roads and between Kifer Road and Reed Avenue/Monroe Street. Local traffic would utilize the frontage roads, while through traffic would stay on the expressway. Bicycle/pedestrian features would be primarily provided on the frontage roads, although commute cyclists could continue to travel along the shoulder of the expressway.
- Alternative 2 - Interchange Alternative: This alternative would depress Lawrence Expressway below Arques Avenue and elevate it above Kifer Road and Reed Avenue/Monroe Street. It introduced median-ramps at each of the three cross-streets to facilitate access between the expressway and those streets. Median ramps were proposed instead of traditional diamond ramps in order to avoid a conflict between high-speed vehicles and bicycles and pedestrians along the corridor and to improve the functionality of the HOV lanes. Ramps would be provided between bicycle and pedestrian facilities along Lawrence Expressway and the cross-streets to facilitate that connectivity.
- Alternative 3 - Grid Network Concept: This alternative would partially rely on the enhanced street network proposed



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by the Sunnyvale LSAP. The LSAP is proposing an enhanced grid network in the vicinity of the Lawrence Caltrain Station. This alternative would grade separate Lawrence Expressway and rely on existing and proposed roadways to facilitate connections between the expressway and the local community. These connections would function in a similar manner to the square loops that exist today at Central Expressway, using streets such as Titan Way, Kern Avenue, Ryder Street, and Enochs Street to provide for right-turn movements onto and off of the expressway. Lawrence Expressway would be depressed below Arques Avenue, elevated above Kifer Road, and would be elevated above Reed Avenue/Monroe Street. A median ramp interchange, similar to Alternative 2, would be implemented at Reed Avenue/Monroe Street since there is not the opportunity for a sufficient grid street network to provide connectivity as there would be at Kifer Road and Arques Avenue.

Conceptual engineering was prepared in the form of concept-level plan views, cross-sections, and profiles to-scale for the proposed concept. Kimley-Horn evaluated constructability, implementation, and phasing, including a structural feasibility review. Additionally, Kimley-Horn identified changes in circulation and traffic volumes associated with the proposed concept and developed micro-simulation models to analyze intersection delay, corridor travel time, and intersection queuing. The three alternatives were presented at public meetings and with key stakeholders for questions and comments. The key findings, based on our analysis and public feedback, for each of the three alternatives are shown in **Table ES-1**.

Table ES-1 - Alternatives Analysis Summary

	Alternative 1	Alternative 2	Alternative 3
<i>Vehicular Traffic</i>	<i>Best improvement in throughput on expressway. Not as efficient for cross-street traffic due to closely spaced intersections.</i>	<i>Works well for expressway and very well for cross-street traffic.</i>	<i>Works well for expressway and cross-streets, but may result in queuing and congestion for exiting/entering movements.</i>
<i>Multi-Modal Circulation</i>	<i>Pedestrians and cyclists on lower speed frontage road. Introduces high-speed conflict for commuter cyclists.</i>	<i>Greatly improves safety by eliminating conflict points at cross-streets. Bike/ped movements still along high-speed expressway.</i>	<i>Still retains a number of high-speed conflicts for bicyclists and pedestrians.</i>
<i>Community Factors</i>	<i>Lowering of expressway eliminates it as a barrier and frontage roads maintain strong local access.</i>	<i>Elevating expressway introduces a visual barrier.</i>	<i>Elevating expressway introduces a visual barrier and traffic volumes on connecting local streets would greatly increase.</i>
<i>Design Elements</i>	<i>Depressing expressway would be difficult to construct and costly, particularly at Caltrain.</i>	<i>Would require more right-of-way at interchange locations, but can partially utilize existing bridge over Caltrain.</i>	<i>Dependent on elements of LSAP to be implemented for grade separations to proceed.</i>
<i>Project Cost</i>	<i>Very high due to roadway depression.</i>	<i>Moderate with elevated roadway and some right-of-way requirements.</i>	<i>Lowest due to elevated roadway and assumption that LSAP implementation will provide needed right-of-way.</i>



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Proposed Concept

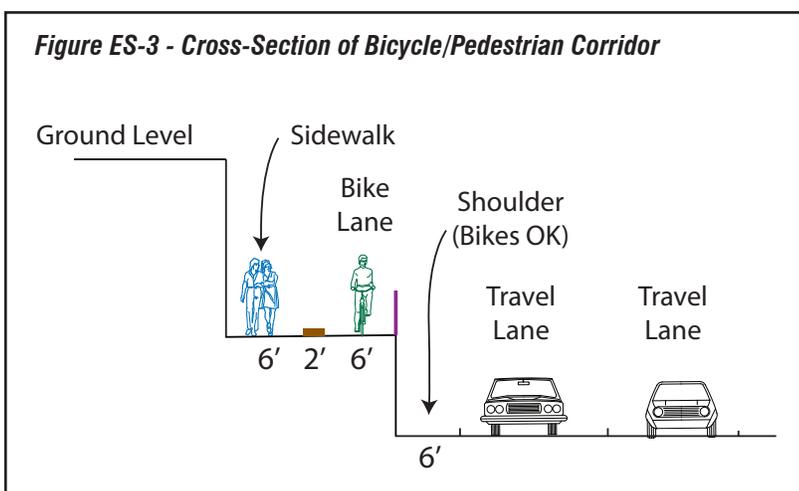
Based on community and stakeholder input and technical analyses, staff representing the three cooperating agencies jointly selected a proposed concept for further study. Alternative 3 was deemed insufficient in meeting the project goals because it would increase traffic flow on community-serving streets, and it would introduce choke points at merge locations along the corridor. Alternative 1 was desired due to its depressing of Lawrence Expressway and its removal of the visual and connectivity barrier. However, Alternative 2 provided a desirable solution for commuting cyclists and presented fewer grade changes for pedestrians, while providing a more efficient connection between Lawrence Expressway and the cross-streets. Community input was strongly in favor of lowering the expressway. Lowering the expressway has a significant trade-off in cost, construction duration, and project complexity due to the required removal of the existing Caltrain bridge and construction of a new tunnel. However, avoiding a substantial, new visual barrier was a critical element to the local community. Therefore, the previous Alternative 2 was modified to include a lowered Lawrence Expressway instead of an elevated structure.

The proposed concept represents a blend of alternatives, developed from community and stakeholder input and selected by members of the Project Working Group representing the three cooperating agencies

The proposed concept is illustrated in **Figure ES-4** on the next page. Lawrence Expressway would be depressed under the three major study intersections as well as Central Expressway and the Caltrain tracks. The depression of Lawrence Expressway for the entirety of the project corridor would remove it as a visual and contextual barrier which was one of the primary goals of the project. Additionally, the proposed concept would include the construction of grade separated interchanges at each of the three major study intersections of Lawrence Expressway: Reed Avenue/Monroe Street, Kifer Road, and Arques Avenue. The interchanges would include median ramps from the expressway up to the cross-street and a signalized intersection. In order to reduce project costs, the cross-streets would be slightly raised above the existing grade to reduce the depth of the depressed Lawrence Expressway. The raising of the cross-street elevations as they pass over Lawrence Expressway would be done in such a way as to minimize impacts to existing driveways located near the expressway on the cross-streets.

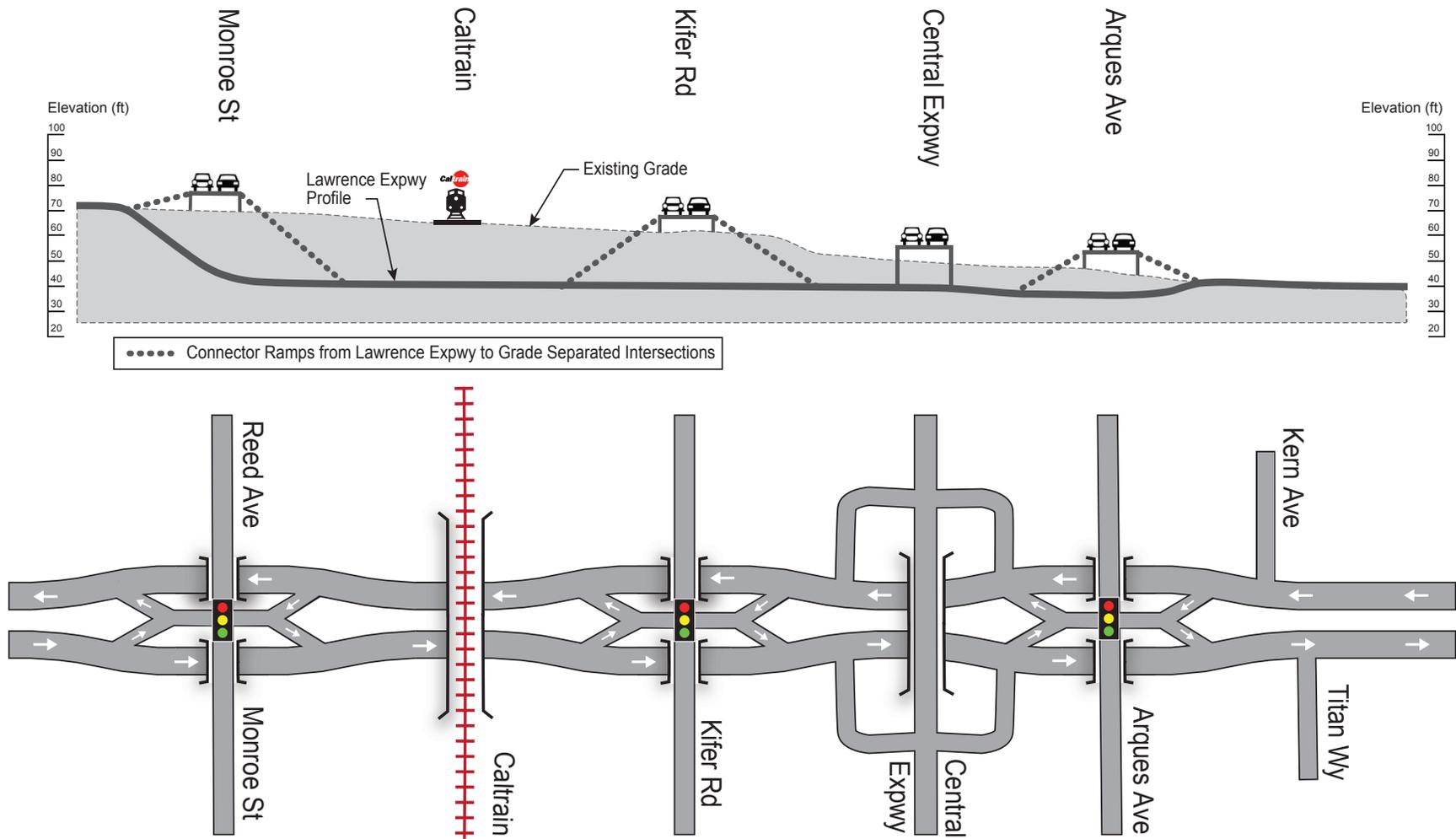
Bicycle and pedestrian movements would be provided in a corridor running adjacent to and slightly elevated above the

vehicular roadway bed. The corridor would include both a bicycle path and a pedestrian path, separated by a small buffer, as shown in the cross-section depicted in **Figure ES-3**. The elevation of the bicycle/pedestrian corridor, on the order of 5 feet to 6 feet above the roadway bed, would improve safety by introducing a barrier from vehicles, reduces cost by minimizing excavation, and would reduce the vertical distance between the bicycle/pedestrian corridor along the expressway and the cross-streets. Bicycle and pedestrian movements between the corridor and cross-streets would



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Figure ES-4 - Proposed Concept Plan and Profile



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occur via two-directional shared ramps on either side of each cross-street. Commuter cyclists also will still have the option to travel within the shoulder of Lawrence Expressway at the elevation of the roadway bed if desired.

Conceptual renderings of the proposed concept were prepared and are provided as **Figure ES-5** and **Figure ES-6**.

Transit stops would be located on the median ramps at the signalized intersections. This would provide easy access to and from adjacent land uses and the stops, while minimizing bus delay. The HOV lane functionality would be significantly

Figure ES-5 - Conceptual Rendering of View from Lawrence Expressway



improved by eliminating a number of the existing right-turn movements that require vehicles to enter and exit the HOV lanes prior to intersections. With the proposed concept, weaving movements across the HOV lane would be eliminated, except at the Central Expressway ramps.

An optional feature of the proposed concept is the provision of bus pullouts along the expressway, directly beneath the Lawrence Caltrain Station. Such pullouts, combined with vertical circulation

elements such as stairs and elevators, would provide direct access between the station and bus service along the expressway. These pullouts will be further evaluated for inclusion at a later stage of the project.

The proposed concept would reduce the projected Year 2040 average travel time between Oakmead Parkway/Duane Avenue and Cabrillo Avenue for the peak-hour travel direction along Lawrence Expressway by 40 percent or greater. Travel time across Lawrence Expressway along the crossing streets is projected to be reduced by 40 percent to as much as 90 percent, depending on the cross-street and time period. These reductions in travel time and associated reductions in vehicle idling time would dramatically reduce fuel consumption and greenhouse gas emissions.

Figure ES-6 - Conceptual Rendering of Birds-Eye View of Interchange



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By grade separating the turn movements from all the approaches at the three study intersections, north/south through traffic along the expressway would be able to flow freely, thus accomplishing one of the primary goals of the project of alleviating congestion along Lawrence Expressway and increasing the throughput of the expressway. The existing four through lanes in each direction on Lawrence Expressway were found to be sufficient to handle projected Year 2040 volumes with the removal of the at-grade intersections. The grade separations would serve to keep traffic on Lawrence Expressway. Bicycle circulation would be improved through the inclusion of a grade-separated, dedicated bike lane to provide both comfort for the recreational cyclist and speed for commuter cyclist. By dramatically reducing the width of existing cross-street intersections to the narrower ramps only, pedestrian and bicycle crossing distances would be significantly shorter compared to existing conditions. This increases pedestrian and bicycle

The proposed concept is projected to reduce average vehicle delay in the study area by over 60 percent and total fuel consumption by roughly 30 percent in both peak hours in Year 2040, providing both significant circulation and environmental benefits.

The proposed concept includes a grade-separated bicycle and pedestrian corridor with connections to cross-streets and transit, which serves to improve safety and remove significant barriers to mobility.

comfort and safety, and reduces travel time. Additionally, vehicle conflicts with pedestrian and bicycle movements would be reduced by eliminating a number of right turn movements that currently exist at the cross-streets, improving pedestrian and bicycle safety.

The proposed concept would require complex construction phasing to maintain access along Lawrence Expressway while the improvements are constructed. Closing the roadway would greatly shorten the project duration, but is likely to be infeasible given the limited number of alternative routes. Construction staging would likely require closing the road in phases, balancing the number of lanes maintained with the

desire for a short construction schedule. Given the strong directionality to traffic movements, reversible lanes during the construction period may be beneficial. It is likely that periods of full closures of Lawrence Expressway and the cross-streets may be needed. The construction duration is currently estimated to be three to five years. Additional design development and consideration to traffic handling during construction will be required in order to refine the duration period.

A high-level opinion of probable cost, with a 40 percent contingency amount, was prepared for the proposed concept. The proposed concept is estimated to cost \$434 Million, which includes approximately \$321 Million in construction cost, \$46 Million in right-of-way acquisition, and \$66 Million for design, environmental studies, project administration, and construction support.

The proposed project has only been designed at a very rough, conceptual level. Further design will be needed in order to increase the confidence in the project cost estimate, the construction schedule and the right-of-way needs. The next step in the design process would be to expand the design work to further explore the drainage/water table issues, better define the bridge, tunnel and retaining wall requirements, and further consider stage construction requirements. A more detailed plan line would serve to better identify required right-of-way and easement boundaries. An environmental analysis will be required, and alternatives evaluated, prior to completion of preliminary engineering. It is anticipated that the most significant risk factors in the project cost, schedule and viability may include the challenges of

Next steps in the project include further design and refinement of the cost estimate, an environmental analysis and identification of funding sources.



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removing an existing bridge over and constructing a new tunnel under an active freight and passenger railway, the high water table, potential contamination of the soil that would be excavated, relocation of existing utilities, construction staging areas, and traffic handling requirements during construction.

The proposed project was presented at a public meeting, stakeholder meetings, and to several advisory and decision-making bodies of the County of Santa Clara, City of Sunnyvale, and City of Santa Clara. Upon receiving support of the proposed project by the decision-making entities of each of the project partners, the proposed project will be incorporated into the Expressway Plan 2040 Study.

