Caltrain Corridor Crossings

Delivery Guide

August 2024

Caltrain

West Virginia Street, San Jose

Delivery Guide Roadmap

This Delivery Guide is aimed to accomplish the following:

- Provide a consolidated location of applicable design, construction, and operational standards for implementing a grade separation project.
- Clearly define the processes, procedures, practices, roles, and responsibilities of Caltrain and local partners needed to implement a grade separation or closure of an existing crossing.

What:

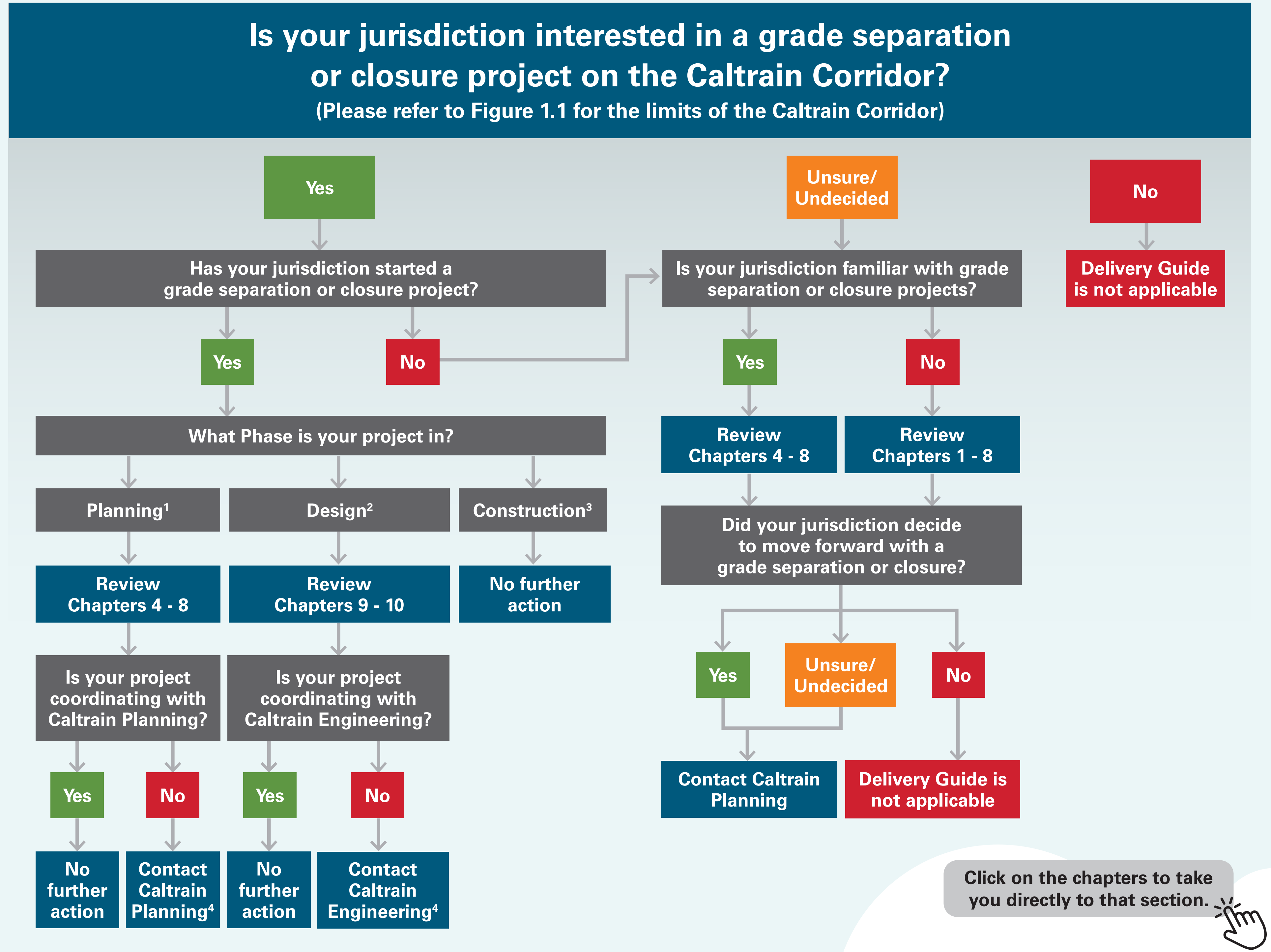
1. **Grade Separation:** where a railroad track and a vehicular roadway, pedestrian path, and/or bike path cross each other at different elevations.

2. **Crossing Closure:** where the intersection of a railroad track and a vehicular roadway, pedestrian path, and/or bike path is removed and closed.

Who:

Planners and engineers at jurisdictions and county transportation authorities along the Caltrain Corridor potentially or currently implementing a grade separation or crossing closure project. For the portion of the corridor owned by Union Pacific Railroad (UPRR), please refer to Figure 1.1 for UPRR limits, this guide provides general guidance for grade separation or closure projects on the UPRR corridor. However, please contact UPRR for projects on their portion of the corridor.

For safety improvements or other crossings related projects, refer to the Third Party Projects.



1. **Planning:** Project identification through conceptual design.
2. **Design:** Preliminary engineering through final design.
3. **Construction:** After completion of design and construction procurement. All funding, right-of-way, and applicable permits are secured.
4. **Caltrain Contact:** Railplanning@caltrain.com

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Dear Valued Corridor Partners:

I am pleased to present the Caltrain Corridor Crossings Delivery Guide. This Delivery Guide is dedicated to improving and delivering grade crossing projects along our corridor and is a testament to the collaborative spirit and vision we share for the future of the Caltrain rail corridor. Realizing this shared vision requires a more streamlined delivery approach that provides transparency and clear communication about the processes, standards, and roles and responsibilities necessary for delivering efficient and successful grade crossing projects for all corridor users.

As Executive Director of Caltrain, I am deeply grateful for the partnership and collaboration of all the partners who have played an instrumental role in shaping this guide. This Delivery Guide—which responds directly to corridor community feedback, combined with the electrification of the Caltrain corridor—is a pivotal step in what will be a transformative process to provide faster, more efficient, and sustainable rail service in the region.

During the year-long development of this Delivery Guide, the partnerships we have fostered with cities, counties, regional member agencies, and our dedicated Caltrain staff have established the groundwork for unprecedented change. Caltrain is appreciative of the participation and collaboration from the corridor partners. The time and feedback from the partners was invaluable in shaping this Delivery Guide. Together, we have embarked on a transformative journey to further modernize our rail corridor, continuing to transition it from its 19th-century beginnings while setting a new standard for 21st-century connectivity and safety.

With its focus on transforming the corridor's crossings, this Delivery Guide brings forth a multitude of benefits for our corridor communities. Not only will this work improve safety, mobility, active transportation, train operations, and seamless connections to local public transit options, but this work will further integrate reliable and efficient rail service within the communities that Caltrain serves. Moreover, the resulting decrease in vehicles idling at crossings will help improve air quality within the corridor.

For Caltrain, this Delivery Guide symbolizes more than infrastructure advancement. It represents Caltrain's unwavering commitment to being a community partner, prioritizing the health, safety, and quality of life of all community members along the Caltrain corridor.

In this transformative phase of our operations, our vision of providing a safe, reliable, and sustainable modern rail system that meets the growing mobility needs of the San Francisco Bay Area region guides all our work. We aim to provide enduring and significant benefits to the communities we serve.

Thank you for entrusting us with this pivotal mission and for your participation in this collaborative journey. This Corridor Crossings Delivery Guide is not just a blueprint for the future; it's a commitment to a safer, healthier, and more connected community for all. Our team is more than a reference; we're here as a collaborative partner. These projects require continuous communication for successful delivery. After reading this guide, give us a call.

Warm regards,

Michelle Bouchard
Executive Director, Caltrain
July 2024

Acronyms

- Accelerated Bridge Construction (ABC)
- Altamont Corridor Express (ACE)
- California Department of Transportation (Caltrans)
- California Environmental Quality Act (CEQA)
- California High-Speed Rail Authority (Authority)
- California Public Utilities Commission (CPUC)
- California State Transportation Agency (CalSTA)
- Capital Corridor Joint Powers Authority (CCJPA)
- Capital Improvement Plan (CIP)
- Capital Investments Grant (CIG)
- Categorical Exclusion (CE)
- Consolidated Rail Infrastructure and Safety Improvements Program (CRISI)
- Construction Manager/General Contractor (CM/GC)
- Corridor Identification and Development Program (Corridor ID)
- County Transportation Agencies (CTAs)
- Department of Transportation (DOT)
- Design-Bid-Build (DBB)
- Design-Build (DB)
- Design-Build-Operate-Maintain (DBOM)
- Disadvantaged Business Enterprise (DBE)
- Division of Local Assistance (DLA)
- Division of Rail and Mass Transit (DRMT)
- Electric Multiple Unit (EMU) Trains
- Emergency Notification System (ENS)
- Environmental Assessment (EA)
- Environmental Impact Report/Supplemental Environmental Impact Statement (EIR/SEIS)
- Federal Railroad Administration (FRA)
- Federal Transit Administration (FTA)
- High-Speed Rail (HSR)
- JPB Property Use Zones (PUZ)
- Letter of Interest (LOI)
- Locally Preferred Alternative (LPA)
- Manual of Uniform Traffic Control Devices (MUTCD)
- Metropolitan Transportation Commission (MTC)
- Multimodal Project Discretionary Grant (MPDG)
- National Association of City Transportation Officials (NACTO)
- National Environmental Policy Act (NEPA)
- National Infrastructure Project Assistance Grants Program (MEGA)
- Nationally Significant Multimodal Freight & Highway Projects Program (INFRA)
- New Austrian Tunneling Method (NATM)
- One Bay Area Grant (OBAG)
- Overhead Contact System (OCS)
- Peninsula Corridor Electrification Project (PCEP)
- Peninsula Corridor Joint Powers Board (JPB)
- Plans, Specifications, and Estimate (PS&E)
- Positive Train Control (PTC)
- Prefabricated Bridge Elements and Systems (PBES)
- Progressive Design-Build (PDB)
- Project Study Report (PSR)
- Public-Private Partnership (PPP)
- Public-Public Partnership (PuP)
- Railroad Corridor Use Policy (RCUP)
- Railroad Crossing Elimination (RCE)
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE)
- Request for Bid (RFB)
- Request for Proposal (RFP)
- Request for Qualifications (RFQ)
- ROW (ROW)
- San Francisco County Transportation Authority (SFCTA)
- San Mateo County Transit District (SamTrans)
- San Mateo County Transportation Authority (SMCTA)
- Santa Clara Valley Transportation Authority (VTA)
- Site-Specific Work Plan (SSWP)
- Southern Pacific Transportation Company (SPTC)
- Statement of Qualifications (SOQ)
- The Reconnecting Communities and Neighborhoods (RCN) Program
- Total Contract Price (TCP)
- Transit and Intercity Rail Capital Program (TIRCP)
- Transit Cooperative Research Program (TCRP)
- Tunnel Boring Machines (TBMs)
- Union Pacific Railroad (UPRR)

Mountain View Transit Center, Mountain View

Introduction

31st Avenue, San Mateo


308
STADLER

Introduction

Corridor Crossings Delivery Guide

The Caltrain corridor includes **43 at-grade crossings (41 at-grade vehicular and two at-grade pedestrian) between San Francisco and San Jose, with an additional 28 at-grade crossings on the Union Pacific Railroad-owned (UPRR) segment of the corridor between the Tamien and Gilroy stations (see Figure 0.1).**[1]

As Caltrain and other operators plan to increase rail service to help connect people to destinations throughout the region, Caltrain understands at-grade crossings present challenges to communities along the corridor. Increased rail service on the corridor entails trains passing more frequently through at-grade crossings, which impacts circulation, safety, and mobility in corridor communities.

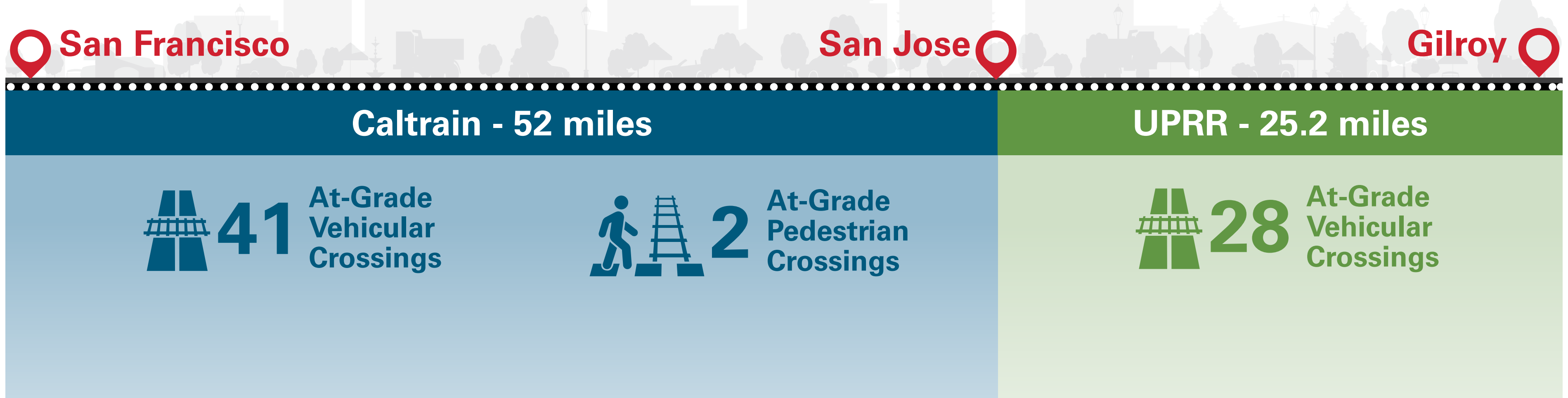
Crossing treatments such as grade separations and closures can help enhance safety, decrease traffic congestion, reduce emissions, improve train operations reliability, and address circulation challenges in corridor communities.

Crossing closures and grade separations improve safety by eliminating vehicular and active transportation conflicts with trains, and grade separations decrease congestion by eliminating the need for multimodal transportation users to wait for trains to pass, and potentially decrease idling vehicles. Overall, the reliability of rail operations improves due to reduced conflicts. Community connectivity is also enhanced from road users not being delayed while trains cross, allowing for smoother local travel.

Caltrain acknowledges that grade separation projects are costly, complex, and challenging and that corridor partners desire grade-separated crossings due to their safety and transportation benefits for local communities.

1. As of December 2023

Figure 0.1: Caltrain Corridor Overview



Development
of the Delivery Guide

The inception of the Caltrain Corridor Crossings Delivery Guide is in response to direct corridor partner feedback as part of the Caltrain Corridor Crossings Strategy (CCS). The CCS was identified as part of the Caltrain Business Plan to enhance the current grade separation process. The CCS is a stakeholder-engaged process to develop a shared vision and a corridor-wide, programmatic approach for implementing and delivering grade crossing improvements across the Caltrain corridor. Corridor partner interviews were conducted early in the development of the CCS and resulted in the corridor partners' desire for transparent and clear communication of the processes, roles, and responsibilities for delivering grade separation projects. The Delivery Guide is Caltrain's commitment to being a partner dedicated to improving the grade separation process.

Development of the Delivery Guide was completed in collaboration with the corridor partners. The draft version of the Delivery Guide was distributed to the corridor partners for review and feedback. Caltrain received over 500 comments and collaborated with each of the corridor partners to resolve and address the comments. The published Delivery Guide is a strong step toward collective delivery of crossing improvements by corridor partners and Caltrain.

Background

1 Corridor Overview


W. Evelyn
1000
900
RAIL ROAD
CROSSING
2
TRACKS

1 Corridor Overview

Caltrain Agency and Organization

Caltrain provides commuter rail service along the San Francisco Peninsula, through the South Bay to San Jose and Gilroy. The San Francisco and San Jose Railroad Company began passenger rail service on the Peninsula in 1863. The system we know today as Caltrain began in 1992, when the Peninsula Corridor Joint Powers Board (JPB) assumed operation of the rail line. The JPB has nine members, with three members each from San Francisco, San Mateo, and Santa Clara Counties.

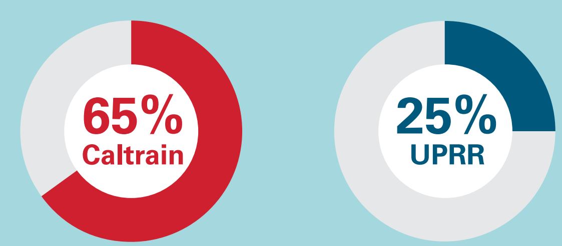
Caltrain Operations

Caltrain operates along a 77.2-mile corridor that extends from the 4th and King Street Station in San Francisco to the Gilroy Station. This corridor crosses 21 jurisdictions and three counties. Caltrain owns 52 miles of the corridor from San Francisco to central San Jose. There are multiple tenant operators along the Caltrain-owned corridor. South of milepost 52, the corridor ownership switches and UPRR owns the rest of the corridor from San Jose to Gilroy. In this portion of the corridor, Caltrain is a tenant operator to UPRR.

A significant portion of the rail corridor is grade-separated from vehicular and pedestrian traffic. **Today, 77 of 118 vehicular crossings along the Caltrain-owned corridor are separated (65%) and nine of 36 vehicular crossings along the UPRR-owned corridor utilized by Caltrain have been separated (25%).** A breakdown of the remaining at-grade crossings by county is provided in **Figure 1.1** and **Table 1.1** on the following page.

Figure 1.1:
Corridor Crossing Summary

Existing Grade Separated Vehicular Crossings:



Key Takeaways:

Established **1992**

Railroad Operational since 1864

77 *of* **118** } *Vehicular crossings in the Caltrain-owned segment of the corridor* **already grade-separated**

9 *of* **36** } *Vehicular crossings in the UPRR-owned segment of the corridor* **already grade-separated**

2020 Caltrain Business Plan
focused on future railroad benefits, impacts, and costs for the next 30 years

Passenger Rail service increases from **4 to 12 trains** *per direction during peak hours in the Adopted Service Vision*

31st Avenue, San Mateo

Table 1.1: At-Grade Crossings by County

County	Types of Crossings	Number of At-Grade Crossings*
San Francisco County	Vehicle Crossings	2
San Mateo County	Vehicle Crossings	29
	Pedestrian Crossings	2
Santa Clara County	Caltrain Corridor - Vehicle	10
	UPRR Corridor - Vehicle	27
	UPRR Corridor - Pedestrian	1
Total		43 (Caltrain Corridor) + 28 (UPRR Corridor)

Source: Caltrain Work Program-Legislative-Planning (WPLP) Committee Presentation on Caltrain Corridor Grade Crossings and Separations, 2/24/21.
**Totals do not include pedestrian crossings within station footprints*

Caltrain Business Planning

Between mid-2018 and mid-2020, Caltrain developed and completed the Caltrain Business Plan. The Business Plan addressed Caltrain's potential over the next 20 to 30 years and assessed the benefits, impacts, and costs of different service visions. This information was used to build the case for investment and develop a plan for implementation. The Business Plan process allowed agency partners and communities along the corridor to engage in developing a more certain, achievable, and financially feasible future for Caltrain based on local, regional, and statewide needs.

A main component of the Business Plan was Caltrain's Long Range Service Vision. The purpose of the Long Range Service Vision is to provide Caltrain with a framework that comprehensively guides the railroad's corridor management activities and long-range service planning. The Long Range Service Vision addresses two key aspects:

- Long-term demand for rail service in and beyond the Caltrain corridor
- Strategies Caltrain could use to meet this demand

To complete the Long Range Service Vision, Caltrain developed growth scenarios that included a range of options for how Caltrain service could expand, given different levels of investments in the corridor. Considerations for developing these growth scenarios included:

Service Differentiation
How can local, regional, and high-speed services be blended and balanced on the corridor to best serve multiple markets?

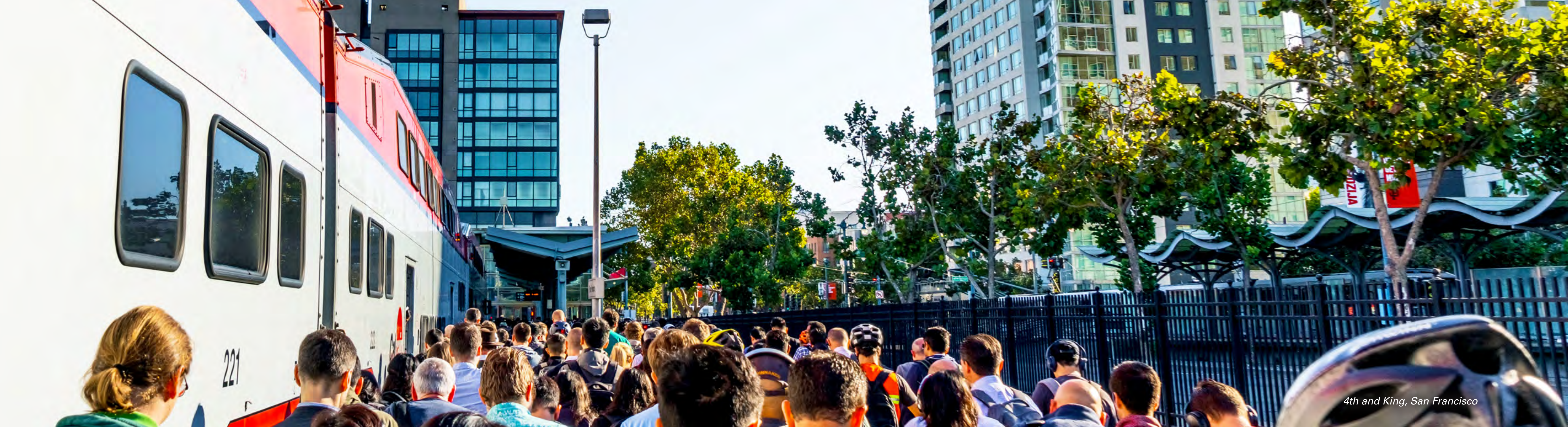
Peak Service Volume
How much growth in peak train traffic volume can the corridor support and what kind of service growth may be required to meet long term demand?

Corridor Investments
What types of investments in operations, systems, and infrastructure will be required to achieve the desired types and volumes of service?

Operations Investments
How can service coordination and expanded service increase to maximize the use of physical infrastructure?

Systems Investments
How can train performance, fleet expansion, train control, and signaling further improve?

Infrastructure Investments
Where else can Caltrain invest in track enhancement and expansion, station and terminal improvements, and grade crossing infrastructure?



4th and King, San Francisco

Through this process, Caltrain developed three distinct growth scenarios: **Baseline Growth**, **Moderate Growth**, and **High Growth.** These growth scenarios were developed with the understanding that detailed service and infrastructure planning would need to be flexible in response to changing key business metrics and the plans of other state and regional rail projects. This process recognizes that scale and location of **corridor infrastructure improvements** would be sensitive to state and regional rail plans, particularly in the High Growth Scenario, and that key business metrics may shift as fundamental assumptions change.

Service Vision Adoption

In 2019, as part of Caltrain's Business Plan development, the JPB adopted the Moderate Growth Scenario as the Adopted Service Vision to guide Caltrain's future growth. Figure 1.2 on the following page illustrates the Adopted Service Vision as outlined in Caltrain's Business Plan.

During business planning development, Caltrain determined that most future growth scenarios require "passing tracks" to be installed. Passing tracks allow for higher speed trains to pass lower speed trains. These speed differentials can come from differing stop frequency or travel speed. Additional physical tracks in the railroad corridor facilitate passing, which results in segments of the corridor that require four tracks. 4-track segments will also require the construction of 4-track train stations to facilitate transfers between the different train services and allow for static overtakes of lower speed trains. A 4-track configuration typically requires more width than the current trackway configuration. Depending on location, this additional width may or may not be accommodated by the existing Caltrain right-of-way (ROW). Per Caltrain Standards and identified in California Public Utilities Commission (CPUC) guidance, separation or closure of an at-grade crossing is required when the crossing spans four or more tracks. The length and frequency of 4-track segments is dependent on expected service levels for Caltrain and tenant railroads.

12 Trains

per Hour, per Direction in the Adopted Service Vision (8 Caltrain/4 High-Speed Rail)

Caltrain's 2040 Adopted Service Vision further directed the railroad to continue its consideration of a potential "higher" growth level of service in the context of major regional and state rail planning. Specifically, the 2040 Adopted Service Vision directed Caltrain to work with regional and state partners to study and evaluate both the feasibility and desirability of higher levels of service in the context of major regional and state rail initiatives, including planning related to the Dumbarton Rail Corridor, the Second Transbay Crossing, the potential for expanded Altamont Corridor Express (ACE) and Capitol Corridor services, and ongoing planning for the California High-Speed Rail (HSR) system.

The 2040 Adopted Service Vision further directed Caltrain to, where feasible, not preclude such higher levels of service as they specifically relate to:

- the planning of rail terminals and related facilities
- the sale or permanent encumbrance of Caltrain land
- the design of grade separations in areas where 4-track segments may be required
- the sizing of future maintenance facilities and storage yards

Castro Street, Mountain View

The service vision from the Caltrain Business Plan is shown in **Figure 1.2** and described below. Approximate limits for 4-track segments were identified for the Adopted Service Vision. Caltrain has completed a 4-Track Analysis to refine the limits of the 4-track segments; it is explained on the following page.

Adopted Service Vision

- Local and Express trains each operating at 15-minute frequencies with timed cross-platform transfer at Redwood City
- Skip stop pattern for some mid-Peninsula stations; some stations are not served by all Local trains
- Trains serve Capitol and Blossom Hill every 15 minutes and Morgan Hill and Gilroy every 30 minutes. This implementation is contingent on future corridor electrification in coordination with HSR and trackage rights negotiation with UPRR.

Service Type: HSR | Skip Stop | Express | Local

Service Level (Trains per Peak Hour): <1 | 1 | 2 | 3 | 4

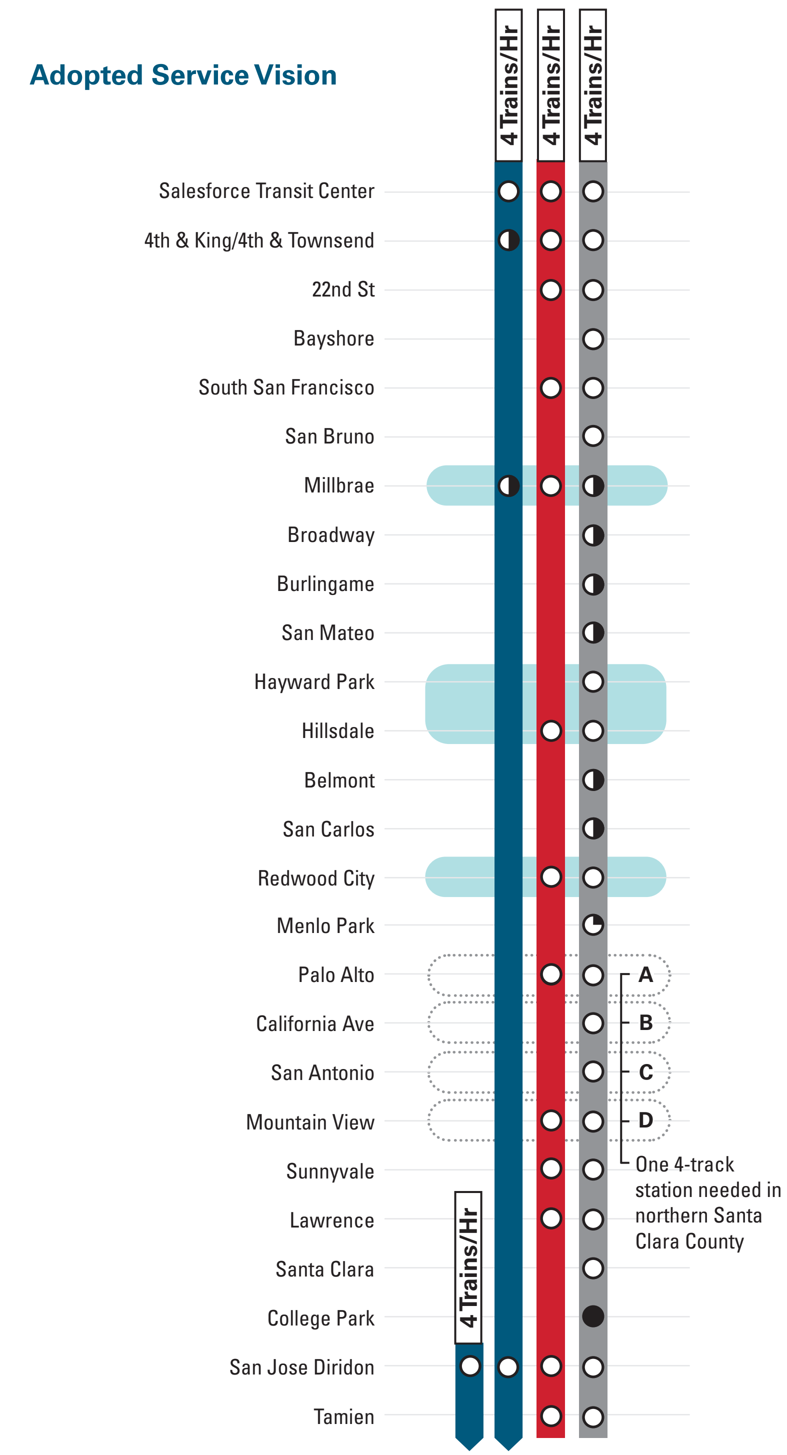
Conceptual new 4-Track Segment or Station to be refined through futher analysis and community engagement.

Trains per Hour, per Direction
Peak: 8 Caltrain + 4 HSR
Off-Peak: 6 Caltrain + 3 HSR

New Passing Tracks
Millbrae, Hayward Park-Hillsdale, Redwood City, Northern Santa Clara County, Blossom Hill

The adopted service vision was based on the HSR service plan that was available when Caltrain adopted their service vision.

Figure 1.2: Adopted Service Vision (Caltrain Business Plan)



4-Track Analysis

The 4-Track Analysis was a focused technical and planning level effort to:

- continue Caltrain's commitment to a future blended service developed in partnership with California High-Speed Rail Authority (CHSRA),
- continue the planning efforts called for in the 2040 Long Range Service Vision, and
- validate and refine the location and milepost limits of the identified 4-track segments from the Adopted Service Vision.

The 4-Track Analysis evaluated requirements among service operations, ROW availability, and engineering design parameters to consider where the opportunity for future 4-track infrastructure must be preserved. **Table 1.2** presents the length and mileposts for the refined 4-track segments for the Adopted Service Vision.

Table 1.2: Refined 4-Track Segments for the Adopted Service Vision

Segment[1]	Length[2] (miles)	North Milepost	South Milepost
Millbrae	1.6	12.9	14.5
Hayward Park-Hillsdale	3	18.2	21.2
Redwood City[3]	1.3	24.75	26.05
California Ave	1.9	30.9	32.85

1. Segment inclusive of station. 2. Length Includes transition from 2-track to 4-track. 3. Per Redwood City Grade Separation Study project summary report. Not further evaluated as part of the CCS 4-Track Analysis.

Adopted Service Vision Refined 4-Track Segments

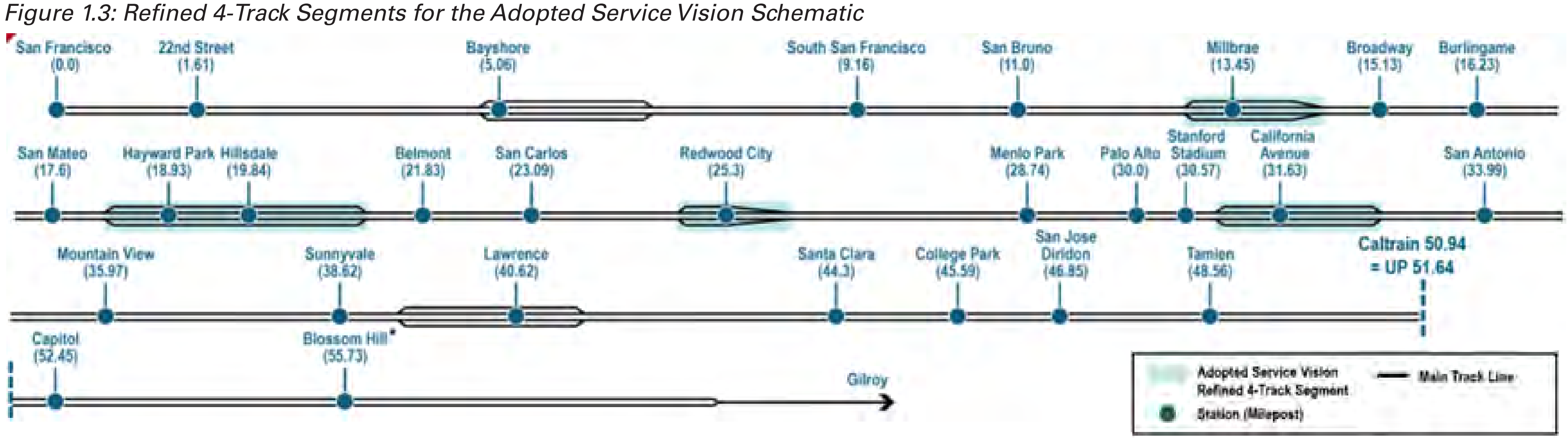
Millbrae, Hayward Park-Hillsdale, and Redwood City stations, and options in north Santa Clara County were identified as the 4-track segments for the Adopted Service Vision. Prior to the 4-Track Analysis, the 4-track segment identified at the Mountain View Station was removed from further consideration because it's located too far south to meet the needs of the Adopted Service Vision.. Four-track segments at Palo Alto, California Avenue, and San Antonio stations were analyzed to determine the optimal passing track location in north Santa Clara County.

Through an iterative process of service operation analysis, testing of 4-track layouts based on engineering criteria, review of horizontal alignments, and workshops with Caltrain and CHSRA, the 4-Track Analysis refined the 4-track segments at Millbrae, Hayward-Hillsdale, Redwood City, and north Santa Clara County with length and milepost limits. **Figure 1.3** presents a schematic of the Adopted Service Vision refined 4-track segments.

Flexibility in service operations, impacts to existing community assets and infrastructure, available right-of-way, and engineering criteria were reviewed to evaluate each option in north Santa Clara County. As a result of the analysis, California Avenue is the optimal north Santa Clara County 4-track segment to support the Adopted Service Vision.

The technical analyses validated and confirmed the passing track locations and lengths to enable the future blended service pattern for both Caltrain and CHSRA. The refined 4-track segments are located at stations to allow for passing trains and increased operational flexibility.

Figure 1.3: Refined 4-Track Segments for the Adopted Service Vision Schematic



Influence on Active Projects

Active projects along the corridor were identified and overlaid upon the Adopted Service Vision refined 4-track segments. **Table 1.3** shows the active projects located in or adjacent to the Adopted Service Vision refined 4-track segments.

Table 1.3: Active Crossing Projects Located In or Adjacent to Adopted Service Vision Refined 4-Track Segments

Adopted Service Vision Refined 4-Track Segment	Project Name	Crossing Street
Redwood City	Redwood City Grade Separation Study	• Whipple Ave[1] • Brewster Ave • Broadway • Maple St • Main St • Chestnut St
California Avenue	Connecting Palo Alto	• Churchill Ave • East Meadow Dr • Charleston Rd

1. Immediately adjacent to Adopted Service Vision refined 4-track segment.

The 4-Track Analysis applied the alternatives developed by Redwood City rather than developing a new concept for the Redwood City 4-track segment. Caltrain is coordinating with Redwood City to confirm the grade separations in this segment can support the future 4-track infrastructure.

The California Avenue 4-track segment overlaps with the City of Palo Alto's "Connecting Palo Alto" project. The Connecting Palo Alto project is in the planning phase as of June 2024, and there is not a locally preferred alternative selected. The crossings at Churchill Avenue and Meadow Drive are adjacent to the California Avenue 4-track segment and will likely require minor modifications to planning concepts to accommodate the transition between 2-tracks and 4-tracks. Caltrain is actively coordinating this effort.

Future crossing projects located within the Adopted Service Vision's 4-track limits must be designed to accommodate four tracks and/or the transition from 2-tracks to 4-tracks, although only two tracks may need to be constructed in the interim.

Corridor Operators

While Caltrain is the largest operator on its corridor, there are other operators that use or plan to use the Caltrain corridor. Some of these operators plan to increase service on the corridor. The other operators include the California High-Speed Rail Authority (Authority), UPRR, Amtrak, ACE, and Capital Corridor Joint Powers Authority (CCJPA). **Table 1.4** depicts the different operators' current and forecasted usage of the Caltrain corridor in the subsequent years.

The areas of operation, hours of peak operation, and average speed of trains vary between each operator. Details regarding the corridor operators usage are presented in the following sections and their operating ranges are shown in **Figure 1.4**.

Table 1.4: Operators on Caltrain Corridor

Operators	Current Peak Trains Per Hour Per Direction	Future Peak Trains Per Hour Per Direction [1]
Caltrain	4	8
HSR	0	4
UPRR[2]	0	0
Amtrak	1	1
ACE	1	2
CCJPA	1	2-3

1. As reflected in the 2040 Business Plan (Adopted Service Vision). 2. UPRR typically does not operate trains during the peak hours for passenger rail service

Key Operators Along the Corridor

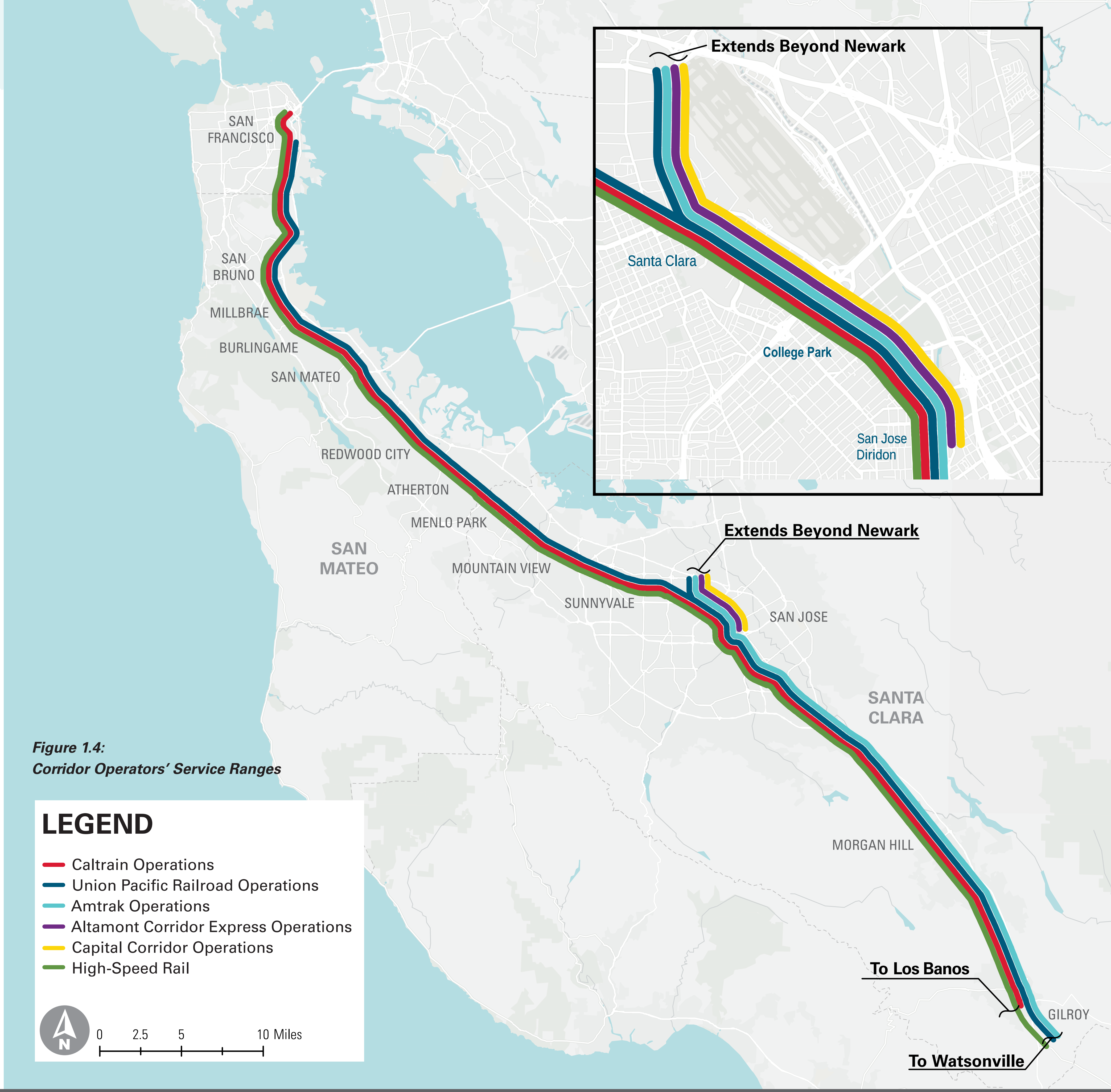


Figure 1.4: Corridor Operators' Service Ranges

California High-Speed Rail Authority (Authority)

CALIFORNIA High-Speed Rail Authority

HSR will connect San Francisco and Los Angeles in under three hours. In the Caltrain corridor, HSR trains will travel at speeds of up to 110mph. While HSR plans to build new railroad infrastructure for multiple parts of its alignment, it is required by state law to utilize the existing Caltrain corridor and operate in a "blended service" pattern with Caltrain on the San Francisco Peninsula. To accomplish this blended service model on the existing rail corridor, HSR is investing in necessary infrastructure improvements including corridor-wide electrification, station modifications, and speed and safety upgrades.

As part of developing a Blended System Approach for both Caltrain and HSR service, Caltrain made commitments to HSR with respect to future corridor planning. These commitments include the following sentiments:

- *"Caltrain shall take no action that Caltrain knows, or reasonably should have known at the time of action, that would effectively preclude improvements or make improvements materially more complicated or expensive for HSR implementation."*
- *"Caltrain agrees that it will not take action—whether with respect to Caltrain's design and construction of the Peninsula Corridor Electrification Project, operation of the Peninsula Rail Corridor, real property ownership or control in the Peninsula Rail Corridor, or otherwise—that Caltrain knows or reasonably should have known at the time of the action would effectively preclude or make materially more complicated or expensive CAHSR's future operation in the Peninsula Rail Corridor."*

4 HSR Trains
per direction, per hour on Caltrain corridor

- **Salesforce Transit Center***
- **4th and King/ Townsend in San Francisco**
- **Millbrae**
- **San Jose Diridon**
- **Gilroy**

** Requires completion of Dowtown Extension Project (Portal)*

Photo courtesy of the California High-Speed Rail Authority

Union Pacific Railroad (UPRR)

UPRR is a freight rail service that operates throughout the western United States. Through a number of legal agreements—most notably the Trackage Rights Agreement (TRA) from 1992—ownership, rights, and responsibility for the Caltrain corridor were divided between UPRR and Caltrain. UPRR has operator rights to operate freight on the mainline along the full corridor. Through these agreements, UPRR also owns the rights to intercity passenger rail, which they lease to Amtrak. More details on Amtrak's operations are provided in this chapter.

UPRR owns the portion of track south of Tamien Station to Gilroy Station. Additionally, UPRR owns a mainline track in JPB's ROW from the Diridon Station to the Santa Clara Station. These locations, as well as locations of UPRR spurs, setouts, and pocket tracks, are presented in **Figure 1.5**. These areas of UPRR asset ownership are important for future projects because they are subject to UPRR design standards and design processes. Note that while Caltrain and UPRR share ownership of assets from the Diridon Station to the Santa Clara Station, that segment of the rail corridor is fully grade-separated.

Similar to HSR, Caltrain has contractual commitments for maintaining UPRR freight service. These are generally derived from Caltrain's purchase of the corridor from Southern Pacific Transportation Company (SPTC) in December 1991. This agreement is called "Trackage Rights Agreement – Peninsula Main Line and Santa Clara/Lick Line." This agreement stipulates that Caltrain is required to maintain the ROW at levels necessary to accommodate UPRR's present and future operations and allow UPRR to maintain competitive service levels (TRA Peninsula Mainline 9.3). The UPRR Trackage Rights do not stipulate allowable construction methods, but they require that maintenance and construction not be scheduled to unreasonably impact UPRR's operational rights (TRA Peninsula Mainline 9.4). Since this original agreement, there have been additional agreements made between Caltrain and UPRR. These agreements pertain to functional changes to the corridor, such as the introduction of new train control systems and the electrification of the Caltrain-owned corridor.

Figure 1.5: Union Pacific Railroad Map

Amtrak

South of Santa Clara, Amtrak provides intercity rail service along the Caltrain corridor through its agreements with UPRR. Amtrak does not have ownership rights or responsibilities and functions solely as a corridor operator. Amtrak has a single route, the Coast Starlight, which passes through the Santa Clara Station, stops at the Diridon Station, and continues on the Caltrain/UPRR corridor through Gilroy to its next stop in Salinas. **There are no at-grade crossings between the Santa Clara and Diridon Stations, but Amtrak operates across the southernmost at-grade crossings in the Caltrain corridor (Auzerais Avenue and W. Virginia Street) and the remaining at-grade crossings in the UPRR-owned segment of the corridor.** Amtrak's current operation frequency is once per day per direction, a southbound departure in the morning and a northbound departure in the evening, and future service expansions are not yet defined.

Altamont Corridor Express (ACE)

ACE is an intercity commuter rail service that runs from San Jose to Stockton along an 86-mile route with 10 stops. It does not have ownership rights or responsibilities, and functions solely as a corridor operator. Eastbound ACE trains start at the San Jose Diridon Station, continue to the Santa Clara Station, and then depart the Caltrain corridor. Westbound ACE trains join the Caltrain corridor east of the Santa Clara Station and terminate at the San Jose Diridon Station. **As noted previously, the track in this segment of the corridor is fully grade-separated at crossings.** Service consists of four westbound trains in the morning at roughly hourly frequencies from Stockton, and four eastbound trains in the late afternoon at roughly hourly frequencies from San Jose. In the near term, ACE plans to add another trip in both directions; service is slated to further increase in the future. It also has long-term plans to increase ridership by increasing service to every 15-30 minutes during the peak periods.

Capitol Corridor Joint Powers Authority (CCJPA)

The CCJPA operates intercity rail and bus services from north of Sacramento to San Jose. CCJPA does not have ownership rights or responsibilities and functions solely as a corridor operator. Eastbound CCJPA trains start at the San Jose Diridon Station, continue to the Santa Clara Station, and then depart the Caltrain corridor. Westbound CCJPA trains join the Caltrain corridor east of the Santa Clara Station and terminate at the San Jose Diridon Station. As noted previously, the track in this segment of the corridor is fully grade-separated at crossings. Service consists of six trains per day, throughout the day, in each direction, with a vision to increase the number of daily trains in the long-term.

Diridon Station, San Jose

2 Regulatory Environment

Mountain View Transit Center, Mountain View


31st Avenue, San Mateo

Key Takeaways:

Local, state, and federal partners *impact railroad crossings to the extent that they impose a series of intersecting regulations that dictate work products.*

County transportation authorities' funding *often plays a key role in a grade separation project's total funding plan, as it can provide the local match to leverage larger federal disbursements.*

2 Regulatory Environment

Federal and Statewide

Federal Railroad Administration (FRA)

FRA is a federal regulatory body dedicated to rail operations for movement of people and goods. FRA manages both freight and passenger rail, including safety through implementation of legislative, non-legislative, and management rules. They also maintain a national rail crossing inventory database.

FRA's rules are developed both for freight and passenger rail and provide direction on many aspects of the railroad environment, including structures and operating systems.

The requirements that govern freight rail design and operations are derived from FRA rules.

FRA also serves as a funding partner for rail crossing projects. There are several funding programs administered by FRA for rail crossing projects. The most notable are the Railroad Crossing Elimination Grant Program and Consolidated Rail Infrastructure and Safety Improvements Program (CRISI). Obtaining FRA funding involves a thorough and collaborative process between local and federal agencies. Of note, most federal funding through FRA requires a minimum 20% local funding match, which can be provided through local, regional, state, and private partners. Projects receiving FRA funding are required to fulfill the requirements of the FRA. Where federal funds, either FRA or FTA, may be used for the project, Caltrain prepares the necessary National Environmental Policy Act (NEPA) documentation with the appropriate federal lead agency. Caltrain recommends completing NEPA documentation to not preclude the use of federal funds in the future.

California Public Utilities Commission (CPUC)

The CPUC is a State of California Governor-appointed commission that regulates utility and transportation services. CPUC has regulatory authority of rail crossings, railroad safety, and rail transit safety through their Rail Safety Division. The Rail Safety Division produces annual and monthly reports on rail safety metrics, including collisions and investigations, prepares General Orders to inform design decisions, and approves construction and modifications to rail crossings.

CPUC grants authority for rail crossing construction through its Formal Application and General Order 88-B (GO 88) processes. The Formal Application is required for constructing a new public rail crossing. The GO 88 process is utilized for modifying an existing public rail crossing. Modifying an existing public rail crossing includes widening a crossing, changing warning and safety devices, or constructing a grade separation or closure that eliminates an at-grade crossing. A copy of the GO 88 Request Form is included in **Appendix 1**.

CPUC also provides funding for rail safety improvements through their Section 130 and Section 190 programs. CPUC maintains a priority funding list for projects in these programs. To be eligible for Section 130 and Section 190 funding, an application must be submitted to CPUC so the crossing can be evaluated. For additional information on these programs, see **Chapter 6, Funding and Grant Programs.**

California Department of Transportation (Caltrans)

Caltrans manages highways and freeways, intercity rail services, and airport and heliport permits for the State of California. Their goal is to ensure a reliable transportation network throughout the state, which is achieved by planning, state of good repair, and other efforts. Caltrans divides the state into 12 districts. The nine Bay Area counties and the Caltrain corridor are located in District 4.

The district staff are dedicated to managing the transportation elements on a regional level. District 4 functions involved in grade separations include the offices of Regional and Community Planning, and Transit and Active Transportation.

At the statewide level, Caltrans has a Division of Rail and Mass Transportation and a Division of Local Assistance (DLA). Through these divisions, Caltrans administers the disbursement of certain State and Federal funding to project sponsors.

Caltrans owns and manages highways and freeways adjacent to the Caltrain corridor, including portions of El Camino Real. The level of Caltrans involvement in projects is related to the type of work and impact on Caltrans facilities. For minor alterations, a project will need an Encroachment Permit to construct improvements on Caltrans facilities or within Caltrans ROW. For major road or freeway realignment, a full-cycle Caltrans design project delivery may be required as outlined in Caltrans' Project Development Procedures Manual.

California State Transportation Agency (CalSTA)

CalSTA develops and coordinates policies and programs to support transportation throughout the state. Many California transportation entities exist under CalSTA, including the Department of Transportation (Caltrans) and the Authority.

CalSTA may serve as a direct funding partner for rail crossing projects, as they distribute funds set aside by the California Legislature. This funding is distributed through the Transit and Intercity Rail Capital Program (TIRCP), which CalSTA operates to support efforts that reduce emissions, expand and integrate transit, and improve transit safety.

West Virginia Street, San Jose

Local Governance

County Transportation Authorities

County transportation authorities often manage many forms of transportation in their counties including public transportation, roadways, and active transportation. These authorities produce area transportation plans and typically manage county funding for transportation projects, as well as provide oversight of the projects they fund. Area transportation plans may indicate a need for projects, like grade separations, to improve transportation. As a county authority, they can implement legislative measures to generate revenue to fund capital improvement projects. Their funding often plays a key role in a project's total funding plan, as it can provide the local match to leverage larger state and federal disbursements. This role is discussed further in **Chapter 6, Funding and Grant Programs** of this Delivery Guide.

There are three counties along the Caltrain corridor: San Francisco, San Mateo, and Santa Clara Counties. These counties have a respective, corresponding transportation authority: San Francisco County Transportation Authority (SFCTA), San Mateo County Transportation Authority (SMCTA), and Santa Clara Valley Transportation Authority (VTA). The JPB consists of three representatives from each of the three counties.

Jurisdictions

The Caltrain corridor has 21 jurisdictions along its alignment. A jurisdiction is often the lead project sponsor for a grade separation in the Caltrain corridor. The role of a jurisdiction as a lead project sponsor includes selection of a locally preferred alternative, developing a funding plan, public outreach, and several additional responsibilities. The project sponsor will often provide a local funding match required for federal funding. The role of the jurisdiction as project sponsor is discussed in **Chapter 5, Grade Separation Implementation Process** of this Delivery Guide.

3 At-Grade Rail Crossings

Castro Street, Mountain View

3 At-Grade Rail Crossings

Background

Both Caltrain and UPRR have standards associated with safety for at-grade crossings. This chapter will primarily focus on At-Grade Rail crossings within the Caltrain Corridor.

Caltrain promotes at-grade crossing safety improvements through its Hazard Analysis process. This Hazard Analysis is a comprehensive, full-corridor review and is performed every three to four years. This analysis allows Caltrain to quantify crossing hazards and prioritize mitigation measures to improve crossing safety. The most recent Hazard Analysis was completed in 2021, and consists of the following methodologies:

- Review collision data and traffic volume
- Determine hazard scenarios
  - » Vehicles stopped on tracks
  - » Vehicles turning onto tracks
  - » Vehicles maneuvering around down gates
  - » Pedestrian intrusion into track
- Determine potential cause of hazard
- Determine probability of hazard scenario
- Determine severity of hazard scenario
- Recommend cost effective safety improvements to mitigate hazard
- Program improvements for implementation

13 at-grade crossings improved between 2016-2019

Through this process, Caltrain improved eight at-grade crossings in 2016 and five at-grade crossings in 2019. Additionally, there is a group of four at-grade crossing improvements in construction, and a group of five projects in active design. These crossing improvements vary in scope, from roadway restriping to the installation of new crossing gates and the creation of new sidewalks. Through this continued coordination with and investment from local jurisdictions, Caltrain has made incremental and important improvements to increase overall safety of the corridor.

Types of Crossings

At-grade crossings are classified by the underlying property owner and the types of warning devices at the crossing. In general, most of the at-grade crossings in the Caltrain corridor are public facilities and are permanent in nature.

Public Crossings

Public grade crossings exist along public roadways or pathways. The crossing will be operated and maintained by a local, state, or federal agency. Within the Caltrain-owned portion of the corridor, Caltrain is responsible for operating and maintaining equipment.

Private Crossings

Private grade crossings exist on private accessways, such as private driveways or access points to businesses or residences. While uncommon along the Caltrain corridor, private crossings are present along the UPRR-owned portion of the corridor in southern Santa Clara County.

Private crossings typically do not incur the same level of use as public crossings. Because they exist on private property, these crossings are not maintained by public agencies, but rather by private entities.

Private crossings are typically identified by a displayed Private Crossing Sign. The approved Private Crossing Sign per CPUC is displayed in **Figure 3.1**.

Temporary Crossings

Temporary grade crossings are non-permanent crossings, usually applied as part of a construction staging process. If a temporary grade crossing operates for over six months, it is required to have a Department of Transportation (DOT) number assigned to it by the FRA, and the emergency notification system (ENS) sign required at permanent grade crossings is necessary. Temporary grade crossings must also meet the same safety criteria that govern permanent grade crossings.

At-grade crossings also may be classified by the presence of passive or active warning devices. In general, most of the at-grade crossings in the Caltrain corridor are active crossings.

Active Crossings

Active crossings are supplied with electrical power. The crossings have warning devices that activate as a train is approaching to warn motorists, pedestrians, and cyclists. These crossings may be equipped with flashing lights, automatic gates, bells, wayside horns, or other train-activated warning systems. Active crossings must have a crossbuck sign displayed at the crossing; these signs should be mounted on a mast with flashing light pairs. **Most at-grade crossings in the Caltrain Corridor are active crossings.** A more detailed description of the types of active warning devices is provided later in this Chapter.

Passive Crossings

Passive crossings are commonly applied in rural areas, areas without electrical power, or on low-traffic segments of track. These crossings may have warning signage and pavement striping in advance of the crossing, as well as warning signage at the crossing. However, these crossings do not have flashing lights, bells, automatic gates, or other train-activated warning systems. **Some of the at-grade crossings in the UPRR corridor are passive crossings.** These crossings should be equipped with a Standard 1 series device. A Standard 1-R assembly is shown in **Figure 3.2**, which is a crossbuck sign (R15-1) mounted on a post. If the assembly has a stop sign (R1-1) mounted below the crossbuck sign, it is a Standard 1-S. If the assembly has a yield (R1-2) sign mounted below the crossbuck, it is a Standard 1-Y.

Figure 3.1: CPUC Private Crossing Sign

Figure 3.2: Standard 1-R Assembly

Most of the at-grade crossings in the Caltrain corridor are public and permanent facilities.

Figure 3.3: At-Grade Crossing SE Quadrant

Ravenswood Ave, Menlo Park, CA

This figure provides an example of an existing at-grade crossing that is discussed in the next section.

1. "Do Not Stop on Tracks" Sign (Type R8-8)
2. Median vehicular gate arm assembly (CPUC Standard 9A)
3. Cantilever assembly with flashing light pairs (CPUC Standard 9A)
4. Vehicular gate arm assembly (CPUC Standard 9A)
5. Pedestrian emergency egress gate
6. Pedestrian channelizing barriers
7. Pedestrian gate arm assembly with flashing light pairs (CPUC Standard 9D)

Figure 3.4: At-Grade Crossing NW Quadrant

Ravenswood Ave, Menlo Park, CA

This figure provides an example of an existing at-grade crossing that is discussed in the next section.

1. Pedestrian channelizing barriers
2. Median vehicular gate arm assembly (CPUC Standard 9A)
3. Cantilever assembly with flashing light pairs (CPUC Standard 9A)
4. Vehicular gate arm assembly (CPUC Standard 9A)
5. Pedestrian emergency egress gate
6. Pedestrian gate arm assembly with flashing light pairs (CPUC Standard 9D)

Figure 3.5: At-Grade Crossing NE Quadrant

Ravenswood Ave, Menlo Park, CA

This figure provides an example of an existing at-grade crossing that is discussed in the next section.

1. Median vehicular gate arm assembly (CPUC Standard 9A)
2. Cantilever and vehicular gate arm assembly on separate masts (CPUC Standard 9A)
3. Pedestrian emergency egress gate
4. Pedestrian gate arm assembly with flashing light pairs (CPUC Standard 9D)
5. Pedestrian channelizing barriers
6. Tactile warning surface
7. Pedestrian gate arm assembly with flashing light pairs (CPUC Standard 9D)

Components of At-Grade Crossings

The infrastructure for an at-grade crossing can extend hundreds of feet in advance of the actual crossing. This infrastructure includes the crossing surface, warning devices and gates, roadway signage, and pavement striping. The infrastructure may also include medians, lighting, and traffic signals. This infrastructure is shown in **Figures 3.3, 3.4** and **3.5**.

Crossing Surface

The crossing surface is the area directly adjacent to the railroad tracks. Most commonly, the crossing surface is comprised of asphalt or concrete. Concrete panels can be constructed via a cast-in-place or precast method.

Along the Caltrain corridor, precast concrete crossing panels are the most typical crossing surface. Concrete panels have standard dimensions, with widths of 8’-6”, 9’-0”, or 10’-0”, and lengths of 8’-1.5”, 9’-0”, or 10’-0”, respectively. With concrete crossing surfaces, there should be a 2’ strip of asphalt pavement placed around all four sides of the crossing panels, including the area on the train approach to the crossing.

Active Warning Devices and Gates

Active warning devices have an electrical power source and provide an actuated response to a train approaching the crossing. CPUC has standard naming conventions for each device type, which are referenced in this section. FRA and the Manual of Uniform Traffic Control Devices (MUTCD) also provide standards and guidance for warning devices. However, these sources classify devices by their gate count, cantilever count, and flashing light pairs.

Vehicular

The CPUC Standard 8 series, shown in **Figure 3.6**, of warning devices includes flashing light pairs but does not include gate arms. The Standard 8 series is generally not utilized on the Caltrain corridor due to the lack of gate arms. Without gate arms, there is no physical barrier to prevent vehicles and pedestrians from entering the trackway.

The CPUC Standard 9, shown in **Figure 3.7**, series of devices includes flashing light pairs and automatic gates. A Standard 9 consists of a gate arm on a mast with flashing light pairs. A Standard 9A includes a cantilevered structure. If the gate arm is on the same mast as the cantilever, it is considered a Standard 9A Combined. A gate arm on a separate mast than the cantilever is considered a Standard 9A Separate.

Figure 3.6: CPUC Standard 8

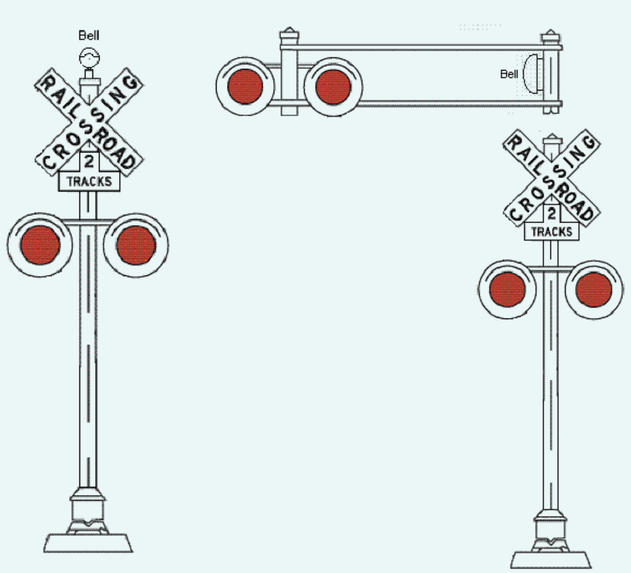
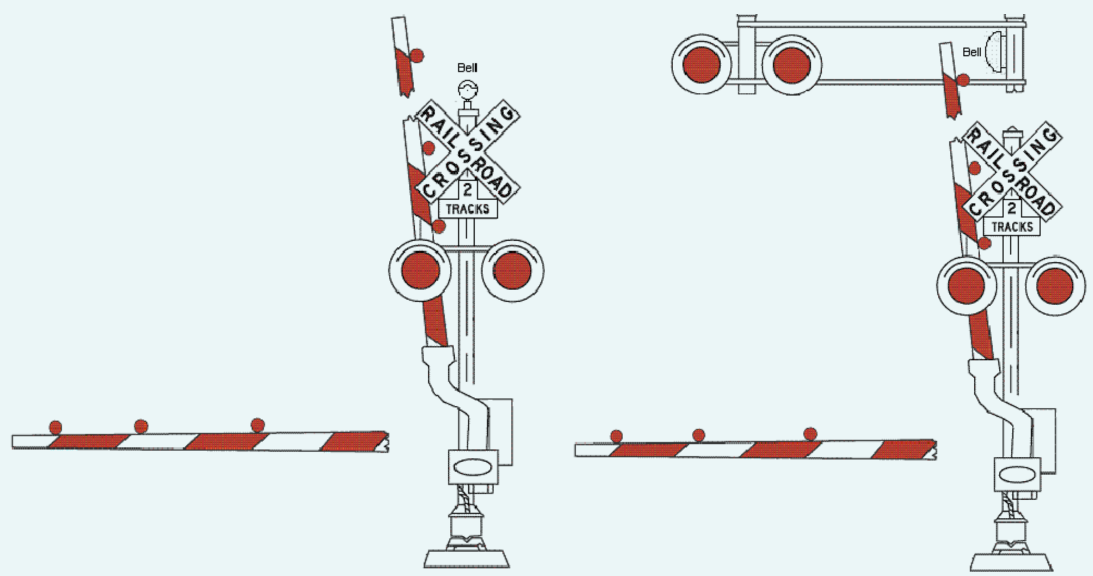


Figure 3.7: CPUC Standard 9



A Standard 9E is an exit gate, which is placed on the far side of a vehicle crossing to prevent vehicles from driving on the wrong side of the road to traverse the crossing.

The Standard 8A and 9A devices are cantilevered structures. These are often provided for visibility purposes on multi-lane roadways without median-mounted gates. The cantilever supports overhead flashing light pairs to increase visibility for drivers not in the rightmost lane. The Standard 9A structure also has a gate arm either on the same post or on a separate post.

Exit Gates (Four-Quadrant Gates)

A typical gate configuration is installing gates on the approach quadrants of a crossing (two-quadrant solution). A more robust solution involves also installing exit gates on the departures for a crossing (four-quadrant solution). Exit gates aim to prevent a roadway user from taking an “S-curve” around active gates while a train is approaching. Exit gates are often installed with medians on both sides of the crossing to further deter this movement. An example of exit gate installation is the Fair Oaks Lane crossing in Atherton.

Pedestrian

A Standard 9D is a warning device for pedestrians, which resembles Standard 8 or Standard 9 devices, although the size of a Standard 9D may differ. The defining characteristic of a Standard 9D device is that they are intended specifically for pedestrians, and they warn users located on a sidewalk or pathway.

Pedestrian Emergency Egress Gates

Pedestrian emergency egress gates are commonly located adjacent to an automatic pedestrian gate. Pedestrian emergency egress gates are intended only for use during emergency exits. Pedestrian emergency egress gates may be utilized for a pedestrian to exit the trackway if the automatic pedestrian gates are down during a train crossing event. If a pedestrian is within the limits of the automatic gates as they move into the down position during a train event, the pedestrian emergency egress gates allow a pedestrian to exit.

Other Crossing Components

In addition to the crossing surfaces and active warning devices, at-grade crossings often have these additional components:

Tactile Warning Surface

Tactile warning surfaces should be placed slightly ahead of the pedestrian devices to warn persons with visual impairments that they are approaching the crossing. Per California Building Code, the tactile warning surface on the approach to railroad tracks should be 3' in width. The tactile warning surface along the Caltrain corridor typically spans the full width of the sidewalk.

Medians

Medians are used as channelization measures for vehicles approaching a crossing. The primary use of medians is to prevent vehicles from driving on the opposite side of the roadway to cross the tracks or bypass traffic or a downed gate arm. Typically, a median must be 6" in height. A traversable (i.e., mountable) median can be installed to allow emergency vehicle access through a crossing.

Traffic Signals

A railroad crossing near a signalized intersection may be interconnected with adjacent traffic signals. The proximity of the closest adjacent signalized intersection and the railroad crossing is the primary factor in determining the need for traffic signal interconnect. Traffic signals within 200 feet of a railroad crossing should be interconnected per CA MUTCD 8C.09.

Vehicular queues extending up to and across the railroad tracks is the other primary factor for traffic signal interconnect. In this situation it is common to include other strategies such as a pre-signal or a queue cutter traffic signal to manage the vehicular queuing under normal operations, and railroad preemption to stop traffic approaching the tracks when a train is approaching.

A pre-signal is a nearside traffic signal indication (upstream of the tracks) with the purpose of preventing approaching vehicles from queuing onto the tracks during normal and railroad preemption operations. A pre-signal is part of the traffic signal that is interconnected with the railroad crossing.

A queue cutter traffic signal is a traffic signal that controls vehicular, bicycle or pedestrian traffic at a railroad crossing when the closest traffic signal to the railroad crossing is too far away to be interconnected. A queue cutter will prevent approaching vehicles upstream of the tracks from proceeding onto the tracks when the queues downstream of the tracks are such that the approaching vehicles may be obstructed by those queues and not clear the tracks. A queue cutter traffic signal is interconnected with the railroad crossing.

When a traffic signal and railroad crossing are interconnected, there are several stages of railroad preemption that may be implemented, per CA MUTCD 4D.27. These include:

- The traffic signal will be placed into all-red when a train is approaching.
- The traffic signal will be placed into flashing all-red when a train is approaching.
- The traffic signal will operate under Limited Service where vehicular, bicycle or pedestrian movements that do not conflict with train movements are allowed to be served while all other conflicting movements will remain in red.

Railroad Signal Cabinets

Hardware for railroad signals or actuated devices is housed in a central location. A railroad signal cabinet, signal bungalow, or signal house is a structure containing the wiring and controls that allow railroad staff to upgrade and maintain activated systems. Often these cabinets have a small light on the exterior to confirm power is being supplied to the crossing.

Signage and Pavement Markings

All railroad crossings are required to be equipped with signage and pavement markings. The RXR sign (W10-1) and RXR pavement markings are required on direct approaches to a railroad crossing, placed at a specified distance based on the roadway speed limit. In California, when a railroad crossing has multiple tracks, the W48(CA) sign must be placed in combination with the W10-1 sign.

Crossings must possess a limit line pavement marking, placed upstream of the warning devices so an approaching vehicle is informed of a clear location to stop.

For crossings with queueing issues, the placement of R8-8 signage ("DO NOT STOP ON TRACKS") can be used to deter vehicles from stopping on the tracks. The R8-8 sign can be placed either upstream or downstream of the crossing, but the sign should be located so an approaching vehicle can easily see the sign.

Many Caltrain grade crossings have "KEEP CLEAR" pavement markings over the tracks and along a portion of a dynamic envelope (i.e., an area near railroad crossings designed to keep motorists out of the danger zone) on the approaches. These pavement markings are an additional measure to mitigate queueing on the tracks but are not federally required for an at-grade crossing.

At a railroad crossing, warning devices are required to be equipped with an I-13 sign, typically referred to as the Emergency Notification System (ENS) sign. This sign is a blue plaque that must be affixed to the warning devices on the approach to the crossing, containing the name of the railroad with maintenance jurisdiction or ownership, the emergency phone number for that railroad, and the federally assigned DOT number of the crossing.

Site Specific Considerations

When considering improvements to an at-grade crossing, the following elements should be considered:

Visibility

The geometry of both the roadway and the railroad tracks plays a role in the safety of the crossing. If approach angles are not 90 degrees, visibility for vehicles, pedestrians, and cyclists to spot oncoming trains can be reduced.

Trees or other landscaping can reduce visibility if not maintained properly. Landscape overgrowth can also obstruct flashing light pairs, sight distances along the tracks, or nearby street lighting.

Roadway illumination is another aspect of railroad crossings that can impact visibility. Proper illumination at a railroad crossing helps alleviate a hazard associated with vehicles mistaking the tracks for a roadway and turning onto them.

Driveways and Intersections

Nearby driveways or roadway intersections can increase hazards for at-grade crossings. A common issue with driveways and intersections near an at-grade crossing involves increased queueing onto the tracks. For example, a vehicle approaching the crossing from a closely spaced driveway may block traffic such that vehicles cannot clear the tracks.

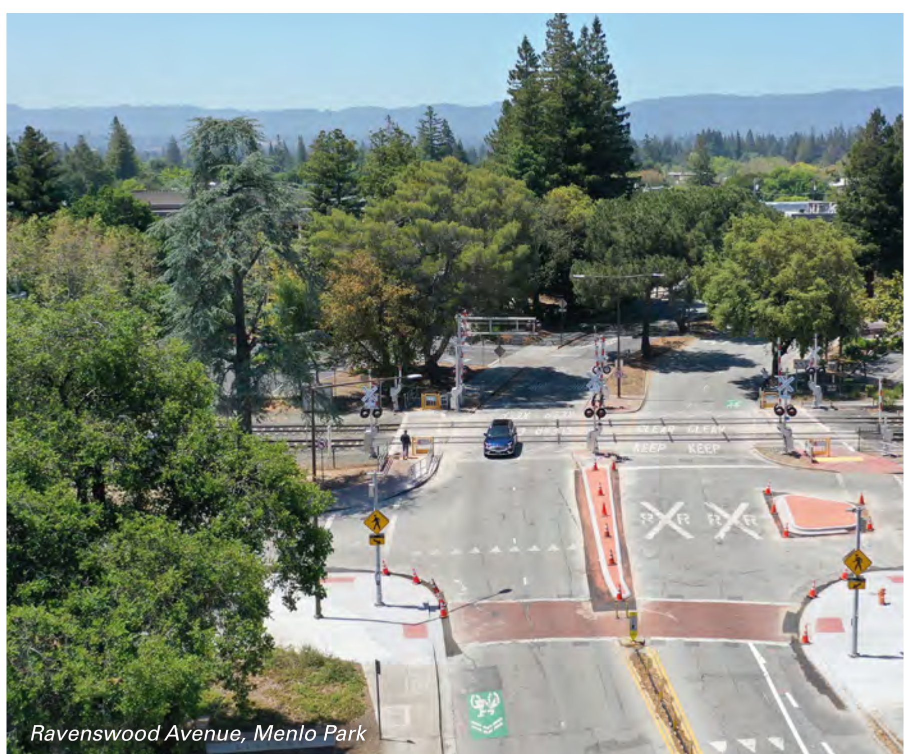
Another implication of driveways and intersecting roadways is reduced sight distance. Driveways or intersections should not be positioned closer than 60-100' from a crossing in order to maintain proper line of sight on the approach to a crossing.

Crossing Use Level

The use-level (i.e., volume) of a crossing can play a role in its safety. Crossings with less vehicular or pedestrian traffic have lower exposure to hazards in comparison to crossings with more vehicular or pedestrian traffic. Queues extending onto the tracks become a larger safety concern with increased traffic volumes at the crossing. The time of day with higher crossing volumes may also skew heavily toward typical commute times, which can increase queueing onto and beyond the tracks.

Transit

Buses and other forms of transit run on fixed schedules and must move from stop-to-stop on time. Many forms of transit are required to stop before proceeding across at-grade crossings, which can increase vehicular queues around the tracks. In some locations, a transit stop may be placed close to the crossing, which may also generate queueing.


Ravenswood Avenue, Menlo Park

Bicycles

Cyclists require special considerations at grade crossings. Bicycle tires are much narrower than vehicular tires and have the potential to get stuck in the track channel at shallow crossing angles. Per National Association of City Transportation Officials (NACTO) guidance, the acceptable crossing angle for a bicycle is between 60-90 degrees, with 90 degrees being preferred. If this angle cannot be provided by the existing roadway conditions, additional asphalt width, signage, and pavement markings should be placed at the crossing to provide a better crossing angle for bicyclists.

Pedestrians

Pedestrians are other users of at-grade crossings who require considerations beyond the standards for vehicular warning. Along with specialized activated warning devices like the CPUC Standard 9D and the installation of detectable warning surface, Caltrain also employs the use of pedestrian channelization barriers, pedestrian-specific pavement markings, and specialized signage.

As previously seen in **Figure 3.5**, there is barrier railing on either side of the sidewalk to channelize pedestrians, reducing the potential for trespassing or movement along the corridor outside the designated crossing zone. There is also instructional signage on the pedestrian emergency egress gates to confirm they are used properly and to warn against accessing the crossing while the activated devices are flashing and the gate arms are down.

Skew Angle

Skewed crossings are where a roadway or pathway intersects the railroad tracks at an angle other than 90 degrees. Skewed crossings are not preferred, as visibility and sight distance are decreased, which increases hazards at the crossing. To mitigate these safety hazards, a roadway or pedestrian pathway should be realigned. If a 90-degree intersection angle is infeasible due to site constraints, the next-best range for a crossing angle is between 60 and 90 degrees.

The crossing angle or skew of an at-grade crossing is measured as the smallest angle between the roadway and tracks through the crossing (see **Figure 3.8**). Treatments to improve skewed crossings include cantilever structures, median gates, additional advanced warning signage or pavement markings, traffic signal interconnection, increased lighting, and minimized vegetation.

A perpendicular crossing is where the roadway or pathway intersects the railroad tracks at a 90-degree crossing angle. This geometry is preferred due to the improved visibility. When possible, reconfiguration of the crossing or any enhancements to the crossing should protect this crossing angle (see **Figure 3.9**).

Figure 3.8: Skewed Crossing

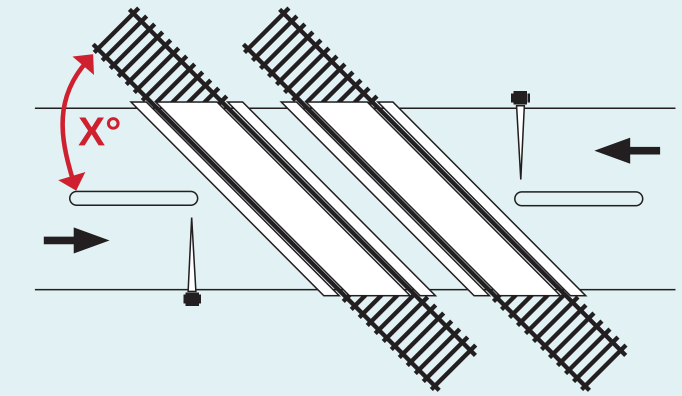
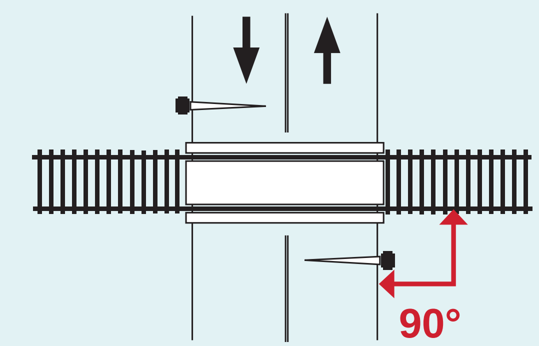


Figure 3.9: Perpendicular Crossings



Quiet Zones

Quiet Zones are segments of a rail corridor where train operators are not required to routinely sound train horns in advance of grade crossings during quiet zone hours. A Quiet Zone approval often involves the construction of new infrastructure, such as medians and exit gates. A Quiet Zone also requires certification by the FRA. Caltrain does not have the ability to create or approve a Quiet Zone. Quiet Zones can only be created by the public authority responsible for traffic control or law enforcement at the crossing. For more information on Quiet Zones, please visit the Caltrain website at: https://www.caltrain.com/projects/quiet-zone

Project Initiation

4 | Planning a Grade Separation

31st Avenue, San Mateo

Ravenswood Avenue, Menlo Park


Castro Street, Mountain View

Key Takeaways:

There are multiple guiding factors to evaluate at-grade crossings for grade separation as grade separations, while beneficial, can be costly and time-consuming to implement. Grade separation improvements should balance between practicality and financial feasibility for the community. Crossing closures are a cost-effective option to grade separations, where applicable.

4 Planning a Grade Separation

Key Factors in Grade Separations

The grade separation process is comprised of multiple steps or phases. **Phase 0 (Project Identification)** and **Phase 1 (Project Initiation)** involve evaluating crossing improvements and selecting the most appropriate type.

When reviewing improvements for corridor crossings, it is important to pursue solutions that are sensitive to the local community and the funding partners. The chosen improvement should strike a balance between practicality and financial feasibility for the community.

While grade separation projects are generally beneficial to the local community, they are expensive and time-consuming to implement. Therefore, it is prudent to critically assess corridor crossings to determine the appropriate level of improvements.

Ultimately, there are multiple guiding factors to evaluate crossings and the urgency of improvements. **This chapter outlines the methods that can be used to select the crossing improvement type.**

Table 4.1 provides criteria for considering at-grade crossings for future separations. The goal of this table is to compare the priority level of crossings across multiple project locations and to help determine the urgency of implementing a grade separation. Items that are criteria from FHWA's Highway-Rail Crossing Handbook are denoted with (**FHWA**). This handbook can be found at https://highways.dot.gov/safety/hsip/xings/highway-rail-crossing-handbook-third-edition.

Table 4.1: Considerations for Grade Separated Crossings

	Lower Consideration	Higher Consideration
Active Transportation	• The crossing has few connections to local bicycle and pedestrian networks • There are low pedestrian and bicycle volumes in the surrounding area	• The crossing is a key element of the local or regional bicycle and pedestrian networks • The crossing is in the vicinity of large pedestrian trip generators, such as schools, hospitals, medical centers, senior facilities, shopping centers, recreation centers, parks, or transit stops, among others • Crossing is highlighted as a key facility in an active transportation plan
Traffic Capacity and Demand	• Crossing is not currently close to exceeding traffic volume capacity • Average Annual Daily Traffic is less than 3,000 vehicles per day **(FHWA)** • Lack of new development or re-development around the crossing	• Crossing is at or exceeding its traffic volume capacity • Average Annual Daily Traffic is more than 30,000 vehicles per day in an urban region and 20,000 vehicles per day in a rural region **(FHWA)** • Transportation projects and other developments are being completed or progressed near the crossing • Vehicle delay at the crossing exceeds 30 vehicle hours per day **(FHWA)**
Safety and Collision History	• Few vehicle, bicycle, and/or pedestrian collisions have occurred near or at the crossing • No observed pedestrian trespassing into the Caltrain corridor	• The expected collision frequency for crossings with gates, as calculated by the USDOT Accident Prediction Formula for five-year collision history, exceeds 0.5 (per year) **(FHWA)** • There are past occurrences of trespassing into the Caltrain corridor at the crossing
Caltrain Facilities	• The crossing is located in an area with two Caltrain tracks and a 40-foot-wide corridor • Trains travel at speeds <40mph along the corresponding stretch of the rail corridor	• The crossing is located in an area with four existing or planned Caltrain tracks and an 80-foot-wide corridor • Trains travel at speeds >40mph along the corresponding stretch of the railroad corridor

Table 4.1: Considerations of Grade Separated Locations (continued)

	Lower Consideration	Higher Consideration
Corridor Operations	• Trains tend not to dwell near the crossing for any reason (i.e., not near a station)	• There are adjacent rail yards or industrial spur tracks where trains remain stationary for an extended period • Passing tracks exist and are frequently used in the vicinity of the crossing. • On average 30 or more trains pass over the crossing each day **(FHWA)**
Transportation or Development Projects	• Crossing is not close to ongoing or proposed transportation or development improvement projects	• Crossing is located in an area with ongoing and proposed transportation or development improvement projects
Service Population	• The crossing is located in an area with high median household income and low residential density • There are no schools, elder care facilities, or other attractors of vulnerable users	• The crossing is located in an Equity Priority Community (EPC) • Nearby schools, senior, health, and other facilities would make the crossing important to vulnerable communities
Nearby Land Uses	• The crossing is in an area with lots of empty space and low trip generation potential	• The crossing is located near an existing or proposed dense commercial or residential center with high levels of activity • The crossing provides access to priority and regionally-significant destinations (schools, hospitals, freeway access, etc.) • The crossing has high volumes of emergency vehicles or travel surges from special events
Adjacent Crossings	• There are adjacent grade separated facilities that are easily accessible and in close proximity to the at-grade facility	• There are few nearby grade-separated crossings, or the nearby grade-separated crossings do not serve all road users
Facility Visibility	• The crossing is easy to see from all directions of travel • Straight approaches and lack of slope help make the crossing visible to users	• There are sight distance issues, such as nearby trees or street-adjacent buildings • Curved approaches or large grade differentials make the crossing difficult to see
Transit Network	• The crossing is not located close to Caltrain stations or other local transit facilities • Local transit routes do not rely on the crossing for routing or the routes that have low ridership	• The crossing is located within a quarter-mile of a Caltrain station or other local transit facility • Local and regional transit routes with high ridership, including school buses, rely on the crossing for network connectivity
Construction Impact	• Construction of a grade-separated crossing would require ROW acquisition and cause displacement of residential units • Staging during construction would be detrimental to the surrounding transportation network and nearby businesses	• Site is characterized by high levels of available or government-owned ROW • Construction staging could largely avoid major interruptions to the surrounding transportation network and nearby businesses
Roadway Conditions	• The adjacent roadway network is dense with intersections and signals • Site conditions require significant change to roadway profile to achieve grade separation • Posted speeds on roadway crossing the Caltrain tracks are at or below 25 mph	• The adjacent roadway network is relatively simple and does not feature many signals • The posted highway speed equals or exceeds 55 miles per hour **(FHWA)** • There are traffic signals in close proximity to the crossing that could induce queueing on the tracks
Utilities	• There are known overhead or underground critical utilities that would make the construction of a grade-separated crossing more complex	• There are few known overhead or underground critical utilities that would make the construction of a grade-separated crossing less complex

Mountain View Transit Center, Mountain View

Crossing Closure

When planning a project for a potential grade separation, it is important to also evaluate the possibility of closing the crossing or closing the crossing for vehicular traffic and maintaining bicycle and pedestrian access. A closure is accomplished by severing the roadway or pathway at the railroad tracks, generally by creating two culs-de-sac on both sides of the railroad to facilitate a turnaround. **Crossing closures are a cost-effective solution for eliminating unacceptable crossing hazards. They are fairly simple to implement relative to grade separations.** They also can be integrated with the local mobility network if paired with active transportation improvements or improvements made at adjacent grade crossings.

The closure of a grade crossing requires careful consideration of the surrounding land uses and transportation network. A description of key screening variables is included in **Table 4.2**. Crossing closures, when initiated by local jurisdictions, are expected to be done in partnership with Caltrain with the early involvement of Caltrain Planning. Cities should engage Caltrain Planning staff as soon as they prepare to advance the project through conceptual design.

For more information on other types of crossing improvements, please visit the Caltrain website at: https://www.caltrain.com/about-caltrain/doing-business/engineering/third-party-projects.

Table 4.2: Key Considerations For Crossing Closure

Considerations	Crossing Closure	Vehicular Closure with Pedestrian and Bicycle Crossing	Grade Separated Crossing
Travel Demand	The crossing does not currently accommodate transit or active transportation users and is located relatively far away from relevant multimodal facilities like transit centers or multi-use paths. There is a small amount of travel demand, or moderate demand with adjacent crossings that can absorb additional demand.	There is a relatively small amount of travel demand, but there is pedestrian and bicycle demand. Current or planned land use or critical pedestrian, bicycle, and transit infrastructure could attract active transportation users who would benefit from the crossing. The crossing is part of local transportation long range plans.	There is a large amount of travel demand at the crossing due to nearby infrastructure or land uses. The crossing could experience significant emergency vehicle travel or surges due to special events. The crossing facilitates connections to nearby transit station and accommodates buses serving the station.
Service Population	There is a small population that is serviced by the crossing, and the population is not comprised of disadvantaged or vulnerable demographics, like seniors and children.	There is a large population of residents that use active transportation, like children, and the community surrounding the crossing has lower levels of vehicle usage.	The crossing is essential for users in nearby senior care facilities or schools and would also serve a large driving population.
Transportation Infrastructure	The transportation network surrounding the crossing has additional capacity for anticipated diversion and provides facilities for pedestrians and bicyclists.	The transportation network surrounding the crossing has additional capacity for anticipated diversion, but there are not pedestrian and bicycle facilities in the area and active transportation demand is high.	The transportation network surrounding the crossing would likely be strained by its closure. Pedestrians and cyclists are prevalent in the surrounding area.

Castro Street, Mountain View

5 | Grade Separation Implementation Process

Caltrain

Menlo Park Station, Menlo Park

5 Grade Separation Implementation Process

Grade separation projects are different from other types of capital projects in the Caltrain corridor, which adds complexity to the design review process and implementation steps. Grade separation projects are initiated by local jurisdictions serving as the project sponsor and benefit from Caltrain engagement early in project development. Later in the process, Caltrain assumes the lead role in design and construction, and project sponsors continue to play a critical role in advancing projects. **This Chapter provides an overview of Caltrain's design review process, implementation approach, and the necessary agreements between project sponsors and Caltrain to advance grade separation projects within Caltrain's ROW.**

Project Implementation Process

Figure 5.1 provides a summary of the key actions taken by Caltrain and a project sponsor in implementing a grade separation project, including expected work products and an outline of Caltrain's delivery processes. Project sponsors typically lead the grade separation project from **Phase 0 – Project Identification** to the end of **Phase 2 – Conceptual Planning,** which concludes with selection of the Locally Preferred Alternative (LPA).

Key Takeaways:

Early Involvement & Communication = Less Delays & Redundancy

Caltrain functions as the lead designer/ constructor for grade separation projects along the Caltrain corridor.

Figure 5.1: Grade Separation Implementation Process

	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4-5	PHASE 6	PHASE 7-8
	Project Identification	**Project Initiation**	**Conceptual Planning** *0-15% Design*	**Preliminary Design** *16-35%*	**Final Design** *36-100%*	**Construction Phase**	**Project Completion/ Turnover/Closeout**
KEY ACTIONS	*Define Needs* *Initial Project Scope*	*Development of Alternatives* *Preliminary Cost, Schedule, and Funding Estimates* *Public Engagement on Alternatives* *Develop Funding Plan and Submit Initial Funding Applications*	*Refinement and Evaluation of Alternatives* *Public Engagement on Alternatives* *Baseline Cost, Schedule and Preliminary Funding Plan* *Alternative Contract Delivery Analysis* *RFPs Development for Preliminary Design/ Environmental Review*	*Preliminary Engineering* *Environmental Review* *Refined Cost, Schedule, and Funding Plan* *RFQ/RFP Development for Alternative Contract Delivery Entity [3] (if selected) or RFP for Final Design Consultant (if Design-Bid-Build delivery method)*	*Final Design* *Updated Cost, Schedule, and Funding Estimates* *Secure Full Funding for Construction* *ROW Acquisition* *Construction Invitation to Bid if Design-Bid-Build* *Permitting*	*Construction* *Maintenance of Rail Service* *Maintenance of Traffic and Access* *Public Information during Construction*	*Transition Completed Project Facilities to Local Jurisdiction and Caltrain* *Inspections and Closeout of Construction Contract* *Ongoing Maintenance and Operations*
PROJECT SPONSOR [1]	***Crossing Chosen for Grade Separation***	***Scoping and Development of Conceptual Alternatives***	***Project Study Report (PSR) and Selection of the Locally Preferred Alternative (LPA)***	***Design Coordination***	***Design Review and Permitting***	***Construction Coordination***	***Operations and Maintenance of City Assets***
CALTRAIN PROCESSES	*None*	***1.1*** *– Railroad Corridor Use Policy (RCUP)* ***1.2*** *- Project Agreement Development*	***2.1*** *- Project Agreement Execution* ***2.2*** *- Technical Review of the Design* ***2.3*** *- Alternative Contract Delivery Method Evaluation/Analysis* ***2.4*** *- Procurement of Consultants for Project Development (Environmental Review and Preliminary Engineering)* ***2.5*** *- RCUP Compatibility Review (in conjunction with LPA)*	***3.1*** *– Funding Agreements and Amendments* ***3.2*** *– Management of Design Consultants* ***3.3*** *– CEQA Clearance and Determination (State)* ***3.4*** *– NEPA Clearance (Federal)* ***3.5*** *– Alternative Contract Delivery Entity Procurement (if applicable) or procurement of Final Design Consultant if Design-Bid-Build*	***4.1*** *– Development and Execution of the O&M and Construction Agreements*	***6.1*** *– Construction Agreement in Effect*	***7.1*** *– O&M Agreement in Effect*
CALTRAIN [1]	***Initial Caltrain Planning Coordination***	***Initial Feedback on Feasibility***	***Concurrence with LPA***	***Environmental Clearance and Design Development***	***Complete Final Design and Procurement for Construction***	***Construction Administration***	***Operations and Maintenance of Caltrain Assets***
	Caltrain Planning [2] (Phases 0–2)			*Caltrain Project Delivery [2] (Phases 3–7-8)*			

City Lead — *Caltrain Lead* — *Internal Caltrain Phase Gates*

1. White outline indicates whether City or Caltrain is leading that phase
2. Caltrain's internal lead is responsible for coordinating with all the internal and external stakeholders and gathering input from all the relevant subject matter experts.
3. RFQ/RFP development may occur during Phase 2 for a Progressive Design-Build or CM/GC delivery method

During **Phase 1 – Project Initiation** and **Phase 2 – Conceptual Planning**, Caltrain provides technical input about the design alternatives to enable community members and policymakers to make an informed decision when selecting their preferred alternative. Project sponsors should consult with their local TAs, who could be a potential funding partner.

After selecting the LPA, Caltrain and the project sponsor execute an Agreement that describes the roles and responsibilities of the project's parties (e.g., Caltrain, project sponsor, and funding partner) and allows Caltrain to act as the lead implementing agency to deliver the community's vision on Caltrain's ROW. This Project Agreement is an important tool for communicating Caltrain's tasks and their timeline. This agreement is established before Caltrain assumes the lead implementation role but may be revised at the end of each project phase during the process for reviewing project costs and schedule.

Caltrain will serve as the lead implementing agency for all grade separation projects on Caltrain-owned ROW.

1. On the Caltrain ROW, Caltrain has the obligation to manage the risks and liabilities presented by capital projects, including disruptions to core railroad systems and passenger service. Additionally, as the governing authority for and operator of the passenger service, Caltrain has the necessary corridor-wide perspective and technical expertise to serve as lead implementation agency for grade separation projects.

2. Grade separation projects on the Caltrain ROW should not be viewed as isolated safety or traffic relief projects, but part of a comprehensive San Francisco to San Jose corridor improvement program focused on safety and service delivery.

Caltrain is committed to ongoing partnership with project sponsors to maintain the community vision from **Phase 3 – Preliminary Design** to **Phase 6 – Construction**.

The following pages provide a description of each phase of the implementation process. **A Responsibility Matrix (RACI) template was developed to provide a step-by-step description of the project development phases and outline the responsibilities of each party during the implementation process. The RACI template was communicated with each county's transportation authority for feedback and will remain a living document that should be refined and adjusted over time. Project sponsors should meet at Phase 0 – Project Identification with Caltrain Planning and review the RACI template to make necessary adjustments per specific project need. As the project advances through its lifecycle (Phases 1 through 8), project partners should revisit the project-specific RACI to ensure clarity in roles and communication.**

Phase 0 – Project Identification (Sponsor Led)

Project Identification involves defining and identifying the need to grade separate a crossing. This identification often occurs by the project being included in a local agency's Capital Improvement Plan (CIP) or other long-range planning document. During this phase, project sponsors should seek initial guidance from Caltrain on how to approach the project identification phase and on how to prepare the project for the next phase, Project Initiation.

Phase 1 – Project Initiation (Sponsor Led)

Cooperation between Caltrain and project sponsors during the Project Initiation phase sets a solid foundation for the successful execution of a grade separation project and helps proactively address potential challenges. This approach benefits the stakeholders involved and contributes to the overall efficiency and effectiveness of the project. During the Project Initiation phase, project sponsors are responsible for completing key actions, which include identifying preliminary project schedules, establishing funding requirements for preliminary project phases, securing funding, and conducting public engagement to gather feedback and assess a project's feasibility at a high level. Concurrently, Caltrain staff, through a Project Agreement, work alongside the project sponsor during this phase to complete the necessary Caltrain delivery processes detailed below. This collaborative approach confirms that both parties are prepared for Phase 2.

Caltrain recommends that the development of alternatives takes place during Phase 1, as this is necessary for the development of preliminary cost, schedule, and funding estimates.

Caltrain does not require reimbursement during Phase 1.

Caltrain Process 1.1 – Overview of Conceptual Planning Process (including RCUP)

Caltrain provides the project sponsor with an overview of the conceptual planning process including the Rail Corridor Use Policy (RCUP), if applicable. The RCUP applies to new bicycle and pedestrian crossings of the corridor, as well as local projects that could create "non-railroad uses" on Caltrain property.

Caltrain Process 1.2 – Project Agreement Development

The Project Agreement is an agreement between Caltrain, the project sponsor, and—in some cases—the county's transportation authority, that provides a framework for Caltrain staff to commit time to the project. The Agreement establishes a scope, budget, and schedule for Caltrain staff support needed during Phase 2, or beyond, and confirms the associated costs are reimbursed by the project sponsor. It also outlines all parties' roles, responsibilities, and required processes. Caltrain encourages project sponsors to engage its Capital Planning staff early in Phase 1 – Project Initiation to develop and execute the agreement, which may take several months depending on the project's complexity and the project partners' approval processes. While Caltrain prefers to minimize the number of Project Agreements for a project, multiple agreements are often required based on project needs, status, complexity, and funding availability. An example of a Project Agreement is included in **Appendix 4**.

Phase 2 – Conceptual Planning (Sponsor Led)

During the Conceptual Planning phase (0-15% design), the project sponsor explores various concept alternatives for grade separation. The project sponsor refines alternatives and assesses costs and potential environmental impacts, as well as community preferences and insights to support the evaluation of the alternatives. Alternatives, evaluation results, and community feedback are documented in a Project Study Report (PSR), which is typically reviewed by the City Council for the project sponsor to select an LPA.

While the project sponsor is engaged in concept development and public outreach, there are also concurrent Caltrain processes that prepare the project for the Preliminary and Final Design phases. Caltrain support with the following processes are reimbursed by the project sponsor per the **Project Agreement defined in Caltrain Process 1.2.**

Caltrain Process 2.1 – Project Agreement Execution

With the Project Agreement developed as part of Process 1.2, Caltrain and the project sponsor will formally execute the agreement for Caltrain staff to support the project through the various design phases.

Caltrain Process 2.2 – Technical Review of the Design

Caltrain provides feedback to project sponsors, through technical reviews, as early as the Conceptual Planning phase. Caltrain's feedback is primarily focused safety and engineering/practical constraints, ensuring Caltrain continues to provide safe operations and maintenance as corridor partners plan for and construct grade separation projects.

Caltrain reviews, based on available planning information (e.g., concept alternatives), support project sponsor decision-making through the following:

- Conformance with Caltrain Standards and Design Criteria
- Identification of potential impacts to Caltrain right-of-way, facilities, operations, and maintenance
- Identification of changes to Caltrain station multimodal access—people walking, biking, and using buses or shuttles
- Identification of specific facilities that may be affected, including third-party utilities, Caltrain's fiber backbone, positive train control (PTC) infrastructure, communications systems, overhead contact system (OCS) components, switches, track, ROW access points, and other special trackwork
- Providing guidance on clearances that need to be considered during design. These clearances include separation from the track (vertical and horizontal), separation from the OCS, and clearance to utilities.
- Identification of potential environmental impacts, environmental clearances, and resource agency permits necessary for Caltrain to obtain
- Identification of factors the local agency should consider to reduce risk and cost
- Review of constructability opportunities/challenges
- Review of engineer's cost estimates

Caltrain's insights during the Conceptual Planning phase help the project sponsor make an informed decision when selecting an LPA. Multiple rounds of technical review may be needed depending on the complexity of the project.

Caltrain Process 2.3 – Alternative Contract Delivery Method Evaluation/Analysis

After selecting the LPA, an Alternative Contract Delivery Method Evaluation is conducted to determine the optimal contracting method for the grade separation project. While Design-Bid-Build (DBB) is the standard contract delivery method, other contract delivery methods have the potential to be more cost and schedule effective for a grade separation project on the Caltrain corridor.

Different project delivery methods—such as Construction Manager/General Contractor (CM/GC), Design-Build (DB), and Progressive Design-Build (PDB)—require teams with different expertise, size, and composition. The project delivery methods have different contractual roles between the owner (Caltrain), designer, and contractor. The project delivery methods also have differing timelines for procuring consultants and contractors for Final Design, Pre-Construction Services, and Construction. Consequently, determining the delivery method early in a project's development optimizes schedule and costs.

Caltrain is legally required to perform and document an analysis of delivery methods if a method other than the DBB method is selected (CPUC Section 103393 et. seq.). Jurisdictions also have different contracting and procurement procedures that need to be considered in the analysis. This task typically requires approximately three months for Caltrain to evaluate delivery methods, prepare a staff report, and obtain necessary Board approval. Additional information regarding the Alternative Contract Delivery Method Evaluation is provided in **Chapter 9, Delivery Methods**.

Caltrain Process 2.4 – Procurement of Consultants for Project Development (Environmental Review and Preliminary Engineering)

Caltrain staff, in collaboration with the project sponsor, will undertake the procurement tasks identified below to hire a consultant for the environmental review and preliminary design phase of the project. The procurement tasks include:

- Developing scopes of work and independent cost estimates
- Coordinating with the office of Civil Rights to establish Disadvantaged Business Enterprise (DBE) goals for federal funding and Small Business Enterprise (SBE) goals for local funding, as needed
- Developing criteria for ranking proposals
- Advertising procurements
- Establishing the proposal review committee
- Reviewing and ranking proposals
- Conducting consultant interviews and selection
- Completing contract negotiations with the selected consultants
- Securing approval through the Caltrain Board and the City (through staff reports and resolutions)
- Awarding contracts

Caltrain Process 2.5 – RCUP Compatibility Review (in conjunction with LPA)

For new vehicle, bicycle, and/or pedestrian crossings on the Caltrain corridor or projects that could create "non-railroad uses" on Caltrain property, the project sponsor will need to request use of Caltrain's ROW through the RCUP. This process was adopted by the Caltrain Board in February 2020 to (1) provide a policy to check compatibility of proposed uses and (2) guide use of Caltrain property to achieve Caltrain's Adopted Service Vision.

The primary objectives of the RCUP are to:

- Support the long-term use of Caltrain property to deliver the Adopted Service Vision, while also clarifying opportunities for nonrailroad uses (of short and long duration) on the rail corridor
- Develop a process for considering and approving the compatibility of the range of proposed uses and projects on Caltrain property
- Provide transparency about Caltrain's decision-making process and outcomes

In simple terms, RCUP is a process for reviewing and approving the project sponsor's proposed uses of Caltrain's property, including proposed capital projects such as new bicycle and pedestrian crossings of the Caltrain corridor. **Figure 5.2** depicts Caltrain's decision-making framework that proposed project sponsors are required to use on the Caltrain corridor. If the RCUP is deemed compatible, the land use is also compared against any planned Caltrain uses for the site for future capital or maintenance projects. If the RCUP is deemed incompatible, the project sponsor must submit a use variance application. Gaining approval of this use variance may require implementing a set of recommendations that will confirm compatibility with current and future rail needs. Note that the RCUP compatibility review, and the use variance application, has nominal fees that are separate from the Project Agreement. If a "non-railroad use" is approved though RCUP, then the requesting agency must enter into an agreement with Caltrain to allow the "non-railroad use" and must pay relevant fees, as set forth in Caltrain's fee schedule.

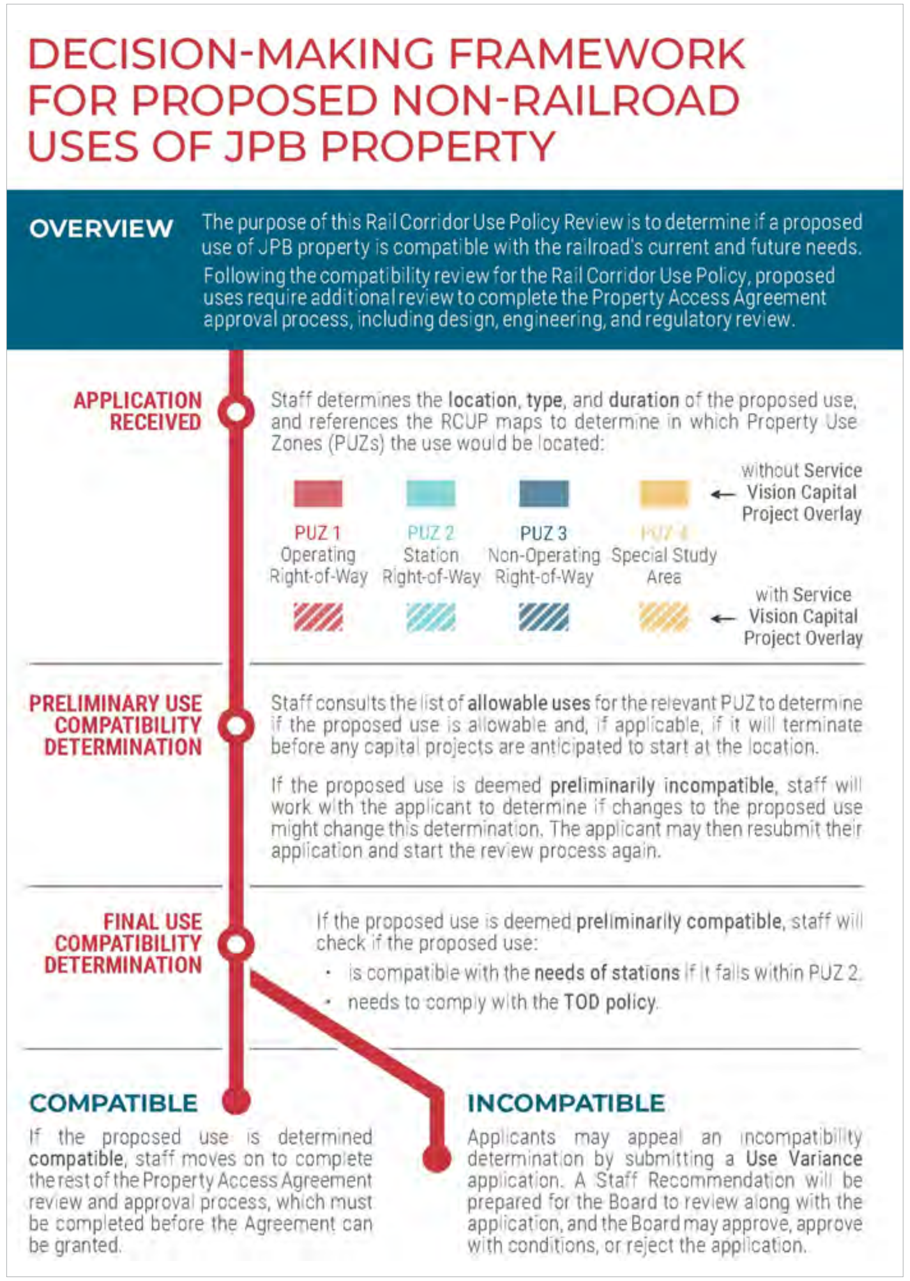
Projects should go through the RCUP compatibility review process when the project sponsor has selected the LPA. This is for the following reasons:

- An LPA has a defined project scope that allows staff to make a recommendation to JPB. The intent is for staff to evaluate a single alternative.
- Coming back to the Board with a different recommendation may impact process credibility and Board trust.
- If multiple alternatives are still being considered and make very difference uses of Caltrain ROW, staff assists the project sponsor (through a Project Agreement) in advancing the alternatives analysis, and making an informed decision on the LPA.
- If more than one alternative under consideration makes similar use of Caltrain ROW, staff can issue a recommendation to JPB to approve the compatibility before the selection of the LPA.

As shown in **Figure 5.2**, there are four types of Caltrain Property Use Zones (PUZ):

- **PUZ 1 –** Operating ROW includes property that is required for safe operation of the railroad in its current configuration including for the Peninsula Corridor Electrification Project (PCEP).
- **PUZ 2 –** Station ROW includes property that is located at and near Caltrain's stations.
- **PUZ 3 –** Non-Operating ROW includes all Caltrain property that is not already included in PUZ 1 and 2.
- **PUZ 4 –** Special Study Area includes Caltrain property that is currently involved in a defined planning process that formally involves multiple stakeholders.

Figure 5.2: Caltrain Rail Corridor Use Policy Framework



These PUZs were overlayed with Adopted Service Vision Capital Project zones to represent the areas along the Caltrain corridor that may be needed for potential future capital projects to create a RCUP Map. This map can be viewed on the Caltrain website at https://www.caltrain.com/media/2078/download?inline.

Caltrain staff and Board Members will consult the RCUP Map and take necessary actions outlined in **Figure 5.2** to help make the final determination on the proposed grade separation project. Caltrain's technical review and planning coordination performed under the Project Agreement framework, ahead of the RCUP compatibility review process, sets the project up for success.

For more information on RCUP, please visit the Caltrain website at: https://www.caltrain.com/projects/rail-corridor-use-policy-rcup.

Phase 3 – Preliminary Design (Caltrain Led)

After the LPA has been selected and the Project Agreement amended, the project is ready to proceed to the Preliminary Design phase. During this phase, Caltrain assumes the role of the lead implementing agency and contracts with a design consultant, with the project sponsor's staff directly coordinating with the design consultant to advance the project sponsor's preferred design and concurrently obtain environmental clearances (California Environmental Quality Act/National Environmental Policy Act [CEQA/NEPA]) for the project.

During the Preliminary Design phase, in addition to progressing design and environmental clearance, Caltrain also develops refined cost and schedule estimates for final design and construction. This enables project sponsors to advance the funding strategy and continue to secure financial resources for the project.

Caltrain will conduct routine coordination and incorporate the project sponsor's input throughout the life cycle of the project, from design through construction and closeout. Caltrain processes during this phase of the project include the following:

Caltrain Process 3.1 - Funding Agreements and Amendments

A Cooperative Agreement—also known as a Funding Agreement—is a formal agreement between Caltrain and other project partners that outlines shared goals and commitments for the grade separation project. A Funding Agreement is used to allocate roles and responsibilities and establish expectations between Caltrain, project sponsors, transit agencies, and other parties involved in the project. A Funding Agreement may address a variety of issues related to the project, such as funding, project timelines, grant funding processes, design specifications, and environmental approvals. In addition to allocating responsibilities, the Funding Agreement can also be used to establish a framework for communication and coordination among the agencies.

The Funding Agreement must be established before Caltrain assumes the lead implementing role. Caltrain typically will assume the lead implementing role in Phase 3 (or in unique circumstances, Phase 4 by mutual agreement). The Funding Agreement development process is defined under the Project Agreement (Caltrain Process 2.1) and should start at least six months prior to the anticipated project transition from the project sponsor to Caltrain, providing adequate time for legal counsel reviews and Board and/or Council actions. The Funding Agreement may be subject to renegotiation at the end of each project phase, which allows the project sponsor to provide input on project cost and schedule.

Caltrain Process 3.2 – Management of Design Consultants

Managing a consultant involves overseeing the work of the firm providing design services for a project. Caltrain's engineering knowledge in rail development streamlines coordination with the design firm, enhances risk mitigation, and identifies ways to accelerate the project schedule. The role of Caltrain's Engineering staff is to confirm that the design consultant's work aligns with Caltrain's technical requirements and design standards. By managing the design consultant, Caltrain can also confirm the project meets regulatory and funding requirements. Caltrain's Engineering staff can help identify potential risks and challenges early, which can help mitigate delays and cost overruns later in the project. Also, Caltrain guides the design consultant to follow Caltrain's management processes to confirm consistency in cost and quality management with other projects along the corridor. Local agencies also play a role with their understanding of local conditions (e.g., local utilities).

Caltrain Process 3.3 – CEQA Clearance and Determination (State)

A CEQA clearance for a project can take different forms depending on the scope and complexity of a grade separation project. Environmental clearance processes for grade separation projects can range from a Statutory Exemption to an EIR. Final CEQA determination for development or construction in the Caltrain ROW must be made by Caltrain as the Lead Agency.

Caltrain leads CEQA review for grade separation projects. There are instances where project sponsors may help advance the CEQA process. In these cases, project sponsors should consult with the Caltrain Environmental Planning team early in the process to determine the required level of CEQA review. This helps streamline the environmental review and avoid duplicative work.

Caltrain Process 3.4 – NEPA Clearance (Federal)

The responsibility of NEPA environmental clearance lies solely with Caltrain under federal regulations. NEPA clearance is required when grade crossing projects are anticipating federal grants to fund a project or require federal permits for construction. The NEPA clearance process also varies based on the scope and complexity of the project and can range from a Categorical Exclusion (CE) or Environmental Assessment (EA) to a full Environmental Impact Statement (EIS). Advancing to 30% design before seeking a NEPA clearance can better define the project footprint and reduce the need for supplemental analyses later in the process.

Caltrain's Environmental Planning team can complete NEPA and CEQA environmental reviews concurrently. Partnering with the Caltrain Environmental Planning team early in the environmental review phase will help streamline the process of obtaining environmental clearance.

Caltrain Process 3.5 - Alternative Contract Delivery Entity Procurement (if applicable) or Procurement of Final Design Consultant (if DBB)

Depending on the selection of a DBB or Alternative Delivery method, Caltrain will procure a Final Design Consultant or procure an Alternative Contract Delivery Entity. More detailed information on these processes are described in Chapter 9, Delivery Methods.

Caltrain assumes the lead role to advance the design into implementation, with continued coordination with project sponsors.

Phases 4 through 8 – Final Design, Construction, and Closeout (Caltrain Led)

Phases 4-8 are led by Caltrain. Caltrain assumes the lead role to advance the design into implementation, with continued coordination with project sponsors. **Phases 4 and 5 (Final Design)** involve advancing the design developed in the Preliminary Design phase and completing the readiness steps to prepare the project for the construction phase, including securing needed ROW, permitting, and updating the cost and schedule estimates. Project sponsors take the lead in securing funding, which is a critical step before construction can begin. The key schedule milestone is securing full funding for the project, so final design can be completed and a contractor can be procured. The timing for bringing on a contractor depends on the selected delivery method.

Caltrain Process 4.1 - Development and Execution of the O&M Agreement

Since a grade separation project creates new infrastructure, an Operations and Maintenance (O&M) agreement is important to clarify future responsibilities for maintaining the newly constructed infrastructure. Ideally, O&M agreements are developed prior to construction. This allows Caltrain and the project sponsor to have a clear agreement on responsibilities prior to the project being completed. This agreement will outline the responsibilities for maintaining the completed grade separation infrastructure, including structures and walls, bridges, drainage, landscaping, and local roadway infrastructure. The specific obligations will vary depending on the project location and type.

ROW Acquisition

All property rights required for the project (including all necessary temporary construction easements) should be identified by no later than 65% design.

ROW acquisition is typically an area of coordination between Caltrain and the project sponsor. During the design phase, Caltrain and the project sponsor need to decide which agency will be the lead, responsible for acquiring ROW, and which agency will approve property purchases and be the condemning authority, as needed. Historically, Caltrain has acquired necessary property rights for projects on its ROW, including the provision of necessary relocation services.

As a best practice, the agency responsible for buying the property should delegate appropriate property purchase authority to its staff to make the process as efficient possible.

Utilities

Utility relocations are often in the critical path of grade separation projects and multiple relocations are often required. If utility relocations are required for a project, Caltrain takes the lead role in working with utilities to develop relocation plans. Legally enforceable relocation notices are then issued by Caltrain for utilities in its ROW and by the City for utilities in its ROW. The parties need to decide which legal team will be responsible for enforcing such notices to verify timely utility relocation.

Phase 6 (Construction) is when a grade separation project is built. Caltrain continues in the lead role and coordinates with the project sponsor. Revisions to the Funding Agreement are sometimes needed during the construction stage due to unanticipated project changes to scope, schedule, and budget. Important activities in the construction phase include construction management, inspection, managing project funding/grants, maintenance of rail service, maintenance of traffic (vehicular, pedestrian, and cyclist), access to adjacent properties, and public information during construction.

Phases 7 and 8 (Project Startup/Turnover/Closeout) are for project completion and closeout. During these phases, non-Caltrain owned assets such as the local roadway are turned over to the project sponsor for ongoing operations and maintenance. All other project-related agreements terminate in these phases and long-term operations and maintenance agreements are the only agreements left in place.

6 Funding and Grant Programs

Castro Street, Mountain View

6 Funding and Grant Programs

This chapter discusses the importance of developing a detailed funding plan and provides an overview of the available funding sources for grade separation projects. **Grade separation projects can be expensive and often require the project sponsor to secure grants from multiple sources. Grade separations have been recognized as a priority in California and nationally and there are several available funding programs for project sponsors to support these types of projects.** It should be noted that while Caltrain has an essential role in designing and constructing within the ROW and can serve as a partner in obtaining project funding, **Caltrain does not fund grade separation projects**.

Local jurisdictions are the project sponsors responsible for preparing and executing a funding plan to support all phases of a grade separation project in the Caltrain corridor. Caltrain funds the delivery of cost-efficient rail services, which includes the management, operation, maintenance, replacement, and improvement of capital assets that support the commuter rail service.

Funding Plan

Project sponsors should create a detailed funding plan that aligns with an accurate and conservative cost estimate, which is crucial for advancing grade separation projects. This funding plan and project cost estimates should be developed, in coordination with their Transportation Authority, as early as possible, ideally during a project's initiation phase. These cost estimates should be updated regularly as the project progresses through the various design phases to represent current market conditions. This update should factor in soft costs, including Caltrain's management of the grade separation project. Soft costs should also include contingency funds, which vary depending on the phase of the project. As the project advances and there are fewer risks and unknowns, the contingency may be reduced. Refer to **Table 6.1** for Caltrain's contingency guidance for capital improvement projects, which is consistent with guidance from the Association for the Advancement of Cost Engineering International. More details on project cost and funding for each phase is illustrated in **Figure 6.1**. Funding for each project phase should be fully secured before its commencement to confirm the efficient progression of the project. Caltrain practices are based on guidance from Association for the Advancement of Cost Engineering (AACE).

Table 6.1 - Caltrain's Contingency Guidance for Capital Improvement Projects

Phase	Contingency (*% of Total Project Cost*)
Phase 2: Conceptual Planning (0-15% design)	50%
Phase 3: Preliminary Design (16-35% design)	30%
Phase 4: Final Design (36-65% design)	20%
Phase 5: Final Design (66-100% design)	15%
Phase 6: Construction	10%

Santa Clara Station, Santa Clara

Key Takeaways:

Grade separations are recognized as a priority in California and nationally—*several funding programs are available for local jurisdictions*

Caltrain can serve as a partner *in obtaining funds but cannot direct funds toward grade separation projects*

Funding sources: *Federal, State, County, Local, and Private*

Minimize project delays *with a detalied funding plan that correlates with a frequently updated project cost*

Project sponsors are responsible for preparing grant applications for grade separation projects *and communicating the requirements to Caltrain staff early in the process*

Funding for capital projects is derived from five distinct sources: federal, state, county, local, and private. While federal, state, and county sources play a consistent role in funding grade separation projects, local and private funding sources tend to vary on a project-by-project basis. Local funds typically come from the project sponsor and are often used as matching funds to leverage additional funding from county, state, or federal programs, which have varying minimum matching requirements. Private funds may be available from institutions or agencies that may benefit from grade separating a railroad crossing in the vicinity of their property.

The following page includes a list of of Federal, State, County, and Local funding programs that project sponsors can pursue to fund a grade separation project on the Caltrain corridor. Many of these grant programs are very competitive, with more grant requests than grant funding available. It is imperative that grant applications are competitive and have regional support. For the full summary of grant opportunities, visit our website at www.caltrain.com/ccs/resources.

Hhillsdale, San Mateo

Local funds are often utilized as matching funds to leverage funding from a County, State, or Federal program

Figure 6.1: Typical Project Budget Summary

	Project Initiation/ Exploration	Conceptual Design	Preliminary Engineering/ Environmental Clearance	Final Design	Construction	OPERATION
Design Level	N/A	0-15%	15-35%	35%-100%	N/A	
Funding Range	$250K-$1M	$500K-$1.5M	$1.5M-$5M	$3M-$15M	$50M-$500M	
Approximate Timeframe of Project Phase	6-12 Months	1 Year	1-2 Years	1-3 Years	1-5 Years	
	• Evaluate crossing concepts • Develop high-level cost estimate	• Select Locally Preferred Alternative (LPA) • Develop preliminary funding plan	• Develop a detailed funding plan	• Finalize full funding agreement from 65%-95% design • Execute maintenance agreement • ROW acquisition initiated	• ROW acquisition completed	

LEGEND

Design Level

Funding Range

Approximate Timeframe of Project Phase

Federal, State, County, and Local Funding Programs

The funding programs mentioned in this chapter and dollars allocated are current as of the publication date of this Delivery Guide. While some of the programs listed below are directly allocated to grade crossings, others have much broader eligibility criteria. Programs, requirements, and available funding amounts are subject to change and should be verified directly with each funding source at the time of application.

Federal

$1.43 B *2022*	**Consolidated Rail Infrastructure and Safety Improvements Program (CRISI)**
$573 M *2022*	**Railroad Crossing Elimination Grant Program (RCE)**
$1.55 B *2022*	**Nationally Significant Multimodal Freight and Highways Projects Grants Program (INFRA)**
$1.0 B *2022*	**National Infrastructure Project Assistance Grants Program (MEGA)**
$2.3 B *2023*	**Rebuilding American Infrastructure with Sustainability and Equity (RAISE)**
$200 M *Anually*	**Reconnecting Communities and Neighborhoods Grant Program**
	One Bay Area Grant County and Local Program (OBAG) 3
$62 M	**San Francisco County**
$37 M	**San Mateo County**
$109 M	**Santa Clara County**

Visit www.caltrain.com/ccs/resources for the full Funding Summary Guide.

State

$17 M *Anually*	**California Public Utilities Section: 130 Program**
$15 M *Anually*	**California Public Utilities Section: 190 Program**
$149 M *Fiscal Year (FY) 2023*	**Reconnecting Communities: Highway to Boulevards (RC:H2B)**
$3.63 B *Cycle 6*	**Transit and Intercity Rail Capital Program (TIRCP)**
$65.9 M *Fiscal Year (FY) 2024-25*	**Caltrans Sustainable Transportation Planning Grants**

County/Local

$108 M *Annual Amount*	**Measure RR Program by San Francisco, San Mateo, and Santa Clara Counties**
$160 M *Funding Lifetime*	**SMCTA Measure A**
$68 M *Funding Lifetime*	**SMCTA Measure W**
$700 M *Funding Lifetime*	**VTA Measure B Funding Program**
$9.6 M *Annual Amount*	**Palo Alto Measure K** 1/3 for Transportation and Safe Train Crossings
$2.6 B *Funding Lifetime*	**SFCTA Proposition L**

Santa Clara Station, Santa Clara

Federal Funding Sources

Federal funding sources are extremely competitive, with demand across the country typically exceeding available resources. Some programs also have caps on allocations to individual states or for projects of a certain type. Because of the constrained federal funding landscape, coordination is important for successful applications.

FRA

RCE Grant Program

- The RCE Grant Program is a new program available to state and cities with rail crossing projects that focus on improving the safety and mobility of people and goods.
- Enacted in 2022, this grant program is authorized to allocate $573 million in Fiscal Year 2022.
- There is no specific allocation for states, but each eligible funded project will receive at least $1 million, except for planning projects, with no predetermined maximum amount.
- No state shall receive more than 20% of grant funds and 20% of the funds are dedicated to Rural Areas and Tribal Lands.

https://railroads.dot.gov/grants-loans/competitive-discretionary-grant-programs/railroad-crossing-elimination-grant-program

CRISI

- The CRISI is a federal funding program targeting improvements to safety, efficiency, and reliability for intercity passenger and freight rail, which includes highway-rail grade crossing improvement projects.
- Additional funding added for 2022 increased the total funding up to $1.43 billion, which includes $150 million dedicated to intercity passenger rail projects and $25 million dedicated to anti-trespassing measures.
- The federal share must not make up more than 80% of a project's funding, but there is no dollar limit on the funding available for a given project.
- Grants awarded under CRISI must have a nexus to freight and intercity rail. Commuter rail can only be a secondary benefit, limiting the potential applicability to the Caltrain corridor.

https://railroads.dot.gov/grants-loans/competitive-discretionary-grant-programs/consolidated-rail-infrastructure-and-safety-2

United States Department of Transportation (USDOT)

INFRA

- INFRA is a federal funding program available for multimodal freight and highway projects of national or regional significance to improve the safety, efficiency, and reliability of the movement of freight and people. Few projects have been awarded in commuter rail-only corridors under this program.
- In FY 2022, $1.55 billion in funding was made available under the Multimodal Project Discretionary Grant (MPDG).
- The minimum award amount for projects with less than $100 million in costs is $5 million, and the minimum award amount for projects with more than $100 million in costs is $25 million.
- Federal assistance may not exceed 80% of future total eligible project costs, except for states with a population density of not more than 80 persons per square mile.

https://www.transportation.gov/grants/infra-grants-program

Funding Program Requirements

Funding programs often include requirements that the project sponsor must meet to secure the funding. Project sponsors should be aware of the funding requirements and share those requirements with Caltrain staff as early as possible. This communication will enable the project sponsor and Caltrain to work collaboratively to meet the program requirements in the most efficient manner. Below are examples of some, but not all, of the funding program requirements that can influence a grade separation project:

- **Section 190 Program Requirement –** For consideration to attain CPUC funding programs, agencies must submit their crossing for evaluation and ranking within the Section 190 Program.
- **Federal Program Requirement –** For projects that receive federal funding, Caltrain is required to complete an environmental review process per NEPA.
- **Grant Drawdown Requirement –** Some funding programs set funding drawdown deadlines for specific phases. This requirement can dictate the project schedule.
- **Local Match Requirement –** Many state and federal programs fund a portion of a project's cost. The project sponsor needs to provide the remainder as a local match. The local match requirement varies depending on the state or federal program and project cost.

MEGA

- Mega is a federal funding program available under the Multimodal Project Discretionary Grant (MPDG) program.
- In FY 2022, this program provided $1 billion in funding for large, complex projects that are difficult to fund by other means and are likely to generate national or regional economic, mobility, or safety benefits.
- There is no award minimum, but federal assistance may not exceed 80% of future total eligible project costs.

https://www.transportation.gov/grants/mega-grant-program

RAISE

- The RAISE program provides funds for road, rail, transit, and port projects that improve safety, economic strength and global competitiveness, equity, and climate and sustainability.
- The minimum award size for capital grants is $1 million in rural areas and $5 million in urban areas. There is no minimum award size for planning projects.
- Grant requests must not exceed $25 million to be considered under the full $2.3 billion funding amount for the program in 2023.

https://www.transportation.gov/RAISEgrants

The Reconnecting Communities and Neighborhoods (RCN) Program

- The RCN Program was announced in 2022 with the goal to fund projects that reconnect communities impacted by past transportation infrastructure projects.
- In FY 2023, $198 million was apportioned, with $50 million allocated for planning projects and $148 million allocated for capital projects.
- Individual planning projects will receive no more than $2 million, whereas the minimum amount for construction projects is $5 million.

https://www.transportation.gov/grants/reconnecting-communities

Metropolitan Transportation Commission (MTC)

One Bay Area Grant (OBAG 3) County and Local Program

- OBAG 3 was adopted by MTC in 2022 and includes $750 million in federal funding for Bay Area projects between 2023 and 2026. Total OBAG 3 nomination targets for projects in the counties along the Caltrain corridor include $62 million for San Francisco, $37 million for San Mateo, and $109 million for Santa Clara.
- The County & Local Program enables County Transportation Agencies (CTAs) to nominate specific projects to be funded. The Middle Ave Undercrossing project in Menlo Park was allocated $5M through this source.

https://mtc.ca.gov/funding/federal-funding/federal-highway-administration-grants/one-bay-area-grant-obag-3

State Funding Sources

California Public Utilities Commission (CPUC)

Section 130 Grade Crossing Hazard Elimination Program (Section 130)

- This program provides state funds to project sponsors to reduce the number and severity of highway collisions by eliminating hazards to vehicles, cyclists, and pedestrians at existing railroad crossings.
- Under Section 130, most eligible projects involve incremental improvements to grade crossings.
- Grade crossing elimination projects (through roadway closure) are also eligible. Agencies must submit their crossing for evaluation and ranking by CPUC.

https://dot.ca.gov/programs/local-assistance/fed-and-state-programs/sec130

Section 190 Grade Separation Program (Section 190)

- The Section 190 program provides state funds to project sponsors for grade separation projects.
- The program typically provides approximately $15 million each fiscal year distributed among three to four projects. In addition, no project will receive an allocation exceeding $5 million each fiscal year. For consideration, project sponsors must submit their crossing for evaluation and ranking.

https://dot.ca.gov/programs/rail-and-mass-transportation/grade-separation-program-section-190-guidelines

Caltrans Sustainable Transportation Planning Grants

- This program makes $65.9 million available (in FY 2024-25) for transportation planning projects statewide and includes:
  - » Sustainable Communities Grants ($29.5 million) to encourage local and regional planning that supports state goals, implements Regional Transportation Plan (RTP) Sustainable Communities Strategies (SCS) (where applicable), and to ultimately achieve the state's greenhouse gas (GHG) reduction target of 40 and 80 percent below 1990 levels by 2030 and 2050, respectively.
  - » Climate Adaptation Planning Grants ($31.9 million) support local and regional identification of transportation-related climate vulnerabilities through the development of climate adaptation plans, as well as project-level adaptation planning to identify adaptation projects and strategies for transportation infrastructure.
  - » Strategic Partnerships Grants ($4.5 million) to identify and address statewide, interregional, or regional transportation deficiencies on the state highway system in partnership with Caltrans. A sub-category funds transit-focused planning projects that address multimodal transportation deficiencies.
- Eligible planning projects must have a transportation nexus and are expected to directly benefit the multimodal transportation system.
- For grade crossings, this program could be used to fund the initial planning phases of the project (up to Phase 2: Conceptual Planning).

https://dot.ca.gov/programs/transportation-planning/division-of-transportation-planning/regional-and-community-planning/sustainable-transportation-planning-grants

TIRCP

- The TIRCP was created by CalSTA to fund transformative capital improvements that modernize California's intercity rail, bus, ferry, and rail transit systems.
- TIRCP funds available for a General Fund cycle are regionally subdivided, with minimum distribution requirements, and will be awarded to new projects selected through the regular TIRCP process.
- Past rounds of funding allocation have included a target range of $70 to $210 million in funding for high-priority grade crossing improvement and separation projects for the rest of the state (outside the Southern California region).
- Outside of grade crossing allocations, TIRCP is a highly competitive program that requires demonstrating reduction in greenhouse gas emissions as a result of a project.

https://calsta.ca.gov/subject-areas/transit-intercity-rail-capital-prog

Reconnecting Communities: Highways to Boulevards (RC:H2B)

- This program established $149 million in FY 2023 to fund the conversion of highways or other transportation facilities, including rail facilities, that create barriers to community connectivity in order to reconnect communities divided by previous transportation infrastructure.
- 100% of the program funds are awarded to projects that benefit underserved communities. Funding is provided on a reimbursement basis after jurisdictions enter an agreement with Caltrans.

The program guidelines were published on June 20, 2023. Refer to the website below for more information.

https://dot.ca.gov/programs/local-assistance/fed-and-state-programs/rc-h2b

County Funding Sources

Measure RR Program by San Francisco, San Mateo, and Santa Clara Counties

- Measure RR increased the sales tax in San Francisco, Santa Mateo and Santa Clara counties by one-eighth of a percentage point and dedicates the revenue to Caltrain.
- This source provides the first dedicated funding for Caltrain, which has relied on annual discretionary appropriations from its member counties.
- The measure expects to generate an estimated $108 million per year for operations and capital improvements. These funds will support implementing Caltrain's Long-Range Service Vision, including the San Francisco Downtown Extension, the extension of electrified train service to Gilroy, and grade separations throughout the Caltrain Corridor.

https://www.spur.org/voter-guide/2020-11/ba-measure-rr-caltrain-sales-tax

Measure A Program by SMCTA

- The Measure A program is available for the San Mateo County Transit District (SamTrans), San Mateo County cities, San Mateo County, and the JPB. The Measure A half-cent transportation sales tax was reauthorized in 2004 and the extension went into effect in 2009 (2009-2033 Transportation Expenditure Plan).
- Measure A provides 15% of its revenue to the Grade Separation Category, which is estimated to be $225 million over the lifespan of the measure. Measure A funding has been largely allocated on a first come, first served basis.
- For the 2009-2033 Measure A Funding Program, there are 46 candidate grade separation projects, and as of December 2023, five projects have received $135.5 million of the Measure A funding.

https://www.smcta.com/about-us/funding-overview/measure

Measure W Program by SMCTA

- The Measure W program is a half-cent sales tax which went into effect in 2019. Half of the funds are administered by SamTrans for the County Public Transportation Systems category in Measure W's Congestion Relief Plan, and half of the funds are administered by the San Mateo County Transportation Authority for administering the other categories, which make up the remaining 50 percent of the measure.
- Among the other categories, Measure W allocates 2.5% of the overall sales tax revenue for grade separations, which is estimated to be $68 million (approximately $2 million per year) over the 30-year lifespan of the measure. To date, the SMCTA has not programmed or allocated any grade separations from the Measure W grade separation category.
- Future allocation of Measure W funds will be based on the results of the SMCTA Strategic Plan 2025-2029 or further actions by the SMCTA Board.

https://www.smcta.com/about-us/funding-overview/measure-w

2016 Measure B Program by VTA

- The 2016 Measure B program is a county-wide funding program sourced from a 30-year, half-cent sales tax, to enhance transit, highways, expressways, and active transportation (bicycles, pedestrians, and complete streets) projects.
- The 2016 Measure B was approved in 2016 and went into effect in 2017. It allocates approximately 11% of the program tax revenues to the "Caltrain Grade Separations" category, which is estimated to be approximately $700 million over the lifespan of the measure. $178 million has been allocated through Fiscal Year 2025.
- This allocation is to be divided between three cities, with 25% to Sunnyvale, 25% to Mountain View, and 50% to Palo Alto.

https://www.vta.org/projects/funding/2016-measure-b

Local Funding Sources

Palo Alto Measure K

- Palo Alto's Measure K is a city-wide business tax that raises funds for public safety, affordable housing and homeless services, and grade-separated train crossings, with one-third of the funds targeted for each of the categories.
- This measure passed in the November 2022 election and is expected to provide an estimated total of $9.6 million in funding each year.

https://www.cityofpaloalto.org/Business/Business-Tax-Implementation-Information

Proposition L by SFCTA

In November 2022, San Francisco voters approved Proposition L, the Sales Tax for Transportation Projects measure that will direct $2.6 billion (2020 dollars) in half-cent sales tax funds over 30 years. Prop L came into effect on April 1, 2023, superseding the previous half-cent sales tax, Prop K. Projects funded through Propostion L include the Downtown Caltrain Extension to the Salesforce Transit Center. The 2022 Transportation Expenditure Plan identifies transportation improvements to be funded from the retail transactions and use tax ("sales tax") authorized under Public Utilities Code Section 131000 et seq. and passed by San Francisco voters at the November 2022 election as Proposition L ("2022 Sales Tax"). The programs included in the 2022 Transportation Expenditure Plan are designed to be implemented over the next 30 years.

Additional Local Funding Sources

Additional funding sources can be developed at the discretion of the local municipality, such as a Business Improvement District (BID) or a Enhanced Infrastructure Financing District (EIFD).

Design Criteria and Grade Separation Types

7 Key Considerations and Design Criteria

Caltrain

Castro Street, Mountain View


Castro Street, Mountain View

7 Key Considerations and Design Criteria

Railroad property is Caltrain's most valuable and durable asset. When planning and designing a grade separation project, the following criteria will have a significant impact on project viability.

Governing Design Standards

One of the most significant elements of planning and designing a grade separation project is understanding the governing design standards. As discussed in Chapter 1, the Caltrain corridor has multiple owners, operators, and tenant railroads. The governing design standards will depend on project location.

Caltrain-Owned

If a project is located within the Caltrain-owned corridor, a grade separation will be designed in accordance with the Caltrain Design Criteria. These criteria can be found on the Caltrain website at https://www.caltrain.com/about-caltrain/doing-business/engineering/engineering-standards. Caltrain's current version of the Design Criteria is the Fourth Edition, dated January 1, 2024.

There are UPRR-owned facilities within the Caltrain corridor, such as UPRR-owned setouts or pocket trains. These facilities, and the connections to them, will be designed in accordance with UPRR criteria discussed in the next section.

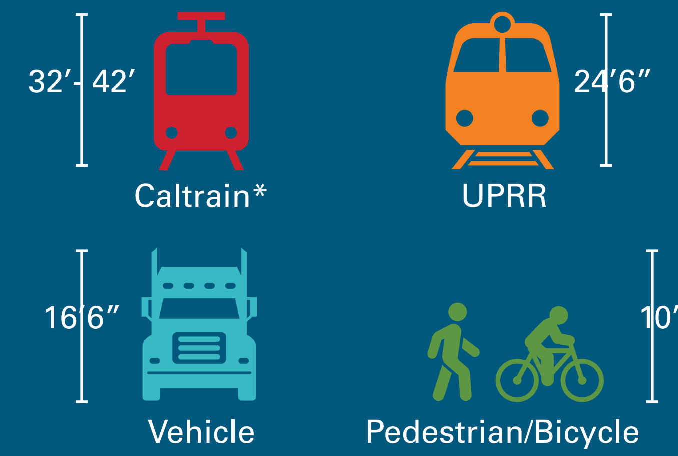
UPRR-Owned

If a project is located within the UPRR-owned corridor, a grade separation will be designed in accordance with UPRR Design Criteria. This includes the Union Pacific Railroad Public Projects Manual and the UPRR Guidelines for Railroad Grade Separation projects. These criteria can be found on the UPRR website at https://www.up.com/cs/groups/public/@uprr/@corprel/documents/up_pdf_nativedocs/pdf_up_public_projects_manual.pdf and https://www.up.com/cs/groups/public/documents/up_pdf_nativedocs/pdf_rr_grade_sep_projects.pdf. Future electrification of the UPRR corridor to accommodate the HSR project, may have additional impacts on governing design standards (including vertical clearance).

The remainder of this section will discuss criteria within the Caltrain-owned corridor.

Key Takeaways:

Caltrain Design Vertical Clearance Criteria:



Corridor Design Criteria Manual:

*Dependent on OCS configuration

Vertical Clearances for Overpasses

Caltrain's electrification of the corridor introduces new considerations for vertical clearance requirements. The corridor is electrified with an OCS to supply 25 kV electric power to the new Electric Multiple Unit trains (EMUs). The OCS is a system of electrical conductors supported aerially above the tracks, typically with steel poles and support arms, brackets, and cross spans comprised of the following major components.

- **Contact Wire** – centered above each track at a height of approximately 24', this wire provides power directly to the trains via the pantograph on the top of the vehicle.
- **Messenger Wire** – centered above the contact wire at a height of 27.25' to 29.58', this wire supports and stabilizes the contact wire.
- **Static Wire** – this aerial ground wire connects OCS supports to the traction power return circuit and system grounding grids at a typical height of 24' to 30' and a maximum of 41'.
- **Feeder Wire** – located near the top of the OCS poles on both sides of the tracks, this wire interconnects the main power transformers throughout the corridor. The height of this wire varies throughout the system, typically from 32-36' above the top of rail with a maximum height of 47' in some areas.
- **Shunt Wire** – located at utility crossings to provide a path to ground in case of a failure of the crossing utility conductors, this wire is installed above the feeder wire when needed.
- **Insulators** – located between the electrified wires and the OCS structure, insulators prevent the high-voltage electricity from flowing into the OCS pole or OCS foundation.

Caltrain Design Vertical Clearance Criteria:

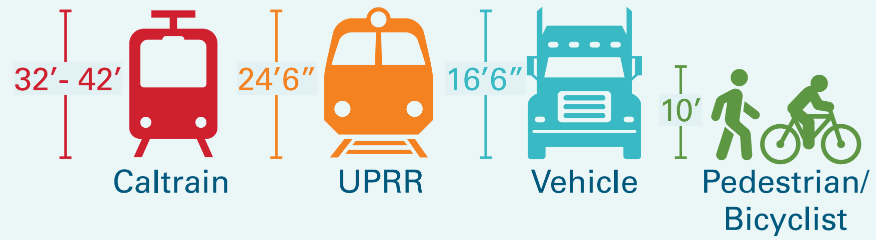
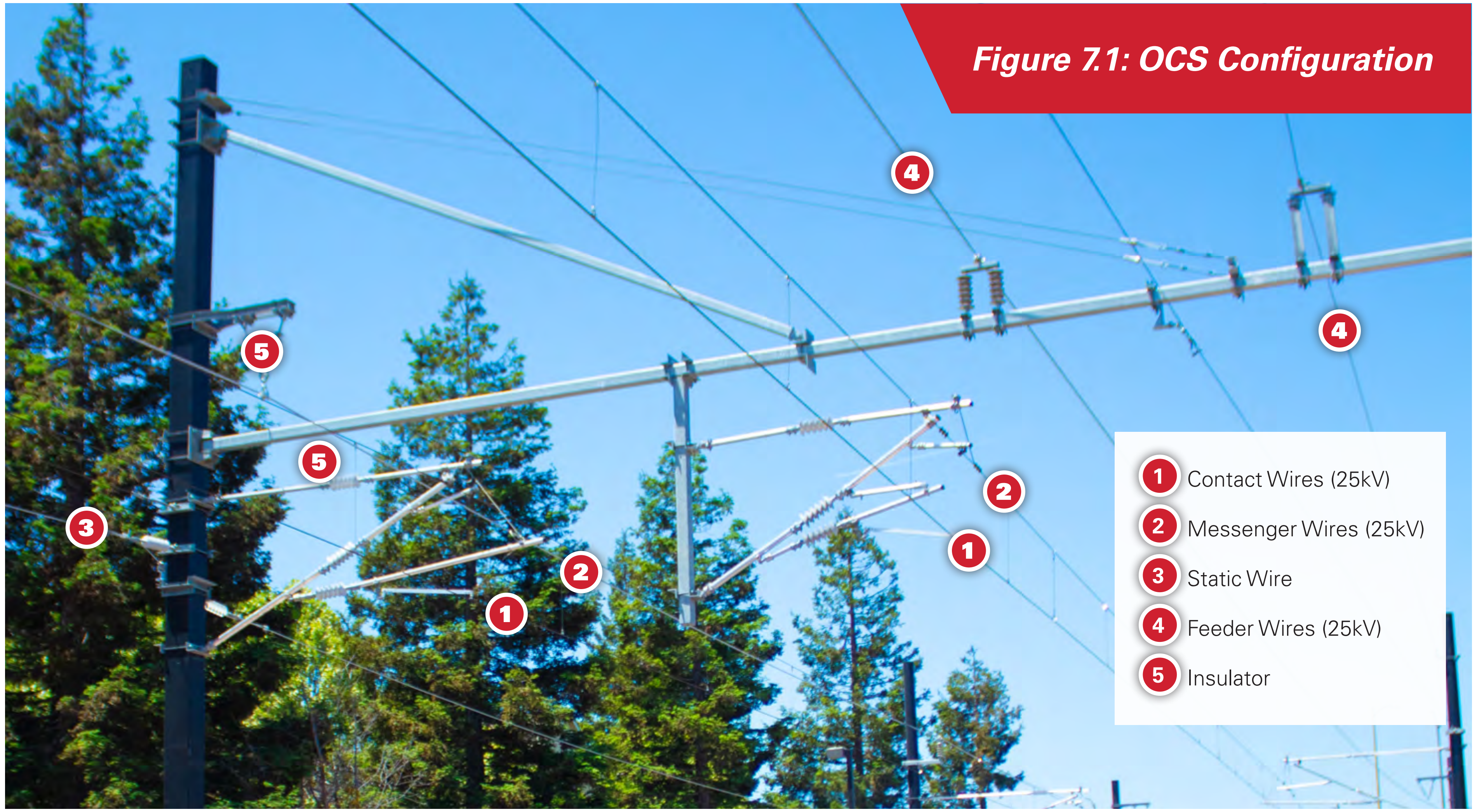


Figure 7.1 represents a typical configuration of the OCS infrastructure.

The height of a new overpass over the Caltrain ROW will be governed by the height of the OCS equipment, which varies throughout the corridor. Per the Caltrain Design Criteria, the contact wire shall be installed and maintained at a nominal constant height of 22 feet, measured from the top of the rail. The heights of the messenger, static, and feeder wires are normally set above the contact wire. Typical heights of feeder wires are 32' to 36', but are set higher in various locations within the corridor. Clearances from a new overpass to the OCS equipment is set by regulation, including CPUC General Order 95. As a result, the height of a new overpass will be site specific and dependent on structure type and configuration of OCS equipment at the crossing. For most locations, this vertical clearance will be 32'to 42'.

Modification of the OCS to allow for a lower overpass height can be beneficial to proposed grade separations. However, modifying the OCS to support a grade separation should not be the first choice and should only be considered after all other viable alternatives have been exhausted. This is because modifications to in-service OCS infrastructure will add cost and duration to a project while adversely impacting railroad operations. OCS modifications to lower overpass heights include lowering wires (i.e., feeder wires and/or messenger wires). It is generally impracticable to relocate the contact wire without significant changes to other components of the OCS. **If OCS modifications are being considered, Caltrain should be engaged early in the planning process to help evaluate alternatives**, as Caltrain and project sponsors will need to consider the significant costs and impacts of modifying and recertifying the OCS systems.

Figure 7.1: OCS Configuration



Vertical Clearances for Underpasses

For constructing an underpass under the Caltrain ROW, clearances need to be considered in the context of construction method, soil and subsurface conditions, and rail conditions. Per Caltrain Design Criteria, vehicular underpasses require a minimum of 16'-6" of clearance from the top of the roadway to the underside of the structure for the full-width of Caltrain ROW. The minimum pedestrian and bicycle vertical clearance is 10'.

Underpasses can be constructed as excavations with structures, box jacking, or tunneling methods. Underpasses can be constructed with as little as 5' of cover (measured from the bottom of railroad ties to the top of the structure) if a minimally invasive method such as box jacking or tunneling is utilized. The depth of cover is heavily dependent on construction methods, subsurface factors, and the railroad infrastructure at the crossing. Considerations may include:

- A tunneling method for construction may need to be deeper to not disturb the soil above.
- Utilities or poor soil conditions may necessitate a deeper construction depth.
- Railroad infrastructure such as switches, signals, or OCS poles may dictate an underpass alignment. An underpass beneath a railroad switch or signal is not desirable due to the smaller construction tolerances. An underpass cannot undermine the foundations for the OCS poles.
- Box jacking and tunneling may not be viable for all underpass crossings. In addition, box jacking is contingent on a large jacking pit being constructed adjacent to the crossing.
- More commonly used bridge construction methods, such as simply supported bridge spans, will have different structural depths. This is discussed in the Structural Design section of this chapter.

Profile Grade

Profile grade defines the rate of elevation change of the railroad. It is a ratio of vertical grade change/horizontal length and is often expressed as a percentage. Caltrain's criteria allows profile grades up to 2% with review and approval of the Director of Engineering. The approval will be based on a detailed review of the specific location, track configuration, proximity to UPRR and future CAHSR facilities and other operational and maintenance factors. Note that the maximum 2% grade requirement is for projects within the Caltrain corridor. Projects within the UPRR corridor will need to be constructed to UPRR Standards.

ROW impacts

When planning a grade separation, it is important to consider how such a project impacts the railroad ROW. Caltrain must maintain the ROW required to meet safety, maintenance, and operating needs. **As a general policy, Caltrain preserves the existing ROW for current and future Caltrain operations and maintenance.**

Horizontal Clearances

Horizontal clearances from tracks, equipment, and structures will often dictate the overall width of a grade separation. A list of horizontal clearance criteria is shown in **Table 7.1**. Note that if the project is being constructed on the Caltrain-owned portion of the corridor (as defined by **Figure 1.4**), the project needs to comply with Caltrain Standards. If the project is being constructed on the UPRR Portion of the corridor, the project needs to comply with UPRR Standards.

Table 7.1 - Horizontal Clearance

From Nearest Track Center to	Caltrain	Reference	UPRR	Reference
Adjacent Tangent Track	15'-0"	CDC 2.C.3.1	15'-0" 20'-0" (Preferred)	UPRR STD DWG 0002
Adjacent Tangent Track with Center Fencing	18'-0"	CDC 3.D1.1.f		
Standard Clearance Envelope (Tangent and Curved Track)*	12'-6"	CSD SD-2002	9'-0"	UPRR STD DWG 0038
Underground Utilities	12'-0"	CSD SD-2002	15'-0"	UPRR/BNSF Guidelines for Temporary Shoring Figure 1
Pole (non-electrical)	10'-0"	CSD SD-9000	15'-0"	UPRR STD DWG 0038
Pole (electrical)	13'-0"		15'-0"	UPRR STD DWG 0038
Post/Signs	10'-0"	CSD SD-9000	12'-4"	UPRR STD DWG 0038
Permanent Structure (Buildings and Trees)	25'-0"	CDC 3.C.2.1.a	9'-0"	UPRR STD DWG 0038
Permanent Structure (Bridge Columns)	25'-0"	CSD 3.3.1		
Signal House	25'-0"	CSD SD-5108	25'-0"	
Crossing Gate	10'-0"	CDC 3.C.2.1.c	12'-0" 15'-0" (Preferred)	
Excavation Limits	10'-0"	Caltrain Excavation Support Systems Figure 2.1	15'-0"	UPRR/BNSF Guidelines for Temporary Shoring Figure 1

**Additional clearance criteria exist for station platforms*

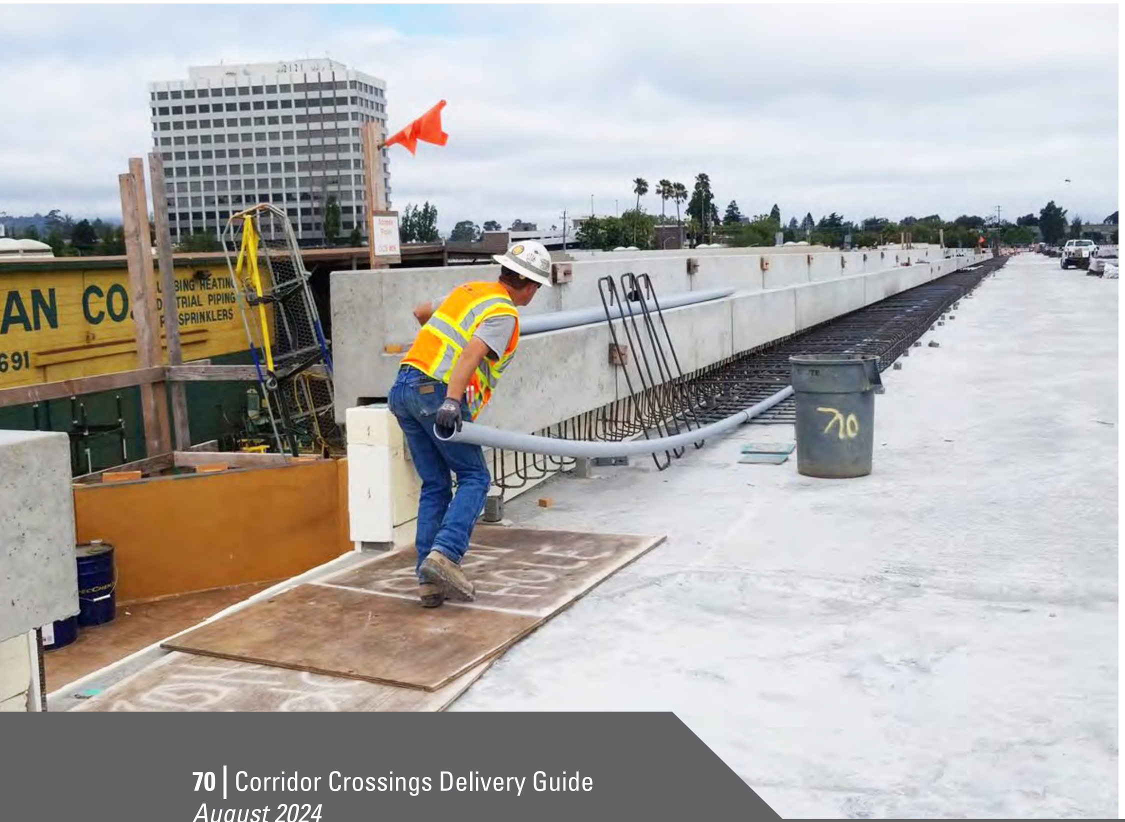
Structural Design

When planning a grade separation project, it is important to consider the design process for the structural systems. A structural system is designed to support the loading that can be expected to be placed on the structure. This is generally divided into two categories: dead loads and live loads. Dead loads are permanent loads from the weight of the structure. This includes the concrete or steel of the structure, any support surfaces on the structure, and the railroad ballast and tracks. Live loads are variable loads placed on the structure by occupancy or intended use. Live loading of a railroad structure includes trains, passengers, cargo, or vehicles.

A railroad bridge needs to resist the live and dead load forces placed within its span, or the distance between supports. Supports include the abutments of a structure, or piers in the middle of a structure. Since the Caltrain corridor conveys both freight rail and commuter rail, it is subject to both load cases when designing a structural system. The controlling load case is the freight rail loading, as it is much heavier than a commuter rail loading. **As a result, bridges on the Caltrain corridor are larger than bridges that solely support commuter rail.**

Generally, a structure resists the live load and dead load forces in two ways: by shortening the span or increasing the depth of the deck. Short spans are not always feasible on a railroad grade separation, as there is a need to provide clear space below to allow vehicles, buses, cyclists, and pedestrians to travel beneath the bridge. The large loading case, combined with longer span lengths, means that bridge decks need to be deeper to support the load. **As a result, most Caltrain bridge decks range from 8′ to 12′ in depth.** Load cases are standardized and cannot be reduced. As a consequence, structure depth can be reduced by either reducing the span length by adding more supports or selecting a different structure type with a shallower deck thickness, such as a through-plate girder or a through-box girder. Note that these structure types have other tradeoffs such as construction cost and visual impacts.

The Caltrain Standards for Design and Maintenance of Structures provide guidance on allowable structure types. To provide redundancy and ease of maintenance, railroads prefer structural systems that are segmental and simply supported. These segmental and simply supported structures tend to have deeper decks compared to alternative structural systems. However, these alternative structural systems may provide benefits such as lower costs, ease of construction, less visual impacts, and reduced vertical clearances. More detailed information is provided in the Caltrain Standards for Design and Maintenance of Structures, the BNSF/UPRR Structural design guidelines, and the AREMA Manual for Railway Engineering.



Design Variances

If the Caltrain design criteria cannot be met, a Design Variance would be required. These are the factors that are considered when evaluating the appropriateness of a variance:

- Several project elements need to be developed to a preliminary design level to discuss variances. These include horizontal geometry, vertical alignment, and profile.
- Variance requests should be fact-based and supported by cost-benefit analysis.
- Variance requests should be made with the Caltrain Variance Request form, which is included in **Appendix 2**.
- OCS modifications should be supported by a documented, robust analysis separate from a variance request. OCS modifications also need to consider construction impacts to transit service and future maintenance costs.

Operational Impacts

When planning a grade separation, it is important to understand how the project will impact existing operations. A few key items include:

- Construction on the active railroad corridor will require the preparation of a site specific work plan (SSWP). This plan will describe how to schedule the work activities, the worker protection required, and how impacts to Caltrain operations will be mitigated. Depending on the magnitude of the work, construction activities may need to be coordinated months or years in advance with Caltrain. Key elements of a SSWP include:
  - » Excavations will not be allowed around the active railroad. If excavations are necessary within the Zone of Influence (as defined in the Engineering Standards for Excavation Support Systems), the track will need to be taken out of service while excavations are occurring.
  - » SSWPs are required when the work is inside a prescribed clearance envelope from the active railroad.
  - » Equipment and activities that have the ability to foul the tracks require an SSWP, even if the activities fall outside of the clearance envelope.
  - » Construction activities on the active railroad requires support from multiple Caltrain groups, including railroad flaggers, Roadway Worker in Charge (RWIC), and signal and traction power support. Early and frequent communication of work activities is essential to ensure a safe and efficient construction environment.

In planning for construction along the corridor, Caltrain and the partner cities must balance the tensions of providing reliable passenger rail service with efficient construction of local projects.

Caltrain is currently developing a shutdown policy, anticipated to be adopted in 2024, to provide a structured framework for advanced planning to balance competing railroad operations needs and construction activities so capital improvements do not result in detrimental service disruptions. Until this policy is adopted, Caltrain will evaluate the short and long term impacts on railroad operations and passenger service disruptions in conjunction with the impacts to project cost and project duration. Below are operational mitigations that may be considered.

Shoofly Tracks

Shoofly tracks provide a temporary track detour allowing rail traffic to continue flowing around the construction zone. If shoofly tracks are contemplated, considerations include:

- **Operations.** Shoofly tracks should be designed to facilitate double-track operations.
- **OCS system.** Shoofly tracks will need a complete OCS system that is compatible with the main trackways.
- **Available ROW adjacent to construction activities.** If insufficient ROW is available for the construction of shoofly tracks, ROW acquisition would be required. This has the potential to significantly increase project cost and schedule
- **Construction and demolition.** Shoofly tracks, once constructed, can be left in place indefinitely. However, they generally serve no purpose once the grade separation is completed. They are usually demolished post-construction.
- **Impacts to project budget.** Shoofly tracks are expensive to design, construct, and electrify.

Single Tracking

Single tracking is the temporary closure of all but one mainline track to facilitate maintenance or construction activities on the closed tracks. Some construction activities will require a single track closure of the railroad. This may include installation of a new bridge section or installing facilities beneath the railroad. If a single track closure is contemplated, considerations include:

- Caltrain would only consider single-track closures during off-peak and weekend hours. Single-tracking will not be allowed during peak travel times, as it reduces operational capacity and service obligations cannot be met with single track service.
- Freight rail access still needs to be accommodated during a closure. This right to access is codified in the Trackage Rights Agreement between Caltrain and UPRR.
- Single track scheduling depends on the location of railroad control points and the locations of these control points with respect to the closure. Work closures must occur between one set of control points.
- Single tracking introduces delay and inconveniences passengers, so this will need to be balanced against construction impacts and duration.

More impactful service impacts, such as full track closures during non-revenue hours, nights, and weekends have a direct revenue and operational impact to Caltrain that must be considered carefully. Costs related to a full track closure, including necessary bus bridges, shall be considered as project costs. Full track closures and similar project impacts will be considered at Caltrain's sole discretion. Construction and operational impacts need to be considered early in the project development process.

Active Transportation

Pedestrian, Bike, and Micro-Mobility Access

Facilities for people walking and biking should be considered for all grade-separated crossings. Critical elements to support these modes include accessible sidewalks, bicycle lanes, multi-use trails, and crosswalks.

For the purposes of this discussion and simplicity, "pedestrians" or "people walking" also includes people using strollers, wheelchairs, or other mobility assistance devices; "cyclists" or "people biking" also includes people using scooters or other active transportation and micro-mobility modes. Active transportation modes are the most vulnerable roadway users, and care should be taken to provide safe, convenient facilities for people walking and biking. **These facilities should be designed in a way to support intuitive, comfortable, and secure use and should be identified and prioritized in the early planning stages of a project.**

Given the scale of grade separation projects, these projects offer a prime opportunity to increase active transportation access for the surrounding community. Improvements to surrounding infrastructure should be prioritized and closely coordinated with local partners.

Access Priorities

Caltrain has clarified access priorities through its Comprehensive Access Program Policy, dated May 2010. Caltrain is updating this policy in 2024. In accordance with this policy, access to Caltrain facilities (including grade separations) should be prioritized by the following transportation modes:

Shared and Separated Bike Facilities

Where a crossing serves as the only protected bicycle crossing within 0.5-miles or could serve as a link in the local agency's or region's bike plan, the facility should be designed to allow for through-bike-movements without dismounting.

If there are reasonable alternative routes and the site is extremely constrained, requiring bikers to dismount and walk their bike may be considered. However, designing facilities to work with how people want to travel will increase correct usage and safety for all users. Additionally, providing comfortable, convenient, active transportation facilities will help encourage more active transportation travel, contributing towards local, regional, and state greenhouse gas reduction goals.

Accommodation Selection

People driving, biking, and walking typically have different speeds and needs. To minimize potential conflicts and improve the user experience, separate facilities for each user group should be provided when feasible. Where accommodating all transportation modes is appropriate, facility types are noted in order of preference below:

1. Separate vehicle, bike, and pedestrian facilities
2. Separate vehicle facilities and a widened shared use path
   a. Provide a widened shared use path that allows for bikes to travel through the grade-separated crossing without dismounting
3. Separate vehicle and pedestrian facilities
   a. Bikes must dismount and walk their bike along a widened sidewalk

Location Selection

When parallel to roadways, pedestrian and bike facilities at grade-separated crossings may be placed on one or both sides of the roadway depending on the adjacent land uses and network configuration. Typically, providing pedestrian and bike facilities on each side of the roadway will increase convenience, safety, and correct usage.

Bike Facility Design

Bike facility type (i.e. Class II, III, IV) should be selected using NACTO's "Choosing an All Ages & Abilities Bicycle Facility," which considers vehicle speeds and volumes to make a facility type recommendation, or current local or regional guidance as applicable. Bike facility widths should be based on current local or regional guidance as applicable; general recommended and minimum widths are noted on the following page.

Class I

- Refer to "Shared Use Path" section below

Class II

- Minimum: 6-foot (5-foot absolute minimum)
- Preferred: 7-foot bike lane with 2-foot striped buffer

Class III

- Bikes share the vehicle travel lane; no minimum
- Lane width needs to discourage side-by-side riding and driving

Class IV

- Each side of the road
  - Minimum: 6-foot (5-foot absolute minimum) bike lane with 1.5-foot buffer or vertical element separation
  - Preferred: 7-foot bike lane with 3-foot buffer with separation
- Two-way cycle track
  - Minimum: 9-foot (8-foot absolute minimum) two-way cycle track with 2-foot buffer with separation
  - Preferred: 12-foot two-way cycle track with 3-foot buffer with separation

Pedestrian Facility Design

Sidewalks along grade-separated crossings must be designed to meet local, state, and ADA requirements including clear width and maximum grades. Accessible curb ramps with truncated domes must be provided at intersections, as applicable. Sidewalk width should consider the number of anticipated pedestrians, if people walking bikes or strollers will be present, edge conditions, and pedestrian comfort. General recommended and minimum clear widths are noted below.

- Minimum: 6-foot (low pedestrian volumes, separate bike facilities)
- Minimum: 8-foot plus (may include people walking bikes)
- Preferred: 10-foot plus

Shared Use Path Design

Shared use paths (also referred to as Class I or multi-use paths) along crossings must be designed to meet local, state, and ADA requirements, including maximum grades. Accessible curb ramps with truncated domes must be provided at intersections, as applicable. The path geometry should be designed to allow bikes to safely navigate turns at appropriate speeds. Signs or pavement markings encouraging bikes to yield to pedestrians and travel at appropriate speeds should be provided.

Shared use path width should consider the daily and peak hour number of anticipated pedestrians and cyclists and user comfort. General recommended and minimum clear widths are noted below.

- Minimum: 8-foot path with 2-foot clear shoulders on each side of path
- Preferred: 12-foot plus path with 2-foot clear shoulders on each side of path
- Alternative Minimum: 2-foot shoulder, 8-foot bike path, 6-foot pedestrian path

Alternatives to Bikes Dismount Signs

It is important to consider alternatives to requiring bikers to dismount and walk their bikes at crossings. There is a delicate balance between meeting all user needs and protecting vulnerable roadway users. Signage and pavement markings may be used to encourage slower bicycle speeds and pedestrian priority, allowing people to continue biking slowly through the overhead or underpass crossing. A few examples are included below:

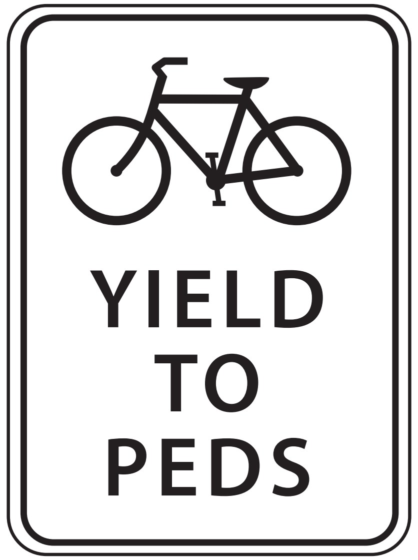
- "Pedestrian Priority Zone, Ride Slowly"
- "Bikes Yield to Peds"
- "Shared Path, Please consider other path users"
- "Bike at Walking Speed"
- "5 MPH"

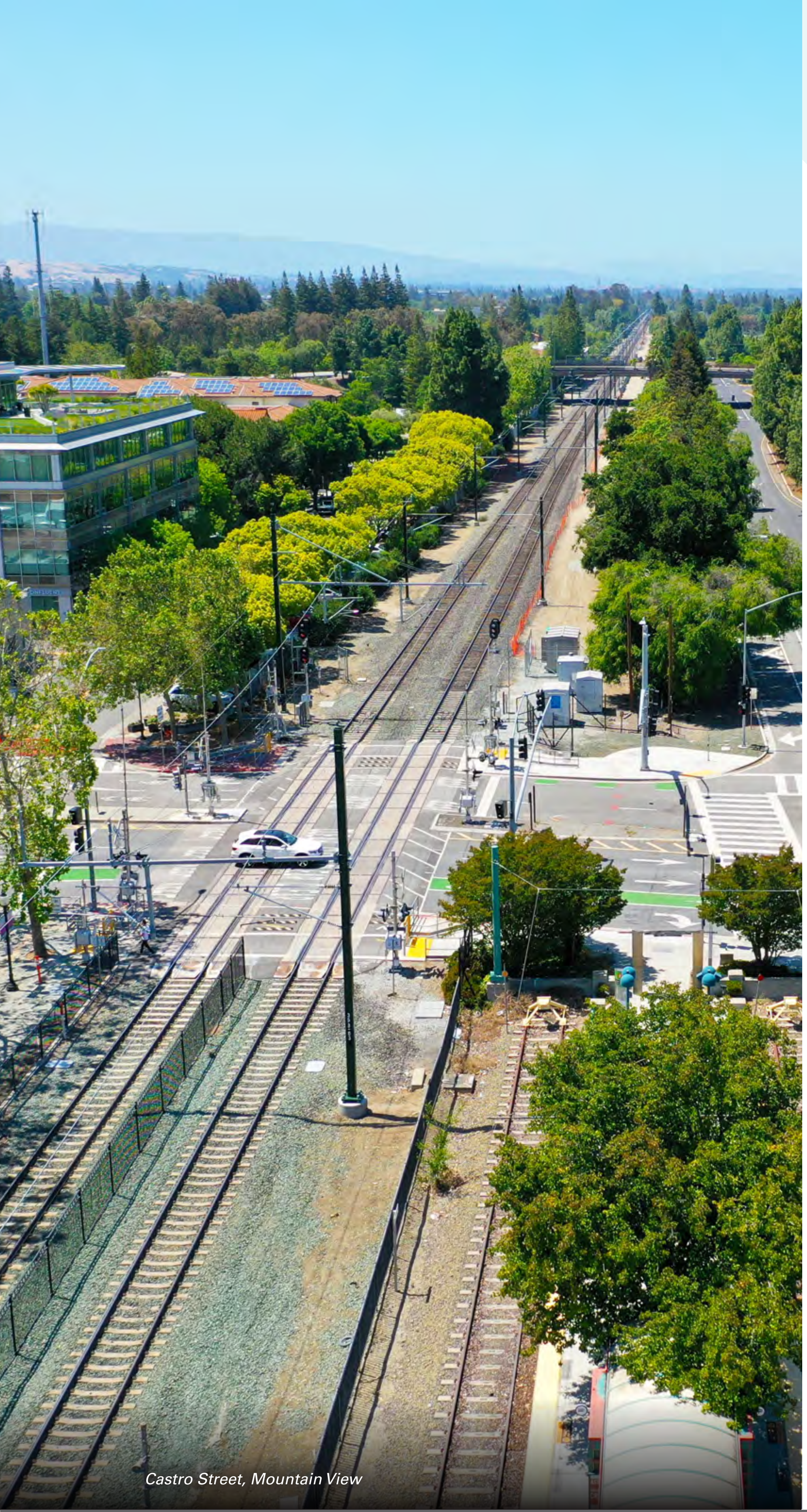
Additional Pedestrian and Bicycle Facility Elements and Bike Accommodation

While sidewalks, bike lanes, and shared-use paths serve as the foundation of the pedestrian and bicycle experience leading up to and along a crossing, there are additional elements that are essential to creating a safe and inviting active transportation experience. The following elements should be considered in the crossing design, either along or leading up to the crossing, and should be included in the design as contextually appropriate:

- Station access routes and connections to transit and pick-off/drop-off
- Access to adjacent properties
- Intersection treatments (curb extensions, leading bike and pedestrian intervals, crossing refuge islands, crossing treatments, crosswalks, conflict markings, bike signals, dedicated/protected intersections, etc.)
- Pedestrian scale lighting
- Landscaping
- Bike racks and bike lockers
- Placemaking features, such as shade and street furniture

These elements should be designed in a way to support comfortable and secure use of the facilities. These elements should be identified and prioritized in the early planning stages of a project so that all crossing users can be accommodated.





Castro Street, Mountain View

Grade Separation Components

In addition to the Key Criteria mentioned in this chapter, grade separations will have many, if not all, of the major components listed below. Additional information as it pertains to each grade separation type is shown in **Chapter 8, Grade Separation Types**.

- **Caltrain Facilities and OCS:** The OCS provides electricity to power the Caltrain EMUs. The system requires a series of poles along the center or sides of the corridor that hold the OCS wires and supporting equipment. The OCS wires run parallel to the tracks and vary in height. Industry standards require vertical and horizontal clearances from the OCS for both permanent structures and construction equipment. Caltrain must be involved in conversations related to proposals that request to move OCS equipment. OCS wires are typically 1/2 of a mile in length, and cannot be spliced. As a result, a modification at a single point of the OCS system can impact over a 1/2-mile of OCS wiring. In addition, service disconnects that allow a segment to be de-energized can be spaced miles apart. As a result, de-energizing a portion of the system can impact service to multiple grade crossings, stations, or other Caltrain facilities.
- **Vertical and Horizontal Clearances:** To confirm a new grade-separated facility is safe for both users and the Caltrain system, vertical and horizontal separation is required between the grade-separated crossing infrastructure and Caltrain facilities. Details on the vertical and horizontal clearance requirements are provided in the **Key Considerations and Design Criteria** section of this chapter.
- **Retaining Walls/Structures:** Retaining Walls and Piers will often be required to support excavations or the bridge structures above.
- **Drainage:** Strategies for designing and implementing drainage systems vary for overhead and underpass crossings and must meet state and local design standards. Underpass crossings generally require pumping systems to drain the crossing.
- **Lighting:** A combination of roadway and pedestrian-scale lighting should be included in the crossing, depending on the crossing configuration.
- **Pedestrian, Bike, and Active Transportation Access:** Active transportation modes are the most vulnerable roadway users, and care should be taken to provide safe, convenient facilities for people walking and biking.
- **Utilities:** Relocations and temporary modification of utilities should be expected for most grade separation projects.
- **Construction Staging:** Understanding the required construction staging is important for comparing different alternatives, properly informing the public, and estimating cost.
- **Emergency Access:** Grade-separated crossings must be accessible by emergency vehicles.
- **Impacts to Private Property:** ROW considerations are important to consider early in the project design cycle, confirming that the footprint of the grade separation would not significantly encroach on private property or restrict access to private property.
- **Noise and Vibration:** Each grade separation configuration will generate noise and vibration. The frequency, intensity, and duration of these impacts needs to be considered for adjacent land uses. Of note, there are temporary noise and vibration impacts generated by construction activities and permanent noise and vibration impacts from the operating railroad.

8 Grade Separation Types

Santa Clara Station, Santa Clara

8 Grade Separation Types

Grade-separated crossings and closures are alternatives to an at-grade crossing. Grade separations create a physical separation in the elevation between railroad tracks and a roadway. The grade separation is usually accomplished by constructing a bridge for either the roadway or railroad. As a result, the railroad and roadways cross each other at different heights.

A crossing closure removes roadway connectivity across the tracks and generally does not change the existing Caltrain alignment.

This chapter details six grade separation and crossing closure configurations including graphical representations, corridor examples, descriptions, benefits, disadvantages, and key characteristics of each configuration type.

The type of grade seperations discussed in this chapter include:

- Crossing Closures (**Figure 8.1**)
- Overhead Crossing (**Figure 8.2**)
- Underpass Crossing (**Figure 8.3**)
- Hybrid Crossing (**Figure 8.4**)
- Multi-Crossing Separation (**Figure 8.5**)
- Pedestrian and Bicycle Crossing (**Figure 8.6**)

Key Takeaways:

Grade Separation:
An alternative to an at-grade crossing, creating a physical separation in elevation between railroad tracks and a roadway

Cost | **Safety** | **Mobility**

6 Grade Separation Configurations Described in this Chapter

Characteristics of Grade Separation Types

Crossing Closure

A CROSSING CLOSURE is the complete removal of the at-grade crossing.

This is the simplest, and therefore least costly, method for eliminating at-grade movements across the tracks. Depending on project and community needs, a pedestrian and bicycle crossing may be installed in conjunction with a crossing closure to maintain mobility across the railroad. It is important to understand the existing mobility network to confirm the feasibility of a crossing closure.

Consider implementing a crossing closure if there is a history of crashes at the crossing as well as the other factors included in *Table 4.2: Key Considerations For Crossing Closure*.

Benefits and Disadvantages:

- (+) Completely removes at-grade movements
- (+) Can be combined with a pedestrian and bicycle crossing to maintain connectivity for active transportation modes

- (−) May cause adverse mobility impacts if other vehicular crossing opportunities are not provided by the surrounding roadway network
- (−) Loss of access for local residents and businesses is often undesirable
- (−) May be undesirable in the long term if surrounding land uses change

Key components are described and annotated in **Figure 8.1**.

BRIDGE

1. **Caltrain Tracks:** Track section with more than 4 tracks is unlikely to be safe for an at-grade crossing. Potential candidates for closure may be located in sections where the Caltrain corridor is wider.

FENCING

2. **Access Restriction:** Fencing and bollards help confirm that pedestrians and vehicles are not able to enter the Caltrain ROW.

PEDESTRIAN AND BIKE ACCESS

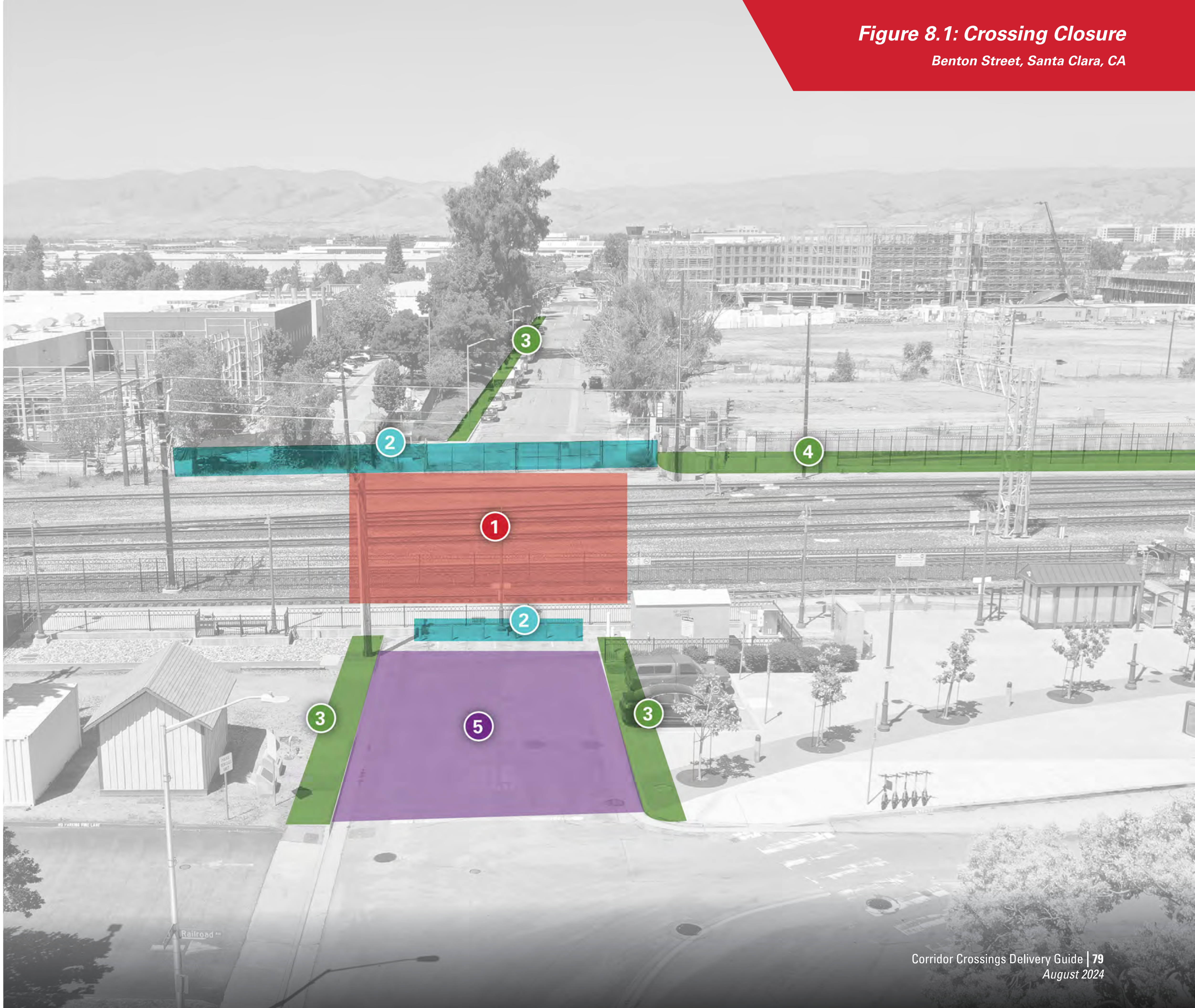
3. **Removal of Pedestrian and Bicycle Access:** Crossing closures result in the removal of pedestrian and bicycle connectivity across the Caltrain tracks.
4. **Pedestrian and Bicycle Crossings:** Opportunities for overhead or underpass pedestrian and bicycle crossings may be implemented with a crossing closure. Detours and alternative routes across the tracks should be clearly marked within the vicinity of the closure.

ROADWAY FOOTPRINT

5. **Roadway Access:** Removal of roadway access requires additional signage and confirmation that emergency response times are not adversely impacted.

Figure 8.1: Crossing Closure

Benton Street, Santa Clara, CA



Overhead Crossing

An OVERHEAD CROSSING is a type of grade separation that provides vehicle, bike, and pedestrian access over the Caltrain railroad.

Overhead crossings involve transitioning the roadway or pathway to a bridge structure over the railroad and connecting back to the road network (or pathway) on either side of the tracks. By raising the roadway/pathway over the railway, the existing profile of the railway is maintained. Roadway/pathway overhead crossings may be preferred when there is more flexibility with the roadway profile, less access-constrained private ROW adjacent to the crossing, and railway adjustments are constrained.

Consider implementing an overhead crossing where there are fewer transportation network connections or less land uses impacted by a grade separation.

Benefits and Disadvantages:

- ⊕ Lessened construction impacts to Caltrain operations when using precast or Accelerated Bridge Construction (ABC) methods
- ⊕ Lessened construction durations

- ⊖ Maintaining clearances above the railway's overhead contact system creates a tall crossing
- ⊖ Challenging to maintain connectivity to local roads for cyclists and pedestrians

Key components are described and annotated in **Figure 8.2**.

BRIDGE

- The bridge structure supporting the roadway is the primary component of a roadway overhead crossing. Columns and supports need to be carefully placed to not interfere with the existing railroad or utilities below. Since bridge columns cannot be located within Caltrain ROW, a longer bridge span (and thicker bridge depth) may be needed.

OVERHEAD CONTACT SYSTEM (OCS)

- The vertical distance between the bottom of the overhead bridge and the top of the Caltrain tracks needs to provide sufficient clearance from the OCS. See Chapter 7 for vertical clearance specifications.
- Electrical grounding and insulation may be needed on the underside of the bridge to protect against electrical arc flashes from the OCS system.

FENCING

- **Protective Bridge Fencing:** A 10-foot tall protective solid barrier is required to confirm the safety of both the trains and the public. The barrier is intended to prevent pedestrians and cyclists from touching the OCS wires or throwing items into the railroad corridor.
- **Access Control Fencing:** For passenger safety, fencing may be needed to separate passengers from vehicular traffic and the railroad. This includes fencing between the railroad tracks, as well as fencing between the tracks or stations and adjacent streets.

PEDESTRIAN AND BIKE ACCESS

- Access for active transportation modes shall be provided on overhead or underground crossings. Active transportation facilities shall be designed to meet NACTO's criteria for being comfortable for all ages and abilities.
- When it is difficult to accommodate pedestrian and bicycle access on an overhead crossing, it may be accommodated with a pedestrian and bicycle underpass. The placement of the underpass should take into consideration the streets or destinations on either side of the tracks, total travel distance, sight lines, and personal comfort and safety.

LIGHTING

- Both vehicle and pedestrian/bicycle lighting are needed on the bridge and under the bridge.

ROADWAY FOOTPRINT

- The length of the overhead bridge is dependent on the width of the Caltrain ROW and the roadway network configuration. The existing at-grade crossing and corresponding roadway network may be modified to accommodate the new overhead crossing.

DRAINAGE

- Drain water on the overhead bridge away from the railroad corridor.

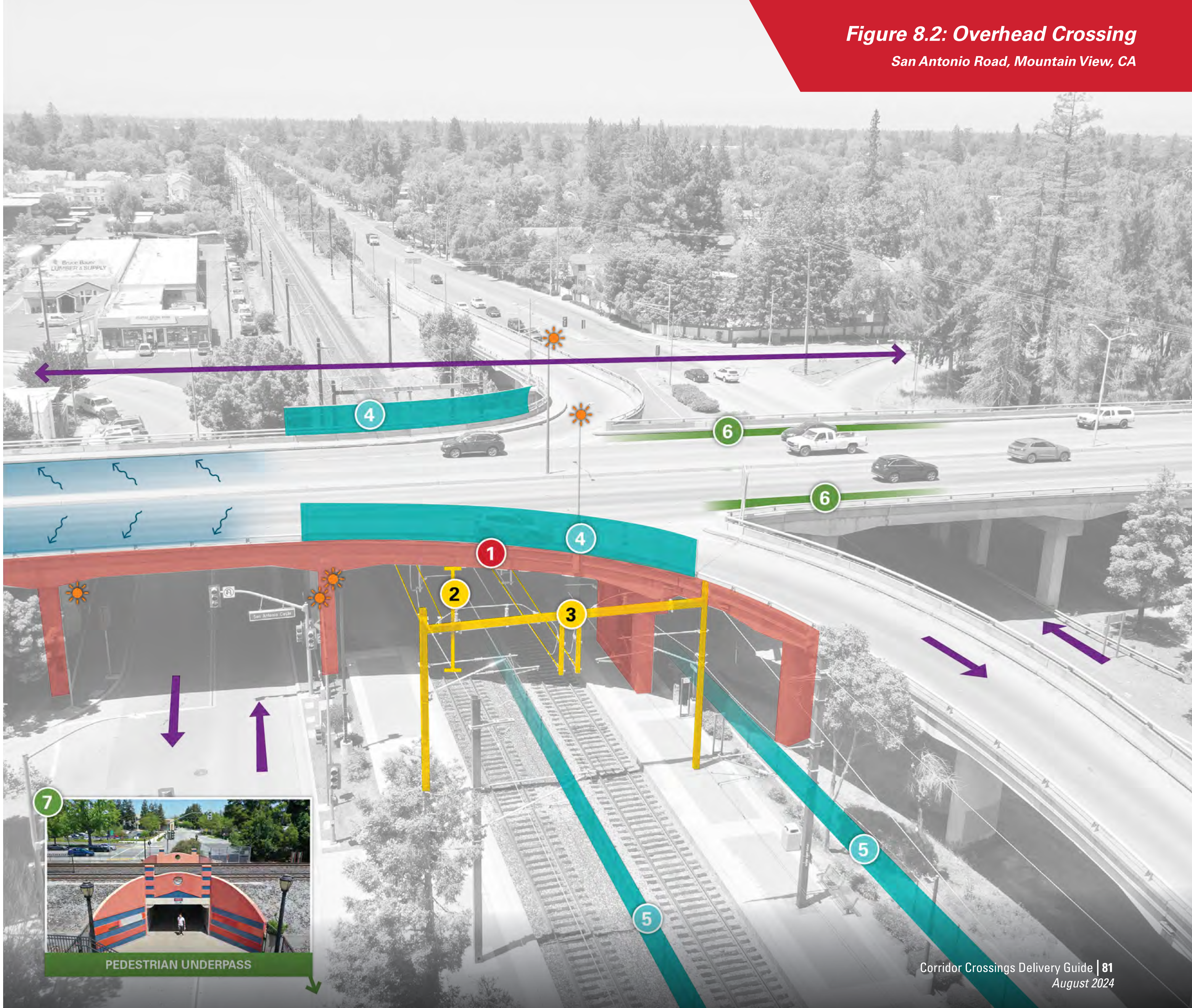


Figure 8.2: Overhead Crossing

San Antonio Road, Mountain View, CA

Underpass Crossing

An UNDERPASS CROSSING is a type of grade separation that provides vehicle, bike, and pedestrian access beneath the Caltrain railroad.

An underpass crossing involves depressing the roadway to create a travel path beneath the railroad. Since the crossing is beneath the railroad tracks, the underpass has a smaller vertical clearance requirement in comparison to an overhead crossing. As a result, underpasses may be a better option when there are ROW constraints in proximity to the crossing. However, there are additional construction complexities associated with excavating beneath an active railroad corridor.

Consider implementing an underpass crossing when the surrounding roadway network and land uses are constrained.

Benefits and Disadvantages:

- (+) Opportunities to minimize OCS and service impacts during construction and operations
- (+) Less vertical change in elevation is required than for overhead crossings

- (−) Utilities and drainage are often in conflict and require third-party coordination
- (−) May be disruptive to the transportation network and active, electrified railroad. This can be mitigated with innovative construction techniques such as tunneling or box jacking
- (−) Challenging to maintain connectivity to local roads for cyclists and pedestrians

Key components are described and annotated in **Figure 8.3**.

Figure 8.3: Underpass Crossing

31st Avenue, San Mateo, CA

BRIDGE

1 An underpass crossing includes a bridge structure supporting the railroad above the crossing and the roadway below the crossing. This can take the form of a bridge on abutments, a tunnel, or a box-type structure.

2 The roadway needs sufficient clearance (normally 16'6") to clear the railroad bridge. The depth of the railroad structure is very dependent on construction method.

OVERHEAD CONTACT SYSTEM (OCS)

3 The construction methods around and near the OCS equipment must avoid potential impacts to Caltrain operations.

FENCING

4 **Protective Bridge Fencing:** Underpasses generally have fencing to separate public and private property, as well as to prevent intrusion into the Caltrain ROW.

5 **Access Control Fencing:** For passenger safety, fencing may need to be installed to separate passengers from vehicular traffic and the railroad.

PEDESTRIAN AND BIKE ACCESS

6 Underpasses provide opportunities to accommodate active transportation. In this underpass example, the sidewalk and bike path are elevated in comparison to the roadway and provide a gentler slope than the roadway.

LIGHTING

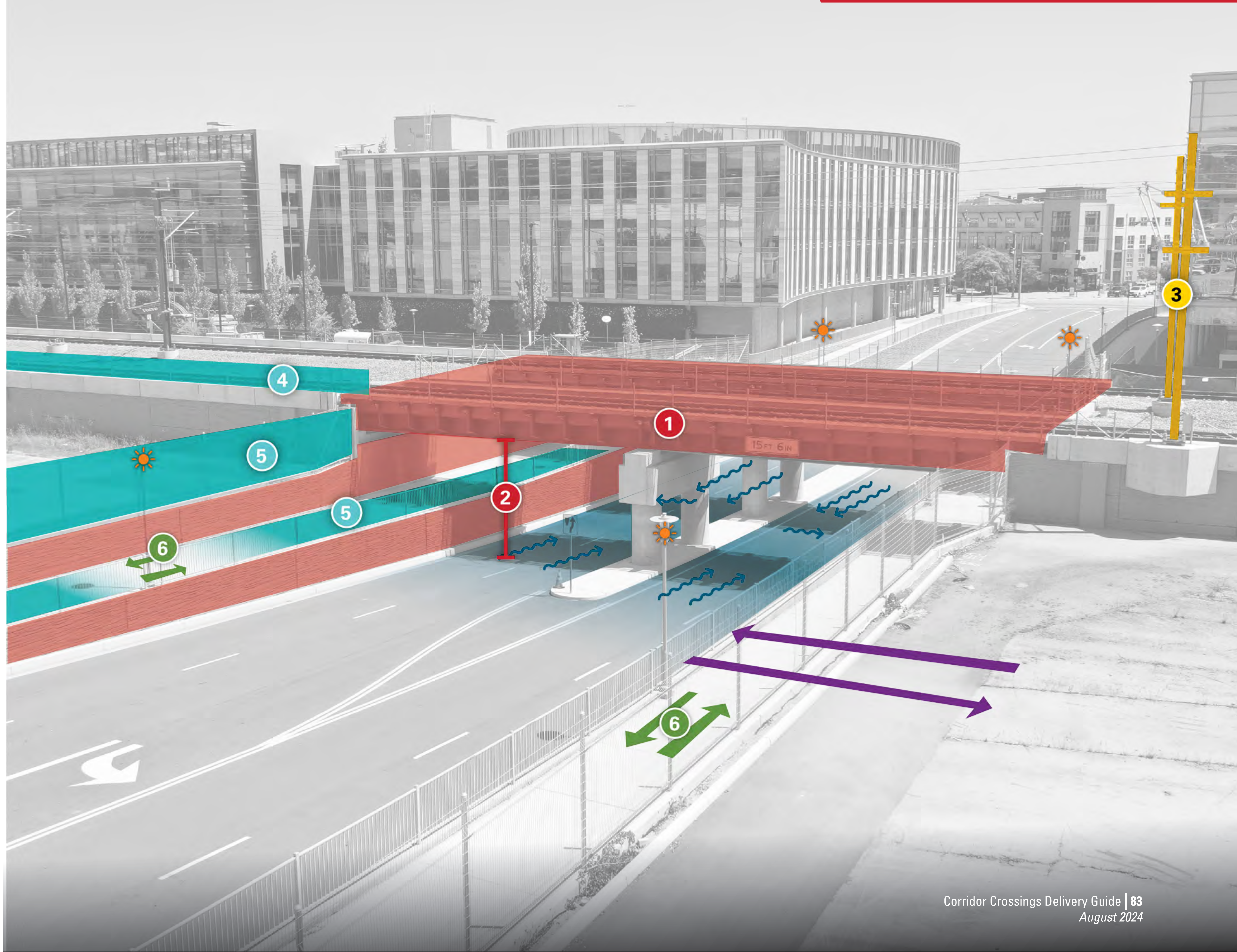
To maintain safe facilities, both vehicle and pedestrian/bicycle lighting are needed on the bridge. Additional lighting may be needed adjacent to the bridge for access roads and Caltrain facilities.

ROADWAY FOOTPRINT

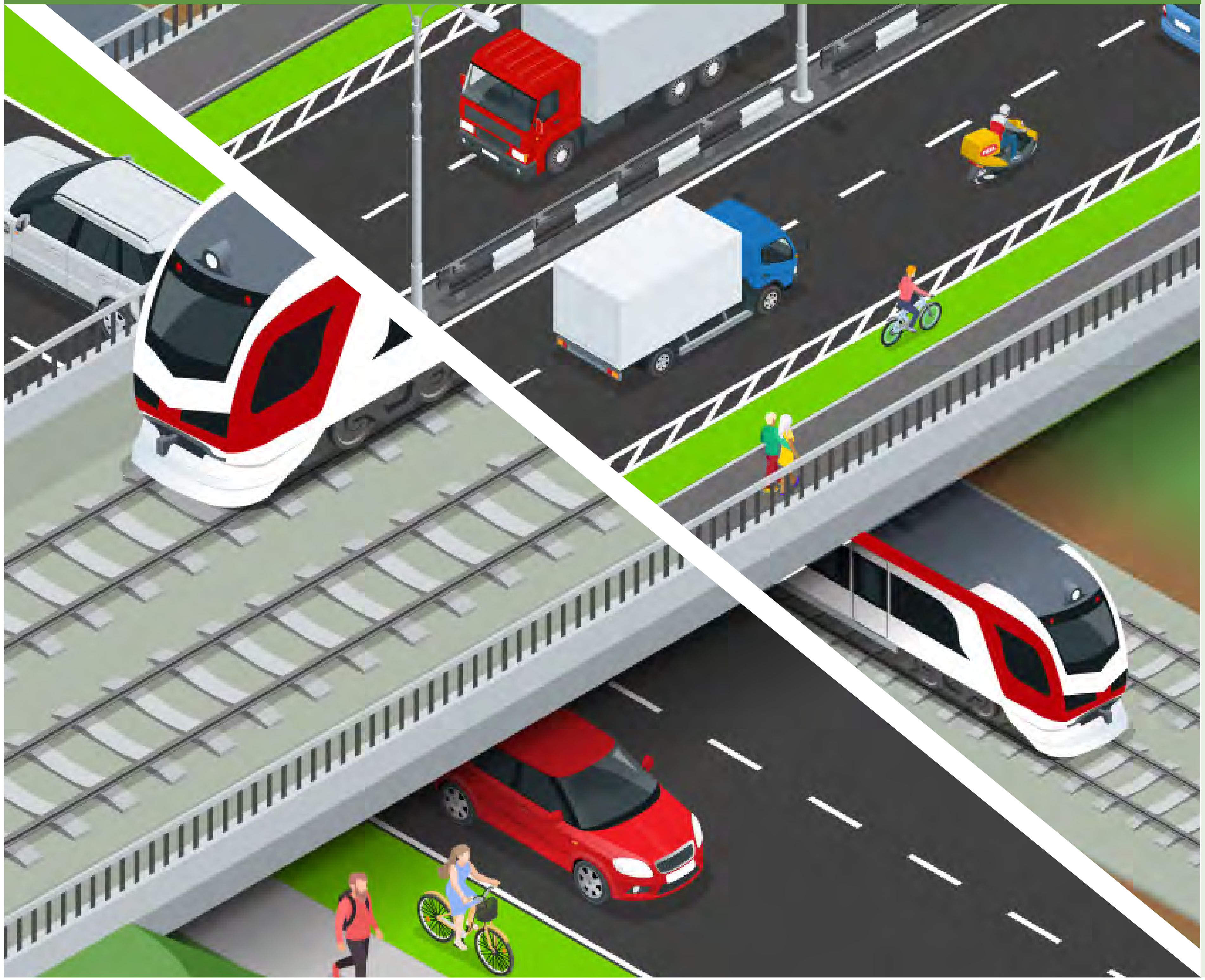
Due to the grade differential with the underpass, some property access points can be rendered unusable if located too close to the crossing.

DRAINAGE

Proper drainage systems are critical in underpass crossings. This is because an underpass creates a low point beneath the railroad where water will collect. If not drained properly, this water collection can flood the undercrossing and become a hazard for all road users. Because the elevation of the underpass is generally lower than the surrounding ground, it is difficult to drain an underpass with gravity alone. In most circumstances, an electrified pump station is required to convey the water to storm water management systems.



Hybrid Crossing



A HYBRID CROSSING occurs when both the grade of the Caltrain railroad corridor and the intersecting roadway are adjusted for the grade separation.

Hybrid crossings include components from both overhead crossings and underpass crossings.

Consider a hybrid crossing when the adjustment of both roadway and railroad profiles will benefit the community or transportation network.

Benefits and Disadvantages:

- (+) Overall reduction in elevation changes can result in better connectivity on either side of the railway
- (+) Potential constructability advantages when grade separating multiple crossings
- (+) Potential to balance impacts to rail and roadway infrastructure, and reduce overall cost and schedule
- (+) Less challenging to maintain connectivity to local roads for cyclists and pedestrians

- (−) Impacts to railroad profile often result in service impacts during construction
- (−) Utilities and drainage are often in conflict and require third-party coordination
- (−) Relocation/reconstruction of electrification facilities could increase construction costs

Key components are described and annotated in **Figure 8.4**.

BRIDGE

1. Hybrid crossings modify the elevation of both the roadway and the Caltrain railroad corridor rather than focusing on just one of the facilities. In this example, the roadway is depressed while the railroad corridor is elevated.
2. Vertical clearance is achieved with both roadway depression and rail elevation.

OVERHEAD CONTACT SYSTEM (OCS)

3. The OCS equipment influences the construction requirements along and below the railroad corridor.

FENCING

4. **Protective Bridge Fencing:** Elevated facilities should be designed with pedestrian and bicycle safety in mind. Protective fencing should be used in areas that may see high levels of pedestrian and bicycle traffic.

PEDESTRIAN AND BIKE ACCESS

5. Improvements at nearby intersections should be prioritized. High-visibility crosswalks, wide sidewalks, median refuges, and exclusive pedestrian phases can make facilities more easily navigable by foot, wheelchair, or other active transportation devices. ADA-accessible ramps should be constructed at nearby crosswalks.
6. Providing pedestrian and bicycle access through infrastructure such as a shared-use path, bike lanes, or similar infrastructure that facilitates active transportation can make a crossing more accessible.
7. Universal access ramps and stairways provide access.
8. Wayfinding signs at station access points should be implemented to help pedestrians navigate the surrounding area.

LIGHTING

Maintain safe facilities by providing both vehicle and pedestrian/bicycle lighting on the bridge. Additional lighting may be needed under the bridge for access roads and Caltrain facilities.

ACCESS

9. Vehicle access points near a crossing can introduce potential conflicts and sight distance constraints. Adjacent property access should be monitored and modified as necessary. In this example, a median restricts vehicular access to adjacent properties to right turns, improving traffic operations and safety. Adequate distance should be maintained between access roads and the crossing footprint.
10. Maintain adjacent property access.

DRAINAGE

Permeable surfaces can be implemented in the vicinity of the crossing to reduce the load on the drainage system. Permeable surfaces adjacent to parking lots, ramps, and other paved surfaces will reduce risk of flooding. Planting strips may be used to accommodate excess runoff.

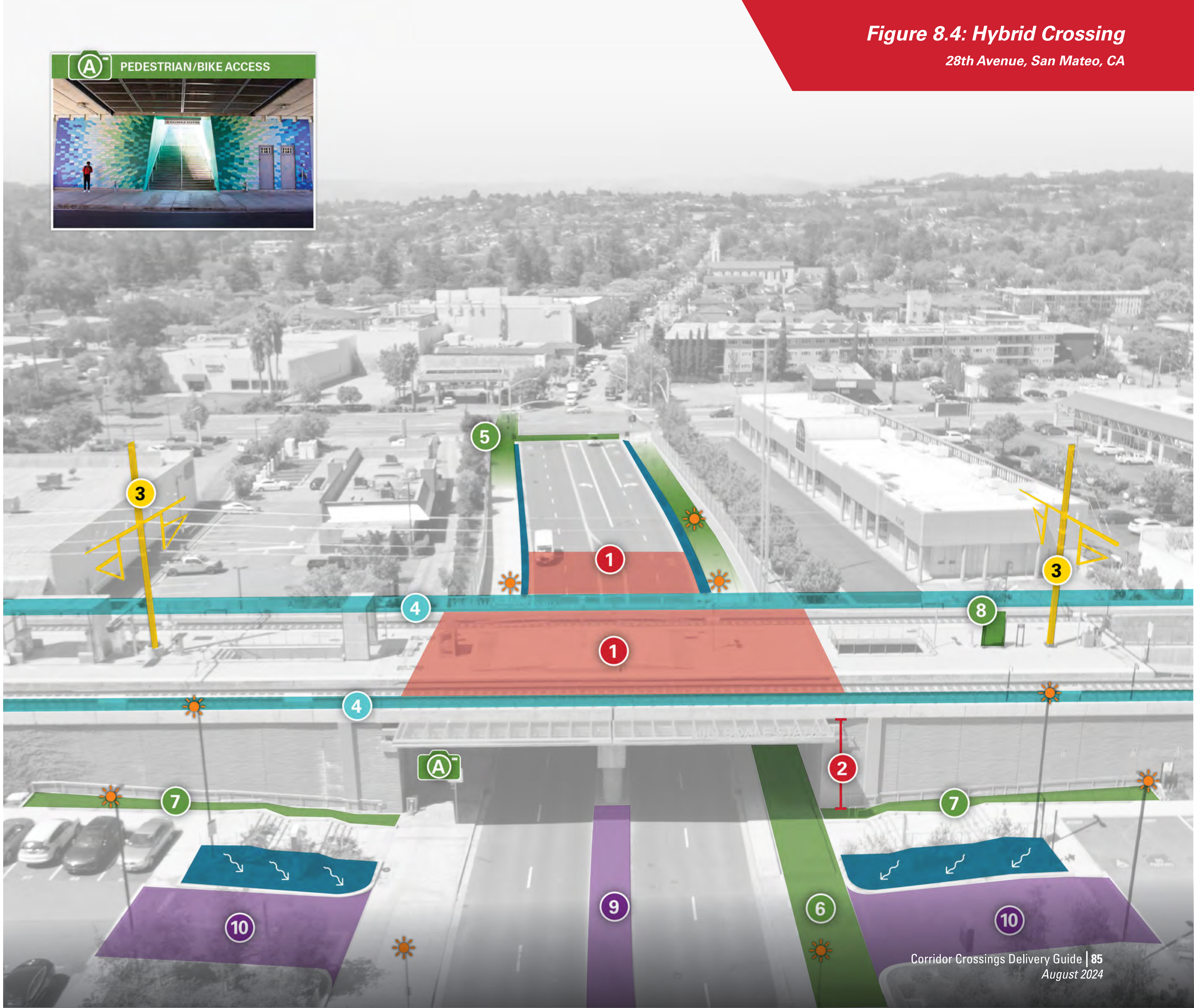
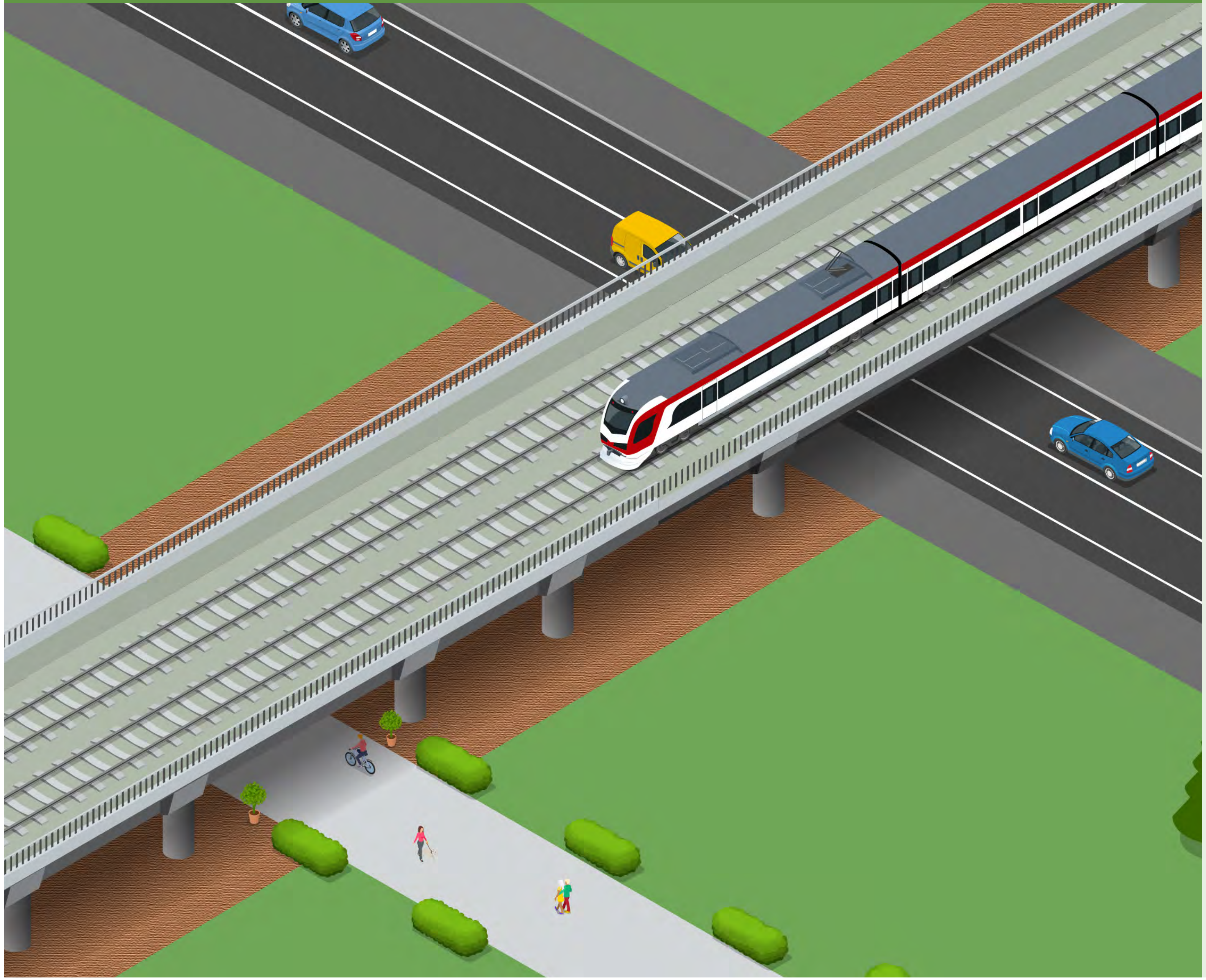


Figure 8.4: Hybrid Crossing

28th Avenue, San Mateo, CA

Multi-Crossing Separation



A MULTI-CROSSING SEPARATION is a project that grade separates multiple at-grade crossings, usually spaced closely together.

These types of projects are of regional significance and often involve multiple project sponsors. They also usually involve a railroad profile change to make the grade separations efficient to construct. Multi-crossing separations can take advantage of construction and delivery methods that are not as advantageous for individual grade separation projects, such as innovative construction methods or temporary service options. These construction methods can include viaducts, tunneling, or trenching. These projects may require an alternative delivery method due to their complexity.

Consider a multi-crossing solution when there are multiple at-grade crossings spaced closely together.

Benefits and Disadvantages:

- (+) Opportunity for innovative design and construction techniques
- (+) Can provide regional or multi-jurisdictional solutions

- (−) Generally more expensive and takes longer to implement
- (−) Often requires alternative delivery methods due to complexity
- (−) May have permanent noise and privacy impacts for adjacent property owners

Key components are described and annotated in **Figure 8.5**.

BRIDGE

1 **Length:** Structure may extend for a long distance, with some viaducts extending multiple miles along a corridor. Longer facilities reduce ground-level conflicts with Caltrain infrastructure.

2 **Deck Structure and Supports:** Columns support the bridge structure to elevate the railroad above existing roadway, which helps maintain connectivity.

OVERHEAD CONTACT SYSTEM (OCS)

3 **OCS Considerations:** Though not illustrated in this example from BART, OCS equipment along the Caltrain corridor would need to be modified for implementation of a viaduct.

FENCING

4 **Access Fence:** Protective bridge fencing helps separate public and private property and prevents intrusion into the Caltrain ROW.

PEDESTRIAN AND BIKE ACCESS

5 **Maintaining Access:** Open space under the viaduct may offer the opportunity to maintain safe and efficient pedestrian and bicycle connections.

LIGHTING

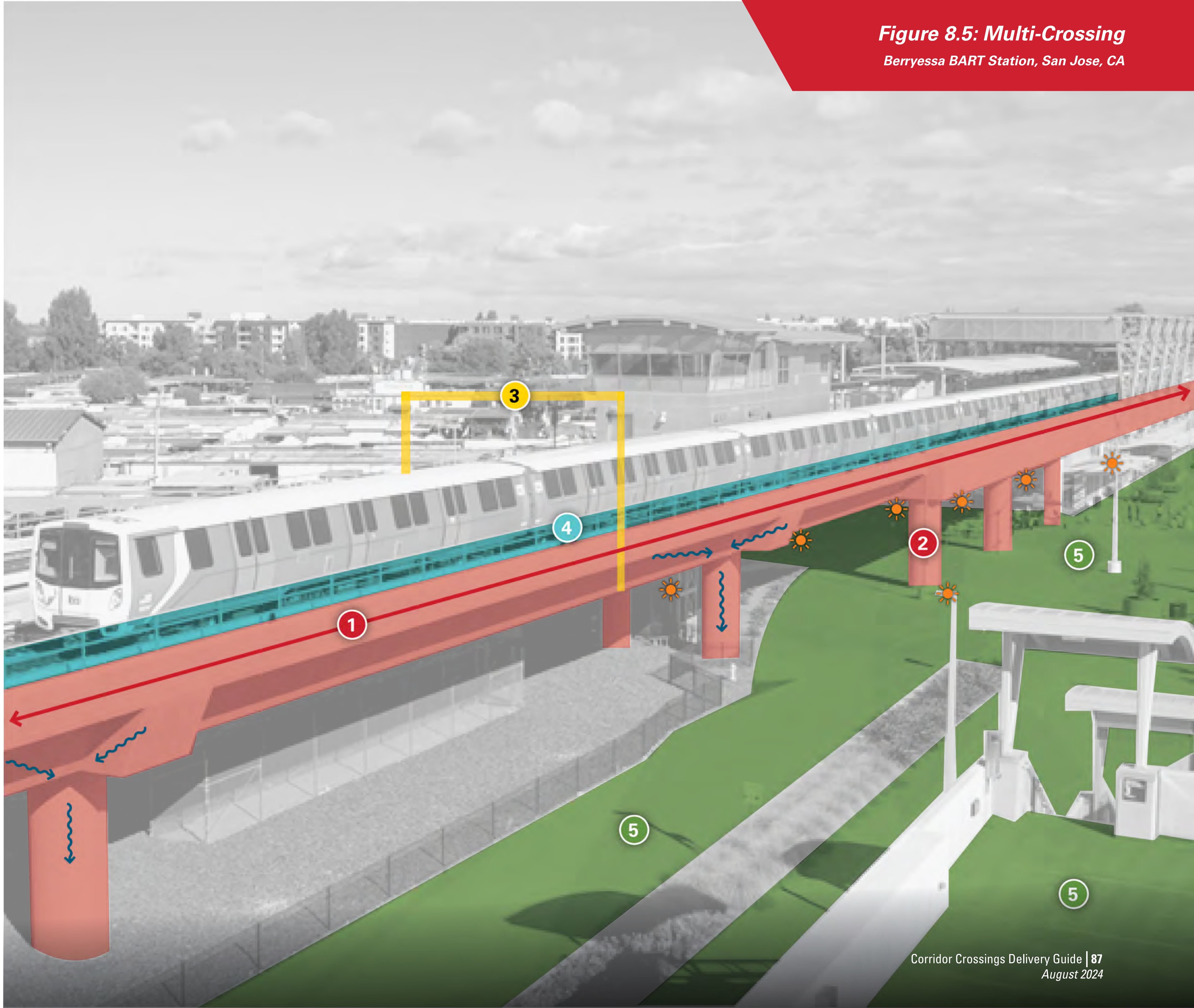
Pedestrian-scale lighting should be installed in areas under the viaduct to create a safer and more inviting environment.

DRAINAGE

Storm water is directed from the tracks down the columns and toward the storm drains.

Figure 8.5: Multi-Crossing

Berryessa BART Station, San Jose, CA



Pedestrian and Bicycle Crossing

PEDESTRIAN AND BICYCLE CROSSINGS are grade-separated facilities for pedestrians, cyclists, wheelchair users, and other active transportation mode users.

These facilities include either an overhead or underpass crossing, depending on the site conditions and local goals and priorities. Pedestrian and bicycle crossings can replace a closed at-grade crossing or be added at a location where no crossing previously existed.

Consider implementing a pedestrian and bicycle crossing when active transportation access is important, but it is not necessary or feasible to maintain vehicular traffic.

Benefits and Disadvantages:

- ⊕ Smaller project footprints and costs compared to vehicular grade separations
- ⊕ May be paired with an at-grade crossing closure or adjacent grade separation project

- ⊖ Viability of removing vehicular access is dependent on adjacent crossings and overall transportation network mobility
- ⊖ Supplemental safety measures, such as lighting and CCTV, may be required particularly for underpass crossings to enhance public comfort and sense of security

Key components are described and annotated in **Figure 8.6**.

Figure 8.6: Pedestrian Crossing

Santa Clara Station Undercrossing, Santa Clara, CA

BRIDGE

1. Caltrain requires vertical clearance from the top of the Caltrain tracks to the top of the underpass structure. For overhead crossings, Caltrain requires clearance requirements above the OCS equipment. See Chapter 7 for the specific clearance requirements.
2. Retaining walls provide structural support.

OVERHEAD CONTACT SYSTEM (OCS)

3. The OCS equipment influences the construction requirements, as well as the vertical clearance requirements for overhead crossings.

FENCING

4. **Protective Barrier:** A solid barrier provides safety due to differences in elevation.

5. **Access Control Fencing:** For passenger safety, fencing may need to be installed to separate passengers from vehicular traffic and the railroad. This includes fencing between the railroad tracks, as well as fencing to separate stations from adjacent streets.

PEDESTRIAN AND BIKE ACCESS

6/7 Stairways and universal access ramps provide access to the underpass for various ages and abilities. Bike grooves should be provided on stairways to provide cyclists an easier method to transport their bicycle through the facility.

8 Bike lockers offer a secure form of bicycle storage at crossing facilities, in particular at stations.

9 Plaza areas around crossing entrances can activate the area and provide an inviting place for the community. Entry areas to undercrossings should be well-lit and maintained.

10 Convex mirrors and CCTV cameras can contribute to safety and an improved sense of security.

11 **Economic Catalysts:** Bicycle and pedestrian crossings can create more pedestrian-friendly communities, spurring economic development and growth. New developments offer additional opportunities to further implement human-scale infrastructure.

LIGHTING

Pedestrian-scale lighting should be implemented throughout an undercrossing and the entrance and exit areas. Good visibility improves safety and the sense of security for users.

12 Skylights can be used in an underpass to provide more natural light in the undercrossing, leading to a more secure-feeling facility.

ACCESS

13 Wayfinding signs help users orient themselves spatially along the Caltrain corridor and can help users understand where the undercrossing ends on the other side of the tracks.

DRAINAGE

Implementation of permeable facilities and greenery assists the drainage system and makes the undercrossing facility more attractive.

Drainage systems are required to manage storm water. In underpass facilities, removing water from the facility typically requires an electrified pump station due to the lower elevation.

Summary of Grade Separation Types

Each type of grade separation has an intended application and corresponding strengths and weaknesses. **Table 8.1** provides a comparison of the key elements across the grade separation types.

Table 8.1 – Comparison of Grade Separation Types

Categories	Crossing Closure	Overhead Crossing	Underpass Crossing	Hybrid Crossing	Multi-Crossing	Pedestrian & Bicycle Crossing
Clearances		• Additional clearances required above OCS wires for vertical separation between overpass and the top of rail	• Total clearances below the top of rail are generally less restrictive than overhead clearances. Soil conditions can influence this clearance	• Similar clearances to overhead or underpass crossings, depending on the rail and road configuration	• Similar clearances to overhead or underpass crossings, depending on the rail and road configuration	• Overhead clearances are identical to vehicle crossings. Underpass clearances are less – generally 10′ compared to 16′6″ for a vehicular underpass
Constructability	• Generally simple construction • Fewer modifications to active Caltrain facilities	• Construction over the OCS system requires additional construction coordination and provides limited working windows	• Traditional underpass construction methods are very disruptive to an active, electrified railroad. Innovative construction methods such as box jacking or tunneling have the potential to substantially reduce railroad impact • Locations of special trackwork and other Caltrain facilities can influence constructability	• Potential to balance impacts to rail and roadway infrastructure, reduce overall cost, and schedule • Construction limitations from both the overhead and underpass elements need to be considered • Changes to the Caltrain profile can trigger OCS modifications, further complicating construction	• Generally larger projects, which create more constructability concerns • Contracting methods can provide opportunities for innovation	• Similar considerations to vehicular overpasses and underpasses, depending on configuration
Drainage	• Minimal drainage impacts	• The roadway profile can convey storm water away from the Caltrain tracks and to local storm drain systems	• A pump station is typically required to remove storm water from the underpass	• Similar considerations for overhead and underpass construction	• May require a systemwide approach to drainage, depending on configuration • Trench alternatives have significant drainage concerns, due to the larger drainage areas	• Similar considerations to vehicular overpasses and underpasses, depending on configuration
Property Access	• Property access usually maintained • Mobility across railroad crossing is lost	• Overhead crossings may remove access to adjacent properties • Parallel frontage roads often required	• Underpass crossings can impact the adjacent properties • Heavily dependent on property location, land use, and location of access points	• Rail and road profiles can be adjusted to minimize adjacent property impacts	• Heavily dependent on construction type • Construction methods can impact property access	• Often more flexibility to maintain property access compared to vehicular overpasses or underpasses • Accessibility requirements will often dictate level of property access – usually ramps and stairs
Maintenance of Crossing	• Maintenance reduced • No direct vehicle access requires consideration for impacts to maintenance and emergency response times	• Overhead crossings need to provide provisions for bridge maintenance and the active OCS system	• Additional maintenance required with pump stations • Caltrain may need a way to access the railway from the crossing location	• Similar considerations for overhead and underpass construction	• Heavily dependent on construction type	• No direct vehicle access requires special design consideration for maintenance and emergency vehicles • Security measures necessary for user comfort and safety

Project Delivery and Implementation

9 Delivery Methods

Caltrain

Santa Clara Station, Santa Clara

9 Delivery Methods

A project delivery method is a comprehensive process by which an infrastructure project is planned, designed, and constructed. The project delivery method defines the roles, contractual obligations, and relationships between the owner (Caltrain), designer, and contractor. The chosen delivery method will also define the project's scope, schedule, and organization needs.

Along the Caltrain corridor, approximately 95% of past and present projects have utilized the DBB method. While the DBB method can be efficient, effective, and familiar to most contractors and agencies, there are challenges inherent to its structure that can lead to cost and schedule overruns during construction. To help mitigate cost and schedule impacts, the owner has the option to pursue alternative delivery methods such as DB, PDB, or CM/GC. These alternative methods are structured to avoid the shortcomings of DBB. However, each alternative delivery method comes with its own set of challenges and applicable use cases. This chapter will evaluate, compare, and recommend best use cases for traditional DBB, as well as the following six alternative delivery methods.

For large complex public infrastructure projects, industry trends are moving towards early contractor involvement delivery methods.

Availability and timing of funding for pre-construction and construction activities need to be considered when evaluating potential delivery methods. For many alternative delivery methods, funding for the construction phase needs to be available earlier as compared to a DBB method.

Legislative Basis for Alternative Delivery Methods

Currently, the State of California has granted authority to Caltrain and Project Sponsors to pursue any form of alternative delivery method they see fit through CPUC Sections 160005 and 180152, respectively.

Six Alternative Delivery Methods Described in this Chapter:

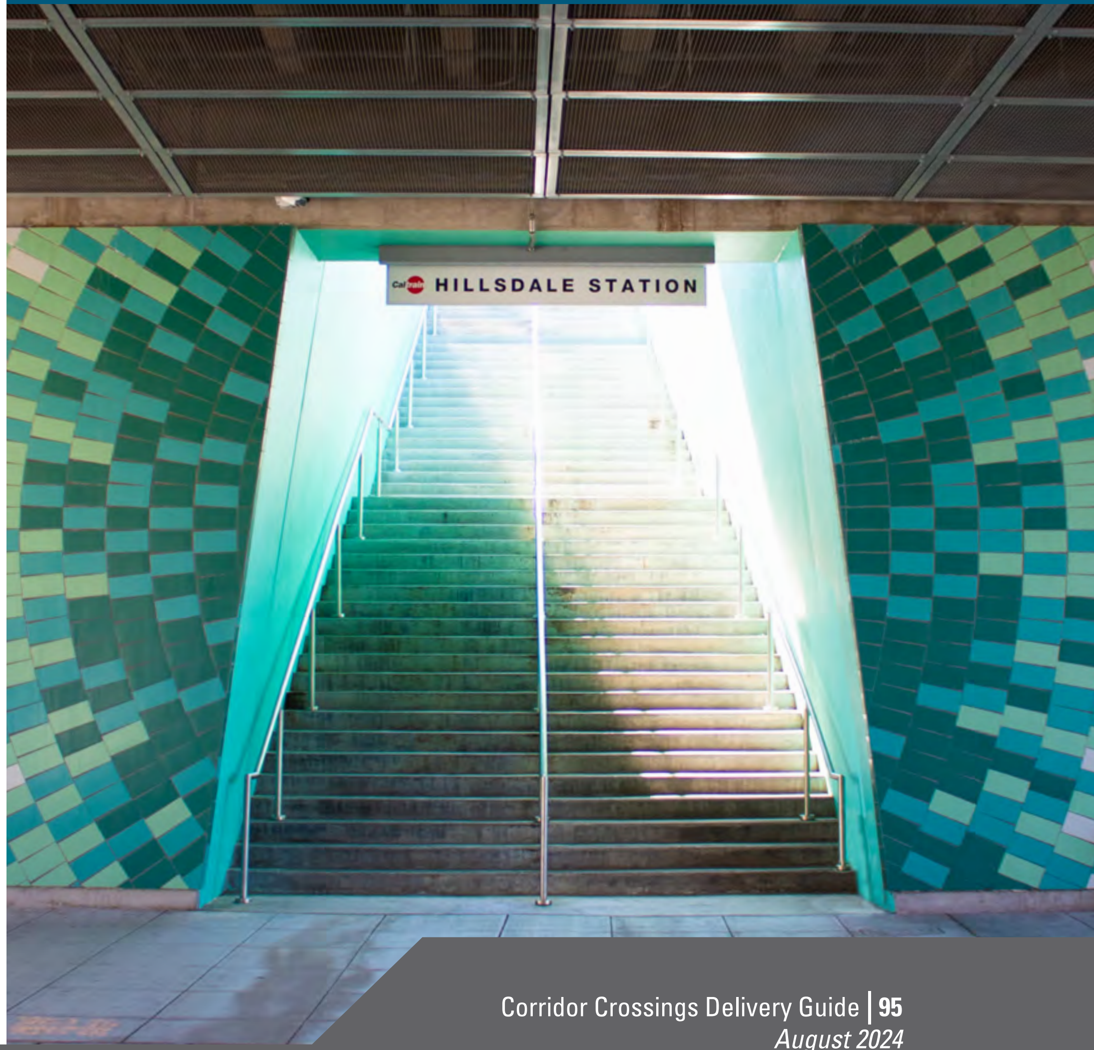
Most Applicable for Caltrain corridor	Less Applicable for Caltrain corridor
1 Design-Build (DB)	4 Design-Build-Operate-Maintain (DBOM)
2 Progressive Design-Build (PDB)	5 Public-Private Partnership (PPP)
3 Construction Manager/General Contractor (CM/GC)	6 Public-Public Partnership (PuP)

Key Takeaways:

Design-Bid-Build (DBB)
has been the most common delivery method

95% Projects along the Caltrain Corridor utilized DBB

6 Potential Alternative Delivery Methods
with 3 most applicable methods



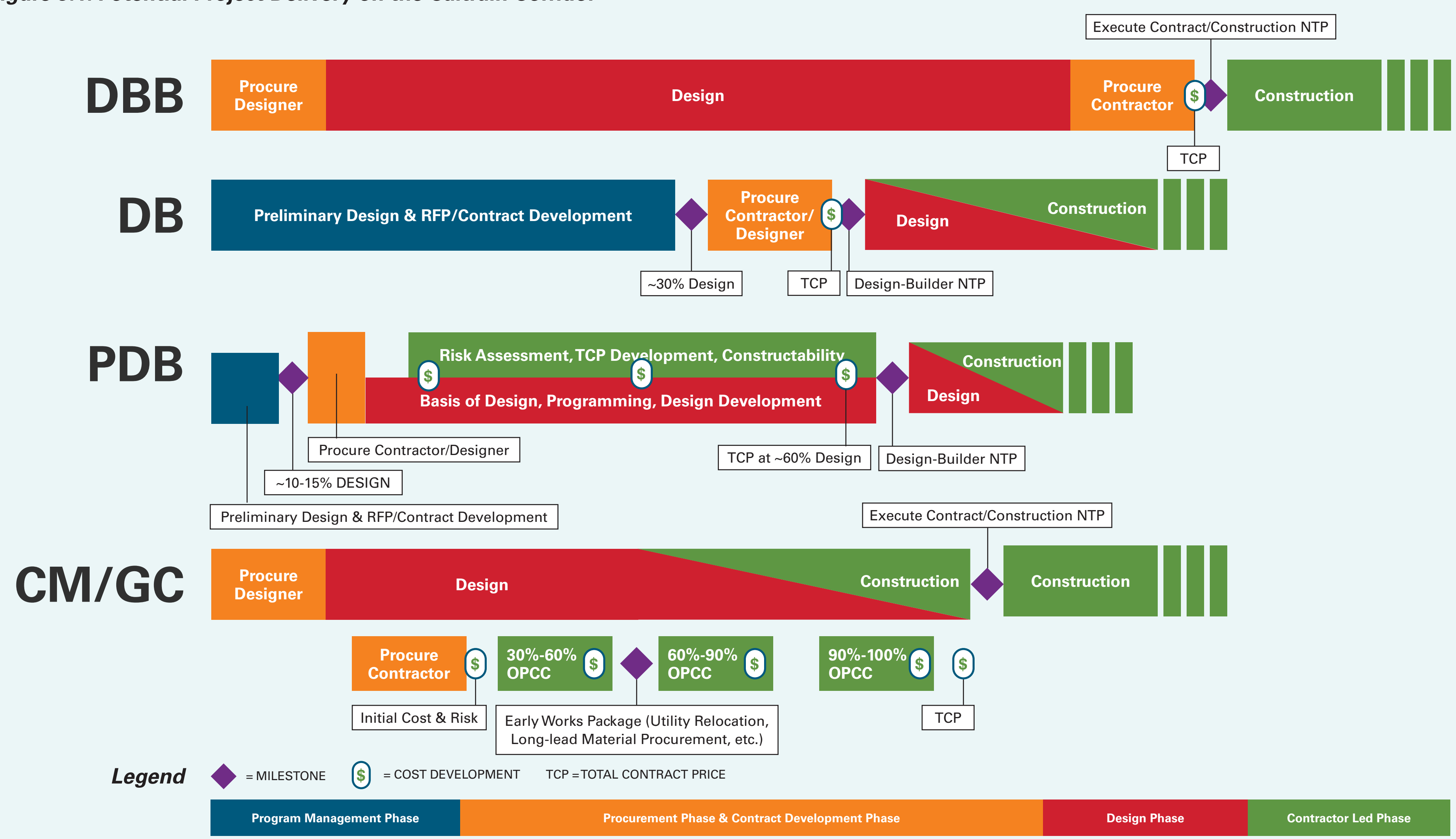
Alternative Delivery on the Caltrain Corridor

Historically, grade separation projects along the Caltrain corridor have been initiated by Project Sponsors and have been executed using the traditional DBB method. Due to the inherent complexity of grade separation projects, these projects are costly and have long construction durations. With the adoption of the corridor electrification system and the future expansion to 4-track sections in areas, grade separation design complexity and construction challenges have increased and will increase further in the future.

Caltrain recognizes that increases in project complexity can result in undesirable increases in construction cost and construction duration. Alternative delivery methods, if used properly, can reduce costs and construction duration. In support of this goal, Caltrain has been conducting alternative contract delivery evaluations with project partners for grade separation projects. These evaluations have been used to develop the written report and public meeting content required to legally justify the use of alternative delivery methods. These evaluations have also been used to justify Caltrain's use of the DB method for the PCEP.

Each delivery evaluation requires resources and time. To consolidate resources and provide a common starting ground for decision-makers, Caltrain has developed this guide to educate project sponsors and partners on the relative advantages and disadvantages of each delivery method. **Figure 9.1** illustrates the phases involved for the contract delivery methods most applicable for a grade separation project along the Caltrain corridor.

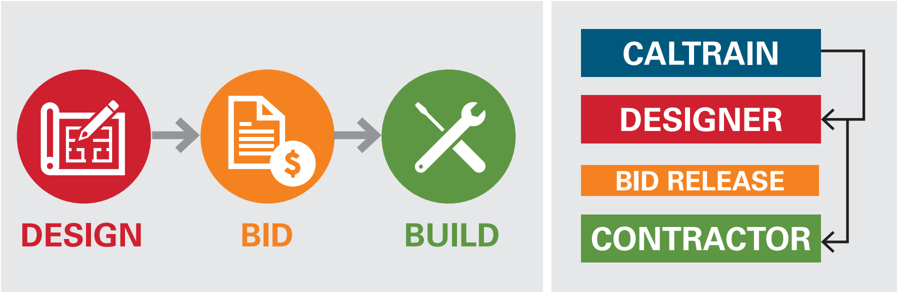
Figure 9.1: Potential Project Delivery on the Caltrain Corridor



Delivery Method Options

Design-Bid-Build (DBB)

DBB is the conventional project delivery method applied by U.S. infrastructure owners and is the baseline by which alternative project delivery methods are evaluated. DBB is named after its three phases of project delivery: the design phase, bid phase, and build phase.



Advantages

- Contractors and project sponsors/owners are experienced with this process
- Separating design and construction allows specialized companies to compete in their own area of competence
- The designer is independent and monitors the project in the best interest of the owner
- The project owner has freedom to explore alternatives during the design phase
- Competitive pricing environment for contractors

Challenges

- Lack of early contractor involvement reduces input on constructability, current construction costs, and other construction related items
- The relationship between contractor and designer can become adversarial
- The contractor focuses on achieving the lowest bid possible, potentially compromising quality
- Separate design, bid, and build phases can increase project duration

DBB requires a well-defined design concept and a realistic understanding of the potential phasing options and construction means and methods to secure a competitive bid. DBB is a linear, sequential project development process beginning with the owner retaining a designer based on qualifications to complete design services.

After the design is complete, **the owner then advertises and awards a separate competitive bid construction contract** based on the designer's completed plans, specifications, and estimate (PS&E). These PS&E documents are referred to as the construction documents.

The DBB contractor selection process is familiar to, and regularly implemented by, infrastructure project owners. When the selected designer has completed the PS&E construction documents, the owner will publicly advertise the project for competitive contractor bids. Under normal procedures, contractor pre-qualifications are not allowed, so any licensed contractor can submit a competitive bid. The apparent low bidder is identified after the owner evaluates the bids for irregularities, unbalanced pricing, or other errors.

The owner reviews the bids to determine the lowest responsive and responsible bidder. The owner will check references, insurance and bonds, and review to determine that the bid is fair and reasonable compared to the owner's independent cost estimate.

The DBB delivery method assumes that all bidders will produce the same product from the construction documents provided by the owner. Caltrain contracts with the design team to provide design services during construction (DSDC) and a consultant to provide construction management services. Caltrain also issues a Work Directive, or contract, to TransAmerica Services, also known as TASI, to provide Capital Project Support Services for Roadway Worker Protection. Projects that benefit from the use of DBB are infrastructure projects with commonly understood design concepts and methods of construction.

DBB construction contracts have some distinct shortcomings with respect to other delivery methods. In the DBB contracting method, bids must be prepared based on the completed design documents. These contracts do not provide the ability to price or mitigate contract risks, either known or unforeseen. Examples of these risks include unforeseen site conditions, delays caused by third-parties, or long lead time required for the procurement of materials. If these impacts occur on a DBB project, contract change orders may need to be executed to address cost impacts and schedule delay.

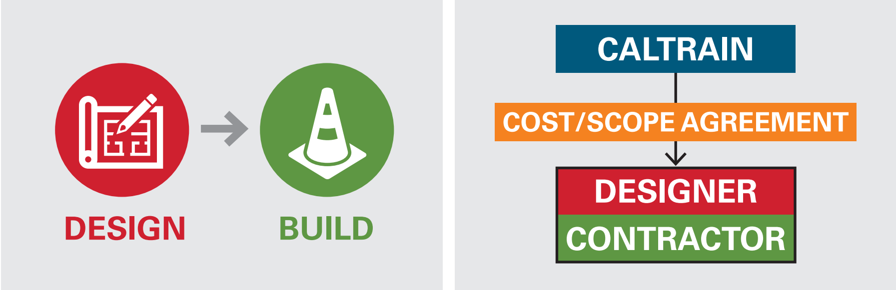
Since the DBB method is a low-bid environment where all contractors bid on identical contract documents, there is little incentive to propose modifications, cost saving measures, or innovative techniques to reduce cost and schedule. While this approach is often appropriate on construction projects with well-understood means and methods, DBB is ill-suited for projects for which contractor means and methods can have a significant impact on project cost, schedule, operational impacts, or impacts to the existing transportation network.

In addition, the high potential for change orders can result in an adversarial relationship between the contractor and designer. The structural setup of DBB can lead to the contractor identifying design errors in the construction documents during the bid phase and using those for change orders during the build phase. DBB can de-incentivize cooperation between designer and contractor, further perpetuating the adversarial relationship between the two parties. This tension can slow the project delivery process and, in some cases, can lead to legal action between the owner, contractor, and/or designer.

Another structural disadvantage of DBB arises from the practice of bringing the contractor into the process at the bid phase, rather than earlier. Excluding early contractor input reduces contractor input on constructability, current construction costs, site access challenges, and other unique construction perspectives.

Design-Build (DB)

DB is an alternative delivery method. In DB, instead of holding separate contracts with the designer and contractor, the owner procures construction and design services in the same contract from a single legal entity known as the design-builder. The DB method was utilized by Caltrain for the PCEP.



Advantages

- Expedited project delivery due to a single procurement for design and construction phases and the potential for overlap in the design and construction phases
- Design risk shifts from the owner to the design-builder
- Early contractor input allows for implementation of innovations and reduction of construction claims and disputes
- Provides greater degree of cost and schedule certainty early in the design process
- Best-value selection process reduces quality issues associated with lowest-bidder
- Proven and familiar alternative delivery method
- Having contractor on-site during the design phase allows for greater site investigation and discovery capabilities

Challenges

- Risk assumed by the design-builder is included in the up-front costs
- Designer monitors project quality and completion in the best interest of the design-builder, rather than the owner
- Less common contracting method; therefore, a smaller pool of bidders
- Owner must have adequate staff, expertise, and resources to effectively manage the design-build process
- Owner has limited ability to make cost effective design changes after contract award

Typically, the project owner will develop "bridging documents" before advertising the project for a design-builder. **These bridging documents typically provide 20% to 30% design drawings and capture the key goals, constraints, and programmatic requirements of the project.**

A DB contract can be awarded in a one-step or two-step process used to competitively evaluate technical proposals.

One-Step Process

Under a one-step process, a Request for Proposals (RFP) or Request for Bids (RFB) is issued for a project that has completed bridging documents. After the RFP/RFB is released, design-build teams respond with a proposal. A "best value" selection process is usually used to determine the most appropriate or beneficial proposal from the perspectives of both cost and applicable technical qualifications.

The process of generating a competitive bid or proposal often requires considerable effort by the design-build team. Some design-build teams can be excluded from competing for projects that use a one-step process, because they may not have the financial capacity or staffing needed to generate such a proposal.

Two-Step Process

The two-step process separates the technical proposal from the price (bid) by first issuing a Request for Qualifications (RFQ). Applicants can submit a Statement of Qualifications (SOQ) in response to the RFQ. The SOQ typically details the design-build team's capability to perform the work in the requested timeframe as well as their experience performing similar work. SOQs typically require less effort than the proposals required in the one-step process, broadening the pool of potential applicants. From the SOQs, a shortlist of applicants is identified that typically consists of no more than three qualified teams. An RFP is issued to the shortlisted teams and confidential one-on-one meetings are held for the shortlisted proposers to seek input from the owner on the acceptability of alternative design concepts and other project elements. Shortlisted firms submit a Best and Final Offer (BAFO). SOQ and BAFO scores are combined to determine the highest ranked proposer. A stipend may be provided by the owner to the non-successful shortlisted teams to cover a portion of the costs of developing their proposals.

One advantage of the DB method is that the contractor and designer are paired together on a single team. This pairing helps reduce the adversarial relationship experienced between these two groups in the DBB method; however, the approach also limits the designer's independence in the design process. This limitation can lead to the designer advancing the project in the best interest of the design-build team, rather than in the best interest of the owner. This can be mitigated by the owner retaining a design firm to develop the design and program requirements and then provide over the shoulder review and other critical design services for the owner during design and construction. The DB team retains the Engineer of Record responsibility.

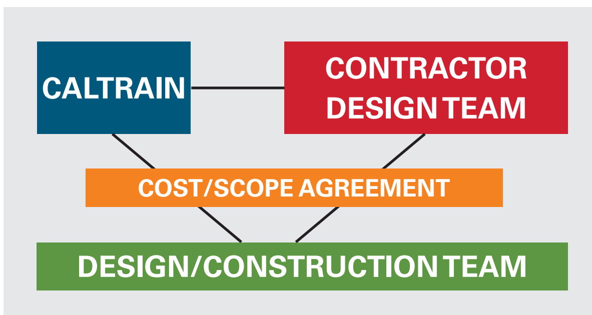
One of the advantages of DB over DBB is the ability to begin construction activities prior to 100 percent completion of design documents. Early construction activities such as demolition, preliminary grading, utility relocations, drainage systems, and the procurement of long lead items can begin before the final design has been completed. This overlaps the design phase with the construction phase, allowing for time savings.

The DB method provides the owner with greater certainty of total project cost earlier in the process than DBB provides, because the design-builder includes risk in their bid and assumes ownership of the design. Additionally, DB contracts are less prone to claims and disputes during the construction phase than DBB contracts. This is assuming the DB contract is well structured and necessary project scope items are included in the original contract. If the initial project scope omits crucial aspects of the project, then the early pricing model associated with DB can leave the owner vulnerable to claims during the length of the DB contract.

Design-build allows for construction to begin before 100% design is completed, allowing for time savings.

Progressive Design-Build (PDB)

PDB is a collaborative approach that involves the owner, designer, and builder working together as a team to complete a project. In PDB, the owner hires a design-build team based on qualifications, experience, and approach rather than price and schedule. This design-build team is secured prior to the design phase and collaborates with the owner and other partners to develop a concept and scope as well as to establish a total contract price (TCP).



The establishment of the TCP is an extensive process during which the design-builder details the cost implications of project components. The design-builder catalogs project assumptions and quantifies project risks. By proactively informing the owner of the cost and risk implications, the design-builder acts as an ally and builds trust with the owner through the process.

Advantages

- Expedited project delivery due to a single procurement for design and construction phases and the potential for overlap in the design and construction phases
- Risks can be identified to the owner and mitigated earlier in the design phase. Owner can negotiate risk profile during design phase
- Early contractor input addresses constructability concerns, provides more accurate pricing, and allows for implementation of innovations
- Greater control of project scope, price, and schedule decisions than DB
- Transparency in developing TCP helps owner receive market-driven prices
- If owner and design-builder are unable to agree on a TCP, owner can transition the project to DBB

Challenges

- Owner must be well staffed and resourced to be heavily involved early in the design phase
- Does not provide a known construction cost at initial contract award to design-builder
- Disagreement on TCP leads to lowest bidder solicitation, which can impact schedule and quality
- Risk assumed by the design-builder is built into the TCP
- Designer monitors project quality and completion in the best interest of the design-builder, rather than the owner

In PDB, the design-builder delivers the project in two distinct phases. Phase One constitutes the preconstruction services and Phase Two constitutes final design and construction.

Phase One

The design-builder first collaborates with the owner to create the project's basis of design and programming requirements, which are used to progress the initial project design. During this phase, the design-builder provides consistent and transparent cost estimates to confirm the owner's budgetary requirements are being achieved. Ultimately, design decisions made by the owner during this phase are based on the cost estimates, while also considering schedule, quality, operability, and project life cycle. Once the design has been advanced to a point determined to be sufficient by the owner, the design-builder provides a formal commercial proposal for Phase Two services, including the TCP and an anticipated schedule. This point can occur at any level of progression of the design documents, but most typically occurs between 30% and 60% design.

Phase Two

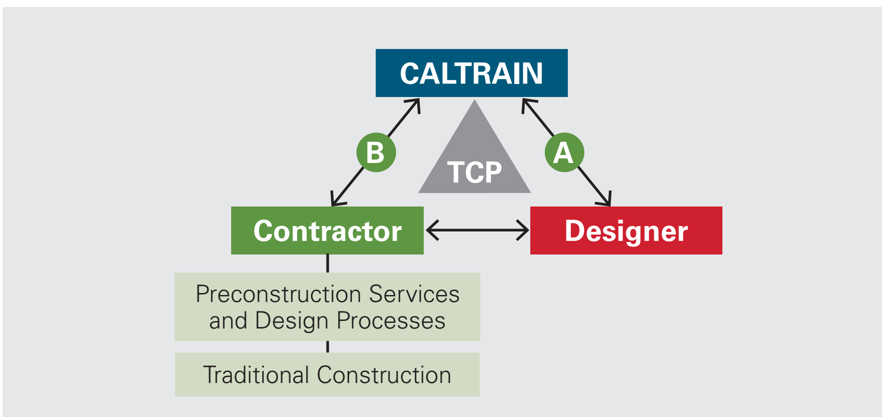
Phase Two services, also called final design and construction services, begin after the owner and design builder agree on the TCP and schedule included in the design-builder's Phase Two proposal. Should the TCP or project schedule not be acceptable to the owner and the design-builder, the owner has the option to transition the project to a DBB delivery method. In Phase Two, the design-builder completes the design and construction of the infrastructure project.

Like DB, the PDB method provides the benefits of early contractor involvement and an overlap of the design and construction phases. With PDB, the owner is afforded the opportunity to collaborate on the design with the design-builder, granting the owner greater control of the scope, price, and schedule decisions. Another advantage of the collaboration between design-builder and owner is the ability to negotiate the risk profile during the design phase. Risks can be identified to the owner and mitigated earlier in the design phase, providing greater certainty in the TCP than can be achieved with DB. Early identification and mitigation of risk can help to reduce change orders in comparison to DB.

PDB has advantages for the owner willing to play an active role in the development of the project. Owners without willingness or capacity to engage in the early design decisions of a project will find managing a PDB contract difficult. Additionally, in contrast to DB, PDB does not provide the owner with a known construction cost at the time of the initial contract award.

✱ Construction Manager/ General Contractor (CM/GC)

Similar to PDB, CM/GC is a collaborative approach to project delivery where the owner, designer, and contractor work together to develop the project scope, optimize the design, improve quality, and manage costs. Under this method, the owner is fully integrated into the early development of the project and works closely with the designer and contractor to make design decisions and advance toward agreement on a TCP.



Advantages

- Expedited project delivery due to potential for overlap in the design and construction phases
- Early contractor input addresses constructability concerns, provides accurate pricing, and allows for implementation of innovations
- Greater control of project scope, price, and schedule decisions than DB
- Owner can negotiate risk profile during design phase
- Transparency in developing TCP helps owner receive market-driven prices
- If owner and contractor are unable to agree on a TCP, owner can transition the project to the lowest bidder
- Designer monitors project quality and completion in the best interest of the owner
- Allows for low bid selection for subcontractors, while maintaining qualifications-based selection for designer and general contractor (GC)
- Risks can be identified, monetized, and assigned to the party best suited to manage the risk

Challenges

- Owner must be well staffed and resourced to be heavily involved early in the design phase
- Does not provide a known construction cost at initial contract awards to designer and contractor
- Disagreement on TCP leads to lowest bidder solicitation, which can impact schedule and quality

The project development and delivery processes of CM/GC are almost identical to those of PDB. See the previous section titled "Progressive Design-Build" for more information on the delivery process for both PDB and CM/GC.

In CM/GC specifically, the contractor acts as the construction manager (CM) during Phase One, offering input on constructability and current costs during the design phase. During Phase Two, the contractor acts as the GC for the construction of the project. The GC may sub-contract specific components or trades to other contractors using the lowest bidder selection process. This allows the owner to retain the quality of a qualifications-based selection process for the designer and contractor, while still experiencing cost benefits of low bid selection for subcontractors.

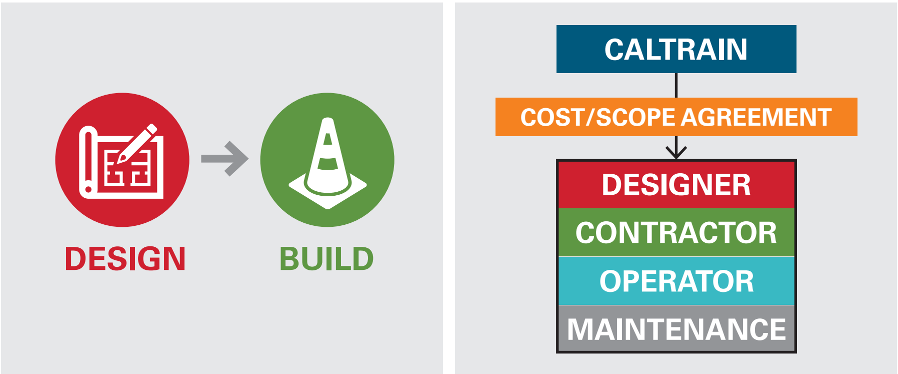
The key difference between PDB and CM/GC is that the owner holds the design contract in CM/GC, whereas in PDB the designer is paired with the contractor to form the design-build team. For CM/GC the owner holds two separate contracts: one with the contractor and one with the designer. These three parties act collaboratively to deliver the project; however, since the designer is partnered directly with the owner rather than the contractor, the designer monitors project quality and completion in the best interest of the owner.

Since CM/GC follows the same functional process as PDB, it benefits from the same advantages. Early contractor input allows for better risk management, more accurate pricing, and a design that is properly vetted for constructability. Both methods offer the ability to overlap the design and construction phases to accelerate project delivery. Most importantly, CM/GC allows the owner to retain control of the design throughout the life of the project. For this reason, CM/GC is best utilized for projects where the owner seeks an active role in design decisions throughout the project.

Similar to PDB, owners—who do not wish or have the capacity to play an active role in the design and direction of the project throughout its lifespan—will find CM/GC difficult to manage. Additionally, CM/GC, like PDB, does not provide the owner with a known construction cost at the time of the initial contract award.

Design-Build-Operate-Maintain (DBOM)

The DBOM delivery method builds upon the design-build concept by adding operations and maintenance responsibilities to the same singular contract.



Advantages

- Advantages of the DB method are also experienced by projects using the DBOM method
- Early certainty in long-term operation and maintenance costs
- Risk is transferred from the owner to the DBOM team
- Long-term cooperative agreement reduces challenges of start-up claims

Challenges

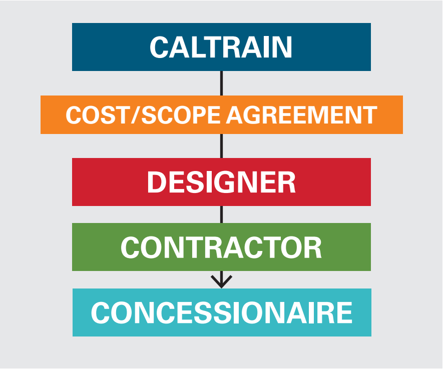
- Challenges of the DB method are also experienced by projects using the DBOM method
- Long-term nature associated with the operations and maintenance component of this method would be complex for a grade separation project in the context of the overall Caltrain system

Due to these added elements of operations and maintenance, the contract duration typically extends longer for DBOM. The contract duration can be 30 years or more and is often financed with public sector funding and/or user fees (e.g., fares or tolls). Operations and maintenance costs are paid to the contracted service provider based on the maintenance or operational service provided.

DBOM is well suited to quickly deliver and adequately sustain new rail services in locations or jurisdictions lacking existing rail infrastructure or operational expertise. This method was chosen to build, operate, and maintain the Hudson-Bergen Light Rail in Northern New Jersey and the Las Vegas Monorail. Despite the success of DBOM for both projects, **this delivery method is unlikely to materialize for grade separation projects along the Caltrain rail corridor.** Caltrain serves as the operator and maintainer of the existing railway and Caltrain's operational framework is well established for the overall system. Application of a DBOM delivery method for a standalone grade separation project would be complex in the context of the operations and maintenance of the overall Caltrain corridor.

Public-Private Partnership (PPP)

A PPP is a long-term contract between a public party and private party for the purpose of delivering a public infrastructure project using the combined resources of the two parties.



Advantages

- May provide the public agency access to capital without the need to issue bonds or obtain federal funding
- Combines expertise and resources of public and private sectors
- Private sector assumes risk and financial liability for project construction and operation
- Financial benefit to the private sector is contingent on the quality of the service provided

Challenges

- Private sector capital may be obtained quickly but is more volatile and costly in the long term than public sector capital
- Negative public perception associated with private entities operating public services
- Long-term, inflexible contracts limit the public agency's ability to make changes or upgrades to infrastructure until the PPP contract has expired

The private sector may finance some of the up-front costs of an infrastructure project and then draw revenue from taxpayers and/or users of the infrastructure over the length of the contract. This revenue is referred to as remuneration and may take the form of user fees (e.g., fares or tolls), revenue sharing, or other methods.

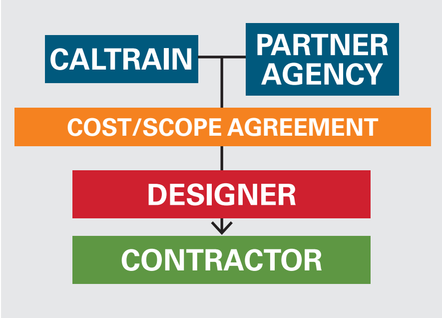
In general, the public party's role is to define the project and obtain environmental clearance, partner support, and political commitment. The role of the private party is to realize the project through design, construction, operation, and some financial commitment. However, the responsibilities of each party are not always split in this way and can be structured between the two parties to suit a particular project. For example, a public agency with a large in-house design team may prefer to design the infrastructure rather than having an outside consultant complete the design.

An advantage of PPP over other forms of project delivery methods is the ability to provide public agencies with access to private capital. This may allow larger and more expensive infrastructure projects to be completed without the need to secure funding from the federal government or to issue bonds to generate capital. Another advantage of PPP is that the private entity assumes responsibility and financial liability for performing design, construction, and operation of a project. These private responsibilities, considered as risks, can include direct capital investment, liability for indebtedness to contractors, or agreeing to fixed price contracts. Transferring these risks to the private party allows the public entity to relax its control of the procurement while granting the private party the opportunity to earn a financial return commensurate with the risks it has assumed.

Challenges associated with PPP include the increased cost of capital from the private sector in comparison to governmental funding sources. Private capital tends to cost more than public capital over the entire length of the contract because the private entity is seeking financial benefit from the transaction (i.e., return on investment). Private financial gain derived from public infrastructure projects, or from public infrastructure users, can also be politically challenging. Some members of the public may oppose private entities operating public services and managing those services for a monetary return, complicating the political landscape for elected officials. Additionally, PPP agreements are typically long-term, complicated, and inflexible. Generally, public agencies are locked into long-term non-compete clauses which can prevent the agency from making major changes or upgrades to the infrastructure until the length of the PPP contract is complete.

Public-Public Partnership (PuP)

PuPs are partnerships between two or more public agencies for the purposes of leveraging shared resources or transferring technical expertise in support of the development of an infrastructure project.



Advantages

- Combines expertise and resources of multiple public agencies to deliver projects quickly and efficiently
- Public sector expertise from around the world can be tapped to deliver complex or unique projects

Challenges

- Does not provide a mechanism for financing like a PPP contract
- Does not provide a mechanism for reduction of risk held by the public agency

PuPs can be formed between any two agencies regardless of relative size, jurisdiction, or location. For example, a transit agency can solicit the expertise of an out-of-state or foreign transit agency in the development of an infrastructure project if the solicited agency has experience successfully delivering similar infrastructure projects. Alternatively, an agency may wish to solve staff shortages by soliciting the staff of another peer agency to aid in the development or management of an infrastructure project.

To an extent, the current grade separation process in the Caltrain corridor can be described as a PuP delivery. Cities lead the project in the planning phase, leveraging their familiarity with the vision of the local community. Caltrain then leads the projects through the design and construction phases, leveraging their expertise with design and construction considerations along an active railroad. Together, these entities partnered together make efficient use of each party's respective strengths to deliver grade separation projects.

Advantages of PuPs include the sharing of public resources between different public agencies to achieve project goals more quickly or efficiently. Additionally, partnering with a peer agency allows access to additional expertise without the need to bring on a private entity. This avoids the added costs for the expected return on investment from private sector involvement.

A disadvantage of the PuP method is it typically lacks a financial benefit in comparison to other alternative delivery methods or even the traditional DBB method. PuPs focus primarily on sharing of resources and expertise. No financial commitment to fund the project is necessary between the agencies involved; therefore, PuPs have little financial benefit over other delivery methods.

Alternative Delivery Evaluation

Caltrain conducts an alternative delivery evaluation process, which involves workshops to establish a common understanding of delivery methods. In preparation for the Alternative Delivery Workshop, Caltrain will gather information and preliminary feedback from the project sponsor about the project goals, objectives, constraints and opportunities. During the alternative delivery workshop, a Caltrain-appointed moderator will review project basics, provide an overview of various alternative delivery methods, and conduct both the qualitative and quantitative evaluations. As part of the evaluations, Caltrain and the project sponsor qualitatively and quantitatively evaluate the delivery methods through a standardized evaluation process to determine the most suitable method for the project. The findings and delivery method recommendations from these workshops will be finalized in a written report and presented for acceptance at a public meeting of the PCJPB and the city council of the project sponsor. This process is typically performed by Caltrain, with high involvement of the project sponsor, during Phase 2 under a Project Agreement and is completed before Caltrain becomes the lead implementing agency. The workshop and evaluation process may require approximately three months, and additional coordination beyond this duration may be necessary. Preparation for the multi-party workshop, and for Council and Board meetings are typical cost drivers of the evaluation. A project sponsor may decide to opt out from the workshop or outreach to its Board to reduce costs.

Legislative Basis

The State of California has granted authority to several public agencies to utilize alternative contract delivery methods for transit infrastructure projects, as outlined in the California Public Utility Code Section 103393 et. seq. The legislation also requires Caltrain to demonstrate through a written report and public meeting that the implementation of an alternative contract delivery method, other than DBB, would achieve one of the following goals for the project:

- Reduce project costs
- Expedite the project's completion
- Provide features not achievable through the DBB method

Evaluation Process

The evaluation process is guided by two primary resources: the Transit Cooperative Research Program (TCRP) Report 131, A Guidebook for the Evaluation of Project Delivery Methods, and the Caltrans Alternative Procurement Guide. Of note, Caltrain makes some slight modifications to the documents to better reflect the goals of a transit project. The evaluation consists of both qualitative and quantitative assessments to determine the most optimal delivery method. The steps of the evaluation process include the following:

- **Step 1.** Understand the Project
- **Step 2.** Define Project-Specific Goals
- **Step 3.** Identify Project-Related Issues
- **Step 4.** Compare the Schedule of Each Method
- **Step 5.** Qualitative and Quantitative Evaluation

Step 1. Understand the Project

The first step in the process is to develop a clear and comprehensive project description that effectively communicates the key characteristics of the project to decision-makers and provides a snapshot of the project's scope at the time the delivery method was evaluated. Because project scope and elements vary, the project description must include pertinent information and address aspects of the project that may be impacted by the delivery method. The project description plays an important role in informing partners and supporting the project delivery method decision. The following is a list of significant project characteristics that should be included to confirm partners have a shared understanding of a grade separation project.

- Name
- Location
- Objective
- Mode of Transportation
- Timeline
- Estimated Budget

Step 2. Define Project-Specific Goals

The most important aspect of selecting an appropriate project delivery method is to establish a clear set of project goals. The project will need to achieve technical goals, such as design, safety, and ridership requirements, as well as performance goals relating to cost, time, quality, maintainability, and sustainability. The subsequent list provides examples of project goals that were identified during an alternative contract delivery analysis workshop for a grade separation project on the Caltrain corridor.

- Early construction cost certainty to validate the proposed scope and available budget
- Accelerated construction schedule
- Include project sponsor staff in the final design process
- Early construction contractor input during design to incorporate preferred construction means and methods and construction phasing

A clear and concise definition of project goals not only assists with selecting an appropriate project delivery method, but also provides a clear measure for project success and clear directions for the CM or design-builder to complete the project if an alternative project delivery method is selected. Project goals set the stage for decision-makers throughout the project lifecycle and keep the project priorities before decision-makers as they analyze different delivery methods. Project goals influence the choice of procurement method, risk-allocation strategies, contracting, progress monitoring and the evaluation of the outcome at the end of the project.

Step 3. Identify Project-Related Issues

Caltrain and the project sponsor must consider various project-related issues and compare the advantages and disadvantages of different project delivery methods. Advantages and disadvantages of project delivery methods may not always be absolute and should be evaluated in comparison to other delivery methods. This discussion provides an overview of the issues related to project delivery methods and serves as a basis for the decision-making process during **Step 5 – The Qualitative and Quantitative Evaluation Stage**. The project-related issues are classified into the following categories.

Project-level issues related to project-specific characteristics

  - Project Size
  - Cost
  - Schedule
  - Risk Management
  - Risk Allocation
  - LEED Certification or Envision Verification

- Agency-level issues related to the owner agency (Caltrain)
  - Agency Experience
  - Staffing Required
  - Staff Capability
  - Agency Goals and Objectives
  - Agency Control of Project
  - Third-Party Agreements
- Public policy/regulatory issues related to existing public policy and regulations
  - Competition
  - DBE Goals
  - Labor Unions
  - Federal/State/Local Laws
  - FTA/EPA Regulations
  - Partner/Community Input
- Lifecycle issues related to the project delivery methods in a long-term, post-construction context
  - Lifecycle Cost
  - Maintainability
  - Sustainable Design Goals
  - Sustainable Construction Goals
  - Construction Claims
  - Adversarial Relationship

Step 4. Compare the Schedule of Each Method

Since an infrastructure project can only be delivered using one project delivery method, direct comparative data relative to schedule and cost performance for DBB in comparison to another project delivery is not available. For this reason, Caltrain staff prepares a draft project schedule for different project delivery methods for the workshop.

Step 5. Qualitative and Quantitative Evaluation

The qualitative and quantitative evaluation involves ranking the contemplated project delivery methods by using the analytical project delivery method assessment presented in the TCRP Report 131 and the Caltrans Alternative Procurement Guide. Samples of these assessment documents are included in **Appendix 3**.

Next Steps After the Alternative Delivery Evaluation

After the alternative delivery evaluation, Caltrain is required to document the findings in a written report. These findings will describe the process and the recommended contract delivery method. These findings need to be accepted by PCJPB and the local sponsor for an alternative delivery method to be utilized. The general steps for this process are below:

- Identify and agree on a project delivery method
- Review and approve the Project Delivery Decision Report
- Prepare Caltrain Board Report Presentation Workshop, results, and project delivery recommendation
- Conduct a Caltrain Board public meeting and present the analysis and Project Delivery Decision Report
- Secure Caltrain Board approval to authorize the selected project delivery method and amend the existing Cooperative Agreement to incorporate the selected project delivery method and include the estimated pre-construction costs
- Complete any required FTA or FRA communication to confirm selected project delivery method decision
- Confirm the project goals, objectives, and risks to incorporate into the contractor procurement documents and contracts
- Coordinate with the project sponsor for any City Council or other City Governance requirements necessary to authorize the selected project delivery method
- For alternative delivery methods with a pre-construction element, coordinate with the project sponsor and county transit authority to ensure adequate funding for pre-construction services
- Coordinate with the project sponsor and county transit authority to execute the funding agreement to address the potential for early construction work enabled by the selected project delivery method
- Amend the existing Cooperative Agreement to incorporate the identified delivery method approach and estimated costs
- Update the template for Caltrain professional services qualifications-based selection RFP to select a contractor
- Consider conducting an industry forum to review the project details with interested contractors
- Prepare and issue a Request for Letter of Interest (LOI) to advise the construction industry of the upcoming project and create an initial contractor list to confirm they receive the RFP when issued
- Request Caltrain legal counsel to update the template for professional services contract to tailor the contract for the contractor preconstruction professional services
- Request Caltrain legal counsel to review the construction contract to incorporate requirements, including risk sharing, mitigation, and incentives to address encountered risks in a timely manner
- Initiate project RFP process for the selected project delivery method
- Secure Caltrain Board approval to execute the contract

10 Construction Methods


NO
STOPPING
ANY
TIME
HILLSDALE STATION
Caltrain
920

10 Construction Methods

Grade separation construction along an active railroad is complex and highly dependent on local conditions. Factors unique to each crossing will influence the process by which the grade separation is constructed. No two grade separation projects are identical; however, the projects can be broadly categorized by construction method. This section will summarize, analyze, and compare the following construction methods for grade separations to inform the most appropriate method for a given crossing location.

- **Ground-Up Construction (Traditional)**
- **Top-Down Construction**
- **Box Jacking/ Placement**
- **Accelerated Bridge Construction**
- **Viaduct**
- **Cut & Cover**
- **Tunnel**

Key Takeaways:

Summaries, analyses, and comparisons of the most appropriate construction methods for a given grade separation location

All construction methods need to consider the adjacent transportation network, local permitting, and maintenance of travel during construction.

Ground-Up Construction (Traditional)

Overview

- Construction method most familiar to contractors and lead agencies
- Rigid, linear, construction sequencing can increase construction duration compared to other methods
- Likely to require temporary measures to maintain rail service during construction

Ground-up construction is a conventional construction method for grade separations and is familiar to the greatest number of contractors. Ground-up construction is applicable to most design solutions and is frequently used for infrastructure projects in the U.S. **As the name suggests, ground-up construction begins from the ground level and builds upwards.** If the design solution establishes a proposed ground elevation (e.g., embankment), earthwork activities required to establish the proposed ground elevation must be completed prior to commencing work on grade separation structures. The rigid, linear nature of this construction method can minimize construction complexity at the expense of elongated construction duration. Depending on the chosen design solution, ground-up construction may require the installation of temporary measures (i.e., infrastructure) to maintain rail service during the construction phase.

Construction Process

Ground-up construction typically starts by constructing the bottom-most structure and working upwards. For an underpass structure, the first construction step is to excavate to the lowest level before construction of the bottom-most structure can begin. During excavation, bracing systems are required to support the walls of the excavated area, and construction of new structures cannot begin until the excavation work is entirely complete. This early excavation work is generally referred to as earthwork. In a ground-up construction process, earthwork activities must be completed prior to commencing construction of trackwork or structures.

Preparing to Grade Separate

Most grade separation construction methods begin by first performing the preparatory activities below.

Utility Relocations

Most third-party utility agencies will be required to relocate their utility lines located in public or railroad ROW to accommodate the proposed grade separation. These utilities typically relocate their lines prior to the start of major construction activities to avoid conflicts and maintain service. In other situations, the contractor may relocate utilities as an early construction activity.

Site Preparation

Construction activities begin by mobilizing the construction equipment, installing fencing around the worksite where needed to protect the public, clearing the construction site of vegetation or other minor items, and proceeding with demolition and removal of items such as buildings, walls, and pavement.

Temporary Service Establishment

Prior to beginning construction on the proposed facility, temporary measures must first be established to maintain train operations during construction. The most common temporary measure is a temporary track constructed adjacent to the construction zone that allows train service to bypass construction work. These temporary tracks are referred to as shoofly tracks. Other temporary service options are detailed in the Maintaining Operations section. After these temporary measures have been accomplished, the major phases of work can begin.

Phase 1: Earthwork

Earthwork activities include excavation of existing materials as well as the importing and moving of fill soil. In general, ground-up construction starts at the ground level and works upwards. For this reason, earthwork must generally be completed prior to the construction of other project elements.

Phase 2: Grade Separation Construction

After the earthwork activities have been completed, work can begin on the proposed track and grade separation structures. During this phase, features appurtenant to the proposed grade separation are also constructed, such as roadways, drainage systems, lighting, signals, landscaping, etc.

Phase 3: Service Transfer

After construction activities are completed for the new grade separation, service is routed to the new permanent tracks and the shoofly tracks are removed.

Application

The traditional ground-up construction method can be used to construct overpasses, underpasses, pedestrian/bicycle grade separations, and grade separations at stations. Whether the profile of the rail, road, or a combination of the two is being adjusted to achieve separation, the ground-up method can be used to accomplish any of these types of grade separations. Ground-up construction is particularly well-suited for construction of overheads (i.e., overpasses) since the construction work generally builds upward from existing ground level.

Construction Cost

Construction cost is contingent on existing site conditions and proposed design features, making the cost highly project-specific.

Two general factors that significantly influence cost on a grade separation project using the ground-up method are:

1. **Contractor familiarity**
2. **Choice of temporary service option**

Since ground-up construction is familiar to the greatest number of contractors, projects using this method will likely have a greater number of bidders, thus increasing competition and reducing project costs. Temporary service options like shoofly tracks can be expensive to design, construct, and demolish post-construction. Projects requiring shoofly tracks can expect significant cost increases.

Construction Duration

Ground-up construction typically requires earthwork activities to be complete before beginning construction on structures and tracks. This sequence may result in increased project duration in comparison to the other construction methods discussed in this chapter. Ultimately, total construction duration is most influenced by choice of temporary service option, complexity of the structures used to grade separate, and impact to the rail corridor's OCS.

Maintaining Operations

The method by which rail operations are maintained during the ground-up construction process is influenced by the availability of railroad ROW adjacent to the construction activities. Typically if railroad ROW is available, shoofly tracks are used to maintain rail service capacity and preserve customer experience for riders. Shoofly tracks provide a temporary track detour allowing rail traffic to continue flowing around a construction zone. Shoofly tracks can be left in place for long periods to allow the contractor ample time to construct the grade separation. Once construction activities have been completed, service is transferred back to the newly grade-separated mainline tracks and the shoofly tracks are demolished.

In some areas along the Caltrain corridor, for example between 1st and 9th Avenues in the City of San Mateo, existing railroad ROW is limited and may not be sufficient for the construction of temporary tracks without railroad ROW acquisition. A situation like this would require significant impacts to Caltrain service to construct. These service impacts reduce operational capacity of the railway, introduce delay, and inconvenience passengers.

In areas less constrained by existing railroad ROW availability, design solutions may be applied to limit the need for expensive or disruptive temporary service measures required when performing ground-up construction. If sufficient ROW exists, the grade separation can be designed adjacent to the existing crossing, allowing the existing mainline tracks to act as the temporary detour around the construction zone, thus eliminating the need for shoofly tracks. This process was used on the 25th Avenue Grade Separation Project in the City of San Mateo, resulting in both schedule and cost savings.

Electrification

The introduction of the OCS along the Caltrain-owned portion of the corridor presents challenges to future grade separation construction. Impacts to the OCS can increase costs and construction duration and can interrupt rail operations. Additionally, shoofly tracks added during construction must be temporarily electrified, further increasing cost and schedule. For these reasons, regardless of construction approach, grade separations should attempt to minimize or eliminate impacts to the OCS system.

Top-Down Construction

Overview

- Primarily used for construction of underpass grade separations
- Provides cost and schedule efficiencies in comparison to ground-up construction method
- Requires removal of OCS infrastructure during construction

Top-down construction is another traditional construction method that is used primarily for constructing underpass grade separations. The top-down method allows the contractor to overlap earthwork and construction activities and eliminates the need for temporary shoring during construction. These advantages bring efficiencies to schedule and cost in comparison to the ground-up method when utilized to construct underpass structures.

Similar to the ground-up method, the top-down method generally requires temporary service measures such as shoofly tracks to be installed prior to construction to maintain railway operations. These temporary service measures can be costly to construct and extend the project duration.

Construction Process

In the top-down construction process, structure or track construction can begin prior to the completion of earthwork activities. This overlap of construction activities helps shorten construction duration and provides greater flexibility for construction staging on active roads or railways.

Similar to the ground-up method, top-down construction also typically begins with utility relocations, site preparation, and establishment of temporary service. When using shoofly tracks to maintain service, construction of a temporary OCS system may be required to power trains through the construction zone, depending on the length of the shoofly tracks needed. For further descriptions of these activities, see the Preparing to Grade Separate information in the Ground-Up Construction section. After these initiation activities are complete, the top-down construction process can begin.

Phase 1: Track Preparation

Prior to impacting the existing track and OCS, electrified shoofly tracks will need to be constructed. A new OCS system will need to be installed with the shoofly tracks.

During weekday and weekend non-revenue windows, the OCS is relocated to the shoofly tracks. After the track panels have been installed, train operations can continue uninterrupted on the shoofly tracks.

Phase 2: Installation of Cutoff Walls and Soldier Piles

During a weekend window (typically 48 hours) to minimize interruptions to rail operations, soldier piles and cutoff walls are installed to frame the excavation area. Once the cutoff walls are in place, the track panels and ballast are reinstalled, and rail service can continue uninterrupted.

Phase 3: Earthwork and Structure Construction

With train operations shifted to the shoofly tracks, construction of the grade separation structure can proceed on the mainline tracks. Since the excavation area has been walled off, excavation of the underpass area can proceed alongside construction of the separation structure.

Phase 4: Transfer Service

After the grade separation structure and associated trackwork are complete, service can be switched back to the mainline and the shoofly tracks can be removed. This allows for the completion of the undercrossing excavation underneath the shoofly tracks.

Phase 5: Finalize Underpass Construction

With the final earthwork operations complete, construction of the roadway beneath the grade separation structure can be accomplished. Final construction details are also completed, including but not limited to signals, lighting, and landscaping.

Application

Top-down construction is best suited for underpass grade separations utilizing either a full-road reprofiling or a hybrid road-rail reprofiling. This method can also be considered for trench construction. Top-down construction is incompatible for overheads or overcrossing structures.

Construction Cost

Construction costs for top-down construction are typically less than for ground-up construction, due to the contractor's ability to overlap the earthwork and structural phases of construction to accelerate project delivery. Accelerated project delivery reduces resources required for traffic handling, environmental mitigation, and project administration. The top-down method also eliminates the need for and cost of temporary shoring during construction, by driving the final walls into the ground prior to commencing excavation.

Construction Duration

The top-down construction process offers schedule efficiencies in comparison to the ground-up method for constructing undercrossings or trenches. The same characteristics of top-down construction that help to reduce project cost also help to accelerate project delivery (i.e. shorten construction duration).

Temporary service options available for top-down construction are identical to those available for ground-up construction; therefore, the effects these options have on construction duration do not differ from those experienced by projects using ground-up construction.

Maintaining Operations

Similar to ground-up construction, shoofly tracks are a possible temporary service option to reduce impacts to rail operations. The downside of shoofly tracks is that they are expensive to design, construct, and electrify, and are typically only useful during the construction phase. Post-construction, shoofly tracks serve little to no purpose and are usually demolished once the grade separation is complete. Caltrain will need to evaluate the use of shoofly tracks based on project cost, site conditions, available ROW, and overall construction duration.

If shoofly tracks are deemed too expensive or not possible to construct due to ROW constraints, then top-down construction may, with Caltrain approval, be performed while maintaining operations on a single track. To achieve this, instead of rerouting rail traffic to separate shoofly tracks during construction of the grade separation structure, the structure is constructed in segments. Shutting down a single track allows for half of the structure to be completed while operations are maintained on the other track. After construction is complete on the first half of the structure, operations are switched to the completed track while construction of the other half of the structure is underway. This method can help save time and money; however, the method has a greater impact on rail operations. Work windows for these activities will be very limited, since shoring construction will only be allowed with an OCS power down situation. This limits the work window to a handful of non-revenue hours.

Electrification

Retaining wall construction using the top-down method requires use of tall drill rigs and large cranes. Large construction equipment such as this cannot operate in proximity to the OCS due to height limitations and clearance requirements. For this reason, top-down construction requires the removal and replacement of the OCS during construction.

In 2023, Caltrain spent

$1.3 Million

to replace 2,600′ of auto-tension OCS and 2,200′ of feeder and static wire for the Guadalupe River Bridge Project. The lengthy process required 51 days to remove and 45 days to reinstall the OCS.

This expense is in addition to the cost of electrifying the shoofly tracks, should that temporary service option be chosen.

Box Jacking / Box Placement

Overview

- Accelerated method most proven for small vehicular or pedestrian/bike underpasses
- Potential to minimize or eliminate impacts to existing operations and OCS infrastructure
- Requires specialty contractor, which can increase construction costs

Box jacking is an accelerated construction method for grade separations that is most proven for smaller street or active transportation undercrossings. **The advantage of this method is to minimize or eliminate impacts to existing operations by constructing the grade separation structure adjacent to the existing crossing location. After the structure is complete, it is pushed into its final location during a short closure window.** This method eliminates the need for shoofly tracks or single-track operations and limits impacts to the OCS infrastructure.

Although this method has been utilized in the United States, it is still a relatively new construction method. Due to less contractors being familiar with this method, there may be reduced bid competition for this construction method.

Example photos used in this section are conceptual renderings of a proposed box jacking construction sequence for the Mountain View Transit Center Grade Separation at Castro Street. At the time of this publication, the preferred construction method for this project had yet to be determined. These graphics were generated for the purpose of evaluation of construction methods and may not accurately represent every detail of the construction sequence.

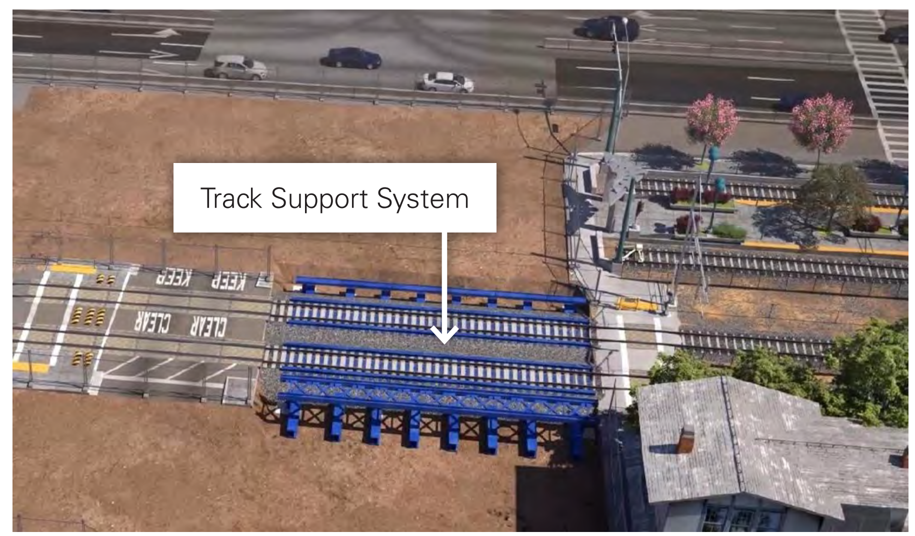
Construction Process

Like most grade separation construction methods, box jacking requires site preparation and utility relocation activities to be performed prior to commencing construction. For a detailed description of these activities, please see "Preparing to Grade Separate" in the Ground-Up Construction section. Unlike other construction methods, box jacking allows rail service to be maintained during construction, eliminating the step of temporary service establishment. Once the construction site has been prepared, the construction sequence described below can begin.

Phase 1: Install Track Support System

To adequately support the existing mainline tracks during the subsequent construction phases, it is necessary to install a track support system beneath the existing mainline tracks. This process can occur during a short overnight closure window to minimize impacts to rail operations. The process begins by first de-energizing the OCS to allow construction crews to operate safely underneath. Micro-piles are then installed along the outside of the mainline tracks. Next, the transverse and longitudinal support beams that make up the track support system are installed beneath the existing track section (see **Figure 10.1**). Finally, construction equipment and materials are cleared from the area and the OCS is reenergized, allowing for train operations to resume.

Figure 10.1: Install Track Support System

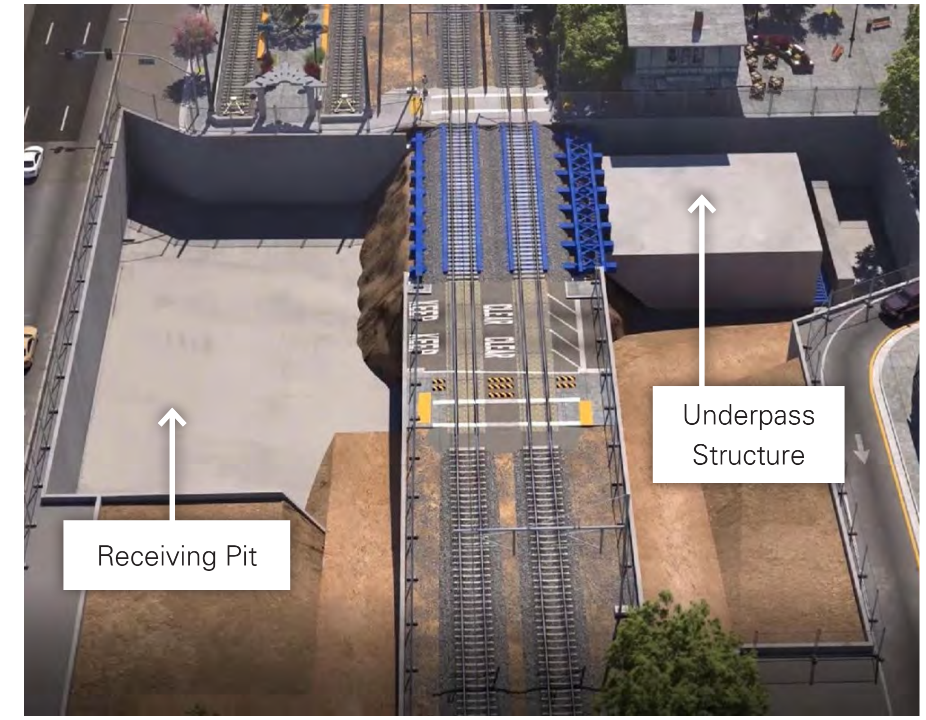


Phase 2: Construct Underpass Structure

Once the track support system is in place, work can begin to dewater the site and install shoring around the staging pits to support excavation activities. After the staging pit shoring is installed, the contractor can safely begin excavating the staging pits adjacent to the active tracks. After the staging pits are excavated to their required bottom elevations, working slabs are constructed at the base of the pits. Next, work begins on constructing the grade separation structure. Note that these activities are performed away from the active tracks, allowing for construction to proceed without track closures or the need to de-energize the OCS.

In the case of the example photo (see **Figure 10.2**), a cast-in-place reinforced concrete box will be used to grade separate the crossing.

Figure 10.2: Construct Underpass Structure

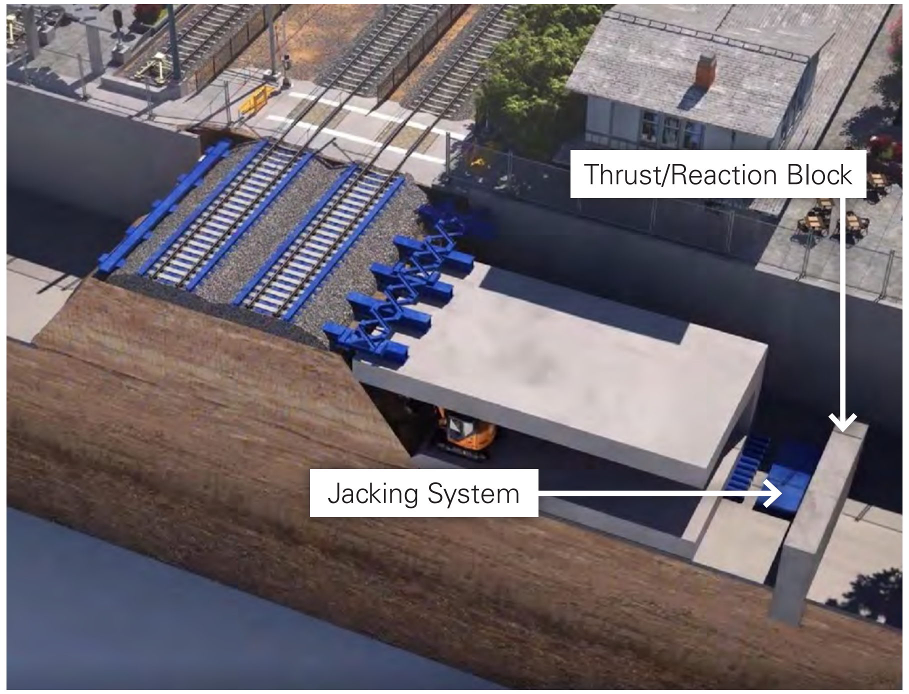


Phase 3: Jacking the Underpass

After the grade separation structure is completed, the next step is to push the structure into its final location beneath the active tracks and the track support hardware (shown in the example pictures in blue). To achieve this, the contractor constructs a thrust/reaction block behind the structure to provide an immovable object to push against. Next, a hydraulic jacking system is installed between the structure and the thrust block (see **Figure 10.3** on the following page). The contractor then begins jacking (or pushing) the structure under the active track. As the structure is pushed into place, an excavator sits within the structure to excavate soil as necessary.

Similar to Phase 2, Phase 3 can be performed while the tracks above remain active. Alternatively, this work can be performed in short closure windows. This is due to the track support system installed in Phase 1, which transfers the load of the rail section from the earth to the top of the grade separation structure as the structure is pushed beneath it.

Figure 10.3: Jacking the Underpass



Phase 4: Install Waterproofing

With the grade separation structure set in its final location, work can begin on waterproofing the structure and installing the base asphalt layer of the proposed track section. To install these features, the contractor first panelizes the existing track, or cuts it into smaller, more manageable pieces for quick deconstruction and reconstruction. The process to panelize the tracks occurs during an overnight closure to minimize operational impacts. Next, during a longer weekend window, a single track can be removed to allow for the construction of the waterproofing and asphalt layers on top of the separation structure (see **Figure 10.4**). Next, the ballast and track panels are reinstalled on top of the asphalt and the process is repeated for the second track. After work on both tracks is complete, the crossing structure has been successfully installed and work can shift to other areas of the project.

Figure 10.4: Install Waterproofing

Application

The box jacking method is most proven for smaller undercrossing separations like those used for low volume (i.e., narrower) roads or pedestrian/bicycle-only crossings. These undercrossing structures are small enough to be jacked effectively. Undercrossing projects seeking to avoid impacts to existing rail operations and reduce project duration may be best served by the box jacking method.

A modified version of the box jacking method, referred to as box placement, uses a precast undercrossing structure that is lifted into place with a crane. The placement can be done at once or in pieces for construction of larger undercrossing structures. The downside of this method is the requirement for either (1) complete closure of the tracks for longer than a weekend window, or (2) construction of shoofly tracks and an OCS system to maintain operations. Placing precast structures helps construction duration; however, impacts to rail operations, or solutions required to avoid such impacts, raise construction costs.

Construction Cost

Total construction costs for box jacking are generally higher than for traditional construction methods like ground-up or top-down; however, there are some areas where box jacking offers cost efficiencies. For example, since box jacking eliminates the need for shoofly tracks during construction and minimizes total impacts to rail operations, this method reduces costs for design and construction of temporary service options. Additionally, minimizing impacts to the OCS provides cost savings.

Despite these efficiencies, total construction costs are typically higher for this method due to it being a specialty construction type. Few national construction firms have executed box jacking. Even fewer local firms have the technical knowledge to perform such an intricate process. Due to less competition, costs for specialty jacking services are high and may off-set cost efficiencies associated with elimination of temporary service tracks or OCS impacts.

Benefits

The box jacking method offers several advantages in comparison to ground-up and top-down construction when used for undercrossing construction. Box jacking is capable of reducing construction duration in comparison to its peer construction methods and largely eliminates impacts to rail operations. These benefits are achieved by (1) eliminating the need to construct temporary electrified shoofly tracks, (2) opportunity for overlapping activities in the construction sequence, and (3) constructing the separation structure away from the active track.

Maintaining Operations

Unlike other construction methods, box jacking can be performed without the need for installing expensive and time-consuming electrified shoofly tracks to maintain temporary operations. Instead, service during construction can be maintained along the existing mainline tracks with few service interruptions. Most of the construction activities requiring service interruptions can occur during overnight windows. Activities requiring longer interruptions may be completed over weekend windows, minimizing impacts to riders.

Electrification

Assuming the undercrossing is designed to avoid impacts to OCS pole foundations, the box jacking construction method has little impact on the OCS infrastructure. Most of the heavy construction activities associated with this construction method occur away from active tracks, allowing the OCS to remain active during much of the construction process. Only infrequent, short-term interruptions to the electrification of the OCS are required when work occurs on the track section.

Accelerated Bridge Construction

Overview

- Reduces construction duration for grade separations involving construction of a bridge structure
- Prefabrication and installation increases construction costs, but reduces lifetime maintenance costs in comparison to traditional methods
- Likely to impact the OCS during construction

ABC is a grade separation construction method that uses innovative planning, design, materials, and construction methods to reduce the onsite construction time that occurs when building new bridges and replacing or rehabilitating existing bridges. This method is similar to box jacking in facilitating rapid construction of the grade separation structure. The key difference between the two methods is that ABC is used for bridge construction, while box jacking is used for the construction of reinforced concrete boxes. In comparison to traditional construction methods such as ground-up or top-down, ABC can improve site constructability, construction quality, and total project delivery time. **The FHWA and Caltrans have both published guidance documents for evaluation of the ABC method during the planning phase. The FHWA Manual is titled Decision-Making Framework for Prefabricated Bridge Elements and Systems (PBES), Publication Number FHWA-HIF-06-030, May 2006. The Caltrans Manual is titled Caltrans Accelerated Bridge Construction Manual, July 2021.**

Construction Process

Several innovations support ABC, including (1) foundation and wall construction, (2) rapid embankment construction, and (3) fast-track contracting. For the purposes of this document, the construction process described for ABC will focus on the rapid placement of prefabricated bridge elements. For an in-depth understanding of all available construction innovations associated with ABC, please see Chapter Two: Accelerated Bridge Construction Technologies of the **FHWA's Accelerated Bridge Construction Manual, November 2011**.

In ABC construction, prior to preparing the construction site, construction of prefabricated bridge pieces can begin at the manufacturing plant or staging area. This approach allows the contractor to reduce time spent impacting rail or road operations at the construction site. Like other construction methods, site preparation and utility relocation activities are performed prior to commencing construction. For a detailed description of these activities, please see the Preparing to Grade Separate information in the Ground-Up Construction section.

Once the construction site has been prepared, the following construction sequence can begin.

Phase 1: Prepare Site for Structural Installation

The initial phase of the ABC method is to prepare the construction site ahead of the installation of the prefabricated bridge pieces. This step includes the construction of necessary earthwork, abutment walls, retaining walls, or other prerequisite infrastructure needed to support the prefabricated bridge pieces. Chapter Two of the FHWA's Accelerated Bridge Construction Manual details innovative and accelerated construction techniques that can be applied for these construction activities using the ABC method.

Phase 2: Install Prefabricated Bridge Pieces

Once the construction site has been prepared, the prefabricated bridge pieces can be moved from the manufacturing plant or staging area to the construction site. The process used to transport and install these pieces varies depending on the site conditions, size of the bridge pieces, and distance required to transport them. Prefabricating the bridge in smaller pieces can make it easier to move and install; however, this approach can present specific design challenges like small bridge spans. Conversely, prefabricating large bridge structures or sometimes even entire superstructures can be easier to design, but harder to transport and install. Please see Section 2.4 of the FHWA's Accelerated Bridge Construction Manual for more information on available structural placement technologies.

Application

ABC is best suited for building overhead structures (road over rail) or underpass structures (rail over road). The approach uses bridge structures to grade separate, rather than a reinforced concrete box or tunnel. A project seeking to improve work zone safety, accelerate project delivery, and minimize local traffic disruption could be well-suited to apply the ABC construction method.

Although ABC can be used in place of traditional methods for almost any bridge construction, ABC may not always be the best method considering the equipment and staging requirements to transport and lift the bridge. The project sponsor, planner, design engineer and/or other decision-maker should evaluate the applicability of ABC over traditional construction methods early in the planning stage. Early consideration is key to the success of an ABC project.

ABC is best paired with a project delivery method which can accommodate accelerated delivery techniques. Methods such as DB, PDB, and CM/GC allow the design and construction phases to overlap, helping to accelerate project delivery. Additionally, all three of these delivery methods allow the contractor to provide input on the design of the project earlier than is possible with a traditional DBB delivery method. Given the complexity of the construction process under ABC, early contractor input is important for an ABC project. For this reason, ABC projects are best paired with alternative project delivery methods such as DB, PDB, or CM/GC.

Construction Cost

In general, accelerating the construction process increases the cost required to complete construction. This phenomenon is true for ABC. According to the FHWA, the additional construction cost premium for deploying ABC on eight bridge projects, built as a part of the Highways for Life Program, was found to range between 6 and 21 percent in comparison to cost estimates for traditional construction. This increase in construction cost is driven by the need for specialized transportation and lifting equipment to install the prefabricated bridge pieces. In addition, less contractors are familiar with this method, thus reducing competition and increasing prices.

Although ABC methods are often more expensive than conventional construction methods, ABC can yield savings in life-cycle costs and other aspects of the project. Prefabricating bridge pieces in a controlled, monitored environment increases quality, reduces maintenance requirements, and increases service life. Fewer days spent in construction means less disruption to the public and fewer resources required for traffic handling, environmental mitigation, and administration than for traditional construction methods. Eliminating the need for falsework can benefit design, allowing for lower bridge profiles that reduce earthwork at the bridge abutments. These cost benefits help make the overall cost of an ABC project more competitive when compared to other construction methods.

Construction Duration

For a pedestrian or vehicular overpass, ABC's main benefits are reduced construction duration and by extension less duration interrupting rail, road, and access operations. These benefits are achieved by prefabricating the bridge structure (or pieces of it) off-site and moving those pieces into place over a shortened closure window. For railroad grade changes or bridges with significant OCS impacts, temporary service options, such as an electrified shoofly, will still need to be constructed.

Construction projects are often limited by environmental factors, for instance the spawning of fish can set limitations on when and for how long in-water work can be accomplished. Limitations like this can prolong the construction process, sometimes leading to delays of months or years depending on the magnitude of the environmental impacts associated with construction. ABC can build projects more readily within time limitations set by environmental factors, potentially reducing project durations by years in comparison to traditional construction methods.

Maintaining Operations

ABC provides the opportunity to eliminate the need for temporary service measures during the construction phase. For a pedestrian or vehicular overpass, most of the time-consuming work of constructing the bridge structure occurs away from the railroad. The work of placing the bridges over the OCS system will only be allowed during an OCS power down situation, which will limit the work window significantly. If significant OCS impacts are anticipated, such as for railroad grade changes or bridges, an electrified shoofly will need to be constructed. The accelerated nature of this construction method has the potential to reduce the severity and length of temporary service options.

Electrification

ABC offers multiple techniques for the installation of prefabricated bridge pieces. Section 2.4 of the FHWA's Accelerated Bridge Construction Manual further examines the available options depending on the type and design of the grade separation, as well as site-specific project constraints. In general, ABC is achieved by lifting large, heavy bridge pieces into place with tall cranes. ABC would thus require de-energizing and dismantling ½-mile segment(s) of the OCS during the installation of the bridge pieces to allow for operations of the crane equipment. Dismantling the OCS, no matter for how long, will increase project costs.

Viaduct *(Segmental Bridge Construction)*

Overview

- Accelerated construction method for separating multiple crossings with a single design solution/project
- Potential to impact existing operations and OCS infrastructure depending on ROW availability
- Multi-crossing solutions may reduce cost to separate individual crossings
- Structural design may be challenging with heavy rail loading

A viaduct is a series of piers or columns supporting an elevated railway over land or water. **Viaducts may be used to grade separate multiple crossings with a single design solution.** The construction process for a viaduct combines the ground-up method with the ABC method to expedite construction of the longer, elevated structure. This process is referred to as segmental bridge construction. After the viaduct is complete, the space beneath the viaduct may be repurposed for public use. Common applications of this space are active transportation routes.

Construction Process

Viaduct construction is typically preceded by site preparation, utility relocation, and temporary service establishment. For detailed descriptions of each, please see the Preparing to Grade Separate information in the Ground-Up Construction section. Similar to ABC, the horizontal spans between the columns of a viaduct can be precast at a manufacturing facility and shipped to the construction site when they are needed for installation. Construction of these bridge pieces can begin prior to the site preparation phase to attain shorter construction durations.

Phase 1: Construct Column Foundation

The foundations for the columns sit beneath the ground surface on top of piles driven deep into the earth. Construction begins by first driving the piles into the ground, then excavating down around the piles to the bottom elevation of the foundation. The foundation is then cast-in-place on top of the piles.

Phase 2: Construct Column

Next, the column can be cast-in-place on top of the foundation. This process is completed in vertical sections until the column reaches its final elevation. The foundation is then covered to the finished grade and construction moves to the next column.

Phase 3: Install Precast Bridge Pieces

The horizontal segments between the columns are then installed piece by piece using a conventional or gantry crane. The pieces are connected using an internal post-tensioning system and water-proofed using an epoxy seal. The process continues along the length of the viaduct until the entire viaduct has been constructed.

Phase 4: Rail and OCS Construction

After the viaduct is complete, the rail section can be placed and the OCS infrastructure can be installed.

Application

Segmental bridge construction as described in this section is specific to the construction of viaducts.

Construction Cost

Construction methods that grade separate multiple crossings with a single design solution will have higher costs than a single crossing project due to their greater scale. However, applying a single solution to grade separate multiple crossings, rather than advancing multiple individual projects, can reduce construction costs.

Viaducts, typical of multiple grade crossing separations, are expensive to construct. Much of the cost is driven by the structural elements needed to support the railway above the ground. By comparison, the cut and cover method for constructing a trench or tunnel is similar in cost to viaduct construction. However, constructing a viaduct is less expensive in comparison to bored tunneling, due to the greater complexity of subsurface construction.

Construction Duration

When used to construct viaducts, segmental bridge construction can be considered an accelerated construction method, similar to ABC. This is due to the use and rapid installation of precast bridge pieces to assemble the spans of the viaduct. Since these bridge pieces are precast, their construction can occur off-site and can begin prior to commencing construction activities on-site. This process facilitates overlapping the construction of the bridge pieces with the construction of the columns, reducing overall construction duration.

If the proposed viaduct will be located in the same location as the active track, the active track needs to be shut down during construction and temporary service options will be required. The addition of shoofly tracks will increase project duration.

Maintaining Operations

Temporary service requirements will vary depending on design and existing ROW. In locations with wider ROW, viaducts may be constructed adjacent to the active tracks to avoid impacts to existing operations. In these locations, consideration must be given to clearance requirements from the active OCS. Special care is needed for impacts to the existing OCS system, since a viaduct system often requires large gantries and support structures. These structures, and the methods of erecting them, have the potential to damage or impact the existing OCS system. If sufficient clearance from the active OCS is not possible during construction, temporary service options will be required.

Electrification

Interruption to the OCS infrastructure is possible during the construction of a viaduct. Only the availability of adequate ROW for construction activities and a deliberate effort to avoid OCS impacts during the design phase can prevent interruptions to the OCS during construction.

After the viaduct is constructed, new OCS infrastructure will need to be installed on the viaduct to service the new tracks. This process will render the existing OCS infrastructure obsolete along the length of the viaduct. Additionally, adding OCS poles and wires to an elevated viaduct further increases visibility of the structure from adjacent neighborhoods.

Cut and Cover

Overview

- Primarily used to construct trenches and tunnels spanning multiple crossings
- Causes significant impacts to rail operations and OCS infrastructure
- Requires temporary service options during construction, increasing cost and duration

Cut and cover is primarily used for the construction of trenches and tunnels spanning multiple crossings. In this method, the contractor digs a trench to the elevation of the proposed rail, constructs the rail and trench/tunnel structure, and then potentially covers the trench depending on the proposed design. A negative impact of cut and cover is excessive and extended surface impacts, which can interrupt existing traffic patterns, rail operations, and the community.

To mitigate this, cut and cover may borrow from the top-down method by driving retaining walls into the ground prior to beginning earthwork activities. The trench can then be cut within the retaining walls to help limit surface impacts.

Constructing an open trench adjacent to an active rail line and beneath active OCS lines is complicated. Rail operations must be shut down and, in some cases, the existing OCS needs to be removed to accommodate the large trenching equipment needed for this method. Temporary service options are a requirement through a cut and cover construction area.

Construction Process

Construction is preceded by site preparation, utility relocation, and temporary service establishment. For detailed descriptions of each, please see the Preparing to Grade Separate information in the Ground-Up Construction section. One exception for cut and cover construction is for utilities that parallel the existing track. Temporary service options may be needed to maintain those utilities during the construction process. Once the trench or tunnel is complete, those utilities can be rerouted through the new structure.

Phase 1: Install Trench/Tunnel Support System

Once the site has been prepared and temporary service has been activated, work can begin on the support walls lining the trench or tunnel. These walls are driven into the earth from the surface, consistent with the top-down construction method. Special consideration should be given to wall design near adjacent structures to prevent undermining such structures.

Phase 2: Earthwork

With the trench support in place, excavation of the proposed trench between the trench support walls can begin. Bracing is added to the walls as the trench is dug to counteract the force of the adjacent soil pushing on the top of the support walls.

Phase 3: Construct Structures

After the trench or tunnel is excavated to the bottom elevation, work can begin on the trench foundation and walls. In the case of a tunnel, the tunnel roof is also constructed during this phase. Precast trenches or tunnel pieces can be used to accelerate the construction process. After the structures are complete, rail infrastructure and OCS can be installed within the trench or tunnel.

Phase 4: Backfill and Resurface (Tunnel Only)

In the case of a tunnel, the constructed tunnel structure is covered with soil to the original grade of the site prior to construction. The new empty space above the tunnel may be used for other facilities such as active transportation.

Application

Cut and cover may be used for grade separations spanning multiple crossings. Since this method is specific to excavation, cut and cover is only used for trenches and tunnels. **Consideration should be given to the practical temporary service options available to a specific project before choosing the cut and cover method, due to propensity for surface impacts and long construction duration.**

Construction Cost

In comparison to using a tunnel boring machine, tunneling or trenching using the cut and cover method is less expensive and more cost-effective for constructing multiple grade separations as a single project. However, the cost to maintain temporary service during construction and potential loss of farebox revenue due to construction are substantial and should be considered when choosing this method.

There are opportunities for efficiency by combining this construction technique with top-down or accelerated methods. Using the top-down approach of driving the final retaining walls into the ground prior to beginning earthwork saves the cost of temporary walls. Using precast tunnel base and cover sections can indirectly reduce costs by reducing construction duration.

Construction Duration

Cut and cover is a time-consuming construction method, in large part due to the scale of the projects for this method. The larger scale of the projects increases the duration of phases of the construction sequence. Additionally, constructing shoofly tracks for a long stretch of railway takes longer than constructing a short segment of shoofly tracks for a single crossing.

Using the top-down approach for retaining wall construction and using precast sections of tunnel can reduce construction duration. However, this construction method introduces significant impacts to Caltrain service.

Maintaining Operations

Maintaining service during cut and cover construction requires sufficient ROW to construct shoofly tracks away from construction activities. If sufficient ROW does not exist, complex staging and work windows will be required to maintain rail operations during construction, which can extend construction duration and significantly impact railroad operations.

Electrification

Driving the retaining walls and digging the initial trench as described in Phases One and Two of the construction sequence, requires large and tall construction equipment. This equipment cannot operate in proximity to the OCS infrastructure due to its height; therefore, cut and cover construction will likely require the removal and reconstruction of long portions of the OCS. This impact will increase construction costs and project duration.

Tunneling

Overview

- Best suited for a series of closely spaced crossings
- Minimizes or eliminates impacts to existing operations and OCS infrastructure
- Requires specialty contractor and construction equipment, increasing cost and duration in comparison to other multi-crossing methods

Tunneling refers to the process of boring a hole or shaft underground to create a subsurface corridor. The cut and cover method can also be used to construct subsurface corridors; however, the key difference between this method and tunneling method is that most construction activities for tunneling occur without impacting the surface.

Historically, subsurface tunnels have been dug using tools to chip away and carry out material. Today, bored tunnels use large machines to rapidly break apart the earth and conveyor belts to carry the earth out of the tunnel. **There are multiple tunneling methods available for the construction of subsurface transportation infrastructure, including, but not limited to, drill and blast tunneling, Tunnel Boring Machines (TBMs), and the New Austrian Tunneling Method (NATM).**

Drill and blast tunneling utilizes explosives placed at the end of long shafts drilled into the tunnel wall to break up the rock and advance the tunnel.

TBMs are massive drill bits with conveyor belts attached to the end that churn through rock and carry out the material as they progress. Some TBMs can also simultaneously place the structural pieces of the tunnel as they move along, providing structural support to prevent collapse.

NATM is a method of tunnel stabilization that can be applied to either method of excavation. Through NATM, the characteristics of the existing rock are monitored as excavation of the rock progresses, and the strength of the surrounding rock is accounted for in the design of the tunnel support system. This method has been referred to as "design-as-you-go" and can save design and construction costs in comparison to designing the entire tunnel support system around the weakest possible soil characteristics.

Construction Process

Tunnel construction is preceded by site preparation, utility relocation, and temporary service establishment. For detailed descriptions of each, please see "Preparing to Grade Separate" in the Ground-Up Construction section.

Phase 1: Dig Bore Pits and Prep Equipment

The first step to constructing a rail tunnel is to dig the bore pits used to access the subsurface construction site. These pits are typically deep underground and wide enough to allow for the movement of heavy equipment and earth in and out of the tunnel. They require temporary walls and concrete foundations to prevent collapse during construction. Tunnel projects typically have multiple bore pits along the length of the tunnel, including at both the start and end of the tunnel.

Once the bore pits have been established, construction equipment can be placed in the pit and prepared for use. If using the drill and blast method, the drill rigs and excavators used to excavate the tunnel are quick to set up and construction can begin rapidly. Conversely, a TBM requires more time to assemble, test, and achieve operational capacity.

Phase 2: Tunnel Excavation

Once the construction equipment is operational, excavation work can begin. For a drill and bore method, tunnel excavation is completed in segments. The first segment is dismantled using controlled explosions to break apart the earth. This earth is hauled out using excavators or conveyor belts. Once the tunnel is clear of the debris from the first controlled explosion, the next segment is broken apart with a subsequent explosion. This process continues until the tunnel reaches the desired end point.

A TBM consistently churns the earth using a giant metal drill bit. The churned earth is carried via conveyor belt to the surface as the machine pushes its way through the rock. **TBMs move at a slow pace, but eliminate the need for controlled explosions, improving the safety of the construction process.** Some TBMs can construct the tunnel reinforcement as they move through the earth.

Phase 3: Construct Tunnel Reinforcement

Work can begin on reinforcing the tunnel after the excavation work has progressed further along the tunnel alignment. Tunnel reinforcement is typically accomplished in two stages: (1) initial ground support and (2) permanent support. Initial ground support can be provided applying shotcrete in combination with welded wire fabric reinforcement, steel arches, and/or soil reinforcement like soil nails. This reinforcement is applied as soon as possible after excavating the tunnel to reduce chances of collapse. Subsequently, permanent support is installed in the form of either a cast-in-place or precast concrete tunnel lining surrounded by a waterproof membrane.

Due to the unpredictability of rock strength underground, the initial and permanent reinforcements are typically designed based on the weakest potential soil strength known at the time of design. The NATM allows for designers to design to the strength of the soil encountered as the tunnel is being excavated. This means that the tunnel reinforcement design can rely on the strength of the surrounding rock where it is safe to do so, allowing for reduced reinforcement and saving tunneling costs.

Phase 4: Rail and OCS Construction

After the tunnel reinforcement is complete, the rail section can be laid and the OCS infrastructure can be installed within the tunnel.

Application

Tunneling is most applicable for grade separating multiple crossings as a single project. This construction method is best suited for stretches of closely spaced crossings in dense urban environments. Projects seeking to build a tunnel without significant impacts to existing rail operations should consider a tunneling method over the cut and cover method due to the reduced impacts to surface operations. Tunneling is well-suited for projects seeking to reduce or eliminate impacts to the OCS infrastructure, if the tunnel can avoid the foundations of the OCS poles.

Construction Cost

Using a bored method for tunneling is the most expensive construction technique described in this chapter. The specialty equipment and expertise required to operate the tunnel boring equipment are expensive and difficult to obtain. However, tunneling offers efficiencies over the cut and cover method. For example, construction activities on the surface are generally limited to the bore pit and staging areas, rather than spread along the length of the project. This reduces or eliminates the need for temporary shoofly tracks and limits impacts to the OCS. These cost savings do not offset the high costs of operating the large, complicated tunneling equipment.

Construction Duration

Tunneling—whether by cut and cover, drill and blast, or TBM—is a time-consuming process. Construction durations for bored tunnels and cut and cover methods are similar; however, their durations are influenced by different factors.

Large underground operations like bored tunneling take a long time to complete due in part to their scale and project size. Safety is another key factor that extends construction duration. Safety precautions required to avoid unintended collapse of the tunnel or bore pit increase construction duration.

Bored tunneling offers efficiencies over cut and cover in terms of temporary service maintenance. The bored tunnel methods do not require the lengthy design and construction of shoofly tracks to support rail operations. Additionally, time spent constructing a bored tunnel has less community impact than a cut and cover operation because the work occurs away from rail and vehicle traffic, as well as homes and businesses.

Maintaining Operations

Maintaining rail service during construction of a bored tunnel is much less complicated than using the cut and cover method. Since construction activities are confined to the bore pits and underground, surface activities like rail operations can proceed without much interruption during the construction of the tunnel. Bore pits can be placed away from active tracks to prevent interruptions to rail service. While there may be temporary service impacts, the frequency and duration of impacts can be significantly reduced.

Electrification

Moving construction activity from the surface to a bore pit or tunnel significantly reduces the impact construction operations have on the OCS infrastructure. Assuming the tunnel is designed to be lower than the base of the OCS pole foundations, constructing a bored tunnel allows for the maintenance of the OCS infrastructure during construction. However, the construction of the tunnel will render the existing OCS obsolete. New OCS infrastructure will need to be constructed within the tunnel to power Caltrain's electrified fleet.

Important Considerations

Selecting construction methods for a project requires decision-makers to have a comprehensive understanding of the project, including challenges and opportunities. A construction method can be chosen as early as the planning stage to allow the design to account for the construction method or can be chosen as late as the preconstruction stage to account for potentially unforeseen circumstances on site. Prior to choosing a construction method, project partners and decision-makers should be well-informed regarding the tradeoffs for each method. To provide a common framework for approaching these decisions, this section describes important considerations for the selection of construction methods.

Perspectives of Key Partners

Construction and delivery methods for a grade separation will be influenced by the perspectives of key partners. For grade separation projects along the Caltrain corridor, three key partners are the Contractor, (Railroad) Operations, and the Local Communities. This section describes how the perspectives of these three partners influence construction and delivery methods.

Contractor Perspective

The contractor perspective encompasses the entities involved in the construction of a grade separation project. This may include entities such as the construction manager, general contractor, or subcontractors. The contractor's main goal should be to construct the project quickly and efficiently, which may be achieved by minimizing or mitigating impacts to existing utilities, the surrounding community, and the environment. The contractor values ample site access and work areas to facilitate the construction process.

Operations Perspective

The operations perspective encompasses Caltrain and tenant railroads in the Caltrain corridor, including the Altamont Corridor Express, Capitol Corridor, Amtrak and UPRR. Maintaining operations on the railway during construction is their highest priority. Operations partners will be interested in construction methods that minimize interruptions to rail operations, as minimizing service impacts and schedule delays are key to serving riders and moving freight during construction. Provision of a temporary service option is of greatest consequence to this group. This partner group, and Caltrain in particular, is concerned with impacts to the electrified OCS. Protecting the OCS during construction, as well as design solutions that allow the OCS to remain in place, may reduce construction cost.

From an operator's perspective, service growth should be considered in the design of grade separations. This consideration would allow future service growth to be accommodated with reduced operational impacts. For example, it may be advantageous to design a grade separation bridge wider than is currently necessary to accommodate a future track expansion.

Local Community Perspective

The local community perspective includes project sponsors, businesses, residents, and other public infrastructure users. Local communities are generally concerned about construction impacts, as well as understanding how these grade separation projects will ultimately benefit the community. Construction impacts can temporarily increase traffic, noise, and visual impacts; reduce mobility; and reduce or eliminate access to locations within a community. Properties may be impacted during construction, which can require property acquisition or temporary construction easements. The environmental impacts can include air quality reduction and increased construction noise and vibration. Since all these impacts are experienced during construction, the local community perspective places value on options that reduce construction duration. In all cases, effective outreach and communication with the local community is key to maintaining positive relations during construction.

Project-Specific Elements

Decision-makers should be aware of project-specific elements that may impact the construction method of a grade separation project. This section will explain the impacts of four key project elements that have the greatest impact on construction methods:

- Corridor Electrification
- Geographic Grouping
- Temporary Service Option
- Schedule and Budget

Corridor Electrification

Caltrain, as part of the PCEP, recently installed an OCS along the corridor from San Francisco to San Jose. The OCS consists of electrified wires elevated over the tracks and supported by masts placed adjacent to the tracks. These masts sit on foundations that extend as much as 25 feet into the ground. The complexity and scale of the OCS makes modification time-consuming and expensive. Construction methods considered for a grade separation project must evaluate the effects to the existing OCS system as an important selection criterion.

Electrification of temporary tracks must also be considered when selecting construction methods. Because the corridor's main line is electrified, temporary tracks will also require electrification via either temporary or relocated OCS infrastructure. Construction methods, which do not require the use of shoofly tracks, will provide cost savings from not requiring relocated or temporary OCS infrastructure.

Geographic Grouping

Adjacent crossings could be candidates for the use of multi-crossing construction methods such as tunnels, viaducts, or trenches. These solutions offer construction efficiencies over individually grade separating each crossing and, in some cases, may be the only viable option for grade separation depending on the proximity of the adjacent crossings.

Geographically grouping projects can increase project scope and influence the construction methods. The delivery of larger and more complex projects may be improved by soliciting contractor input early in the design process. For this reason, projects that geographically group crossings together and involve complex design solutions should consider alternative delivery methods such as DB, PDB, or CM/GC.

Temporary Service Options

As described in the Construction Methods section, temporary service options available to a project are contingent on the available ROW and design of the proposed grade separation. Selection of the temporary service option can influence and be influenced by the selection of the construction method. Considering temporary service options when planning the design and construction of a grade separation project will impact the choice of construction method. By considering temporary service options early, a project team can best plan for challenges and take advantage of opportunities during construction.

Schedule and Budget

Choice of construction method has direct impacts on the schedule and cost of a project. Choosing the most appropriate construction method is key to delivering the project on time and on budget.

Total cost and construction duration are significant factors in the choice of project construction method. Construction methods do not cost the same nor take the same amount of time. Schedule constraints and budget requirements should be considered before selecting the construction method. For example, a project with a smaller budget may consider a ground-up or top-down construction method rather than a box jacking method, despite the schedule savings offered by the latter, due to the added costs of the specialized construction method. Construction costs are also very site-specific.

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Appendices

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Appendix 1

GO-88B Request Form

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Instructions for Completing a Request to CPUC Staff for Authorization to Alter a Highway-Rail Crossing Pursuant to General Order 88-B

I. CRITERIA FOR GO 88-B AUTHORIZATION REQUEST PROJECTS

Review the Scope of General Order (GO) 88-B projects listed below. If your project falls outside of this scope, then a formal application must be filed with the Commission's Docket Office for Commission authorization to alter a highway-rail crossing.

Scope of GO 88-B

1. Grade crossing widening within the existing street right-of-way.
2. Approach grade changes.
3. Track elevation changes.
4. Roadway realignment that is functionality related to the existing crossing and can be achieved within the existing or a contiguous right-of-way.
5. Addition of one track within the existing railroad right-of-way.
6. Change in the type or addition of an automatic signaling device, crossing gate, crossing flagman or other forms of crossing protection or reduction of hours during which any such protection is maintained, or other minor alterations.
7. Alterations or reconstruction of an existing grade-separated crossing, where exempt from the California Environmental Quality Act (CEQA) pursuant to California Public Resources (PR) Code Section 21080.13.
8. Construction of a grade-separation that eliminates an existing at-grade highway-rail crossing, where exempt from CEQA pursuant to PR Code Section 21080.13

In addition to meeting the above criteria, all interested parties, including Commission staff, must agree to the project. If any party objects to the proposed project, then a formal application must be filed.

II. GO 88-B AUTHORIZATION REQUEST PROCESS

1. Contact Rail Crossings and Engineering Branch (RCEB) staff assigned to the area. The link below has territory assignment maps for RCEB staff.

   http://www.cpuc.ca.gov/crossings/

   The area engineer will provide information on the GO 88-B process and advise the requesting party on arranging a field diagnostic meeting to review proposed alterations to the crossing.

2. The diagnostic meeting should then be held with all interested parties (rail organization, roadway authority, and RCEB staff). The diagnostic team should evaluate the proposed modifications and identify any other matters that should be addressed as part of the modifications proposed. The requesting party will be able to determine whether RCEB staff is in agreement with the proposed modifications and allow the other parties to form a basis for providing the required evidence of agreement (see below).

3. The requesting party should update its modification plans based on reviews and comments provided by interested parties during the diagnostic meeting.

4. Obtain written concurrence of the rail organization and/or roadway authority with jurisdiction at the crossing.

5. Complete and send the GO 88-B authorization request form (follow instructions in Section III below). The form must be signed by a roadway authority or rail organization official, it cannot be signed by a consultant on behalf of a roadway authority or rail organization.

6. Submit completed form, attachments, and evidence of concurrence signed by interested parties to RCEB. Electronic files are preferred in scanned, PDF/A format. Please confirm with the appropriate engineer if submitting alternate formats. Large files can be transferred to CPUC staff using the site http://cpucftp.cpuc.ca.gov/

Send to the following contacts:

1) Engineer Assigned to the Area

Please refer to http://www.cpuc.ca.gov/crossings/ for contact information of the appropriate engineer assigned to the area.

2) RCEB Supervisors

Please send an electronic copy to the Senior Utilities Engineer Supervisor and Program and Project Supervisor in the appropriate region.

Northern California: Felix Ko, P.E., **felix.ko@cpuc.ca.gov** and Gina Adams: **gina.adams@cpuc.ca.gov**

Southern California: Anh Truong, P.E., **anh.truong@cpuc.ca.gov** and Matthew Bond, P.E.: **matthew.bond@cpuc.ca.gov**

3) Railroad or Roadway agency (interested parties)

III. GO 88-B AUTHORIZATION REQUEST FILL-IN FORM

After a field diagnostic meeting is held and modifications are agreed to by the interested parties, complete the GO 88-B authorization request fill-in form as follows:

1. Date. Self-explanatory.

2. Applicant Info. Self-explanatory, except that the Contact Person should be the agency representative to whom the reply will be sent.

3. Crossing proposed to be altered. RCEB staff member will provide you the CPUC and U.S. DOT assigned crossing numbers.

    a. The railroad must provide current train volume and maximum speed information at the crossing location for all railroads and rail transit agencies operating on the rail corridor.
        i. Passenger: This includes commuter railroad service or passenger railroad service, such as Amtrak.
        ii. Freight: This includes freight railroad service, such as Union Pacific Railroad.
        iii. Transit: This includes light rail transit service such as Los Angeles County MTA.

    b. The roadway agency must provide the most current average daily traffic (ADT) counts for the roadway at the crossing location. The ADT counts should not be older than 5 years.

    c. For construction of a grade-separation that eliminates an existing at-grade highway-rail crossing, the railroad must provide a new U.S. DOT number.

4. Describe Proposed Alterations. This should include a description of roadway changes through the crossing, as well as changes to warning devices, signs, signals, pavement markings, railroad circuitry or other significant aspects of the crossing to be modified.

    Example:
    The proposed alteration consists of widening the existing two-lane highway to include four 12-ft lanes, a 16-foot median, and two 6-ft sidewalks. Traffic signals will be installed at the

intersection 50-ft north of crossing and will be interconnected with the rail crossing warning devices, as detailed in the plans attached as Appendix ____.

The City will install four new "DO NOT STOP ON TRACKS" (MUTCD R8-8) signs. Existing pavement markings and signage will be maintained or reinstalled as shown in the plans attached as Appendix _____.

Discuss any proposed variance(s) from GO minimum clearance requirements. If the GO 88-B request is for construction of a grade separation structure replacing an existing at-grade crossing or is for reconstruction or alteration of an existing grade separation structure, AND a temporary reduced clearance is necessary, A VARIANCE MUST BE SPECIFICALLY REQUESTED IN THIS SECTION.

GO 26-D specifies the minimum vertical clearances (22 feet 6 inches if roadway is over the railroad, and 15 feet if the railroad is over the roadway) and horizontal clearances (8.5 feet from centerline of tangent track). A variance allowing for a temporary impaired clearance may be granted through the GO 88-B approval process, but the applicant must notify the railroad and the Commission's Rail Operations Safety Branch and RCEB in advance of creating the impaired clearance, and subsequently the railroad must notify its operating employees. The concurrence letter from the owning and/or maintaining railroad (as required by part 10 of the fill-in form, below) MUST acknowledge the temporary impaired clearance, and agree to it in their concurrence correspondence.

Design documentation: Include the following documents to the extent applicable:

A. *Signage and Striping Plan*: Plans that show all pavement markings, parking restriction and signage.

B. *Crossing Exhibit*: Plans that show the location and clearance of all railroad warning devices.

For crossing alterations at or near a signalized highway intersection:

C. *Preemption Timing Worksheet*: Worksheets should be one of the three forms: LADOT, TxDOT, and/or Caltrans. When included as part of the GO 88-B request, the timing should be the actual proposed timing.

D. *Preemption Calculation Measurement Exhibit*: Exhibit shows the Minimum Track Clearance Distance (MTCD), Clear Storage Distance (CSD), the longest pedestrian crosswalk distance and other distance parameters shown in the preemption worksheet.

E. *Traffic signal plan*: Scaled exhibit showing the location of existing and proposed traffic control and railroad warning devices with the following information:

I. Phase Diagram
II. Phase sequence upon preemption (or comparable description)
III. Traffic signal masts and signal heads
IV. Part-time turn restriction (Blank-out) signs (if used)
V. Information on railroad interface panel (if used)

F. *Preemption Interconnect Wiring Diagram*

G. *Railroad Preemption Request Form* (if applicable)

H. *Design-Vehicle Turning Template* (where applicable)

5. Describe the public benefits to be achieved by the proposed alterations.
Example:
The public will benefit from the proposed project through improvements to both public safety and convenience. Traffic congestion and associated vehicle queues across the track will be reduced through the addition of one lane in each direction. The installation of medians is intended to reduce the possibility of motorists driving around the lowered Commission Standard No. 9 gate arms. The installation of roadway intersection traffic signals and preemption will allow motorists to more efficiently clear the tracks as a train approaches.

6. Explain why a separation of grades is not practicable. Please note practicability is not solely a function of cost.
Example:
Due to existing buildings and other facilities located in the immediate vicinity of the crossing, it would be physically impracticable to construct a grade-separated crossing.

7. Describe the existing and proposed crossing warning devices
Example:
The existing railroad warning devices consist of two Commission Standard 8s (flashing light signals). It is proposed to replace them with two median-mounted Commission Standard 9s (flashing light signal with automatic gate arm) and two curb-mounted Commission Standard 9As (Standard 9 with additional flashing light signals on a cantilevered mast arm) warning devices.

8. Temporary Traffic Controls - Include a statement of temporary traffic controls to be provided during construction in compliance with Section 8A.05 Temporary Traffic Control Zones, of the California Manual on Uniform Traffic Control Devices, (CA MUTCD):
   Example:
   > Appendix ____is a copy of the latest traffic control plan prepared for the project. During construction, temporary traffic control, including temporary crossing closures and detours will be provided in accordance with the California Manual on Uniform Traffic Control Devices, Section 8A.05 and Figure 6H-46. [Rail agency name] will provide flagging services to warn roadway traffic of approaching trains at any time that the traffic control devices or traffic signals are not in service.

9. CEQA (Applicable only to grade-separation projects). If the project involves grade separation of an existing at grade crossing, then either a copy of the Notice of Exemption from CEQA or other factual evidence that the project is exempt from Public Resources Code Section 21080.13 must be provided:

   The applicant should provide a Notice of Exemption or a statement indicating why the project is exempt.
   Example:
   > This project involves widening and reconstructing the existing grade separated crossing which is statutorily exempt pursuant to Public Resources Code Section 21080.13.

10. Signature - This form must be signed by a government or railroad agency official. It cannot be signed by a consultant on behalf of a government or railroad agency.

11. Evidence of Agreement - Send completed form to interested parties, and ask them to complete this section and return it to you. Evidence of concurrence must not be dated more than two years before the date of the GO 88-B request form. Evidence of concurrence must be obtained from each involved party, including each rail agency responsible for maintaining the crossing warning devices and/or owning the rail right-of-way (see exception below) and the public agency responsible for the roadway, depending on who is submitting the request for authorization.

    Evidence of concurrence is not required from county transportation authorities, such as Los Angeles County Metropolitan Transportation Authority (LACMTA), which own the rail right-of-way maintained by joint powers authorities, such as Southern California Regional Rail Authority. However, evidence of concurrence is required from county transportation authorities for projects involving crossings that are maintained by these agencies, such as light rail transit crossings maintained by LACMTA. Page four of the fill-in form can be replaced by an actual letter(s) containing a similar statement of concurrence, or electronic mail indicating concurrence with the project is acceptable, provided it identifies the individual providing the concurrence by name, title and organization.

If agreement of the involved parties cannot be obtained, then a formal Application must be filed with the Commission's Docket Office to gain Commission approval for the proposed modifications.

REQUEST TO CPUC STAFF FOR AUTHORIZATION TO ALTER HIGHWAY-RAIL CROSSING PURSUANT TO GENERAL ORDER 88-B

1. Date Submitted:

2. Applicant Info

Organization Name:	
Contact Person:	
Title:	
Street Address:	
City:	
Zip:	
Phone:	
Email:	

3. Crossing proposed to be altered

PUC Crossing Number:		
U.S. DOT Crossing Number:		
New U.S. DOT Number: (At-grade to grade-separation only)		
Street Name:		
City:		
County:		
Average Daily Vehicle Traffic (ADT) on roadway crossing tracks		
Year ADT count taken (should be within last 5 years)		
Roadway Speed Limit:		
Railroad Responsible for Crossing:		
Other Railroads Operating on Tracks:		
Average Daily Train Traffic and speed from all operating railroads	Train Volume	Maximum Train Speed
Passenger		
Freight		
Transit		

4. Describe Proposed Alterations (including any temporary reduced clearance variance requests):

5. Describe the public benefits to be achieved by the proposed alterations:

6. Explain why a separation of grades is not practicable:

7. Describe crossing warning devices

Current:	
Proposed:	

8. Temporary Traffic Controls - Include a statement of temporary traffic controls to be provided during construction:

9. CEQA (Applicable only to grade-separation projects). For projects involving the alteration or reconstruction of an existing grade-separated crossing or the construction of a grade-separation that eliminates an existing at-grade crossing, the party desiring the change must provide either (a) a copy of a Notice of Exemption from CEQA requirements filed with the appropriate governmental agency, or (b) other factual evidence that the crossing is exempt pursuant to Public Resources Code Section 21080.13.

10. Signature

I, [Your Name] , am an employee of [Name of your Organization] and authorized to sign this GO 88-B authorization request letter on its behalf.

Typed Name and Title Signature and date

Attachments:

1. Vicinity Map - Map of Immediate Vicinity on a scale of 50 to 200 ft/inch
2. Grade Lines - Plans showing the profile of the existing and proposed grade lines of the track and roadway
3. CEQA (Applicable only to grade-separation projects). If the project involves grade-separated crossings, then either a copy of the Notice of Exemption from CEQA or other factual evidence that the project is exempt from Public Resources Code Section 21080.13 must be provided
4. Design documentation, such as civil and traffic signal plans, to the extent applicable. Refer to instructions for details.

11. Evidence of Agreement:

I, [name of representative of organization concurring to project] , am an employee of [name of organization concurring to project] and authorized to sign this letter of agreement on its behalf, hereby declare that [name of organization concurring to project] concurs with the proposed project described above.

Typed Name and Title | Signature and Date

Address

Note: If there are additional interested parties, make additional copies of this page.

Appendix 2

Variance Request Form

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STANDARD PROCEDURES

Caltrain – Standard Procedure
DESIGN VARIANCES
Procedure Number: G-24 Revision Number: 2
Pages: 10
Frequency of Review: Annual
SP Maintainer: Director, Engineering
Version 2 Approved by: Rob Barnard, Chief, Rail Design and Construction
Issue Date: June 28, 2024 – Revision 2

Caltrain
Standard Procedure
For
Design Variances

Version 2

June 28, 2024

Document Revision History
Caltrain Standard Procedure
For
Design Variances

Revision Date	Revision No.	Revision Summary Description
08/15/2007	0	First Issue
2/13/2019	1	Removed dates referencing Engineering Standards, Added Operations to Design Variance Submittal Sign-off sheet and other updates.
10/08/2019	1a	Section 5 – Clarified that a copy shall be maintained in the "Record Management System." Deleted "Tracking Number" from the Appendix A, Part 1 form.
6/28/2024	2	Made minor changes throughout document to reflect organizational changes and updated policies/contracting methods. Section 5 – Added "Custodian of Records" section.

1. INTRODUCTION AND OBJECTIVES

Caltrain's engineering design standards are embodied in the following documents:

- Design Criteria
- Standard Drawings
- Standard Specifications
- Standards for Design and Maintenance of Structures
- Engineering Standards for Excavation Support Systems
- Electrification Standards

These documents establish the uniform and minimum standards for planning, design, and construction of Peninsula Corridor Joint Powers Board (PCJPB or JPB) projects for Caltrain facilities and systems. The engineering standards are controlled documents subject to regular revision. The version of the standards applicable to each project is the version in effect when the project reaches the 35% design stage. In the event that standards related to an approved Design Variance change after the 35% submittal, reevaluation of the Design Variance will be at the discretion of Caltrain.

The documents are based on best industry standards and accepted practices for Commuter/Class 1 railroads and equal or exceed regulatory requirements. The documents are intended to cover the majority of Caltrain's current and future improvements. The documents do not attempt to cover all the situations that might be encountered or requested throughout a project's life. The documents are intended to provide the designer with flexibility while ensuring that the functionality, goals, and objectives of the Caltrain System are met. The documents shall be used in conjunction with sound engineering judgment, experience, and standard practices. The documents in no way replace the individual designer's adherence to the profession's "standard of care" in design.

It is important to note that Caltrain considers the Design Criteria to be a strong guideline. Any intent by the designer to use a more restrictive, lower dimensioned, higher stressed, or in any way less functional design solution than that identified in the Design Criteria, will require that a Design Variance request be prepared and processed.

Under certain circumstances, it may be appropriate and necessary for a project designer to seek a variance to the engineering standards. The objectives of this Standard Procedure are to define under what conditions a Design Variance may be requested, to standardize the process for defining Design Variance requests, and to standardize the process for reviewing and approving/denying such requests.

2. DEFINITIONS AND ACRONYMS

Caltrain System – The railroad; right-of-way, tracks, structures, overhead catenary system, traction power facilities, terminals, stations, rolling stock, fare collection equipment, control and communications equipment and software, maintenance equipment and facilities, operating and maintenance schedules, personnel, rules, and procedures, and support facilities and equipment all of which comprise the commuter rail service between San Francisco and Gilroy, California.

Caltrain Engineering Standards – The Caltrain Engineering Standards include Design Criteria, Standard Drawings, Standard Specifications, and other documents as indicated in Section 1.

Configuration Management – A management process for establishing and maintaining consistency of a product's (the Caltrain System's) performance, functional, and physical attributes with its requirements, design, and operational information throughout its life. This process includes managing the components of the Caltrain System to ensure that (i) they possess the desired physical and functional characteristics, (ii) that modifications to these characteristics are implemented in a controlled manner, and (iii) that documentation accurately reflects the condition of the system.

Construction Phase – This is the time period for a project, from issuance of construction contract documents for bid (or issuance of a contract modification for construction work under the CMGC method) until completion and close-out of the procurement/construction contract.

Design Basis Report/Memorandum – A report/memorandum, prepared by the designer, that details the engineering standards to be used in the design of a specific project. The Design Basis Report/Memorandum is normally submitted to the Project Manager during the preliminary engineering portion of the design phase of a project. The Design Basis Report/Memorandum documents all the design variances that a project intends to seek approval for.

Design Phase – This is the time period for a project, from completion of a PSR, or PSR equivalent document, until the completion of contract documents suitable for solicitation of bids (or negotiation of a contract modification for construction work under the CMGC method).

Design Variance - An approved and authorized variance to Caltrain Engineering Standards. Design Variances are applicable only on a project specific basis and shall not set a precedent for any future variance approvals.

Project Manager – The individual responsible for the project including the execution of the design process and the timely coordination of design reviews.

PSR – The Project Study Report which documents, at a conceptual level, the design, scope, schedule, and budget for a project. The PSR normally constitutes the baseline against which project changes are measured.

Requestor – The individual responsible for the promulgation, description, analysis, and timely resolution of a Design Variance request for a specific project.

Standard Procedure (SP) - Any of a number of controlled documents which define Caltrain procedures for the conduct of project development and other work.

3. CONDITIONS FOR A DESIGN VARIANCE REQUEST

In the course of developing the design of a capital project, it may become apparent to the designer, project manager or other involved design professional, that having the parameters of the project meet all Caltrain Engineering Standards may be infeasible, or feasible at potentially excessive cost and/or impact to the agency. These circumstances should materialize at the Project Study Report phase and/or the preliminary engineering phase of the project's design development. The Requestor (designer, project manager or other involved design professional) shall determine that a Design Variance request is appropriate to the situation and shall take appropriate action (per this procedure) to resolve the design issue(s).

In particular, it is important for the Requestor to identify potential variances from Caltrain Engineering Standards as early in the planning and design process as possible, to allow time to research and analyze alternatives, to document recommendations, and to minimize the overall impact of a Design Variance on the project and on the Caltrain System. All significant Design Variances must be addressed and submitted by the end of the preliminary engineering phase. To the extent feasible, these Design Variances shall be submitted simultaneously with the Design Basis Report or Memorandum. However, should the benefit of minor additional variances become apparent during detailed design, they should be obtained as part of each Plans, Specifications, and Estimates design review submittal, as applicable.

4. DESIGN VARIANCE IDENTIFICATION AND JUSTIFICATION

A Design Variance can only be obtained on a project specific basis.

A Design Variance can only be obtained by a Requestor who shall be responsible for the expeditious processing of his/her Design Variance request.

To provide for consistent identification and justification, and to allow internal tracking, a Design Variance request shall be submitted using the standard template shown in Appendix A (Part 1 – Memorandum). The last page of the Design Variance submittal shall be the sign-off sheet (Part 2) also shown in Appendix A.

At a minimum, the following information shall be included in the request:
PART 1 - Memorandum

1. Project Name
2. Project Number
3. Current Estimate – Estimated construction cost of the project.
4. Potential Project Cost Reduction if Variance Authorized.
5. Date decision is required before it impacts project schedule.
6. Project Description – general project information, general plan, typical section, project limits by milepost, county, etc.
7. Variance Definition/Request:
    a. Identify Standard(s) and/or Criteria to which variance will apply.
    b. Define variance required from Standard(s) and/or Criteria.
8. Justification
    a. Provide concise reason for request. (engineering hardship, feasibility, cost savings, reduced impact to agency, etc.)
    b. Provide engineering basis for adoption of relaxed or changed Standard and/or Criteria (for example, the revised criteria would be safe for pedestrians; or would allow trains to operate safely and efficiently; or would still be compliant with regulatory requirements).
    c. Assess and evaluate impacts other than costs of implementing the variance including impacts to other design features, ROW, environmental effects, preservation of historical feature, construction issues, social concerns,

reduction of design life, compatibility with adjacent roadway features, and engineering discretion.

9. Attachments
    a. Sketches or drawings
    b. Calculations
    c. Studies
    d. Other Supporting Information

PART 2 – Sign-off Sheet

10. Sealed by preparer and signed by Requestor.
11. Concurrence/non-agreement and approval/denial by Caltrain management. Sufficient written detail and explanation must be provided to facilitate review of the request. At some point, this justification may be used to defend Caltrain's and/or the designer's design decisions. All requested deviations from standards must be uniquely identified, located, and justified.

5. VARIANCE SUBMITTAL AND REVIEW PROCESS STEPS

The Requestor (if not the Caltrain Project Manager) shall submit the completed Design Variance request to the Caltrain Project Manager who will perform a preliminary review for completeness. The completed Design Variance request shall include the seal(s) and signature(s) of the Responsible Registered Engineer(s) who prepared the technical content. If acceptable to the Project Manager, he/she shall forward the submittal to the Director, Engineering. The Engineering Department shall assign a reference number to each request. The submittal shall then be reviewed by appropriate personnel within the Caltrain Engineering Department and by other Caltrain departments as necessary. Requests judged to be incomplete by Engineering Department personnel shall be returned to the Project Manager. Each request shall be reviewed on a case-by-case basis and approved or denied on its merits. The basis for approval or denial shall be documented as an attachment to the request submittal memorandum (see Appendix A). After concurrence by Engineering Department personnel, the request will be reviewed by the Chief, Rail Design and Construction, who shall then approve or deny the request.

If approved, the Chief, Rail Design and Construction shall return the file to the Director, Engineering who will note the approval and then forward it to the Project Manager who in turn shall advise the Requestor of the approval.

If denied, the request file shall be returned to the Director, Engineering, who will note the denial and then forward it to the Project Manager who in turn shall advise the Requestor of the denial. A Requestor may resubmit a Design Variance Request but may only do so if significant revisions to the originally denied submittal have been made.

Custodian of Records:

The Engineering Department shall provide the Design Variance file to the Manager, Records Management, (the Custodian of Records), to be filed in the Record Management System under the assigned reference number for future use.

Appendix B shows the process flowchart for the Design Variance request.

6. INCORPORATION OF APPROVED DESIGN VARIANCES

It shall be the designer's responsibility to incorporate the approved Design Variance into the on-going design work. The project design file shall include the approved Design Variance request file as returned to the designer by the Project Manager.

APPENDIX A – DESIGN VARIANCE SUBMITTAL STANDARD TEMPLATE (PART 1 – MEMORANDUM)

SUBMITTAL MEMORANDUM

For Caltrain use only	
Reference No:	

To: ______________________________ **Date:** ______________

Director, Engineering

Project Name:			
Project Number:			
Current Estimate:		**Cost Reduction if Variance Authorized:**	
Decision required by:			

Project Description:

Variance Definition/Request:

Justification:

Attachments:

** For Caltrain Engineering use only **	
Caltrain Design Variance – Engineering Discipline Lead Recommendation	
Approve ☐	Date:
Deny ☐	Date:
Caltrain Design Variance Recommendation (by Deputy Director, Engineering)	
Recommendation: Approved ☐	Denied ☐
Approval Date:	Denial Date:
Comments: See below and attachment	

APPENDIX A – DESIGN VARIANCE SUBMITTAL STANDARD TEMPLATE (PART 2 – SIGN-OFF SHEET)

Prepared by:

____

Registered Engineer

Professional Engineer's Seal
(for each applicable discipline)

Requested by:

Requestor or Consultant Project Manager	Date
Name of Consulting Firm (if applicable)	
Caltrain Project Manager	Date

Concurred by: Engineering (include only applicable signatures)

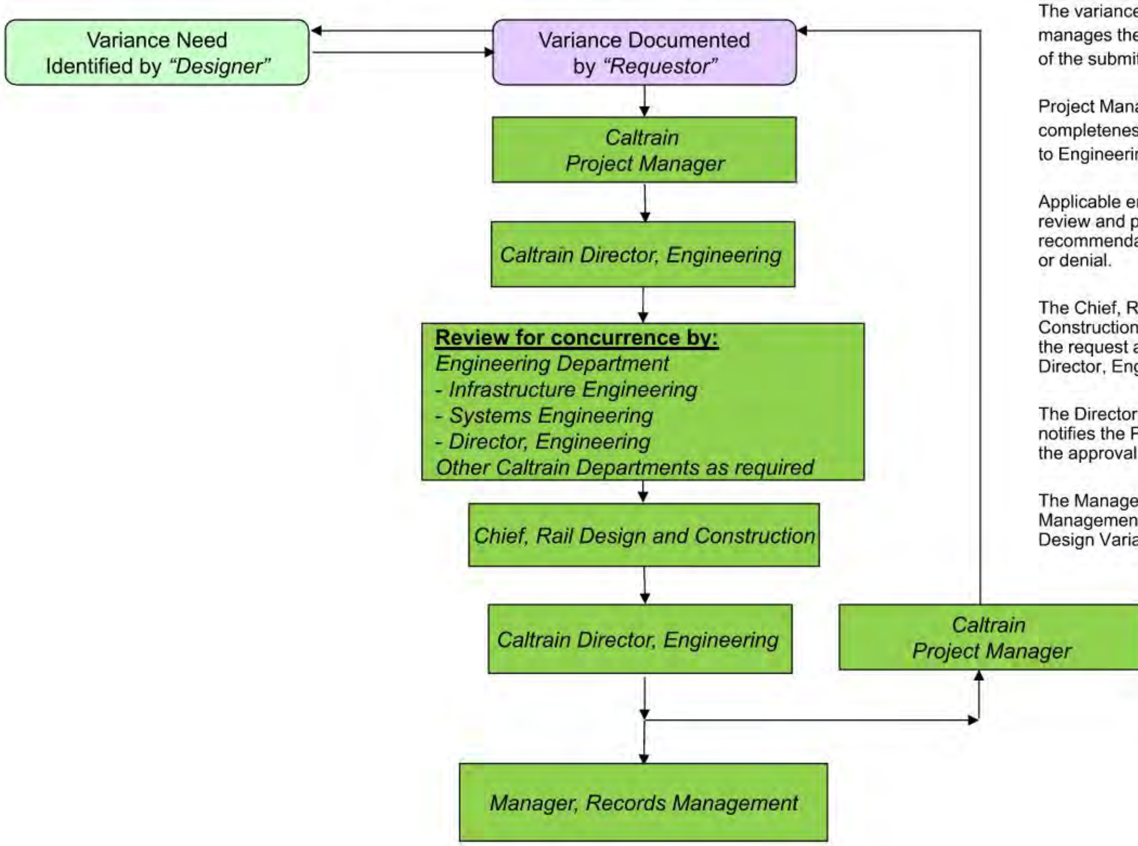
Deputy Director, Infrastructure Engineering	Date
Deputy Director, Systems Engineering	Date
Director, Engineering	Date

Approved by:

Chief, Rail Design and Construction	Date

APPENDIX B

Design Variance Request Process Flowchart



The variance Requestor manages the completion of the submittal.

Project Manager reviews for completeness and submits to Engineering Department.

Applicable engineering sections review and provide recommendations for approval or denial.

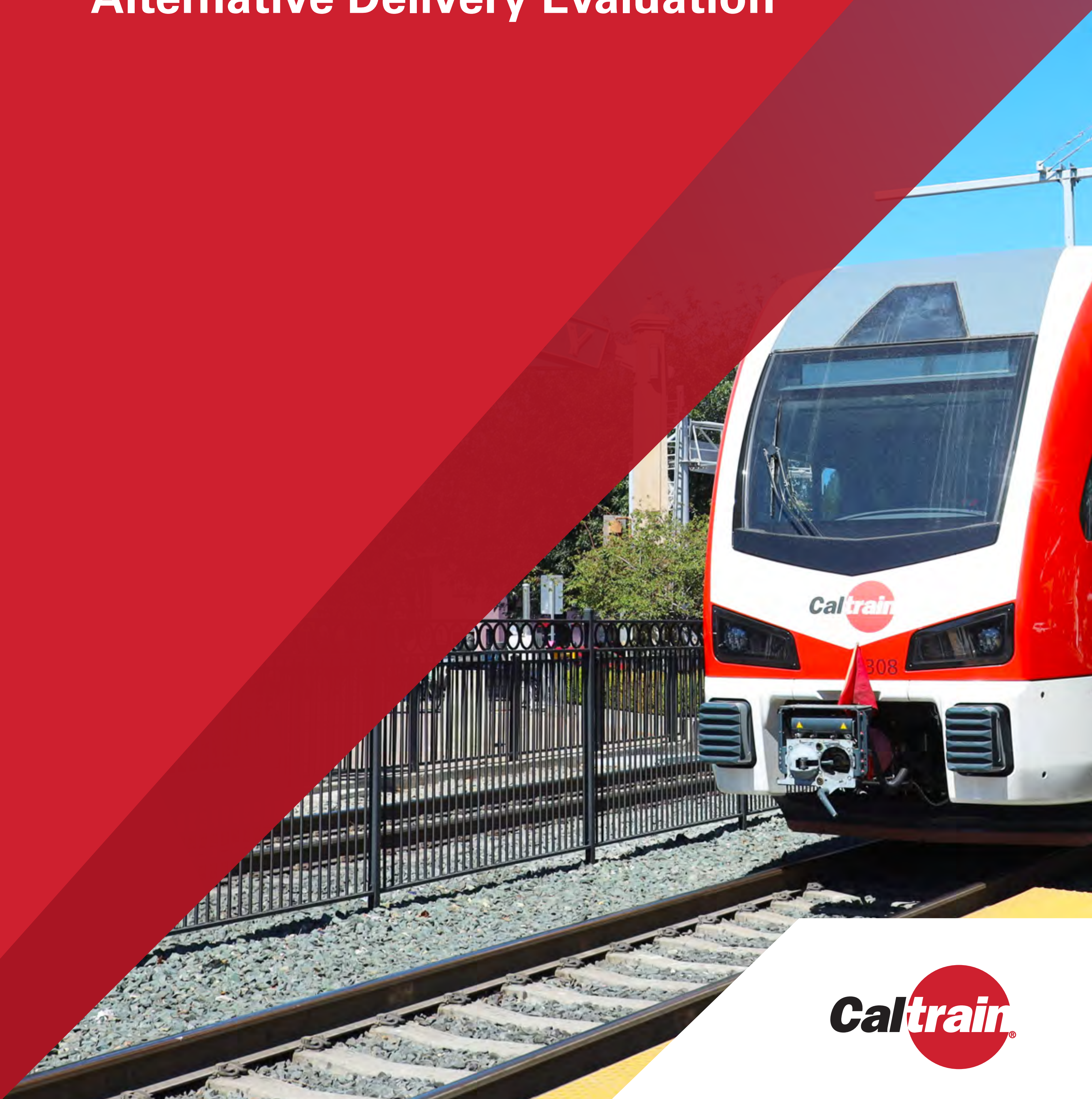
The Chief, Rail Design and Construction approves or denies the request and notifies the Director, Engineering

The Director, Engineering notifies the Project Manager of the approval or denial.

The Manager, Records Management maintains the Design Variance records.

Appendix 3

Alternative Delivery Evaluation



Modified Caltrans Quantitative Project Delivery Method Selection Scoring Summary, Recommendation, and Comments

Project Name				
Date				
Review Panel				
Project Delivery Selection		Design-	CMGC	Progressive
Project Scope and Characteristic Evaluation Score (Worksheet 1)				
Project Success Criteria Evaluation Score (Worksheet 2)				
Total Score				
Project Delivery Method Selection		☐ Design-Bid-Build	☐ CMGC or CMAR	☐ Progressive Design-Build
Comments:				

Note: This Project Delivery Method Recommendation Summary and Evaluation Worksheets are adapted from the Caltrans *Alternative Procurement Guide* dated April 2008, with modifications to address the project delivery requirements.

Project Delivery Method Selection – Quantitative Assessment Framework

This document provides a quantitative assessment framework delivering the Project. Page 1 provides the scoring summary, delivery method recommendation, and comments. Worksheets 1 and 2 provide the quantitative framework for assessing the Project scope and characteristics and success criteria for the potential project delivery methods.

It is recommended that the quantitative assessment be completed through a collaborative process of Caltrain and key stakeholder staff to discuss the Project characteristics to enable a uniform understanding of the Project requirements and subsequent scoring. The group should complete Page 1 with the initial Project summary information. The next step involves individually evaluating each project delivery method's ability to meet the criteria noted. Check the box in the criteria column which best represents the response relative to the Project. Note the point score corresponding to the checked box at the top of each project delivery method. Continue to the end of each Worksheet. Total the score for each Worksheet and transfer the Worksheet scores to Page 1 to determine the total project delivery method score. The highest total point score indicates the project delivery method most appropriate for the Project.

The N/A score in the Project Scope and Characteristics Criteria Questions 1a)-A and 1b)-A and in Project Success Criteria Questions 2e)-3-C and 2e)-4-C indicates the project delivery method is not applicable to the Project and further scoring for this delivery method should not be completed.

WORKSHEET 1 – PROJECT SCOPE AND CHARACTERISTIC CRITERIA EVALUATION

Project Scope and Characteristic Criteria	Design-Bid-	CMGC	Progressive
1a) *Where is the project in the project development process?*	*1a)* ________	*1a)* ________	*1a)* ________
☐ A. Detailed final engineering stage completed	A.10 pts	A. 0 pts	A. 0 pts
☐ B. Preliminary design in process	B. 5 pts	B. 5 pts	B. 5 pts
☐ C. Conceptual engineering stage completed	C. 0 pts	C. 10 pts	C. 10 pts
1b) *What is the size and complexity of the project?*	*1b)* ________	*1b)* ________	*1b)* ________
☐ A. Relatively simple, smaller project with no need for specialized outside expertise	A. 10 pts	A. 0 pts	A. 0 pts
☐ B. Medium size project with more technically complex components and schedule complexity	B. 5 pts	B. 5 pts	B. 5 pts
☐ C. Large, complex project with significant schedule complexity (e.g., multiple phases, extensive third-party issues, specialized expertise needed)	C. 0 pts	C. 10 pts	C. 10 pts
1c) *Does the project involve significant impacts to Caltrain operations, tenants, users, and the local business and community during construction?*	*1c)* ________	*1c)* ________	*1c)* ________
☐ A. No more than typical	A. 10 pts	A. 0 pts	A. 0 pts
☐ B. More than typical	B. 5 pts	B. 5 pts	B. 5 pts
☐ C. Much more than typical	C. 5 pts	C. 10 pts	C. 10 pts

Modified Caltrans Quantitative Project Delivery Method Selection

Project Scope and Characteristic Criteria	Design-Bid-	CMGC	Progressive
1d) Does the project present right-of-way limitations that would benefit from the construction manager's assistance? ☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	*1d)* ________ A.10 pts B. 5 pts C. 0 pts	*1d)* ________ A. 0 pts B. 5 pts C. 10 pts	*1d)* ________ A. 0 pts B. 5 pts C. 10 pts
1e) Does the project present environmental permitting issues that would benefit from the construction manager's assistance? ☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	*1e)* ________ A. 5 pts B. 0 pts C. 0 pts	*1e)* ________ A. 0 pts B. 5 pts C. 5 pts	*1e)* ________ A. 0 pts B. 5 pts C. 5 pts
1f) Does the project present utility or third-party issues that would benefit from the construction manager's assistance? ☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	*1f)* ________ A. 10 pts B. 5 pts C. 0 pts	*1f)* ________ A. 0 pts B. 5 pts C. 10 pts	*1f)* ________ A. 0 pts B. 5 pts C. 10 pts
1g) Does the project present unique work restrictions or Caltrain operation and maintenance requirements that would benefit from the construction manager's assistance? ☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	*1g)* ________ A. 5 pts B. 0 pts C. 0 pts	*1g)* ________ A. 0 pts B. 5 pts C. 5 pts	*1g)* ________ A. 0 pts B. 5 pts C. 5 pts
1h) Would the project benefit by packaging features of work to allow early lock-in of construction material and labor pricing? ☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	*1h)* ________ A. 5 pts B. 0 pts C. 0 pts	*1h)* ________ A. 5 pts B. 5 pts C. 10 pts	*1h)* ________ A. 0 pts B. 5 pts C. 10 pts
1i) Would the project benefit by raising quality standards and benchmarks to minimize maintenance and achieve lower life-cycle cost? ☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	*1i)* ________ A. 0 pts B. 5 pts C. 10 pts	*1i)* ________ A. 0 pts B. 5 pts C. 10 pts	*1i)* ________ A. 0 pts B. 5 pts C. 10 pts
Project Scope and Characteristic Criteria Subtotal (Total	*Score* ______	*Score* ______	*Score* ______

WORKSHEET 2 – PROJECT SUCCESS CRITERIA EVALUATION

Project Success Criteria	Design-Bid-	CMGC	Progressive
2a) *Schedule Issues*			
1. Can time-savings be realized through concurrent design and construction activities such as fast-tracking?	*2a-1)* ________	*2a-1)* ________	*2a-1)* ________
☐ A. No more than typical	A. 5 pts	A. 0 pts	A. 0 pts
☐ B. More than typical	B. 0 pts	B. 4 pts	B. 4 pts
☐ C. Much more than typical	C. 0 pts	C. 7 pts	C. 7 pts
2. Can the schedule be compressed?	*2a-2)* ________	*2a-2)* ________	*2a-2)* ________
☐ A. No more than typical	A. 5 pts	A. 0 pts	A. 0 pts
☐ B. More than typical	B. 0 pts	B. 4 pts	B. 4 pts
☐ C. Much more than typical	C. 0 pts	C. 7 pts	C. 7 pts
2b) *Opportunity for Innovation?*			
1. Will the project scope allow for innovation including alternate designs, Caltrain focused management, and preferred construction means and methods?	*2b-1)* ________	*2b-1)* ________	*2b-1)* ________
☐ A. No more than typical	A. 5 pts	A. 0 pts	A. 0 pts
☐ B. More than typical	B. 0 pts	B. 3 pts	B. 3 pts
☐ C. Much more than typical	C. 0 pts	C. 5 pts	C. 5 pts
2. Must the project scope be primarily defined in terms of prescriptive specifications such as predetermined materials and methods, or can performance specifications expressing desired end results be used, or a combination of both techniques?	*2b-2)* ________	*2b-2)* ________	*2b-2)* ________
☐ A. Primarily prescriptive specifications	A. 5 pts	A. 5 pts	A. 2 pts
☐ B. Combination of prescriptive and performance specifications	B. 0 pts	B. 5 pts	B. 5 pts
☐ C. Performance specifications for significant elements	C. 0 pts	C. 2 pts	C. 5 pts
2c) *Quality Enhancement*			
1. Will there be opportunities for contractors to provide materials or methods that provide greater value than normally specified by Caltrain on similar projects?	*2c-1)* ________	*2c-1)* ________	*2c-1)* ________
☐ A. No more than typical	A. 5 pts	A. 0 pts	A. 0 pts
☐ B. More than typical	B. 5 pts	B. 5 pts	B. 5 pts
☐ C. Much more than typical	C. 0 pts	C. 5 pts	C. 5 pts

Modified Caltrans Quantitative Project Delivery Method Selection

Project Success Criteria	Design-Bid-	CMGC	Progressive
2. *Will there be the opportunity for realization of greater value due to designs tailored to contractor's area of expertise?*	*2c-2)* ________	*2c-2)* ________	*2c-2)* ________
☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	A. 5 pts B. 0 pts C. 0 pts	A. 0 pts B. 5 pts C. 5 pts	A. 0 pts B. 5 pts C. 5 pts
3. *Will warranties or maintenance agreements be used?*	*2c-3)* ________	*2c-3)* ________	*2c-3)* ________
☐ A. No more than typical ☐ B. Limited to short-term workmanship and materials ☐ C. Much more than typical	A. 5 pts B. 0 pts C. 0 pts	A. 0 pts B. 5 pts C. 5 pts	A. 0 pts B. 5 pts C. 5 pts
4. *The Project benefits from close collaboration between designer and the contractor during final design.*	*2c-4)* ________	*2c-4)* ________	*2c-4)* ________
☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	A. 0 pts B. 0 pts C. 0 pts	A. 0 pts B. 5 pts C. 5 pts	A. 0 pts B. 5 pts C. 5 pts
5. *The Project benefits from a delivery team voluntarily assembled by the designer and contractor.*	*2c-5)* ________	*2c-5)* ________	*2c-5)* ________
☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	A. 2 pts B. 2 pts C. 2 pts	A. 2 pts B. 2 pts C. 2 pts	A. 2 pts B. 3 pts C. 5 pts
2d) Cost issues			
1. *Will there be opportunities for contractors to provide designs with lower initial construction costs than those typically specified by Caltrain?*	*2d-1)* ________	*2d-1)* ________	*2d-1)* ________
☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	A. 5 pts B. 0 pts C. 0 pts	A. 2 pts B. 3 pts C. 5 pts	A. 2 pts B. 3 pts C. 5 pts
2. *Will there be opportunities for contractors and subcontractors to provide alternate design concepts with lower lifecycle costs than those typically specified by Caltrain?*	*2d-2)* ________	*2d-2)* ________	*2d-2)* ________
☐ A. No more than typical ☐ B. More than typical ☐ C. Much more than typical	A. 5 pts B. 0 pts C. 0 pts	A. 2 pts B. 3 pts C. 5 pts	A. 2 pts B. 5 pts C. 5 pts

Modified Caltrans Quantitative Project Delivery Method Selection

Project Success Criteria	Design-Bid-	CMGC	Progressive
3. *Is funding for the Project committed and available?*	*2d-3)* ________	*2d-3)* ________	*2d-3)* ________
☐ A. Secured for design phase only or cannot support accelerated construction	A. 5 pts	A. 0 pts	A. 0 pts
☐ B. Funding can accommodate fast-tracking to some extent	B. 0 pts	B. 2 pts	B. 2 pts
☐ C. Funding will accommodate compressed schedule and fast-tracking	C. 0 pts	C. 5 pts	C. 5 pts
4. *Will the cost of procurement affect the number of bidders?*	*2d-4)* ________	*2d-4)* ________	*2d-4)* ________
☐ A. Procurement cost could significantly limit competition	A. 5 pts	A. 3 pts	A. 2 pts
☐ B. Procurement cost could affect the number of bidders	B. 5 pts	B. 4 pts	B. 3 pts
☐ C. Procurement cost would not be a significant issue given the size or complexity of the project	C. 7 pts	C. 7 pts	C. 5 pts
5. *Will project budget control benefit from the use of formal contingencies?*	*2d-5)* ________	*2d-5)* ________	*2d-5)* ________
☐ A. No benefit	A. 0 pts	A. 0 pts	A. 5 pts
☐ B. A formal contingency may permit Caltrain to add project scope or enhance quality within the constraints of its published budget	B. 2 pts	B. 2 pts	B. 0 pts
☐ C. A formal contingency is required to allow Caltrain to maximize project scope and quality within the constraints of its published budget	C. 5 pts	C. 5 pts	C. 0 pts
6. *Caltrain receives the benefit of competitive pricing to determine the Total Contract Price (TCP).*	*2d-6)* ________	*2d-6)* ________	*2d-6)* ________
☐ A. No more than typical	A. 5 pts	A. 2 pts	A. 2 pts
☐ B. More than typical	A. 5 pts	A. 2 pts	A. 2 pts
☐ C. Much more than typical	C. 5 pts	C. 2 pts	C. 2 pts
2e) *Staffing issues*			
1. *Does Caltrain have the expertise and resources necessary for a more complicated procurement process?*	*2e-1)* ________	*2e-1)* ________	*2e-1)* ________
☐ A. Inadequate resources or expertise	A. 0 pts	A. 0 pts	A. 0 pts
☐ B. Limited resources or expertise	B. 3 pts	B. 3 pts	B. 0 pts
☐ C. Adequate resources and expertise	C. 5 pts	C. 5 pts	C. 0 pts

Modified Caltrans Quantitative Project Delivery Method Selection

Project Success Criteria	Design-Bid-	CMGC	Progressive
2. *Caltrain or Consultant staff is actively involved in the final design phase.*	*2e-2)* ________	*2e-2)* ________	*2e-2)* ________
☐ A. No more than typical	A. 5 pts	A. 5 pts	A. 5 pts
☐ B. More than typical	A. 5 pts	A. 5 pts	A. 5 pts
☐ C. Much more than typical	C. 5 pts	C. 7 pts	C. 7 pts
3. *Are Caltrain or Consultant resources available to complete the design?*	*2e-3)* ________	*2e-3)* ________	*2e-3)* ________
☐ A. Resources are available to complete design	A. 5 pts	A. 5 pts	A. 2 pts
☐ B. Resources are available for partial design	B. 2 pts	B. 2 pts	B. 2 pts
☐ C. Specialized expertise, not available in-house, is required	C. 0 pts	C. 2 pts	C. 2 pts
4. *Are Caltrain or Consultant resources available to provide construction oversight?*	*2e-4)* ________	*2e-4)* ________	*2e-4)* ________
☐ A. Resources are available	A. 5 pts	A. 2 pts	A. 2 pts
☐ B. Full-time construction oversight could strain staff resources	B. 2 pts	B. 3 pts	B. 3 pts
☐ C. Resources are unavailable	C. 0 pts	C. 3 pts	C. 3 pts
Project Success Criteria Subtotal (Total questions	*Score* ________	*Score* ________	*Score* ________

TCRP REPORT 131 – TIER 1 – ANALYTICAL DELIVERY DECISION APPROACH RATING SUMMARY, RECOMMENDATION, AND COMMENTS:

Project Name				
Date and Location				
Review Panel				

Project Delivery Selection Summary	Design-	CMGC	Progressive
Project Level Issues Rating			
1. Project Size			
2. Cost			
3. Schedule			
4. Risk Management			
5. Risk Allocation			
6. LEED Certification	N/A	N/A	N/A
Agency-Level Issues Rating			
7. Agency Experience			
8. Staffing Required			
9. Staff Capability			
10. Agency Goals and Objectives			
11. Agency Control of Project			
12. Third-Party Agreements			
Public Policy/Regulatory Issues Rating			
13. Competition			
14. DBE Impacts			
15. Labor Unions			
16. Federal/State/Local Laws			
17. FTA/EPA Regulations			
18. Stakeholder/Community Input			

Rating Key **3** – Most appropriate delivery method; **2** – Appropriate delivery method; **1**– Least appropriate delivery method
0 – Not appropriate delivery method; N/A – Factor not applicable or not relevant to the selection

Project Delivery Selection Summary	Design-	CMGC	Progressive
Lifecycle Issues Rating			
19. Lifecycle Costs			
20. Maintainability			
21. Sustainable Design Goals			
22. Sustainable Construction Goals			
Other Issues Rating			
23. Construction Claims			
24. Adversarial Relationship			
Other	--	--	--
Other	--	--	--
Other	--	--	--
Total Rating Score			
Project Delivery Method Selection Recommendation	☐ Design-Bid-Build	☐ CMGC	☐ Progressive Design Build

Comments:	

Rating Key	
3	Most appropriate delivery method
2	Appropriate delivery method
1	Least appropriate delivery method
0	Not appropriate delivery method
N/A	Factor not applicable or not relevant to the selection

Note: This This Project Delivery Method assessment and decision approach is based on the Transit Cooperative Research Program (TCRP) Report 131 *A Guidebook for the Evaluation of Project Delivery Methods*, using the Tier 1 – Analytical Delivery Decision Approach, with minor modifications to address the project delivery requirements.

TCRP Report 131 – Tier I – Analytical Delivery Decision Approach

Overview

This document provides a decision approach for evaluating and selecting project delivery methods for transit infrastructure projects. The information below lists the project delivery methods followed by the evaluation worksheets for use by Caltrain staff and Project team members. By using these forms, a brief Project Delivery Decision Report will be generated for the Project. The primary objectives of this evaluation tool are:

- Present a structured approach to assist Caltrain in making informed project delivery method decisions
- Assist Caltrain in determining the optimal choice for the project delivery method
- Identify a project delivery method which can:
    - Reduce Project cost
    - Expedite the Project's completion
    - Identify features to optimize the project delivery method
- Provide documentation of the project delivery method assessment and selection decision

Background

The project delivery method is the process by which a construction project is designed and constructed including project scope definition; organization of designers, constructors, and various consultants; sequencing of design and construction operations; execution of design and construction; closeout; and start-up. Thus, the different project delivery methods are distinguished by the manner in which contracts between Caltrain, designers, and constructors are formed and the technical relationships that evolve between each party inside those contracts. There are several types of project delivery systems available for publicly funded transportation projects. The most common systems are Design-Bid-Build (DBB), Traditional Design-Build (D-B), Construction Manager/General Contractor (CMGC) [also known as Construction Manager at Risk (CMAR)], Progressive Design-Build (PD-B), and Design-Build-Operate-Maintain (DBOM). No single project delivery method is appropriate for every project. Each project must be examined individually to determine how it aligns with the attributes of each available delivery method and the owner goals and objectives. For this project delivery Workshop, only the DBB and CMGC project delivery methods are under consideration, so no additional evaluation of the D-B or PD-B project delivery methods will be conducted.

Note: This Project Delivery Method assessment and decision approach is based on the Transit Cooperative Research Program (TCRP) Report 131 *A Guidebook for the Evaluation of Project Delivery Methods*, using the Tier 1 – Analytical Delivery Decision Approach, with minor modifications to address the delivery requirements.

Project delivery methods considered in this evaluation

Design-Bid-Build (DBB) is the traditional, benchmark project delivery method in which Caltrain designs, or retains a Designer to furnish complete design services, and then advertises and awards a separate construction contract based on the Designer's completed construction documents. In DBB, Caltrain owns the details of design during construction and as a result, is responsible for the cost of any errors or omissions encountered in construction.

Construction Manager / General Contractor (CMGC)) is a project delivery method in which Caltrain contracts separately with a Designer and a construction Contractor. Caltrain can perform design or contract with an engineering firm to provide final design. Caltrain selects a construction firm to participate in the pre-construction phase and perform the construction work. The significant characteristic of this delivery method is a contract between Caltrain and a Contractor who will be at risk for the final cost and time of construction. Contractor input into the design development and constructability of complex and innovative projects are the major reasons Caltrain would select the CMGC project delivery method. Unlike DBB, CMGC brings the builder into the design process at a stage where definitive input can have a positive impact on the project features. CMGC is particularly valuable for non-standard or complex designs where Caltrain prefers to remain actively engaged in developing the Project design, technical requirements, and construction phasing while engaging a construction Contractor to provide input during the pre-construction final design phase.

Progressive Design-Build (PDB) combines the benefits of traditional DB and CMGC/CMAR. PDB refines the traditional DB delivery method so Caltrain will select a DB entity based on qualifications. As with the traditional DB delivery method, the designer and contractor work together under a single contract with Caltrain to optimize the project design to meet schedule and budget objectives. As Pre-construction design development proceeds, the Design-Builder and Caltrain progressively evaluate the project Total Contract Price against the agreed-upon budget and adjust the design accordingly to meet the budget. PDB is particularly valuable for new non-standard types of designs where it is difficult for Caltrain to develop the technical requirements necessary for a traditional DB procurement without construction industry input and Caltrain prefers to remain actively engaged in developing the Project design, technical requirements, and construction phasing while engaging a construction Contractor to provide input during the pre-construction final design phase.

Project Delivery Goals and Objectives

An understanding of the overall Project goal and supporting objectives is essential to selecting an appropriate project delivery method. Therefore, the overall Project goal and supporting objectives should be set prior to using the project delivery selection worksheet. Typically, the Project objectives can be defined in three to five items. Example objectives are provided below for reference. These objectives should remain consistent over the life of the Project.

Project-Specific Goal and Objectives	
•	
Do any of these goals and objectives eliminate any of the potential project delivery methods?	

Project Delivery Goals and Objectives

Conduct a brief discussion to brainstorm other Project-specific Goals and Objectives not included on the previous summary page. We will capture the comments and include them in the Workshop Memorandum and Report.

Project-Specific Goals and Objectives	
•	•
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Do any of these goals and objectives eliminate any of the potential project delivery methods?

Project Risks and Constraints

In addition to overall Project goal and objectives, a detailed discussion of Project risks and constraints is a critical step that helps with evaluation of the selection factors.

Project Risks and Constraints	
Project-specific Risks and Constraints	**General Risk and Constraints Categories**
Do any of these risks and constraints eliminate any of the potential project delivery methods?	

Project Risks and Constraints

Conduct a brief discussion to brainstorm other Project Risks and Constraints not included on the previous summary page. We will capture the comments and include them in the Workshop Memorandum and Report.

Project Risks and Constraints	
Project-specific Risks and Constraints	**General Risk and Constraints Categories**
•	•
•	•
•	•
•	•
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•	•
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•	•
•	•
Do any of these risks and constraints eliminate any of the potential project delivery methods?	

TCRP Report 131 – Tier 1 – Analytical Delivery Decision Approach

Project-Level Issues

Issue 1: Project Size

Project size reflects the dollar value and physical dimension of the transit corridor

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments:	

Issue 2: Cost

This issue includes several aspects of project cost, such as ability to handle budget restrictions, early and precise cost estimation, and consistent control of project costs.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ● .	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ● ● ● ● ● .	

Rating Key **3** – Most appropriate delivery method; **2** – Appropriate delivery method; **1**– Least appropriate delivery method
0 – Not appropriate delivery method; N/A – Factor not applicable or not relevant to the selection

Issue 3: Schedule

This issue includes two aspects of project schedule – the ability to shorten the schedule and the opportunity to control and prevent time growth.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ● .	

Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	

Issue 4: Risk Management

This issue involves methods for coping with project uncertainties that are inherent in each delivery method. For more detailed guidance, please see Tier 3 for risk-based approach to selecting project delivery methods.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ● .	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	

Issue 5: Risk Allocation

Each project delivery method has characteristics that affect risk allocation. The overarching goal should be to select the project delivery method that assigns project risks to the parties in the best position to manage them.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Issue 6: LEED Certification

This issue concerns obtaining LEED certification for a project. Each project delivery method needs to be examined to discover its ability to include features that will facilitate obtaining LEED certification in accordance with owner's needs.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating N/A	
Comments: ● ●	

Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating N/A	
Comments: ● ● ●	

Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating N/A	
Comments: ● ●	

Agency-Level Issues

Issue 7: Agency Experience

The level of experience of an owner's staff can affect the success of an alternative project delivery method application.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ● .	

Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Issue 8: Staffing Required

This issue ultimately concerns the amount of owner involvement required by each delivery method. The total number of owner employees is one measure of the extent of owner involvement. Another important measure for the owners is the variation in the number of staff required throughout the project development process.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Issue 9: Staff Capability

This issue regards the owner's requirement to furnish a highly capable staff to complete the duties it must undertake in each delivery method.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ● .	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Issue 10: Agency Goals and Objectives

Agency goals define the project success. The extent to which these goals align with the inherent attributes of each project delivery method has a significant bearing on delivery method selection.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ● ● .	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Issue 11: Agency Control of Project

The owner's ability to control the details of design and construction varies with each project delivery method. (Note the discussion of cost control and time control is included in other issue descriptions.)

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments:	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments:	

Issue 12: Third-party Agreements

Each delivery method can facilitate agreements with third parties, such as political entities, utilities, railroads, etc. in a different manner. The extent to which designers or constructors can facilitate third-party agreements is the basis for the advantage and disadvantage of each delivery method.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments:	

Public Policy/Regulatory Issues

Issue 13: Competition

Each delivery method may affect the level of competition, and thus the effect of each delivery method on competition must be evaluated. Alternative project delivery methods allow agencies to package projects in sizes that can effectively enhance or reduce competition.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments:	

Issue 14: DBE Impacts

The extent to which the delivery methods can be used to promote participation of disadvantaged businesses forms the advantages and disadvantages of this issue.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments:	

Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	

Issue 15: Labor Unions

The choice of delivery method may have an impact on labor usage and hence labor union issues. The issues can be both internal to the transit agency as well as external to its contractors.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments:	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	

Issue 16: Federal/State/Local Laws

Transit agencies may not be able to use some delivery methods due to state or local laws. Some of the states require that transit agencies go through several steps before allowed to use an alternative delivery method. The advantages and disadvantages of each project delivery method for this issue reflect the level of difficulty of using a delivery method from a legal standpoint.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Issue 17: FTA/EPA Regulations

The extent to which the various delivery methods can accommodate FTA requirements and EPA regulations given the unique project characteristics constitutes the advantages and disadvantages of this issue.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Issue 18: Stakeholder/Community Input

This issue addresses the opportunity for stakeholder involvement afforded by each delivery method.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Lifecycle Issues

Issue 19: Lifecycle Costs

Delivery methods can influence costs in the operation and maintenance phase. The issue concerns the opportunities or challenges that each delivery method provides with regard to lifecycle costs.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	

Issue 20: Maintainability

The issue of maintainability involves the owner's ability to specify quality and ease of maintenance. There are advantages and disadvantages to each delivery method with regard to how maintainability is achieved.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments:	

Issue 21: Sustainable Design Goals

Sustainable design is becoming ever more important in achieving overall sustainability goals for projects. There are advantages and disadvantages to each delivery method in terms of addressing sustainability issues and incorporating sustainable design in a project.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: •	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: • •	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: •	

Issue 22: Sustainable Construction Goals

In addition to sustainable design, sustainable construction is an important vehicle for achieving overall sustainability goals. There are advantages and disadvantages to each project delivery method with regard to facilitating sustainable construction.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ●	
Construction Manager General Contractor (CMGC)	
Advantages	
•	•
Rating ______	
Comments:	
•	•
Rating ______	
Comments: ● ●	

Other Issues

Issue 23: Construction Claims

The effect of each delivery method on exposing the agency to potential conflicts and claims is addressed under this issue.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating _______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating _______	
Comments: ●	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating _______	
Comments: ●	

Issue 24: Adversarial Relationship

There are advantages and disadvantages to each project delivery method with regard to avoiding adversarial relationships on the project team. These advantages and disadvantages will vary depending on the nature of the project and the owner's experience with the delivery methods.

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	
Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ● .	
Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ● ● ●	

Issue 25: Other

Design-Bid-Build (DBB)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	

Construction Manager General Contractor (CMGC)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	

Progressive Design-Build (PD-B)	
Advantages	**Disadvantages**
•	•
Rating ______	
Comments: ●	

Appendix 4

Sample Service Agreement

SERVICE AGREEMENT
BETWEEN
PENINSULA CORRIDOR JOINT POWERS BOARD
AND [COUNTERPARTY]
FOR
[PROJECT]

THIS SERVICE AGREEMENT ("Agreement") is effective on the date of the last signature set forth in the signature blocks and is between the Peninsula Corridor Joint Powers Board ("PCJPB" or "CALTRAIN") and [Counterparty] ("[shorthand]"), collectively referred as "the parties."

RECITALS

- Recitals should be simple, direct, and succinct.
- They are in a contract, if at all, to provide background and to explain the transaction's purpose.
- They are not the place for operative contractual language.

WHEREAS, [text]; and

NOW, THEREFORE, in consideration of the recitals and the mutual promises contained herein, CALTRAIN and [COUNTERPARTY] agree as follows:

TERMS OF AGREEMENT

1. Scope of Services

The Scope of Services for this Agreement shall be as set forth in Appendix A, which is subject to change upon mutual agreement in writing as described in [section].

2. Project Delivery Process & Schedules

2.1 Capital Projects Delivery

CALTRAIN has an internal capital projects delivery process that defines distinct phases and periodic check-ins after each project phase, which is set forth in Appendix B. This methodology is used as quality control oversight by CALTRAIN leadership to ensure that projects proceed in alignment with scope, budget, and schedule as approved in the capital budget. The span of this Agreement is included as part of Phase Gate 2.

2.2 Milestones

As project-specific schedules are developed, the following check-in points will be identified as milestones in accordance with this process. For this project, initial estimated milestone dates are:

[Phase Gate Chart]

As it relates to Agreement tasks, the timelines and milestones are included in Appendix C. These timelines may be adjusted as circumstances require upon the written agreement of the parties, which shall not be unreasonably withheld.

3. Work Product Review Periods

The estimated timelines in Appendix C include [COUNTERPARTY] and CALTRAIN review periods.

CALTRAIN will require three weeks to perform review of each design option. Rounds of review will include the technical and constructability evaluation, CALTRAIN's consolidated comments that integrate as applicable engineering, environmental, operations and maintenance needs, urban design and pedestrian, bicycling, and bus/shuttle access improvement considerations, community outreach, and review of cost estimates. The durations of these reviews are an estimation based upon the size and complexity of the project, and CALTRAIN will endeavor to meet the timeframes.

[COUNTERPARTY] will require up to three weeks to review documents produced by CALTRAIN. CALTRAIN will require up to three weeks to incorporate the comments of [COUNTERPARTY] into the deliverables.

4. Budget, Reporting, and Payment

As consideration for the services provided by CALTRAIN under this Agreement, [COUNTERPARTY] will pay the costs for CALTRAIN's services, as provided herein. Costs associated with activities described within this Agreement have been calculated based on CALTRAIN's current understanding of the project to date and information provided by [COUNTERPARTY]. Every effort will be made by the parties to keep the overall project's cost as low as reasonably possible while delivering the intended scope and objectives within schedule.

4.1 Budget

The estimated budget for this Agreement is set forth in Appendix D. The parties agree that this is an estimate and that the actual amount invoiced may be less than or exceed the estimate. CALTRAIN will give [COUNTERPARTY] adequate notice if the amount to be invoiced exceeds the estimate. Specifically, within [X] days after CALTRAIN's invoices meet or exceed [X%] of the estimated budget, the parties will meet and confer to discuss whether the remaining portion of the estimated budget is sufficient to cover the anticipated costs for the remaining work on the project. If the remaining portion of the estimated budget is insufficient to cover the remaining work, the parties shall work together in good faith to revise the estimated budget, the Scope of Services, or other aspects of the project to ensure the project can conclude on mutually agreeable terms.

4.2 CALTRAIN Fully Burdened Unit Cost Rates and Contingency Funds

CALTRAIN's billing rates are designed to ensure reimbursement of actual costs to CALTRAIN for provided services on third-party projects.

CALTRAIN's billing rates include actual salaries and fringe benefit costs, which are billed as direct labor costs. Additionally, CALTRAIN rates also include indirect labor costs in the form of Internal Cost Allocation Plan (ICAP) rates, which reflect actual overhead costs that are not efficient to charge directly to the project, such as financial services.

Both fringe benefit costs and estimated ICAP rate are updated on a fiscal year basis. More details on the current rates applied to San Mateo County Transit District labor including CALTRAIN, Consultants and Non-labor, is in Appendix E.

CALTRAIN may submit a written request to [COUNTERPARTY] for annual labor rate escalation, no later than 30 days before the start of the succeeding fiscal year, to be effective the first day of the subsequent fiscal year, or the date of CALTRAIN's request, whichever date is later. CALTRAIN may also submit a written request to [COUNTERPARTY] for labor rate changes upon staff changes. Increases in future negotiated fully burden billing rates, if requested, shall be limited to an annually negotiated, not-to-exceed percentage, according to the Construction Cost Index from the Engineering News Record for the San Francisco Bay Area. CALTRAIN's requests for new rates shall be subject to approval by [COUNTERPARTY], which approval shall not be unreasonably withheld.

4.3 Invoices

CALTRAIN will invoice [COUNTERPARTY] for work performed under this Agreement quarterly in arrears, via electronic mail. When applicable, copies of pertinent financial records will be included with the submission of billing(s) for all direct reimbursables. All invoices shall be sent to [COUNTERPARTY], attention [text]. Payment by [COUNTERPARTY] is due 45 calendar days following the date of each invoice.

5. Term of Agreement

It is understood by all parties that this Agreement will terminate on **[date]**, unless CALTRAIN and [COUNTERPARTY] mutually agree to extend the duration of this Agreement, or the Agreement is terminated pursuant to [section] below.

6. Confidentiality of Materials

All ideas, memoranda, specifications, plans, calculations, manufacturing procedures, data, drawings, descriptions, documents, discussions or other information developed or received by or for CALTRAIN and all other written information submitted to CALTRAIN in connection with the performance of this Agreement shall be held confidential by CALTRAIN and shall not, without the prior written consent of [COUNTERPARTY], be used for any purposes other than the performance of the project services, nor be disclosed to an entity not connected with the performance of the project services. Nothing furnished to CALTRAIN which is otherwise known to CALTRAIN or is or becomes generally known to the related industry shall be deemed confidential. CALTRAIN shall not use [COUNTERPARTY's] name, insignia or distribute exploitative publicity pertaining to the services rendered under this Agreement in any magazine, trade paper, newspaper or other medium without the express written consent of [COUNTERPARTY].

7. Ownership of Materials

All material, including information developed on computer(s), which shall include, but not be limited to, data, sketches, tracings, drawings, plans, diagrams, quantities, estimates, specifications, proposals, tests, maps, calculations, photographs, reports and other material developed, collected, prepared or caused to be prepared, under this Agreement shall be the property of [COUNTERPARTY], but CALTRAIN may retain and use copies thereof.

[COUNTERPARTY] shall not be limited, in any way, in its use of said material, at any time, for work associated with project. However, CALTRAIN shall not be responsible for damages resulting from the use of said material for work other than project, including, but not limited to the release of this material to third parties for work other than on project.

8. Records, Reports and Documentation

CALTRAIN shall maintain complete and accurate records of its operation, including any additional records required by [COUNTERPARTY] in writing. CALTRAIN shall submit to [COUNTERPARTY] any report concerning its performance under this Agreement that may be requested by [COUNTERPARTY] in writing. CALTRAIN agrees to assist [COUNTERPARTY] in meeting [COUNTERPARTY's] reporting requirements to the state and other agencies with respect to CALTRAIN's work hereunder. All records, reports and documentation relating to the work performed under this Agreement shall be made available to [COUNTERPARTY] during the term of this Agreement.

9. Hold Harmless/Indemnification

To the extent permitted by law (including, without limitation, California Civil Code section 2782.8), CALTRAIN agrees to indemnify, defend, and hold harmless [COUNTERPARTY], its officers and employees from any and all claims, demands, actions, causes of action, losses, damages, liabilities, known or unknown, and all costs and expenses, including reasonable attorneys' fees in connection with any injury or damage to persons or property to the extent arising out of any negligence, recklessness or willful misconduct of CALTRAIN, its officers, employees, agents, contractor, subcontractors or any officer, agent or employee thereof in relation to CALTRAIN's performance under this Agreement. Such defense and indemnification shall not apply in any instance of and to the extent caused by the sole negligence, recklessness or willful misconduct of [COUNTERPARTY], its officers, employees, agents or representatives.

To the extent permitted by law (including, without limitation, California Civil Code section 2782.8), [COUNTERPARTY] agrees to indemnify, defend and hold harmless the CALTRAIN, its officers and employees from any and all claims, demands, actions, causes of action, losses, damages, liabilities, known or unknown, and all costs and expenses, including reasonable attorneys' fees in connection with any injury or damage to persons or property to the extent arising out of any negligence, recklessness or willful misconduct of [COUNTERPARTY], its officers, employees, agents, contractor, subcontractors or any officer, agent or employee thereof in relation to [COUNTERPARTY's] performance and/or obligations under this Agreement. Such defense and indemnification shall not apply in any instance of and to the extent caused by the sole negligence, recklessness or willful misconduct of CALTRAIN, its officers, employees, agents or representatives.

10. Insurance Requirements

[Text – should have a reference to the Insurance Appendix H].

11. Termination

(a) If CALTRAIN defaults in the performance of this Agreement, or materially breaches any of its provisions, then [COUNTERPARTY] may terminate this Agreement by giving written notice to CALTRAIN. In the event of such termination, CALTRAIN shall be compensated in proportion to the percentage of satisfactory services performed or materials furnished (in relation to the total which would have been performed or furnished) through the date of receipt of notification from [COUNTERPARTY] to terminate. CALTRAIN shall present [COUNTERPARTY] with any work product completed at that point in time.

(b) Without limitation to such rights or remedies as either party shall otherwise have by law, either party also shall have the right to terminate this Agreement for any reason upon ten days' written notice to CALTRAIN. In the event of such termination, CALTRAIN shall be compensated in proportion to the percentage of services performed or materials furnished (in relation to the total which would have been performed or furnished) through the date of receipt of notification from [COUNTERPARTY] to terminate. CALTRAIN shall present [COUNTERPARTY] with any work product completed at that point in time.

(c) If [COUNTERPARTY] fails to pay CALTRAIN, CALTRAIN may terminate this Agreement if the failure is not remedied by [COUNTERPARTY] within 30 days after written notification of failure to pay.

12. Notices

All notices required by this Agreement, other than invoices for payment which shall be sent directly to Accounts Payable, shall be in writing, and sent by email or by first class with postage prepaid or commercial courier to an address below.

Nothing in this provision shall be construed to prohibit communication by more expedient means to accomplish timely communication. Each party may change its address below by written notice in accordance with this paragraph. Notices delivered personally shall be deemed communicated as of actual receipt; emailed notices shall be deemed communicated as of sent time; and mailed notices shall be deemed communicated as of three business days after mailing.

To [COUNTERPARTY]: NAME
ADDRESS

To CALTRAIN: NAME
ADDRESS

13. Appendices

All Appendices referenced herein are attached hereto and incorporated herein.

14. Compliance with Laws

The parties shall observe and comply with all Federal, State, and local laws, rules, ordinances, and regulations affecting the conduct of services provided and the performance of all obligations undertaken by this Agreement.

15. Relationship of the Parties

This Agreement does not create a partnership, joint venture, or employment, agency, or fiduciary relationship between the parties. The parties have no power to act for or bind the other, or to assume or create an obligation on behalf of the other.

All persons employed by each respective party in connection with this Agreement are not employees of the other party in any respect. Each party is responsible for obtaining statutory Workers' Compensation coverage for its employees.

16. Conflict of Interest

CALTRAIN shall avoid all conflicts of interest, or appearance of conflict, in performing the services and agrees to notify [COUNTERPARTY] within 7 days of knowing any facts that may give rise to a conflict of interest. CALTRAIN is aware of the prohibition that no officer of [COUNTERPARTY] shall have any interest, direct or indirect, in this Agreement or in the proceeds thereof. During the term of this Agreement, CALTRAIN shall not accept employment or an obligation which is inconsistent or incompatible with CALTRAIN's obligations under this Agreement.

17. Other Agreements

This Agreement shall not prevent either party from entering into similar agreements with others.

18. No Third Party Beneficiary

This Agreement shall not be construed or deemed to be an agreement for the benefit of any third party or parties and no third party or parties shall have any claim or right of action hereunder for any cause whatsoever.

19. Waiver

No failure or delay by a party to exercise a right or remedy provided under this Agreement or by law shall constitute a waiver of that or any other right or remedy, and no such failure or delay shall prevent or restrict the further exercise of that or any other right or remedy. No single or partial exercise of a right or remedy provided under this Agreement or by law shall prevent or restrict the further exercise of that or any other right or remedy.

20. Governing Law

This Agreement shall be interpreted, construed, and enforced in accordance with the laws of California.

21. Amendments

This Agreement may be amended at any time and from time to time, provided that such amendments are in writing and executed by both parties.

22. Severability

In case any one or more of the provisions contained herein shall, for any reason, be held invalid, illegal or unenforceable in any respect, it shall not affect the validity of the other provisions which shall remain in full force and effect.

23. Captions

The captions of the various sections, paragraphs and subparagraphs, of the contract are for convenience only and shall not be considered nor referred to for resolving questions of interpretation.

24. Miscellaneous

Time shall be of the essence in this Agreement. Failure on the part of either party to enforce any provision of this Agreement shall not be construed as a waiver of the right to compel enforcement of such provision or any other provision.

25. Entire Agreement

This Agreement constitutes the entire agreement of the parties with respect to its subject matter and supersedes any prior oral or written understanding on the same subject.

26. Signatures

The individuals executing this Agreement state that they have the right, power, legal capacity, and authority to enter into and to execute this Agreement on behalf of the respective legal entities of CALTRAIN and [COUNTERPARTY]. This Agreement shall insure to the benefit of and be binding upon the parties hereto and their respective successors and assigns.

REMAINDER OF PAGE INTENTIONALLY BLANK.

IN WITNESS WHEREOF, PCJPB and [COUNTERPARTY] execute this Agreement as follows with the intent to be legally bound:

PENINSULA CORRIDOR JOINT POWERS BOARD ("PCJPB or "Caltrain")	[COUNTERPARTY]
By:	By:
______________________________	______________________________
Michelle Bouchard Executive Director	[Name] [Title]
______________________________	______________________________
Date	Date
Approved as to Form:	Approved as to Form:
______________________________	______________________________
James C. Harrison General Counsel	[Name] [Title]
______________________________	______________________________
Date	Date

Caltrain®