FTA Led Risk Refresh Report

Peninsula Corridor Electrification Project (PCEP)
San Francisco to San Jose, CA

Peninsula Corridor Joint Powers Board (JPB)/Caltrain
San Mateo, CA

June 15, 2021

PMOC Contract Number: 69319519D000019
Task Order Number: 69319520F300099 (TO99)

OPs Referenced: 01 - Administrative Conditions and Requirements
40c – Risk and Contingency Review

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Length of Time Firm Assigned to Project: 5 Years, 6 Months
Length of Time Person Assigned to Project: 5 Years, 6 Months

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EXECUTIVE SUMMARY

The purpose of this report is to provide the Federal Transit Administration (FTA) with the Project Management Oversight Contractor's (PMOC) professional opinion regarding the reliability and reasonableness of the Peninsula Corridor Joint Powers Board's (JPB) Peninsula Corridor Electrification Project's (PCEP) scope, cost, and schedule at approximately 50% complete with construction. This information will inform FTA's evaluation of any steps that may be appropriate to improve the grantee's performance, or whether any relief from the FFGA conditions is appropriate under the current circumstances.

NOTE: The risk refresh activities described in this report did not consider the cost and schedule implications of the COVID-19 pandemic on the PCEP except as specifically noted. COVID-19 pandemic related impacts of an unspecified nature may be experienced by this project but were not evaluated due to the unknowable nature of these potential impacts.

Summary Project Results Matrix

The following table summarizes the project baseline elements (costs are without finance charges) and recommended risk results.

<table>
<tr><td>Peninsula Corridor Electrification Project
Risk Workshop Dates:
December 8, 10, 15, and 17, 2020</td><td colspan="3">Project Phase: Construction
Project Type: Commuter Rail
Project Delivery Methods: D-B, DBB
Federal Transit Administration</td></tr>
<tr><td>FFGA: Project Cost $1.93 billion (SCC 10-100)</td><td colspan="3">FFGA Final Completion Date: August 22, 2022</td></tr>
<tr><td colspan="4">Costs below do not include finance charges (SCC 100)</td></tr>
<tr><td>Key Project Scope Elements
Electrification of 51 miles of existing double-track commuter rail line plus modifications to signals, SCADA, and communications systems.
Purchase of 133 new Electric Multiple Unit railcars delivered as seven (7)-car trainsets. (96 included in FFGA)
Notching of four (4) existing tunnels.
Modifications to the existing Central Equipment Maintenance and Operations Facility (CEMOF) to allow servicing of the new EMU fleet.</td><td colspan="3">Summary Cost Risk Results (SCC10-90)<table><tr><td>Grantee Estimate</td><td>$1.924 B</td><td></td></tr><tr><td>P50 Estimate</td><td>$2.223 B</td><td></td></tr><tr><td>P65 Estimate</td><td>$2.254 B</td><td>Recommended</td></tr><tr><td>P80 Estimate</td><td>$2.294 B</td><td></td></tr></table></td></tr>
<tr><td></td><td colspan="3"></td></tr>
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Peninsula Corridor Electrification Project **Risk Workshop Dates:** **December 8, 10, 15, and 17, 2020**	**Project Phase: Construction** **Project Type: Commuter Rail** **Project Delivery Methods: D-B, DBB**
FFGA: Project Cost $1.93 billion (SCC 10-100)	**FFGA Final Completion Date: August 22, 2022**

Top Project Risks

- Resolution of cost and extended-schedule impacts of the Two Speed Check (2SC) grade crossing modifications.
- Resolution of cost and schedule impacts of prior and continuing differing site conditions at OCS pole foundations.
- Other much lesser risks considered in FTA standard risk modeling.

Summary Schedule Risk Results

FFGA Final Completion Date	8/22/2022	
Grantee Forecast Date	7/14/2023	
P50 Date	9/22/2024	
P65 Date	9/26/2024	*Recommended*
P80 Date	10/6/2024	

Project Status Update

The PCEP has been experiencing serious schedule delays for some time, with accompanying pressure on project costs. The following issues have impacted the PCEP's schedule:

- Later than anticipated award of the Full Funding Grant Agreement (FFGA);
- Unexpected ground conditions, including utility conflicts and unfavorable geotechnical conditions throughout the corridor, coupled with contractor planning and logistical issues have slowed construction of foundations for the overhead contact system (OCS) poles and required redesign of multiple pole locations, thus delaying subsequent OCS construction;
- Difficulty in reaching agreement on an acceptable solution for providing the required grade crossing warning time coupled with slower than expected production of the signal design is the critical path for the Electrification contract;
- Complications in gaining Union Pacific Railroad (UPRR) and Federal Railroad Administration (FRA) acceptance of the Two Speed Check (2SC) solution for providing the required grade crossing warning time further delayed this important activity;
- Challenges with design and construction of the two PG&E interconnections providing power to the PCEP have delayed completion of that work;
- Delayed delivery of high voltage switchgear for all traction power substations is impacting the project's critical path.
- Progress in completing the required real estate acquisition has been slower than planned resulting is some delays and resequencing of construction activities;
- Prior to the onset of the COVID-19 pandemic, the Electrification contractor's work that required access to the active rail tracks often experienced delayed track access for a variety of reasons; and
- Impact of the COVID-19 pandemic affected all project participants to varying degrees. The Electrification contractor's crews returned to work after the project was determined to be an essential infrastructure project; however, social distancing and personal protective equipment (PPE) requirements have impacted certain crafts and activities more than others. Production and assembly of the EMUs was particularly affected due to international travel restrictions

which prevented electronic specialists and others from travel to the site to ready TS 1 for testing. Significant infection rates among production workers in Salt Lake City and in Europe has impacted manufacturing and assembly production. The JPB requested schedule relief for COVID-19 impacts at the Quarterly Progress Review Meeting (QPRM) held on October 29, 2020.

The PMOC's opinion is that the PCEP's schedule performance has also been negatively affected by the lack of adequate scheduling resources for a project of this size and complexity.

The FTA, because of the foregoing schedule issues and related budget concerns, requested that Kal Krishnan Consulting Service, Inc. (KKCS), the PMOC assigned to the project, conduct a risk refresh to validate the JPB's schedule and cost projections for completion of the PCEP. The purpose of the risk assessment was to analyze uncertainties and risks; provide a qualitative and quantitative assessment of the cost and schedule status; consider ongoing risk mitigation activities; and provide recommendations regarding adjustments to cost and schedule, and other project management activities to respond to identified risk. This report is the deliverable associated with this task and includes descriptions of the analytical methods used and the risk mitigation framework.

Project Baseline and Risk Overview

Management Capacity and Capability (MCC) Review

The PMOC did not conduct a Management Capacity and Capability Review in advance of the Risk Refresh workshop. However, the PMOC is quite familiar with the PCEP team and its capabilities. The PMOC, over the last year, has recommended that the JPB increase scheduling and systems integration resources. The PMOC has also recommended that the JPB update its staffing plans for the transition period from construction, through testing, acceptance and start-up, and into operations. The PMOC recommends that the Rail Activation Committee (RAC) complete its plan as early as possible so that the timing of rail activation activities is defined and responsibility for accomplishing the activities and related reporting is clearly established. The PMOC has requested that the JPB clarify the organization and leadership of the rail activation process, which currently includes leadership from both PCEP and the JPB's Rail Operations group and is more of a combined activity than an integrated activity.

Project Scope and Project Delivery Review

The overall scope of the PCEP remains largely unchanged, with some exceptions. The most significant change was the JPB's purchase of 37 additional EMU rail cars using a pre-existing contract option. The additional cars will permit the JPB to operate nineteen (19) 7-car trainsets instead of the originally planned sixteen (16) 6-car trainsets.

Another significant change resulted from the JPB's termination-for-cause of its contract for installation of a federally-mandated Positive Train Control (PTC) system, and the re-procurement of a different PTC system from another vendor. This action led to a dispute between the JPB and Balfour-Beatty Infrastructure, Inc. (BBII), its Electrification design-build contractor. The dispute centers around the impact of the PTC change on the design and installation of a federally compliant grade crossing warning system. Design and installation of a Two Speed Check (2SC) solution is now underway, but the work is progressing more slowly than desirable, and this work is on the PCEP's critical path to the FFGA Final Completion Date (FCD). The JPB and BBII have been engaged in a technically facilitated mediation of the 2SC dispute since late 2019 and the JPB reports that progress toward settlement of the dispute is being made. ***The PMOC is unable to assess the potential cost and schedule implications of the settlement negotiations between the JPB, BBII and its subcontractors, and therefore, did not consider them in its risk refresh. The PMOC did,***

however, consider the implications of the underlying dispute and the documentation related to BBII's Change Order Cost Proposal and the associated Time Impact Analysis (TIA) 2.

The PCEP is being delivered using different contracting methods for the five (5) major contracts. A single design-build contract was awarded for the electrification and related elements such as signals and communication systems. Two (2) other contracts, one for notching of four (4) existing tunnels, and another for modifications to the JPB's Central Equipment Maintenance and Operations Facility (CEMOF) were competitively bid, and a fourth sole-source contract was awarded for additions to the JPB's Supervisory Control and Data Acquisition (SCADA) system. The EMU vehicles were procured using a conventional two-step competitive request for proposal (RFP).

Schedule Review

The PCEP's current target date for the start of full revenue operations is July 14, 2023, per the PCEP's Master Project Schedule (MPS), with a data date of October 1, 2020. The MPS does not include any schedule contingency; the PCEP's initial schedule contingency has been entirely exhausted.

During the schedule review process, the PMOC noted several problems with the MPS provided by the JPB. The MPS was underdeveloped, with much of the critical path represented by several very long duration activities. These activities needed to be broken down further to represent specific details of the work. The MPS also needed to have the testing and commissioning and rail activation activities further developed to represent what the PCEP expects to occur on the project. The JPB responded to the PMOC's recommendations by providing the PMOC with a hybrid MPS comprised of an 11,000+ activity Electrification contractor's monthly schedule update and the JPB's added activities for testing and commissioning and rail activation. The PMOC made minor adjustments to the JPB's hybrid MPS before running the risk model. The PMOC's adjusted schedule, to run the model, has an FCD of July 14, 2023.

Project Cost Estimate Review

The PMOC reviewed the standard cost category (SCC) formatted table as presented in Appendix D of the December 2020 PCEP Monthly Progress report (Table 7 in this report). The table presents cost and budget broken down by SCC major and minor codes, the estimate at completion (EAC), and change orders. The table also presents allocated and unallocated project contingency by SCC minor code. For example, the allocated contingency for SCC 10 Guideway is presented as SCC 10.07a Allocated Contingency. Unallocated contingency is presented in SCC 90.

The breakout of allocated contingency by SCC minor code allowed the PMOC to easily remove contingency from the project budget for the risk refresh simply by zeroing out the allocated contingency, as shown in , which presents a stripped budget.

The PMOC notes that the PCEP estimate at completion, as presented in Section 5.1, is the sum of the FFGA grant budget plus total budget changes, including executed, negotiated and forecast change orders, but not potential change orders, including Requests for Change (RFC) which are not in the PCEP's change order log ("over the horizon" change orders). The executed and negotiated change orders have well defined costs, and at least half of the forecast change orders have relatively well-developed costs. Some of the forecast change orders are more speculative; for example, not all of the change notices and RFCs will be approved, and the actual negotiated value of the final approved change order may be significantly different than the value requested by the contractor (either more or less).

The PMOC, therefore, recognizes that the final cost to the JPB of the forecast change orders may be lower than carried in the change order log. The PMOC utilized the full value of the change orders as its estimate of the change order component of the estimate at completion.

The PMOC made adjustments to the project base estimate as indicated in Table 1. The adjustments represent the PMOC's opinion of incurred costs that should be included in the base cost estimate for the project. Some of the incurred costs, such as those associated with the contractor's requested change order for direct costs and extended overhead related to the CWT 2SC dispute, have not been finally determined or paid. However, the PMOC concludes that they are very likely to be paid, and therefore, represent realized risk that belongs in the base estimate rather than in trends or the risk register. The PMOC used conservative assumptions in its projections related to the outcome of the CWT 2SC dispute. The PMOC recognizes that this dispute has not been adjudicated, responsibility for delay has not been assigned to either party and the resultant costs have not been determined. The PMOC concludes that the stripped and adjusted project budget is $2.131 billion, excluding finance charges.

Table 1 - Adjusted Base Cost Estimate Summary

FFGA Budget w/o Contingency	**$1,608M**
PCEP EAC Adjustment	$248M
OCS Foundations contractor time and direct cost	$15M
TPSS 1 Interconnect design change	$2M
CWT 2SC contractor TRO (TIA-2) and direct cost	$163M
PMOC schedule p65 contractor TRO and prof. services	$96M
Adjusted Base Cost Estimate w/o Contingency	**$2,132M**

Project Risk

The PMOC reviewed the costs for, and risk associated with each Standard Cost Category (SCC) and determined the risk factors within the FTA risk model that should be adjusted to reflect the risk more accurately for the PCEP. The PMOC considers the following risks to be most significant, and specific PMOC cost and risk adjustments were made for each (as noted in the cost summary above):

- Resolution of cost and schedule extension impacts of the Two Speed Check (2SC) modifications.
- Resolution of cost and schedule impacts of prior and continuing differing site conditions at OCS pole foundations.

Other identified risks were accounted for using FTA standard risk modeling methods.

Schedule Review and Independent Risk Analysis

The Impacted Risk Model (IRM) distribution range for the Project's completion ranges from the 0% to 100% confidence levels and spans a 112-calendar day period. The probability percentage points, also referred to as p-values, for the IRM are:

- PCEP forecast Final Completion Date (FCD): July 14, 2023
- 50% confidence level (p50) completion date: September 22, 2024
- 65% confidence level (p65) completion date: September 26, 2024
- 80% confidence level (p80) completion date: October 6, 2024

Cost Risk Analysis

The Top-down Risk Model distribution range for project costs is as follows (YOE $ million):

- PCEP EAC: $ 1,921 million
- 50% confidence level (p50): $ 2,223 million
- 65% confidence level (p65): $ 2,254 million
- 80% confidence level (p80): $ 2,294 million

The FFGA budget, without finance costs, is YOE $1,924 million. The modeled recommended budget at the 65th percentile, including the adjusted estimate and contingency, is $2,254 million. The current PCEP FFGA budget and the current PCEP Estimate-At-Completion are modeled as presented.

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1.0 INTRODUCTION

Kal Krishnan Consulting Services, Inc. (KKCS) is the Federal Transit Administration's (FTA) Project Management Oversight Contractor (PMOC) for the Peninsula Corridor Electrification Project (PCEP). The Peninsula Corridor Joint Powers Board (JPB) is the grantee which operates commuter rail service as Caltrain. The PCEP is being funded as a Core Capacity project under the FTA's Capital Investment Grant (CIG) program. The FTA awarded a $647 million Full Funding Grant Agreement (FFGA) to the JPB on May 23, 2017. The PCEP is currently under construction and approximately 50% complete.

1.1 PMOC Review

This Risk Refresh report presents the PMOC's assessment of the reliability of the PCEP's schedule for completion of the project, the estimated cost at completion, and includes the PMOC's recommendations for appropriate cost and schedule contingency. This risk refresh was conducted in accordance with the FTA's Oversight Procedure (OP) 40c - Risk and Contingency Review and included the PMOC's review of the project's current cost, schedule, and risk materials; however, the PMOC did not prepare formal reviews under the applicable OPs.

1.2 Project Description

The PCEP corridor is approximately 51 miles in length. This Core Capacity Improvement Project (CC) includes two (2) components: infrastructure and rolling stock. The infrastructure component is comprised of the construction of Traction Power Substations (TPSS), the connection of those substations to the local utility system, and the installation of the Overhead Contact System (OCS) over the tracks beginning at the 4th and King Caltrain Station in San Francisco and ending at Tamien Station in San Jose. The infrastructure work also includes modifications to the wayside signal system and grade crossing signals to accommodate the new electrified rail system. In addition, four (4) existing rail tunnels have been enlarged to accommodate the expanded clearance envelope of the electrified vehicles. An alignment map is provided as information in Appendix D.

The rolling stock component includes the procurement of ninety-six (96) Electric Multiple Unit (EMU) rail vehicles to replace approximately 75% of Caltrain's existing diesel rolling stock. The initial EMU order was supplemented in December 2018 when the JPB exercised an option to purchase an additional thirty-seven (37) EMUs; the resulting fleet will consist of nineteen (19) seven-car trainsets. The additional thirty-seven (37) EMUs are not part of the JPB's Core Capacity grant. Caltrain's Central Equipment Maintenance and Operation Facility (CEMOF) is being modified to service the electrified vehicles.

The PCEP is part of a larger JPB initiative known as the Caltrain Modernization Program (CalMod). The CalMod program separately installed a Positive Train Control (PTC) system, which is an advanced signal system that includes federally mandated safety improvements. The PTC system is in operation and in the Federal Railroad Administration's (FRA's) Extended Revenue Service Demonstration (RSD) phase prior to final approval by the FRA.

1.3 Project Status

The PCEP is currently in construction and progress can be summarized as follows:

- Scope – The scope remains largely as planned.
- Schedule – The FFGA final completion date (FCD) is August 22, 2022; however, this date will be exceeded.

- Cost – The current JPB forecasted project cost is $1.93 billion in year of expenditure (YOE) dollars including finance charges and contingency. Several factors discussed in this report will cause this cost to be exceeded.

1.4 Significant Project Activities and/or Key Milestones

- The first major milestone in the Electrification contract is the completion of Segment 4; this milestone is currently forecast to occur on June 30, 2021.
- The first EMU trainset (TS-1) completed its initial testing and troubleshooting at Stadler's assembly facility in Salt Lake City, Utah and was shipped on February 10, 2021 to the Association of American Railroads' (AAR) Transportation Technology Center, Inc. (TTCI) in Pueblo, Colorado, for prescribed acceptance and qualification tests. TS-1 has been assembled as an eight (8) car trainset for testing purposes, but will be re-assembled and delivered to the JPB as a seven (7) car trainset following the completion of tests at the TTCI.

1.5 Evaluation Team

The PMOC Evaluation Team members and their respective roles associated with the assessment of the Project are presented in Table 2. A brief description of each team member's experience is provided in Appendix C.

Table 2 – PMOC Evaluation Team

Name	Firm	Role
Mike Eidlin	KKCS	Task Order Manager
David Sillars	Sillars Consulting	Risk Manager
Brett Rekola	KKCS	Program Manager, Railroad Subject Matter Expert
Dan Holzman	KKCS	Cost Estimation Manager, Cost Risk Assessment
Kevin Byers	KKCS	Project Schedule Manager, Schedule Risk Assessment
Janice Johnson	KKCS	Clerical Support, Quality Assurance

2 MANAGEMENT CAPACITY AND CAPABILITY REVIEW

2.1 PMOC Assessment

The PMOC did not conduct a Management Capacity and Capability Review in advance of the Risk Refresh workshop. However, the PMOC is quite familiar with the PCEP team and its capabilities. The PMOC's opinion is that the PCEP team is somewhat smaller than usually encountered on a project of this size, particularly in the project controls area.

- **PMOC Recommendation No. 1 -** The PMOC continues to recommend that the JPB increase scheduling and systems integration resources.
- **PMOC Recommendation No. 2 -** The PMOC recommends that the JPB update its staffing plans for the transition period from construction, through testing, acceptance and start-up, and into revenue operations.
- **PMOC Recommendation No. 3 -** The PMOC recommends that the Rail Activation Committee complete its plan as early as possible so that the timing of rail activation activities is defined and responsibility for accomplishing the activities and related reporting is clearly established. The PMOC has requested that the JPB clarify the organization and leadership of the rail activation process, which currently has leadership from both PCEP and the JPB's Rail Operations group and is more of a combined activity than an integrated activity.

3 PROJECT SCOPE AND PROJECT DELIVERY REVIEW

3.1 PMOC Assessment of Project Scope

The scope of the PCEP has remained relatively unchanged from the time of FFGA execution. The most prominent exceptions are as follows:

- The full Notice to Proceed for both the design-build electrification contract and the EMU vehicle contract was delayed by a later than anticipated award of the FFGA. This delay resulted in the early issuance of Change Orders to both contracts.
- The JPB was in the process of installing a Communication Based Overlay Signal System (CBOSS) Positive Train Control (PTC) system to meet federal requirements prior to the award of the FFGA. The JPB subsequently cancelled the CBOSS contract, and re-procured a PTC system from WABTEC, known as the Interoperable-Electronic Train Management System (I-ETMS). The I-ETMS uses a different control methodology than the CBOSS, which was specified as an existing condition in the Electrification contract. This change led to a dispute between the JPB and its Electrification contractor, Balfour-Beatty Infrastructure Inc. (BBII) and its signal subcontractors. The JPB's originally specified CBOSS was an element in providing the federally required grade crossing warning time. Design and construction of the signals work was delayed for many months as a satisfactory technical solution which met federal, state and Union Pacific Railroad (UPRR) requirements was identified. The agreed upon solution is known as Two Speed Check (2SC). The completion of design and installation of the 2SC solution is now the critical path for substantial completion of the Electrification contract and the operation of the EMUs on an electrified Caltrain system. The dispute over the commercial implications of implementing 2SC has been the subject of a technically facilitated mediation between the JPB and BBII since October 2019, and currently also involves BBII's two signals subcontractors. *Design and installation of 2SC is underway; however, the design progress is slower than expected and only three (3) of twenty (20) planned signal cutovers have been completed to date. Electrified trains cannot run in revenue service without a signal system that has been properly modified for the electrified environment.* The JPB reports that it is meeting frequently with the mediator and its contractors in an effort to reach an acceptable settlement. ***The PMOC is unable to assess the potential cost and schedule implications of the settlement negotiations between the JPB, BBII and its subcontractors, and therefore, did not consider them in its risk refresh. The PMOC did, however, consider the implications of the underlying dispute and the documentation related to BBII's Change Order Cost Proposal and the associated Time Impact Analysis (TIA) 2.***
- The original budget for the PCEP included costs for private utility relocations and 115 kV interconnections to the local electrical grid. The estimate did not contemplate the cost of modifications to the two existing PG&E substations that will supply power to the PCEP's TPSS #1 and #2, and significantly underestimated the cost of the design and construction of the interconnections as well as other PG&E costs. *Modifications to PG&E's existing FMC (originally known as Food Machinery Corporation) and East Grand substations are underway. Construction of the interconnect between FMC and TPSS #2 is complete but not tested or energized. The interconnect between East Grand and TPSS #1 is being redesigned as a mostly underground feed which will result in a substantial Change Order. Temporary power to allow initial testing of the EMUs and the OCS and TPS is in place at the FMC substation, however, PG&E will not energize the temporary power (or permanent power when it becomes available) until an interconnection agreement is signed by the JPB. The*

interconnection agreement is currently on-hold due to a disagreement between the JPB, PG&E, and Silicon Valley Power over a largely complete Single-Phase Study which looks at the impacts of the PCEP load on the local electric grid.

- The original budget for Electrification related work included scope for a Supervisory Control and Data Acquisition (SCADA) system. However, the SCADA scope was not included in the Electrification contract and a separate contract was awarded on a sole-source basis after the start of the project. *This work is underway and mostly complete.*
- The Electrification contract included an Option for construction of an Overhead Contact System within the four (4) existing tunnels. The JPB was unsuccessful in negotiating an acceptable Change Order with the Electrification contractor, and the work had to be added to the tunnel notching contract via modification. *This work is complete except for final integrated testing.*
- The PCEP did not assign responsibility for integration of the electrification, signals, SCADA, and EMU vehicles contracts and the JPB's PTC system to a single individual, consultant, or contractor, which leaves responsibility for this vital function resting with the JPB. Currently a single individual is leading this effort on a part-time basis along with other responsibilities.

3.2 PMOC Assessment of Project Delivery

The PCEP is using a combination of delivery methods. The Electrification work is being delivered using a design-build contract. The tunnel notching contract was competitively bid as was the CEMOF Modifications contract. The EMU procurement was a competitive two-step procurement. The tunnel contract is complete except for final integrated testing. The CEMOF modification contract is expected to be substantially complete in March 2021. The delivery of the first EMU trainset to the JPB is scheduled for July 2021. Substantial completion of the Electrification contract is currently projected for July 14, 2023. The PMOC's opinion is that the delivery plan for the PCEP was thoughtfully conceived and reasonable given the scope of the project.

One consequence of the delayed completion of the electrified railroad is the change in testing and acceptance of the EMU trainsets. Performance testing and acceptance of the first trainset was to be conducted on the JPB's system. Because the JPB's railroad is not currently electrified, and TS 1 is ready for dynamic testing, the JPB and Stadler arranged for dynamic testing to be conducted at the Association of American Railroads' (AAR) Transportation Technology Center, Inc. (TTCI) in Pueblo, Colorado. TS 1 is now being reassembled at the TTCI prior to starting the testing process. TS 1, as well as all subsequent trainsets, will be accepted after being delivered to the JPB's tracks and completing all contractual requirements.

- **PMOC Recommendation No. 4 –** The PMOC recommends that the PCEP complete full integration of the Rail Activation and Testing and Commissioning schedules with the Master Project Schedule for more effective project management.
- **PMOC Recommendation No. 5 –** The PMOC recommends that the JPB consider strategies for placing EMUs safely in service prior to the completion of all required signal modifications if that work continues to be delayed.
- **PMOC Recommendation No. 6 -** The PMOC has previously recommended that the JPB obtain a second opinion from a well-qualified construction attorney with substantial experience in defending complex contractor claims, particularly those related to schedule delays. The second opinion should address the JPB's proposed approach to resolving the complex issues currently subject to the technically facilitated mediation process between the JPB and BBII.

4 PROJECT SCHEDULE REVIEW

4.1 Methodology

The PMOC reviewed the PCEP Project in accordance with FTA OP 34 - Project Schedule Review (dated September 2019) to assess and evaluate the JPB's MPS for the PCEP Project. The purpose of the schedule review is to check the stripped PCEP MPS for logic errors, open-ended tasks, negative lags, start-to-finish links, vague activity names, large duration activities, and other potential problems that could compromise the risk analysis. This step ensures the integrity of the schedule and improves the chances for a meaningful analysis.

4.2 PMOC Assessment

The October 1, 2020 stripped MPS file and Basis of Schedule (BOS), dated January 25, 2021, were used in the risk analysis (Section 5.0). Minor and ultimately inconsequential adjustments were made to the MPS. The MPS has a target FCD of July 14, 2023 (without contingency).

As of December 1, 2020, the Electrification contractor is forecasting a substantial completion date of May 5, 2024. The contractor has stated in its related schedule update narrative that the reason for the May 2024 substantial completion date is that the contractor has added "changes to project schedule to incorporate the 2-speed solution or CWT-2S elements of design, procurement, construction, and testing into the project schedule. Although the scope of the 2-speed solution is not agreed to between JPB and BBII, these elements have been incorporated into the project schedule to manage progress and overall project duration." The JPB and BBII are not in complete agreement on the time required to complete the 2SC installation, therefore, the JPB has modified some elements of its MPS to produce what it considers to be a more realistic completion schedule.

4.3 Project Schedule Review

As noted above, the PMOC worked with the PCEP team to adjust its schedule. The October 1, 2020 schedule included improvements to its mechanical soundness and constructability resulting in a new critical path and near critical paths through the FCD. The PMOC ultimately received a schedule that could be used for risk ranging assigned to activities, and with an appropriate amount of unique detail in the activity names.

The version of the MPS provided to the PMOC contained the eighteen (18) separate calendars indicated in Table 3.

Table 3 - PCEP Schedule Calendars

Standard 5 Day Workweek	113 Activities
0_CalMod 24x7	2 Activities
0_CalMod 5 day workweek (7 Holidays)	172 Activities
Board Calendar	3 Activities
7 Day Workweek-2	3415 Activities
7-Day Workweek	539 Activities
Standard 6 Day Workweek w/ Basic Holidays-2	148 Activities
MRS 8 hour (ST)	668 Activities
Standard 5 Day Workweek	319 Activities
All Segments ST Daytime Weekdays	38 Activities
Drilltech (ST)	48 Activities

Standard 5 Day	2400 Activities
Segment 1 (DT)	123 Activities
Segment 4b (ST)	3 Activities
Segment 4a (DT)	92 Activities
0_CalMod 7-day workweek (7 Holidays)	1 Activities
Unrestricted Off Track	995 Activities
MRS 5 day 10 hr. nights (ST)	2027 Activities

- **PMOC Recommendation No. 7 -** The PMOC made minor adjustments to the October 1, 2020 stripped MPS. The PMOC recommends that the JPB continue to improve the MPS by incorporating and integrating the Rail Activation and Testing and Commissioning schedules along with the contractor's monthly schedule update and ensuring that the logic is correct throughout.

5 PROJECT COST ESTIMATE REVIEW

The purpose of this review is to assess the accuracy and reasonableness of the current PCEP Estimate at Completion (EAC). The PCEP EAC as of January 21, 2021 is $1.931 billion, as shown in the December 2020 core accountability table (Table 4 in this report**)**. The definition of the rows in the core accountability table is as follows:

Cost Estimate: The current estimate (EAC) is the same as the original EAC at the FFGA. The stripped estimate at completion is the Current Estimate minus the remaining total contingency, or $1.931B - $64.7M = $1.866B including finance charges. The PMOC uses the $1.866B figure as the current stripped EAC throughout this report.

Contingency: Contingency is divided into allocated contingency and unallocated contingency. Allocated contingency is assigned to a specific SCC code 10 – 80, while unallocated contingency is project-wide and is carried in SCC 90 in the SCC workbook.

Schedule: The Final Completion Date (FCD) at the FFGA was August 22, 2022. The current PCEP estimate of the FCD is July 14, 2023, which is 326 days later than the originally planned RSD. Note that the Electrification contractor's substantial completion date is in 2024.

Planned Value to Date: The figure of $1.185B represents the anticipated accrued cost to date based on the original baseline schedule with an FCD of August 2022.

Earned Value to Date: PCEP uses the term earned value to mean the overall accrued cost of work for the project. Note that this definition is different than the federal definition of earned value, which generally means the value of work actually performed, which is usually different than accrued cost. If we assume that PCEP only pays for work actually performed, it is reasonable to estimate earned value as accrued cost.

Actual Cost: Actual cost is the total committed value to date. This does not represent the cash cost to date or the earned value to date. Committed costs represent purchase orders issued to vendors, and purchase orders may exceed accrued cost to date.

Contracts: Total contracts awarded represents the sum of purchase orders issued to all the contractors on the project. Note that purchase orders may be more or less than the contracted value including change orders, depending on the type of contract. Total construction contracts awarded represents the sum of purchase orders issued for construction work only, excluding non-construction contracts for services such as insurance or messaging.

Physical Construction Work Completed: This item represents the accrued cost to date for construction work only. Note that PCEP calculates the percent complete by dividing the physical construction work completed by the total construction contracts awarded. Since the total construction contracts awarded actually represent the purchase orders, not the contracted value, the total construction contracts awarded will increase as more purchase orders are assigned.

Table 4: December 2020 Core Accountability Table

Project Status:		Original at FFGA	Current Estimate (EAC)
Cost	Cost Estimate	$1,930,670,934	$1,930,670,934
Contingency	Allocated Contingency	$152,913,317	$14,357,276
	Unallocated Contingency	$162,620,294	$50,336,157
	Total Contingency (Allocated plus Unallocated)	$315,533,611	$64,693,434
Schedule	Revenue Service Date	22-Aug-22	14-Jul-23
		Amount ($)	Percent
Planned Value to Date	Total budgeted cost of work scheduled to date (if available)	$1,185,166,596	61.39%
Earned Value to Date	Budgeted cost of work completed to date, i.e., actual total value of work earned or done (if available)	$773,488,854	40.06%
Actual Cost	Total project cost completed to date (actual total expenditures)	$1,069,343,754	55.39%
Contracts		Amount ($)	Percent
	Total contracts awarded to date	$1,721,330,135	89.16%
	Total construction contracts awarded to date (construction & vehicle contracts only)	$1,441,498,334	74.66%
	Physical construction work completed (amount of construction contract work actually completed)	$700,442,400	48.59%

Estimate at Completion: The critical figure in this report is the estimate at completion (EAC). PCEP reports the EAC as the Pre-FFGA budgeted project cost of $1.980B, minus the Pre-Project Development (PD) FFGA ineligible costs of $49.6M = $1.930B, which is the post-FFGA budgeted project value. This value includes $64.7M of remaining contingency; therefore, as previously noted, the stripped EAC is $1.866B. Currently, only $1.721B of the total budgeted contract value has been formalized with a purchase order; however, the PCEP anticipates awarding purchase orders for the remaining contract work.

The PCEP assigns all project costs to either Infrastructure (Project 2036) or Vehicles (Project 2061). Project 2036 includes the Electrification design-build contract, the tunnel notching contract, the Supervisory Control and Data Acquisition (SCADA) contract, and work performed by Pacific Gas & Electric (PG&E), as well as consultants and some smaller contracts. Project 2061 includes the EMU vehicles, the contract for modification of the CEMOF, and other EMU related support services and equipment. The EAC presented by PCEP includes $250.8M of change orders which are assigned either to Project 2036 or 2061. Change orders are classified as approved or forecast. An approved change order is finalized, has a definite cost value, and is therefore, an element of the Approved

Budget as well as the EAC. Forecasted changes include change orders which are waiting for signature, are pending budget changes, are change notices requested by PCEP, change requests (RFC) by the contractor, or field orders for (typically) minor changes issued by PCEP field personnel.

Projected changes generally have assigned costs which may be approximate, and therefore, are subject to change during negotiations with the contractor. Table 5 and Table 6 show the value of the various change order types by project. The PMOC recognizes that the final value of projected changes is likely to vary, some change requests will not be granted, and the value of pending budget changes may be adjusted prior to finalization. The final value of the approved and pending change orders may be different than the $250.8M of combined 2036 and 2061 change orders; however, the PMOC accepts the change orders as the basis for reporting the base EAC. The PMOC therefore accepts the stripped (no contingency) EAC of $1.866B as the base value for the risk model.

Table 5: Project 2036 Change Orders

Project	STATUS_ID	CO Cost
2036	APRVD CCO	$38,416,873
2036	APRVDNC	$66,161,285
2036	BUD CHNG	$47,779,131
Subtotal 2036 CO Final Cost	$152,357,290	
2036	CN	$22,000,789
2036	SIGNATURE	$4,383,852
2036	CR	$777,975
2036	FO	$6,964,864
2036	RFC	$0
2036	DRB	$0
2036	VE	$0
2036	PND BUD CH	$53,148,321
Subtotal 2036 CO Projected Cost	$87,275,801	
Total 2036 Project CO Cost	$239,633,091	

Table 6: Project 2061 Change Orders

Project	STATUS_ID	CO Cost
2061	APRVD CCO	$4,738,546
2061	APRVDNC	$0
2061	BUD CHNG	$1,744,422
Subtotal 2061 CO Final Cost	$6,482,968	
2061	CN	$0
2061	SIGNATURE	$1,194,941
2061	CR	($805,060)
2061	FO	$112,630
2061	RFC	$0
2061	DRB	$0
2061	VE	$0
2061	PND BUD CH	$4,221,608
Subtotal 2061 CO Projected Cost	$4,724,118	
Total 2061 Project CO Cost	$11,207,087	

5.1 Review Methodology and Assessment

PCEP's December 2020 Monthly Progress Report, Appendix D, forms the basis of the PMOC's cost evaluation, of which Table 7 is a portion. PCEP's Appendix D reports project costs by SCC code, and is the fundamental PCEP cost reporting mechanism for the FTA project. Note that the EAC is $1.931 billion with finance costs, and is consistent with the core accountability table. Of this total, $1.870 billion is SCC 10 – 80 costs, $50.4M is remaining unallocated contingency, and $14.4M is remaining allocated contingency embedded in SCC 10 – 80 costs. These figures are consistent with the December core accountability (Table 4 in this report). Note that the Estimate at Completion includes both approved and forecasted budget changes.

Table 7 - PCEP December 2020 Monthly Progress Report, Appendix D

	Description of Work	FFGA Grant Budget (A)	Approved Budget with Approved CCOs (B)	Cost This Month (C)	Cost To Date (D)	Estimate To Complete (E)	Estimate At Completion (F) = (D) + (E)
10 - GUIDEWAY & TRACK ELEMENTS		**$14,256,739**	**$27,353,871**	**$0**	**$24,997,834**	**$3,082,261**	**$28,080,095**
10.02	Guideway: At-grade semi-exclusive (allows cross-traffic)	$2,500,000	$2,500,000	$0	$144,681	$2,355,319	$2,500,000
10.07	Guideway: Underground tunnel	$8,110,649	$24,853,871	$0	$24,853,153	$726,942	$25,580,095
10.07a	Allocated Contingency	$3,646,090	$0	$0	$0	$0	$0
30 - SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS		**$2,265,200**	**$7,368,343**	**$704,388**	**$6,096,007**	**$2,311,176**	**$8,407,183**
30.03	Heavy Maintenance Facility	$1,344,000	$7,368,343	$704,388	$6,096,007	$2,311,176	$8,407,183
30.03a	Allocated Contingency	$421,200	$0	$0	$0	$0	$0
30.05	Yard and Yard Track	$500,000	$0	$0	$0	$0	$0
40 - SITEWORK & SPECIAL CONDITIONS		**$255,072,402**	**$258,632,656**	**$4,903,675**	**$208,898,638**	**$54,083,017**	**$262,981,654**
40.01	Demolition, Clearing, Earthwork	$3,077,685	$10,110,000	$464,600	$7,416,500	$2,723,500	$10,140,000
40.02	Site Utilities, Utility Relocation	$62,192,517	$97,315,387	$3,292,994	$104,570,056	($5,446,110)	$99,123,945
40.02a	Allocated Contingency	$25,862,000	($0)	$0	$0	($0)	($0)
40.03	Haz. mat'l, contam'd soil removal/mitigation, ground water treatments	$2,200,000	$8,744,961	($11,428)	$6,502,293	$2,249,641	$8,751,934
40.04	Environmental mitigation, e.g. wetlands, historic/archeologic, parks	$32,579,208	$19,504,208	$24,000	$2,189,370	$17,314,838	$19,504,208
40.05	Site structures including retaining walls, sound walls	$568,188	$0	$0	$0	$0	$0
40.06	Pedestrian / bike access and accommodation, landscaping	$804,933	$2,735,000	$0	$0	$2,735,000	$2,735,000
40.07	Automobile, bus, van accessways including roads, parking lots	$284,094	$0	$0	$0	$0	$0
40.08	Temporary Facilities and other indirect costs during construction	$107,343,777	$99,613,100	$1,133,509	$88,220,420	$30,188,748	$118,409,168
40.08a	Allocated Contingency	$20,160,000	$20,610,000	$0	$0	$4,317,399	$4,317,399
50 - SYSTEMS		**$504,445,419**	**$504,986,928**	**$9,336,237**	**$238,683,669**	**$287,140,463**	**$525,824,131**
50.01	Train control and signals	$97,589,149	$120,086,712	$219,560	$44,909,935	$76,448,103	$121,358,038
50.01a	Allocated Contingency	$1,651,000	$0	$0	$0	$0	$0
50.02	Traffic signals and crossing protection	$23,879,905	($0)	$0	$0	($0)	($0)
50.02a	Allocated Contingency	$1,140,000	$1,140,000	$0	$0	$1,140,000	$1,140,000
50.03	Traction power supply: substations	$69,120,009	$102,977,235	$3,973,043	$50,096,142	$54,043,483	$104,139,625
50.03a	Allocated Contingency	$31,755,013	$2,990,895	$0	$0	$2,028,337	$2,028,337
50.04	Traction power distribution: catenary and third rail	$253,683,045	$268,126,899	$5,143,634	$143,619,603	$147,859,952	$291,479,555
50.04a	Allocated Contingency	$18,064,000	$4,100,188	$0	$0	$113,577	$113,577
50.05	Communications	$5,455,000	$5,547,000	$0	$57,989	$5,489,011	$5,547,000
50.07	Central Control	$2,090,298	$0	$0	$0	$0	$0
50.07a	Allocated Contingency	$18,000	$18,000	$0	$0	$18,000	$18,000
60 - ROW, LAND, EXISTING IMPROVEMENTS		**$35,675,084**	**$35,675,084**	**$187,401**	**$21,406,359**	**$14,268,725**	**$35,675,084**
60.01	Purchase or lease of real estate	$25,927,074	$25,927,074	$187,401	$21,272,367	$13,104,707	$34,377,074
60.01a	Allocated Contingency	$8,748,010	$8,748,010	$0	$0	$298,010	$298,010
60.02	Relocation of existing households and businesses	$1,000,000	$1,000,000	$0	$133,992	$866,008	$1,000,000
70 - VEHICLES (96)		**$625,544,147**	**$620,587,713**	**$5,321,691**	**$247,348,135**	**$372,781,424**	**$620,129,560**
70.03	Commuter Rail	$589,167,291	$591,340,151	$5,321,691	$246,809,856	$348,215,573	$595,025,429
70.03a	Allocated Contingency	$9,472,924	$5,415,810	$0	$0	$1,272,379	$1,272,379
70.06	Non-revenue vehicles	$8,140,000	$5,067,821	$0	$538,280	$4,529,541	$5,067,821
70.07	Spare parts	$18,763,931	$18,763,931	$0	$0	$18,763,931	$18,763,931
80 - PROFESSIONAL SERVICES (applies to Cats. 10-50)		**$323,793,010**	**$369,025,619**	**$1,967,286**	**$314,944,190**	**$74,394,240**	**$389,338,430**
80.01	Project Development	$130,350	$130,350	$0	$289,233	($158,883)	$130,350
80.02	Engineering (not applicable to Small Starts)	$180,227,311	$216,915,104	$310,150	$199,726,454	$22,503,049	$222,229,503
80.02a	Allocated Contingency	$1,866,000	$190,678	$0	$0	$10,147	$10,147
80.03	Project Management for Design and Construction	$72,029,265	$84,477,704	$966,268	$82,725,176	$19,817,761	$102,542,936
80.03a	Allocated Contingency	$9,388,080	$5,471,844	$0	$0	($0)	($0)
80.04	Construction Administration & Management	$23,677,949	$33,231,038	$675,002	$22,460,794	$15,874,089	$38,334,883
80.04a	Allocated Contingency	$19,537,000	$10,237,847	$0	$0	$5,159,428	$5,159,428
80.05	Professional Liability and other Non-Construction Insurance	$3,500,000	$4,581,851	$0	$4,581,851	$0	$4,581,851
80.06	Legal; Permits; Review Fees by other agencies, cities, etc.	$7,167,275	$8,721,371	$15,866	$5,114,655	$4,714,087	$9,828,742
80.06a	Allocated Contingency	$556,000	$0	$0	$0	$0	$0
80.07	Surveys, Testing, Investigation, Inspection	$3,287,824	$3,418,022	($0)	$46,027	$3,452,754	$3,498,781
80.08	Start up	$1,797,957	$1,021,808	$0	$0	$3,021,808	$3,021,808
80.08a	Allocated Contingency	$628,000	$628,000	$0	$0	($0)	($0)
Subtotal (10 - 80)		**$1,761,052,001**	**$1,823,630,215**	**$22,420,678**	**$1,062,374,832**	**$808,061,306**	**$1,870,436,138**
90	**UNALLOCATED CONTINGENCY**	**$162,620,295**	**$97,142,081**	**$0**	**$0**	**$50,336,158**	**$50,336,158**
Subtotal (10 - 90)		**$1,923,672,296**	**$1,920,772,296**	**$22,420,678**	**$1,062,374,832**	**$858,397,464**	**$1,920,772,296**
100	**FINANCE CHARGES**	**$6,998,638**	**$9,898,638**	**$214,979**	**$6,968,922**	**$2,929,716**	**$9,898,638**
Total Project Cost (10 - 100)		**$1,930,670,934**	**$1,930,670,934**	**$22,635,657**	**$1,069,343,754**	**$861,327,180**	**$1,930,670,934**

The key challenge in estimating the final project cost is to evaluate change orders that are likely to occur between now and the end of the project. PCEP reports future potential change orders in two different reports. The PCEP Trend Update Report presents identified potential change orders (trends) and credits with a rough order of magnitude cost attached to each trend or credit. As of October 2020, the total trend value was ($12.1M), representing a net credit to PCEP, largely due to an anticipated PG&E reimbursement of $25.6 million for PCEP prepaid substation improvement costs based on an agreed cost allocation formula. The PMOC recognizes that trend change orders likely represent only a small fraction of the remaining project risk.

5.2 SCC Cost Assessment

This section provides the PMOC's detailed review of each SCC category and an assessment of the level of cost risk associated with each. Costs are presented in year of expenditure (YOE) dollars excluding contingency.

5.2.1 SCC 10 – Guideway and Track Elements

The primary cost in SCC 10 is SCC 10.07 Underground Tunnel, which had an estimated total cost of $8.1 million in the FFGA and has a current estimate at completion of $25.6 million. Expenditure to date is $24.9 million, and the work is substantially complete. There is little remaining risk for SCC 10.

5.2.2 SCC 30 Support Facilities

The scope for SCC 30 was to modify an existing maintenance facility to service the EMU vehicles and provide electrified track to reach the facility. The contractor encountered a variety of unexpected conditions, including utilities, during construction. The unexpected conditions coupled with a higher than anticipated contract price resulted in an increase in costs from $2.3 million in the FFGA to the current estimate at completion of $8.4 million, representing an increase of $6.1 million. The cost to date is approximately $6.1 million, leaving approximately $2.3 million of remaining work. Based on the history of significant change orders, the PMOC anticipates that this is a high-risk scope item, and a higher-than-normal beta factor should be assigned to the remaining work.

5.2.3 SCC 40 – Sitework and Special Conditions

The scope for SCC 40 includes the majority of civil work for the project including demolition, site utilities, hazardous material management, environmental mitigation, and indirect cost during construction. The original FFGA budget was $255.1 million including approximately $46 million of allocated contingency. The estimate at completion is $263.0 million, representing a cost overrun at completion of approximately $7.9 million. The PCEP anticipates assigning all allocated contingency for this work.

The cost to date is $208.9 million, and the estimate to complete is $54.1 million. Major change orders occurred on SCC 40.01 Demolition, SCC 40.02 Site Utilities, SCC 40.03 Hazardous Material, SCC 40.06 Pedestrian Bike Access, and SCC 40.08 Temporary Facilities and Other Indirect Costs. The majority of change orders in SCC 40 are associated with differing site conditions primarily related to unexpected utilities and other objects, and the presence of unanticipated hazardous material, which resulted in large cost increases for demolition and site utility work. SCC 40 also includes costs associated with improvements made by PG&E to its FMC and East Grand Avenue substations to provide service to the PCEP. The PMOC anticipates that there is greater than normal risk for the remaining $54.1 million of work, primarily because we anticipate that additional hazardous material will be uncovered in the remaining project segments, and additional unanticipated utilities and/or other conditions will be discovered requiring costly redesign of the catenary poles and potentially

relocation of already installed infrastructure. The PMOC recommends assigning a higher-than-normal beta factor to the remaining work.

5.2.4 SCC 50 – Systems

The scope for SCC 50 includes train control and signals, traffic signals and crossing protection, traction power supply, catenary, communications and central control. The original FFGA budget was $504.4 million, including approximately $52.6 million of allocated contingency. The estimate at completion is $525.8 million, representing a cost overrun at completion of approximately $21.4 million. The PCEP anticipates assigning all allocated contingency for this work.

The cost to date is $238.7 million, and the estimate to complete is $287.1 million. Major change orders occurred on SCC 50.01 Signals, SCC 50.03 Traction Power Supply, and SCC 50.04 Traction Power Distribution. PCEP shows zero cost at completion for SCC 50.02 Traffic Signals and SCC 50.07 Central Control. The PMOC assumes that the costs for traffic signals were reallocated to another SCC code.

The majority of change orders in SCC 50 are associated with difficulty designing and installing the two-speed check (2SC) grade crossing warning solution which impacted installation of signals. There were also major challenges associated with installation of interconnections between PG&E's substations and traction power substations 1 and 2, including difficulty obtaining the required easements.

The PMOC anticipates that SCC 50 poses the greatest potential cost risk to the completion of the project. In addition to the discrete risks discussed in Section 6.1.1, SCC 50 carries higher than normal risk associated with difficulty obtaining long lead time items such as signal bungalows and switchgear, software integration for train control and signals, and overall SCADA integration. The PMOC recommends assigning significantly higher than normal beta factors for the remaining SCC 50 work.

5.2.5 SCC 60 – Real Estate

The scope for SCC 60 includes purchase and lease of real estate and easements, and relocation of existing businesses. The original FFGA budget was $35.7 million including approximately $8.8 million of allocated contingency. The estimate at completion is $35.7 million, indicating that this SCC section should complete within budget.

The cost to date is $21.4 million, and the estimate to complete is $14.3 million. SCC 60.01, purchase of real estate, has consumed essentially all of the assigned allocated contingency; however, PCEP reports that the work should complete within budget. The PMOC understands that the major remaining potential cost for real estate relates to the acquisition of two parcels in Segments 1 and 2 that are in common ownership. This acquisition is needed for installation of OCS poles and a signal bungalow and involves a foreign owner. A further complication is the JPB's lack of eminent domain authority for property acquisitions within the City and County of San Francisco, which is a portion of Segment 1. The JPB reports that the seller is generally agreeable to the transaction but has not yet responded to the agency's offer. Therefore, this particular transaction poses both cost and schedule risk. Additional cost is also expected related to the acquisition of an easement for installation of the PG&E interconnection between its East Grand Avenue substation and the JPB's TPSS #1. The JPB reports that more of the interconnection will now be placed underground instead of overhead as originally planned, thus resolving the property owner's concerns. This solution will involve installing an additional approximately 1000 feet of underground cable rather than overhead wire. Assuming that this change is made, the PMOC anticipates that there is low risk for the remaining SCC 60 work.

5.2.6 SCC 70 – Commuter Rail Vehicles

The scope for SCC 70 is primarily the purchase of 96 electric train units, associated spare parts and non-revenue vehicles as well as Management Oversight and support by TransitAmerica Systems, Inc. (TASI), Caltrain's contract operator. The original FFGA budget was $625.5 million, including approximately $9.5 million of allocated contingency. The estimate at completion is $620.1 million, indicating an expected underrun of approximately $5.4 million for SCC 70.

The cost to date is $247.3 million and the estimate to complete is $372.8 million. There has been approximately $5.9 million of change orders to date for the vehicles, which represents a favorable trend. The PMOC understands that the supplier of the vehicles (Stadler) is anxious to demonstrate the ability to deliver the vehicles within budget, apparently because this is a large initial order in the United States for the supplier. The PMOC understands that the vehicles will be delivered later than planned, partially due to the impact of the COVID-19 pandemic, however, likely within budget for reasons as noted. The PMOC observes that a similar situation occurred recently regarding the delivery of Type 9 light rail vehicles in Boston. The supplier (CAF) delivered the vehicles approximately 3 years late, but with virtually no change orders, likely due to a desire on the part of the supplier to demonstrate their capability to control budget.

5.2.7 SCC 80 – Professional Services

The scope for SCC 80 is professional services including design and engineering, project management, construction administration, legal, permitting, survey, testing, inspection, and startup costs. The original FFGA budget was $323.8 million, including approximately $32.0 million of allocated contingency. The estimate at completion is $389.3 million, indicating an expected overrun of approximately $65.5 million for SCC 80, which will consume all remaining allocated contingency.

The cost to date is $314.9 million, and the estimate to complete is $74.4 million. Major change orders occurred in SCC 80.02 Engineering, SCC 80.03 Project Management, SCC 80.04 Construction Administration, SCC 80.06 Legal and Permits, and SCC 80.0 Startup.

The PMOC anticipates that the major cost risk to SCC 80 going forward is the cost of project delay, which will require additional Agency cost for management, testing and inspection, and the potential for additional design cost due to the problems associated with differing site conditions affecting the OCS, traction power and the 2SC solution. The PMOC recommends assigning a higher-than-normal beta factor to the remaining SCC 80 work.

5.2.8 SCC 90 – Unallocated Contingency

The PMOC evaluates unallocated and allocated contingency as part of the overall risk analysis for the project.

5.2.9 SCC 100 – Finance Charges

The PMOC did not review finance charges for the project.

5.3 Stripped and Adjusted Cost Estimate

The PMOC started with the PCEP Appendix D cost report through December 2020. The PMOC removed all contingency from the estimate to arrive at a stripped budget estimate in SCC format for the project. The PMOC did not make any adjustments to the cost estimate and the PMOC accepts the PCEP estimate at completion as a fair and reasonable representation of the cost at completion including negotiated and pending change orders. The stripped and adjusted estimate at completion for the project excluding finance charges totals $1.856 billion. The PCEP estimate at completion for finance charges is $9.9 million, which was not reviewed by the PMOC as part of this report.

Table 8 - Stripped Cost Estimate

	Description of Work	FFGA Grant Budget	Approved Budget with Approved CCOs	Cost To Date	Estimate At Completion
10 - GUIDEWAY & TRACK ELEMENTS		**$14,256,739**	**$27,353,871**	**$24,997,834**	**$28,080,095**
10.02	Guideway: At-grade semi-exclusive (allows cross-traffic)	$2,500,000	$2,500,000	$144,681	$2,500,000
10.07	Guideway: Underground tunnel	$8,110,649	$24,853,871	$24,853,153	$25,580,095
10.07a	Allocated Contingency	$3,646,090	$0	$0	$0
30 - SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS		**$2,265,200**	**$7,368,343**	**$6,096,007**	**$8,407,183**
30.03	Heavy Maintenance Facility	$1,344,000	$7,368,343	$6,096,007	$8,407,183
30.03a	Allocated Contingency	$421,200	$0	$0	$0
30.05	Yard and Yard Track	$500,000	$0	$0	$0
40 - SITEWORK & SPECIAL CONDITIONS		**$255,072,402**	**$258,632,656**	**$208,898,638**	**$258,664,255**
40.01	Demolition, Clearing, Earthwork	$3,077,685	$10,110,000	$7,416,500	$10,140,000
40.02	Site Utilities, Utility Relocation	$62,192,517	$97,315,387	$104,570,056	$99,123,945
40.02a	Allocated Contingency	$25,862,000	($0)	$0	($0)
40.03	Haz. mat'l, contam'd soil removal/mitigation, ground water treatments	$2,200,000	$8,744,961	$6,502,293	$8,751,934
40.04	Environmental mitigation, e.g. wetlands, historic/archeologic, parks	$32,579,208	$19,504,208	$2,189,370	$19,504,208
40.05	Site structures including retaining walls, sound walls	$568,188	$0	$0	$0
40.06	Pedestrian / bike access and accommodation, landscaping	$804,933	$2,735,000	$0	$2,735,000
40.07	Automobile, bus, van accessways including roads, parking lots	$284,094	$0	$0	$0
40.08	Temporary Facilities and other indirect costs during construction	$107,343,777	$99,613,100	$88,220,420	$118,409,168
40.08a	Allocated Contingency	$20,160,000	$20,610,000	$0	$0
50 - SYSTEMS		**$504,445,419**	**$504,986,928**	**$238,683,669**	**$522,524,218**
50.01	Train control and signals	$97,589,149	$120,086,712	$44,909,935	$121,358,038
50.01a	Allocated Contingency	$1,651,000	$0	$0	$0
50.02	Traffic signals and crossing protection	$23,879,905	($0)	$0	($0)
50.02a	Allocated Contingency	$1,140,000	$1,140,000	$0	$0
50.03	Traction power supply: substations	$69,120,009	$102,977,235	$50,096,142	$104,139,625
50.03a	Allocated Contingency	$31,755,013	$2,990,895	$0	$0
50.04	Traction power distribution: catenary and third rail	$253,683,045	$268,126,899	$143,619,603	$291,479,555
50.04a	Allocated Contingency	$18,064,000	$4,100,188	$0	$0
50.05	Communications	$5,455,000	$5,547,000	$57,989	$5,547,000
50.07	Central Control	$2,090,298	$0	$0	$0
50.07a	Allocated Contingency	$18,000	$18,000	$0	$0
60 - ROW, LAND, EXISTING IMPROVEMENTS		**$35,675,084**	**$35,675,084**	**$21,406,359**	**$35,377,074**
60.01	Purchase or lease of real estate	$25,927,074	$25,927,074	$21,272,367	$34,377,074
60.01a	Allocated Contingency	$8,748,010	$8,748,010	$0	$0
60.02	Relocation of existing households and businesses	$1,000,000	$1,000,000	$133,992	$1,000,000
70 - VEHICLES (96)		**$625,544,147**	**$620,587,713**	**$247,348,135**	**$618,857,181**
70.03	Commuter Rail	$589,167,291	$591,340,151	$246,809,856	$595,025,429
70.03a	Allocated Contingency	$9,472,924	$5,415,810	$0	$0
70.06	Non-revenue vehicles	$8,140,000	$5,067,821	$538,280	$5,067,821
70.07	Spare parts	$18,763,931	$18,763,931	$0	$18,763,931
80 - PROFESSIONAL SERVICES (applies to Cats. 10-50)		**$323,793,010**	**$369,025,619**	**$314,944,190**	**$384,168,855**
80.01	Project Development	$130,350	$130,350	$289,233	$130,350
80.02	Engineering (not applicable to Small Starts)	$180,227,311	$216,915,104	$199,726,454	$222,229,503
80.02a	Allocated Contingency	$1,866,000	$190,678	$0	$0
80.03	Project Management for Design and Construction	$72,029,265	$84,477,704	$82,725,176	$102,542,936
80.03a	Allocated Contingency	$9,388,080	$5,471,844	$0	$0
80.04	Construction Administration & Management	$23,677,949	$33,231,038	$22,460,794	$38,334,883
80.04a	Allocated Contingency	$19,537,000	$10,237,847	$0	$0
80.05	Professional Liability and other Non-Construction Insurance	$3,500,000	$4,581,851	$4,581,851	$4,581,851
80.06	Legal; Permits; Review Fees by other agencies, cities, etc.	$7,167,275	$8,721,371	$5,114,655	$9,828,742
80.06a	Allocated Contingency	$556,000	$0	$0	$0
80.07	Surveys, Testing, Investigation, Inspection	$3,287,824	$3,418,022	$46,027	$3,498,781
80.08	Start up	$1,797,957	$1,021,808	$0	$3,021,808
80.08a	Allocated Contingency	$628,000	$628,000	$0	$0
Subtotal (10 - 80)		**$1,761,052,001**	**$1,823,630,215**	**$1,062,374,832**	**$1,856,078,862**
90	**UNALLOCATED CONTINGENCY**	**$162,620,295**	**$97,142,081**	**$0**	**$0**
Subtotal (10 - 90)		**$1,923,672,296**	**$1,920,772,296**	**$1,062,374,832**	**$1,856,078,862**
100	**FINANCE CHARGES**	**$6,998,638**	**$9,898,638**	**$6,968,922**	**$9,898,638**
Total Project Cost (10 - 100)		**$1,930,670,934**	**$1,930,670,934**	**$1,069,343,754**	**$1,865,977,500**

The PMOC emphasizes that the estimate at completion does NOT include future realized risk in the form of potential change orders. The PMOC also notes that the estimate at completion is based on PCEP assumptions about the size of pending change orders which may over or underestimate the final negotiated value of the change orders. The stripped and adjusted estimate is shown in Table 8.

5.4 Escalation

The PMOC recommends applying an escalation factor of 3 percent per year to delay costs. Because the contracts are already negotiated, no escalation is necessary for work already under contract.

5.5 Direct Cost Adjustments

The FFGA budget for the PCEP is $1,924 million (without finance charges), including a contingency of $316 million, yielding a contingency-free FFGA budget of $1,608 million.

Estimate-At-Completion (EAC): PCEP's latest Estimate-At-Completion contingency-free amount is $1,856 million, excluding finance charges. The PMOC has included a direct cost adjustment of $248 million to account for this cost growth.

In addition to the above EAC cost growth, the PMOC notes that there are several additional issues that are noted as risks in the PCEP Risk Register, which are encumbered costs that must be accounted for in establishing the base estimate before completing the PCEP cost risk analysis. These issues are discussed below.

The January 22, 2021 risk register presents (82) risks graded from 1 (low) to 5 (significant); the top ten risks are presented in Appendix E. The monetary range of the JPB's Cost Risk designations is as follows:

- Low: less than $500,000
- Medium: $500,000 - $2 million
- High: $2 million - $10 Million
- Very High: $10 million - $20 million
- Significant: $20 million - $50 million

The PMOC notes that the upper bound for a significant cost risk is $50 million, and there is an expectation that the actual cost of a significant risk could exceed the upper bound.

Two Speed Check (2SC) Design Impacts: The largest cost risk is #314 - *The contractor may not complete signal and communication design, installation and testing for the two-speed check (2SC) modifications within budget and schedule.* This risk is presented as a very high probability and a significant cost risk. PCEP is currently negotiating resolution of both a direct cost and time-related overhead cost due to a schedule extension. The PMOC has included a direct cost adjustment of $50 million for this issue based on the JPB's cost risk designation. Associated time-related overhead cost is evaluated in Section 5.6.

Differing Site Conditions at OCS Pole Foundations: Risk 303 - *Differing site conditions* is presented as a very high probability, very high-cost risk. The PMOC understands that the Electrification contractor encountered poor soil conditions in Segment 1 that may generate differing site condition claims for the installation of some portion of the remaining approximately 1000 catenary pole foundations. The PMOC notes that PCEP has already issued numerous change orders for previous differing site conditions that impacted catenary pole foundation installation. The PMOC has included a direct cost adjustment of $15 million for this issue based on its assessment of the JPB's cost risk designation.

Design Change for TPSS 1: PCEP presented a revised design for the provision of high voltage power to TPSS #1. The new design installs approximately 1000 additional feet of underground cable in duct bank rather than as overhead wire. The PMOC anticipates that the design change is likely to result in a cost to PCEP of perhaps $2,000 per foot for the ductbank and cable, or approximately $2M. A portion of the cost may be offset by a reduction in the cost of the overhead conductors and

poles and the cost of the easement that were previously planned for the alignment. The PMOC has included a direct cost adjustment of $2 million for this issue.

5.6 Time-Related Overhead (TRO) Cost Adjustments

Project completion is delayed beyond the FFGA FCD of August 22, 2022. Nine hundred twenty-five (925) calendar days remain from the original data date of PCEP's current cost projection of December 31, 2020 to the PCEP's currently forecasted FCD of July 14, 2023. Based on its schedule risk analysis presented in Section 6.3, the PMOC recommends the project plan for an FCD of September 26, 2024. Delay beyond the currently forecasted FCD is most likely to impact contractor overhead of SCC 10 – 50 costs and additional delay costs associated with professional services in SCC 80.

Design-build Contractor Time-Related Overhead: In order to estimate the time-related overhead costs of contractor delay, the PMOC has assumed that 20% of the FFGA budgeted cost (without contingency) less SCC 40.08 ($107M) is a reasonable estimate for contractor overhead. When divided by the Change Order 2 (Electrification contract) duration of 1148 days (37.7 mos.) from June 19, 2017 until August 10, 2020, the overhead cost of construction delay is approximately $99 thousand per day, or about $36.0 million per year. Change Order 2 was issued to BBII in early 2018 to address the delayed issuance of a full Notice to Proceed (NTP) following the later than expected award of the FFGA, and the resulting impact to BBII's contract schedule.

BBII submitted a claim in February 2019 on behalf of its signals subcontractor for direct cost and time-related impacts resulting from the change in the grade crossing warning system. The JPB denied the claim and BBII subsequently submitted a Change Order Request on behalf of itself and the signals subcontractor. Based on the documentation provided by BBII, the length of the CWT 2SC delay is characterized as 1092 days (37.7 mos.), ending on August 7, 2023. When inflated at 3% per annum, yielding an inflation factor of 1.05, the PMOC calculates and has included a cost adjustment of $113 million to SCC 40.08 for this issue. The PMOC used conservative assumptions related to the outcome of the CWT 2SC dispute. The PMOC recognizes that this dispute has not been adjudicated, responsibility for delays have not been assigned to either party and the resultant costs have not been determined.

Beyond the CWT 2SC delay end date of August 7, 2023, an additional 416 calendar days are required to reach the PMOC recommended FCD of September 26, 2024. When inflated at 3% per annum, yielding an inflation factor of 1.06, the PMOC calculates and has included a cost adjustment of $44 million to SCC 40.08 for this issue.

Professional Services Time-Related Overhead: As of December 31, 2020, the JPB has budgeted professional services through February 28, 2023, a period of 789 days (25.9 mos.). Time-related professional services costs include SCCs 80.02-04 and 80.06-08 which have a remaining forecasted cost of $69.4 million without contingency, yielding $88 thousand per day, or approximately $32.1million per year.

The PMOC projects that the PCEP will incur 576 days (18.9 mos.) of additional costs for professional services, spanning from the current budgeted end date of February 28, 2023 to the PMOC recommended p65 date of September 26, 2024. When inflated at 3% per annum, yielding an inflation factor of 1.02, the PMOC calculates, and has included a cost adjustment of $52 million for this issue, applied as follows:

- SCC 80.02 $ 16.815 million
- SCC 80.03 $ 14.809 million
- SCC 80.04 $ 11.862 million

- SCC 80.06 $ 3.523 million
- SCC 80.07 $ 2.580 million
- SCC 80.08 $ 2.258 million

5.7 Project Cost Conclusions

In summary, the PMOC has made several cost adjustments to the FFGA budget as summarized in Table 9, resulting in an adjusted base cost estimate of $2,132 million.

Table 9 - Adjusted Base Cost Estimate Summary

FFGA Budget w/o Contingency	**$1,608M**
PCEP EAC Adjustment	$248M
OCS Foundations contractor time & direct cost	$15M
TPSS 1 Interconnect design change	$2M
CWT 2SC contractor TRO (TIA-2) and direct cost	$163M
PMOC schedule p65 contractor TRO and prof. services	$96M
Adjusted Base Cost Estimate w/o Contingency	**$2,132M**

The PMOC concludes that the PCEP has experienced significantly greater than normal cost exposure to date and will continue to experience risk for the remaining work. Section 6.4 of this report evaluates the expected magnitude of the remaining cost risk to the project.

6 PROJECT RISK ANALYSIS

The PMOC performed a project risk refresh in accordance with FTA OP 40c - Risk and Contingency Review to assess the reliability of the JPB's current cost and schedule projections for completion of the PCEP.

The PMOC evaluated JPB's process for identification of uncertainties and risks, assessed project risk, and took into consideration risk response options and alternatives, including the use of schedule and cost contingencies. The PMOC relied on JPB's development of its risk and contingency processes, including its own internal risk identification, and other elements described in its Project Management Plan (PMP).

This report is based on information provided by the JPB that was current as of December 31, 2020 and selected additional information of later date as noted. The project risk review follows the methodology indicated in OP40c.

NOTE: The risk refresh activities described in this report did not consider the cost and schedule implications of the COVID-19 pandemic on the PCEP except as specifically noted. COVID-19 pandemic related impacts of an unspecified nature may be experienced by this project but were not evaluated due to the unknowable nature of these potential impacts.

6.1 Methodology

The PMOC methodology for the risk review was as follows:

- Study results of scope, cost, and schedule reviews;
- Review the results from the JPB's April 1, 2020 Risk Refresh and subsequent schedule risk assessment;

- Review the project sponsor's Risk Identification and Management Plan (RIMP);
- Review the PCEP Contingency Management Plan which is part of the Project Controls Plan;
- Conduct a risk workshop with the project sponsor on December 8, 10, 15, and 17, 2020;
- Assess schedule risk based on FTA standards;
- Adjust the project sponsor estimate based on currently available project information and evaluation of likely project outcomes; and
- Model project cost risk using FTA's top-down model.

6.2 Risk Identification

Key PCEP risks were reviewed during the December 2020 risk workshops, and additional risks discussed. Several key risks were identified and noted below. The PMOC reviewed the PCEP's updated risk register (dated January 2021) and found that the PCEP has been diligent in its efforts to track and revise its risk register through internal project risk tracking processes.

6.2.1 Key Project Risks

Significant risks from the latest version of the PCEP risk register are summarized below and more detail may be found in Appendix E.

- Resolution of cost and schedule extension impacts related to the Two Speed Check (2SC) grade crossing warning system modifications.
- Differing site conditions have and continue to affect the design and construction of OCS pole foundations, leading to additional direct and time-related overhead costs, with potential to further delay the progress of this work.
- Additional property acquisition is necessitated by changes in design.

6.2.2 Risk Identification Summary

The PCEP risk management process is well-integrated into its project management process and is developed to complement the JPB's Monte Carlo risk process and contingency management. The risk register is being actively used for tracking and managing the impact and mitigation for potential risk events.

6.3 Schedule Risk Analysis

The PMOC assessed the MPS in accordance with FTA OP 40(c) - Risk and Contingency Review (dated September 2019).

6.3.1 Introduction

This risk analysis focuses on the elements of schedule uncertainty associated with the completion of the PCEP and efficiency of PCEP implementation, the project scope, and surrounding project conditions.

The PMOC used Oracle's "Primavera Risk Analysis" (PRA) software program. The PMOC risk analysis process conforms to the software user manual and intent of OP 40(c).

There are two kinds of project schedule risk:

- Uncertainty risks are inherent variability that makes it impossible to predict exactly how long an activity will take.
- Risk events are events separate from an activity that can disrupt or otherwise impact the activity sequence or duration.

PRA handles risk events by utilizing items in the Risk Register to enter potential risk events and estimates of the probability and impact of the risks on activity durations. Once uncertainty and risk event impact estimates have been entered for all tasks within a project, PRA performs a high number of project simulations using "Monte Carlo" sampling of the estimate to select random task durations for every run-through of the simulation. These simulations generate a range of outcomes that can be used to predict project duration with statistical confidence.

The Critical Path Method (CPM) is the traditional means for determining a project finish date. However, because CPM only determines a single date and does not consider potential risks, results are not always reliable. PRA uses risk inputs to determine a range of project finish dates with more confidence and reliability.

6.3.2 Methodology

The PMOC began the risk analysis by conducting a review and evaluation of all risks in the Project Risk Register to determine which risk events should be used for the schedule risk analysis. Once the risks were culled and prioritized, the PMOC associated the risk events with specific activities in the schedule.

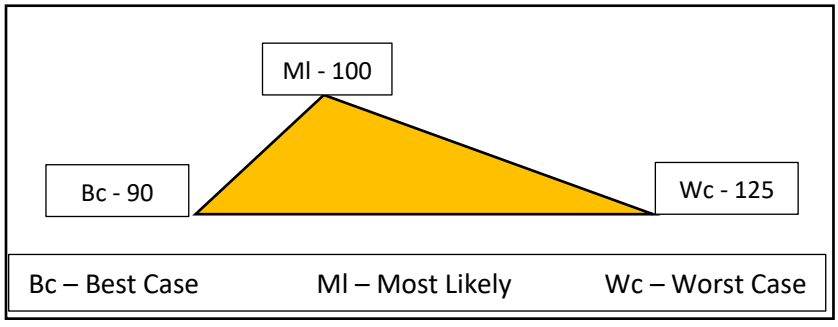
Next, the PMOC assigned three (3) durations to each activity in the schedule. The three (3) durations for each activity represent best-case "minimum," most likely, and worst-case "maximum." The PMOC reviewed the original and remaining duration for each activity in the stripped MPS and made an objective determination of the adequacy of each duration.

In general, the PMOC assigned two types of duration profiles to each activity as follows.

6.3.2.1 Uncertainty

The PMOC assigned a duration profile of 90% / 100% / 125% to most activities to account for normal variability which considers latent contingency and the potential for the activity to overrun as seen in Figure 1.

Figure 1 - Duration Distribution for Most Activities



6.3.2.2 Adjustments for Project Specific Risk Events

The PMOC assigned duration profiles of 75% - 90% / 100% / 150% - 400% to activities associated with very low to very high schedule risks from the risk register and activities that the PMOC thought were optimistic in duration. Examples of these activities are found in Table 10.

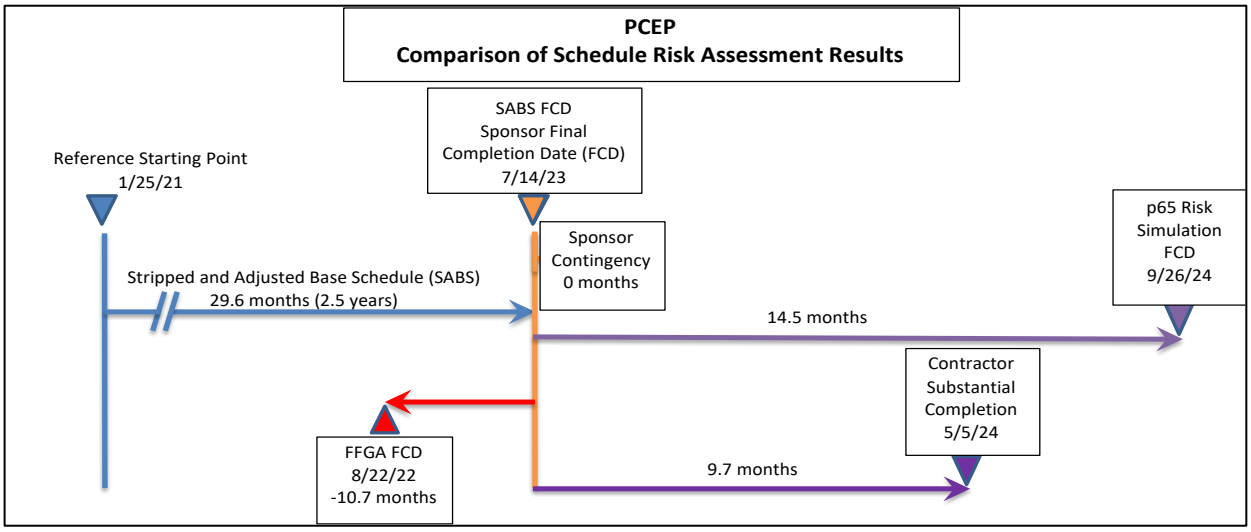
Table 10 - Duration Profile Associated with Project Risks

Activity	Description	Duration Profile
PA.ROW.OCS.250	Completion of Acquisition of Bayshore Parcel (S1WA1)	100%/200%/400%
PA.ROW.OCS.230	Completion of Acquisition of TPS-1 Interconnect Parcel (Britannia Gateway) (Seg-2)	100% / 150% / 200%
PA.ROW.OCS.240	Completion of Acquisition of TPS-2 Interconnect Parcel (VTA) (Seg-4)	100% / 150% / 200%
P.SSP.1000	Procure Signal Spare Parts	75% / 100% / 150%
UT-02-4170	FOR 091 - Permanent Signal/Comm Service to TPS1	75% / 100% / 150%
DS-03-50540	Develop 29.77-Signals 297 & 298 Design 95%	75% / 100% / 150%
DS-02-50530	Develop 19.22 - Signals 193 & 194 Design 65%	75% / 100% / 150%
CWT-01-1023	Manufacture/Wire 1.70 - Signals 16-1 & 16-2 (CWT-2S Updates)	75% / 100% / 150%
SG-01-15635	Install Signal Cable-2.89 - Signals 27 & 28	75% / 100% / 150%
SG-01-15605	Install Foundations-2.89 - Signals 27 & 28	75% / 100% / 150%
SG-01-15540	Install Foundations-1.70 - Signals 16-1 & 16-2	75% / 100% / 150%
PM-01-15845	Procure Signal Equipment -7.52 EC Repeater	75% / 100% / 150%
SG-01-15480	Install / Pretest Misc. Signal Equipment Kit-1.16 - Signals 11-1 & 11-2	75% / 100% / 150%

6.3.3 Schedule Risk Model Results

Once all the activities were assigned their duration distribution, the PMOC ran the model and generated a confidence level histogram. The Impacted Risk Model (IRM) performed 1,000 simulations, selecting random durations with the duration distribution for each task, to estimate the project completion date within a confidence range. This analysis yields the results shown in Figure 2.

Figure 2 - Comparison of Schedule Risk Analysis Results

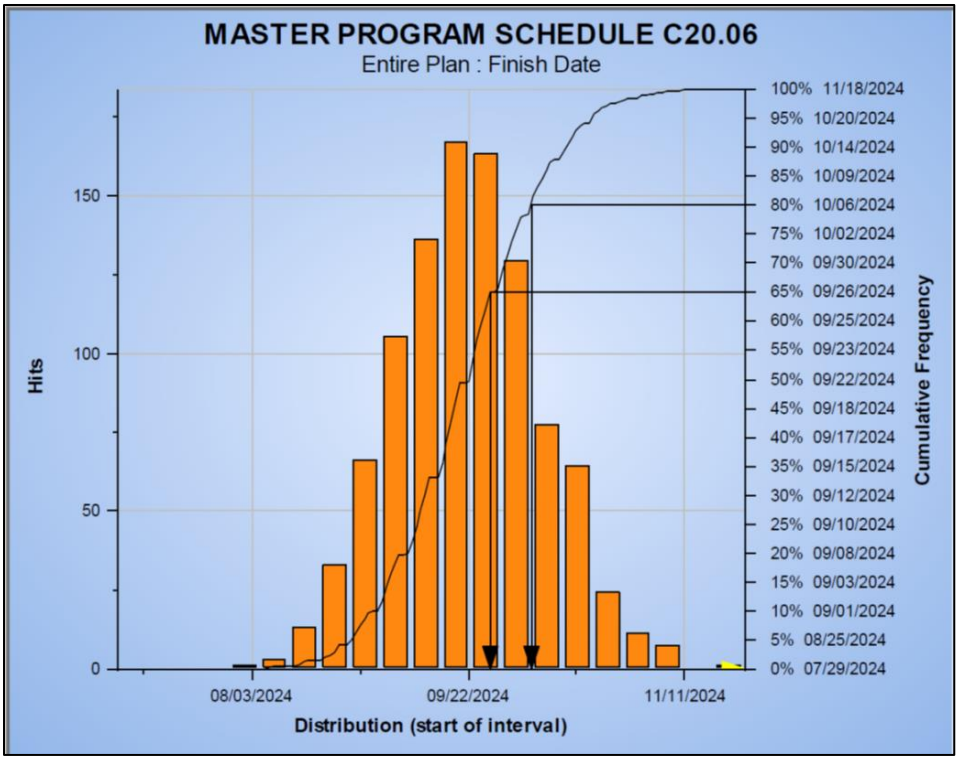


The Impacted Risk Model (IRM) distribution range for the Project's completion ranges from the 0% to 100% confidence levels and spans a 112-calendar day period. The probability percentage points, also referred to as p-values, are indicated below and shown in **Error! Reference source not found.**.

- PCEP forecast FCD: July 14, 2023
- 50% confidence level (p50) completion date: September 22, 2024
- 65% confidence level (p65) completion date: September 26, 2024
- 80% confidence level (p80) completion date: October 6, 2024

OP 40(c) states that a confidence level of at least 65% (p65) of reaching the proposed FCD is recommended. The modeled FCD is calculated to be September 26, 2024, at a p65 confidence level, which is 14.5 months later than PCEP's estimated FCD of July 14, 2023.

Figure 3 – Project Completion Date Confidence Level Histogram



For added perspective, the PMOC ran the IRM to obtain an indication of the sensitivity of the project duration for each risk event. For clarification, a risk event with a very high score does not necessarily mean that it will be highly sensitive to the schedule, as it may only affect non-critical activities. The analysis produced a Tornado Chart, which prioritizes the schedule activities with the greatest schedule risk from highest to lowest. The schedule drivers that contain the most impact potential, contain a high-risk degree, and are on the longest critical path, or near critical path, are work associated with the TPSS-2, Segment 3 signals, and finally, Segment 3 material procurement, potholing, and foundations for the OCS scope of work.

6.3.4 Schedule Contingency Analysis Results

The PCEP has exhausted all schedule contingency.

6.3.5 Schedule Risk Conclusions

The target FCD for the PCEP project before the risk workshop was July 14, 2023, which included no patent project contingency per the JPB's opinion. This target FCD differs from the Electrification D-B contractor's opinion which projects that substantial completion of its contract will occur on May 5, 2024.

Following FTA OP40(c) guidelines, the PMOC calculated the RSD using Oracle's PRA software program, which uses a Monte Carlo approach for analysis of the data. A histogram was produced with various confidence levels for completion dates. At the 65% confidence level, the FCD is September 26, 2024; at the 80% confidence level the FCD is October 6, 2024; and at the 90% confidence level the RSD is October 14, 2024.

- **PMOC Recommendation No. 8**: - The JPB should use the P65 confidence level date, which would result in an FCD of September 26, 2024. This FCD would add 14.5 months of duration to the PCEP's current FCD used for this risk report.

6.4 Cost Risk and Contingency Analysis

6.4.1 Adjustments to FFGA Budget

The PMOC used its professional judgment, as well as evaluation of objective data, to develop its assessment of the project costs and to develop a stripped and adjusted cost estimate. Sections 5.4 and 5.6 of this report discuss several adjustments to the stripped FFGA budget of $1,608 million, which yields an adjusted base estimate, stripped of contingencies, of $2,131 million.

6.4.2 PMOC Cost Risk Modeling

The PMOC developed an assessment of remaining cost risk using principles described in its OP40 guidance and using the FTA cost risk model, using the PMOC stripped and adjusted estimate as described in Section 6.4.1. The project risk was modeled based on the percentage completion of the detailed level of the SCCs, using Cost-To-Date as a function of Estimate-At-Completion.

Standard risk (beta) factors were applied and modified in accordance with the design and construction progression noted above. Exceptions for high-risk SCCs were made as follows, based on issues noted in Section 5.2. The following adjustments were made by increasing the standard Construction risk factor by 50%:

- SCC 30.03 Heavy Maintenance Facility
- SCC 40.01 Demolition, Clearing, Earthwork
- SCC 40.03 Haz. Material, contaminated soil removal/mitigation, ground water treatments.

The risks noted in Section 6.2.1 above have been considered in terms of the need for special line-item cost risk model factor adjustments, and it is the PMOC opinion that the risk factors as described

and adjusted above, and in consideration of the PMOC direct and time-related cost adjustments, are sufficient to provide adequate contingency for protection of the PCEP project.

The resulting cost risk analysis finds the likely outcome, without finance costs, of the PCEP project estimate as follows, and as noted in Table 11.

- PCEP EAC: $ 1,921 million
- 50% confidence level (p50): $ 2,223 million
- 65% confidence level (p65): $ 2,254 million
- 80% confidence level (p80): $ 2,294 million

Table 11 - PMOC Cost Risk Analysis Results

YOE Risk Assessment Detail ($,000) SCC 100 Finance Charges not included	
YOE Sponsor values	**Overall**
Sponsor total estimate (SCC 10-90) (0%ile)	**1,923,672**
Sponsor stripped estimate (SCC 10-80)	**1,608,139**
YOE PMOC values	
Direct Cost Adjustments	314,940
Duration Adjustments	207,991
Latent contingency Deduct	0
Adjusted, Inflated estimate	**2,131,070**
FTA target (65%ile)	2,253,759
Contingency recommendation amount in target	122,689
Target contingency %	6%
Risk analysis	
Lower bound	2,131,070
Lower report range value= (40%ile)	**2,205,473**
Median report range value= (50%ile)	2,223,167
Upper mid report range value= (65%ile)	2,253,759
Upper range reporting amount (80%ile)	**2,294,532**
Upper bound	2,594,210

The model results (Table 12) indicate a recommended p65 value for the project at YOE $2,254 million, without finance costs, as compared to the FFGA budget at $1,924 million (at the p0 level), indicating that the current PCEP FFGA budget is approximately $330 million below the modeled p65. Further, the current PCEP Estimate-At-Completion of $1,921 million (at the p0 level) is approximately $333 million below the modeled p65. Table provides a summary of the development of the recommended budget.

Table 12 - Summary Recommended Budget Development

FFGA Budget w/o Contingency	**$1,608M**
PCEP EAC Adjustment	$248M
OCS Foundations contractor time & direct cost	$15M
TPSS 1 Interconnect design change	$2M
CWT 2SC contractor TRO (TIA-2) and direct cost	$163M
PMOC schedule p65 contractor TRO and prof. services	$96M
Adjusted Base Cost Estimate w/o Contingency	**$2,131M**
Modeled risk-based contingency	$123M
Total Recommended Budget	**$2,254M**

- **PMOC Recommendation No. 9: -** The PMOC recommends that JPB adjust its PCEP budget, exclusive of finance costs, to the p65 value of YOE $2,254 million.

6.4.3 Cost Risk and Contingency Conclusion

The FFGA budget, including contingency but without finance costs, is YOE $1,924 million. The modeled recommended budget at the 65th percentile, including the adjusted estimate and contingency, is $2,254 million. The current PCEP FFGA budget and the current PCEP Estimate-At-Completion are modeled at the 0 percentile.

Appendix A List of Acronyms

Acronyms	List of Terms
2SC	Two Speed Check Grade Crossing Approach Warning System
AAR	Association of American Railroads
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ARINC	Aeronautical Radio, Incorporated
ATF	Autotransformer Feeder
ATP	Alternate Technical Proposal
BAAQMD	Bay Area Air Quality Management District
BAFO	Best and Final Offer
BART	Bay Area Rapid Transit District
BBII	Balfour-Beatty Infrastructure, Inc.
BGSP	Broadway Grade Separation Project
BOS	Basis of Schedule
Caltrans	California Department of Transportation
CAR	Corrective Action Request
CBOSS	Communications Based Overlay Signal System
CC	FTA's Core Capacity Improvement Program
CCB	Change Control Board
CCIP	Contractor Controlled Insurance Program
CCSF	City and County of San Francisco
CEL	Certified Elements List
CEMOF	Central Equipment Maintenance and Operations Facility
CEQA	California Environmental Quality Act
CGA	Construction Grant Agreement
CHSRA	California High-Speed Rail Authority
CIG	FTA's Capital Investment Grant Process
CIL	Certifiable Items List
CMB	Change Management Board
CM/GC	Construction Manager/General Contractor
CNPA	Concurrent Non-Project Activity
CO	Change Order
CP	Control Point
CPM	Critical Path Method
CPUC	California Public Utilities Commission
CSCG	City/County Staff Coordinating Group
CWT	Constant Warning Time
D-B	Design-Build
DBB	Design-Bid-Build
DBE	Disadvantaged Business Enterprise
DEIR	Draft Environmental Impact Report
DQP	Design Quality Plan
DRB	Disputes Review Board
DSC	Differing Site Condition
DSDC	Design Support During Construction

DVR	Design Variance Request
EA	Environmental Assessment
EAC	Estimate at Completion
EE	Entry into Engineering
EIR	Environmental Impact Report
EIS	Environmental Impact Study
EMU	Electric Multiple Unit Rail Vehicle
ESZ	Electrical Safety Zone
ETB	Electrified Trolley Buses
FAI	First Article Inspection
FAT	Factory Acceptance Test
FCD	Final Completion Date
FD	Final Design
FEIR	Final Environmental Impact Report
FERC	Federal Energy Regulatory Commission
FFGA	Full Funding Grant Agreement
FLSC	Fire Life Safety Committee
FMOC	Financial Management Oversight Consultant
FMP	Fleet Management Plan
FONSI	Finding of No Significant Impact
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
FWO	First Written Offer
FY	Fiscal Year
GO	General Order (issued by the CPUC)
HSR	High-Speed Rail
ICE	Independent Cost Estimate
I-ETMS	Interoperable Electronic Train Management System
IFB	Invitation for Bids
IFC	Issued for Construction
IGA	Inter-Governmental Agreement
IJ	Insulated Joints
IRM	Impacted Risk Model
Cal ISO	California Independent System Operator
ITCS	Incremental Train Control System
JPB or PCJPB	Peninsula Corridor Joint Powers Board
Jacobs	Jacobs Project Management Company
KKCS	Kal Krishnan Consulting Services, Inc.
LNTP	Limited Notice to Proceed
LONP	Letter of No Prejudice
LPMG	Local Policy Makers Group
MCC	Management Capacity and Capability
MOU	Memorandum of Understanding
MPS	Master Project Schedule
MRS	Modern Railway Systems
MTC	Metropolitan Transportation Commission
NCR	Non-conformance Report

NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NTO	Notice to Owner (for Utility Relocation)
NTP	Notice to Proceed
OCS	Overhead Contact System/Overhead Catenary System
OP	Oversight Procedure
PAP	Palo Alto Power
PCEP	Peninsula Corridor Electrification Program
PCWG	Peninsula Corridor Working Group
PD	Project Development Phase
PG&E	Pacific Gas and Electric
PHA	Preliminary Hazard Assessment
PMOC	Project Management Oversight Contractor
PMP	Project Management Plan
PRA	Primavera Risk Analysis
ProVen	ProVen Management, Inc.
PS	Paralleling Station for Traction Power Supply
PTC	Positive Train Control
PTCSP	Positive Train Control Safety Plan (FRA)
PTG	Parsons Transportation Group
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
QMP	Quality Management Plan
QPRM	Quarterly Progress Review Meeting
RAC	Rail Activation Committee
RAMP	Real Estate Acquisition and Management Plan
RAP	Rail Activation Plan
RE	Resident Engineer
RFA	Request for Amendment
RFI	Request for Information
RFMP	Rail Fleet Management Plan
RFP	Request for Proposal
RIMP	Risk Identification and Mitigation Plan
RON	Resolution of Necessity (for Eminent Domain purposes)
ROW	Right of Way
RSD	Revenue Service Date or Revenue Service Demonstration
RWIC	Roadway Worker in Charge
RWP	Roadway Worker Protection
RWQCB	Regional Water Quality Control Board
SamTrans	San Mateo County Transit District
SCADA	Supervisory Control and Data Acquisition
SCC	Standard Cost Category
SCVTA/VTA	Santa Clara Valley Transportation Authority
SCVWD	Santa Clara Valley Water District
SF	City of San Francisco
SFCTA	San Francisco County Transportation Authority

SFMTA	San Francisco Municipal Transportation Agency
SHPO	State Historic Preservation Office
SJ	City of San Jose
SLC	Salt Lake City
SMCTA	San Mateo County Transportation Authority
SME	Subject Matter Expert
SOGR	State of Good Repair
SONO	Statement of No Objection
SOO	Statement of Objection
SP	Southern Pacific Transportation Company
SSCP	Safety and Security Certification Plan
SSI	Sensitive Security Information
SSMP	Safety and Security Management Plan
SSOA	State Safety Oversight Agency
SSWP	Site Specific Work Plan
SVP	Silicon Valley Power
TAD	Track Access Delay
TASI	Transit America Services, Inc.
TEAM	Transportation Electronic Award Management System
TIA	Time Impact Analysis
TIRCP	Transportation and Intercity Rail Capital Program
TJPA	Transbay Joint Powers Authority
TPF	Traction Power Facility
TPS	Traction Power System
TPSS	Traction Power Substation
TrAMS	Transportation Award Management System
TTCI	Transportation Technology Center, Inc.
TVA	Threat and Vulnerability Analysis
TVM	Transit Vehicle Manufacturer
UPRR	Union Pacific Railroad
USDOT	U. S. Department of Transportation
USFWS	United States Fish and Wildlife Service
VE	Value Engineering
VECP	Value Engineering Change Proposal
VTA	Santa Clara Valley Transportation Authority
WPC	Wayside Power Cabinet
YOE	Year of Expenditure

Appendix B Documents Reviewed

Document	File Name
PCEP Time-based Staffing Plan	Item 5.01 FTA Comp CalMod StaffPlan_by FTE for FY and CY REV 3
PCEP Core Accountability Cost Matrix (including change orders	Core Accountability 202012 (2021.01.21)
PCEP Summary Risk Report	3.&4. Summary Risk Report-20200618-v0 (Draft)
PCEP QPRM No. 15 Presentation Slide Deck	2021-01-26 FTA Quarterly DRAFT4.pdf
PCEP QPRM No. 15 Confidential Appendix	
PCEP Risk Identification and Mitigation Plan-RevD	1. Risk Identification and Mitigation Plan-RevD (clean)
PCEP 2020.10.23 PROGRAM Risk Register	2. 2020.10.23-PMS-RSK-Program Risk Register-FTA Working Copy.xlsx
PCEP 2021.01.22 PCEP Program Risk Register	2021.01.22-PMS-RSK-Program Risk Register Top Risks-Rev0.pdf
PCEP Baseline Cost Estimate Report, Rev 3	1. 2015 12.02 Program Baseline Estimate Report - Rev 3 FINAL - pdf
PCEP Monthly Report Data for Appendix D - SCC Costs and Budget Change Data thru December 2020.	2. PCEP Appendix D SCC Cost Table and Budget Change Data Thru Dec 2020
Original Contract Award Amounts	3.a. Orig Contract Amt 2020_11_16.docx
PCEP Original Contract Award Amounts	3.a. original contract amounts.pdf
PCEP Executed Contract Change Orders	3.b. PCEP-DB- Risk Refresh Report - Exec CCOs.pdf
PCEP Pending Contract Change Orders	3.c. PCEP-DB- Risk Refresh Report - Pending CCOs.pdf
CEMOF Change Order Forecasts	3.c. Proven CEMOF PCEP Change Forecasts Data_2020.11.16 SK Update.xlsx
Tunnel Change Order Forecasts	3.c. Proven Tunnels PCEP Change Forecasts Data_2020.11.02.xlsx
PCEP Trend Log as of October 2020	3.d. PCEP Trend Log as of October 2020_11.10.2020.pdf
PCEP MPS Schedule Basis C.20.05	2020 11.19 C20.05 Schedule Basis.pdf
PCEP MPS Schedule C.20.05	a) C20.05 Program Schedule.xer
PCEP MPS Summary Schedule C.20.05	b) C20.05 Summary Schedule.pdf
PCEP MPS Critical Path Schedule C.20.05	c) C20.05 Critical Path.pdf
PCEP MPS Interface Schedule C.20.05	d) C20.05 Interface Schedule.pdf
PCEP Segment 4 Testing and Commissioning Planning Schedule	e) Segment 4 Testing and Commissioning Planning Schedule.pdf
BBII September 2020 Progress Schedule	f) Balfour September 2020 Progress Schedule.xer
BBII September 2020 Progress Schedule Narrative	g) Balfour September 2020 Progress Schedule Narrative.pdf
BBBII May 2020 Progress Schedule	h) Balfour May 2020 Progress Schedule.xer
Stadler September 2020 Progress Schedule	i) Stadler September 2020 Progress Schedule.xer
PCEP MPS C.20.06 Schedule Basis	2020 11.23 C20.06 Schedule Basis.pdf

Document	File Name
PCEP MPS C.20.06 Schedule	a) C20.06 Program Schedule.xer
PCEP MPS C.20.06 Summary Schedule	b) C20.06 Summary Schedule.pdf
PCEP MPS C.20.06 Critical Path Schedule	c) C20.06 Critical Path.pdf
PCEP MPS C.20.06 Interface Schedule	d) C20.06 Interface Schedule.pdf
PCEP Segment 4 Testing and Commissioning Planning Schedule	e) Segment 4 Testing and Commissioning Planning Schedule.pdf
BBII September 2020 Progress Schedule	f) Balfour September 2020 Progress Schedule.xer
BBII September 2020 Progress Schedule Narrative	g) Balfour September 2020 Progress Schedule Narrative.pdf
BBII May 2020 Progress Schedule	h) Balfour May 2020 Progress Schedule.xer
Stadler October 2020 Progress Schedule	i) Stadler October 2020 Progress Schedule.xer
2020 12.18 C20.06.R1 Schedule Basis.pdf	2020 12.18 C20.06.R1 Schedule Basis.pdf
PCEP MPS C20.06.R1 Schedule	a) C20.06.R1 Master Program Schedule.xer
PCEP MPS C20.06.R1 Summary Schedule	b) C20.06.R1 Summary Schedule.pdf
PCEP MPS C20.06.R1 Critical Path Schedule	c) C20.06.R1 Critical Path.pdf
PCEP MPS C20.06.R1 Interface Schedule	d) C20.06.R1 Interface Schedule.pdf
PCEP Segment 4 Testing and Commissioning Planning Schedule	e) Segment 4 Testing and Commissioning Planning Schedule.pdf
PCEP Contract Change Order Log Sept 2020	1.b. & Cost 3.c. CCO Log from PCEP September 2020 Monthly Progress Report FINAL
PCEP D-B Risk Refresh CCO Log	1.b. PCEP-DB-Risk Refresh Report-CCO Log.xlsx
PCEP Comparison between Cost of Risk Items and Costs Associated with Change Orders, Forecasts and Trends	Comparison between Cost of Risk Items and Costs Associated with Change Orders, Forecasts and Trends.xlsx
PCEP Potential Costs not included in Change Orders, Forecasts, Trends and Risk Register	Potential Costs not included in Change Orders, Forecasts, Trends and Risk Register.docx
PCEP Table of TIA Issues	Table of TIA Issues.xlsx

Appendix C PMOC Team

The preparation of this report was led by the Task Order Manager, **Mike Eidlin**, J.D. (KKCS) who has more than 40 years of complex project management experience including over 28 years in transit. Mr. Eidlin possesses a B.S. degree, a graduate Degree of Engineer, and a Juris Doctor degree. He is a licensed attorney in the State of Oregon. He has been working as a PMOC for 16 years.

David N. Sillars, Ph.D. (Sillars Consulting) contributed to the report and managed the PCEP risk assessment process. Mr. Sillars holds a Ph.D. in Civil Engineering, an M.S. in Management, and a B.S. in Civil Engineering. With over 45 years of direct, progressively responsible building industry experience, including design, development and trade experience, Mr. Sillars specializes in risk and inter-organizational relationships. He has managed risk assessments for the FTA on a variety of projects across the U.S. He is also Associate Professor Emeritus at Oregon State University. Mr. Sillars is a member of the American Society of Civil Engineers (ASCE).

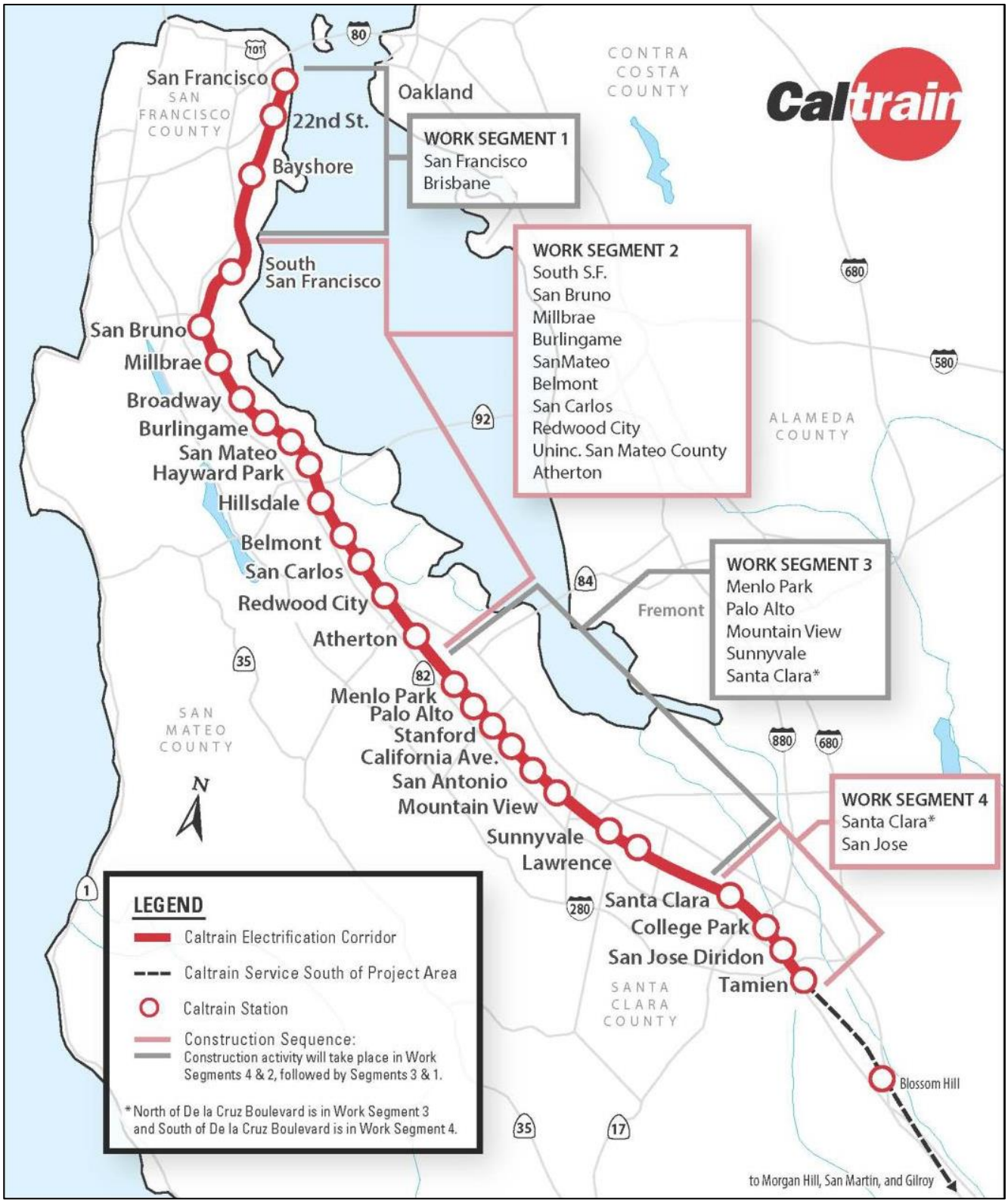
Brett L. Rekola, **P.E.** (KKCS), contributed to the preparation of the report and provided the Quality Assurance (QA) for the report. Mr. Rekola is the Program Manager for KKCS' FTA PMOC prime contract. He is a California professional civil engineer with more than thirty (30) years of experience managing railroad maintenance, planning, and design, construction, and rail operations. He has served as a program manager delivering port/rail/public works projects and programs.

Dan Holzman, P.E., C.C.P. (KKCS) performed the cost review for this assessment. Mr. Holzman possesses a B.S. degree in Environmental Engineering and an M.S. degree in Civil Engineering and is licensed as a Professional Engineer in Massachusetts. He has over 37 years of experience in construction and engineering and is a Certified Cost Professional (CCP).

Kevin Byers, P.S.P. (KKCS) assisted with the report. He is KKCS' Project Scheduling Manager, holds a B.S. degree in Construction Management, and has 29 years' experience in scheduling and claims analysis for railroad and rail transit projects.

The Quality Control (QC) review of this report was done by **Janice Johnson, (KKCS)**, who also serves as the Contracts & Terms Manager. Ms. Johnson has a background in English Studies and over twenty (20) years of experience providing quality review checks of PMOC work products.

Appendix D Project Map



Appendix E PCEP Top Risks (2021.01.22)

Program Risk Register

Version Date: January 22, 2021 - Top Risks

	1	2	3	4	5
	LOW	MEDIUM	HIGH	VERY HIGH	SIGNIFICANT
Probability	< 10%	10% - 50%	50% - 75%	75% - 90%	> 90%
Cost	≤ $500 K	$500 K - $2 M	$2 M - $10 M	$10 M - $20 M	$20 M - $50 M
Schedule	< 1 Month	1 - 3 Months	3 - 6 Months	6 - 12 Months	> 12 Months

ID	RBS FUNC. (P)	RBS FUNC. (S)	RISK DESCRIPTION	EFFECT(S)	TYPE	IMPACT: PROBABILITY	IMPACT: COST	IMPACT: SCHEDULE	PRIORITY: GRADING	OWNER	MITIGATION ACTIONS	RETIREMENT DATE(S)	NOTES	A-C	STATUS & REMARK(S)
314	Elect.	Construction	The contractor may not complete signal and communication design, installation and testing for the Two-speed check (2SC) modifications within budget and schedule.	Delay to integrated testing and operations/revenue service	T	5	5	4	48	DB	1. Streamline design reviews. (In process) 2. Initiate construction prior to IFC. (In process) 3. Consolidate locations for cutover, where possible. (In process) 4. Balfour/WRS has added an additional cutover team (In process)	Completion of Construction	Schedule impact graded against forecast signals completion of Sep 2021 JPB, BB has committed to provide updated design schedule be end of this week, ABT, reevaluate schedule grade at that time. A. Christofes 4/1/2020		Next cutover scheduled for mid-January. Separate team working on cutover 3. Scheduled for mid-February. - S. Cooke 12/2/2020 Regraded per Risk Assessment Committee - 1/12/2021
303	Elect.	Physical Site	Extent of differing site conditions and associated redesign efforts results in delays to the completion of the electrification contract and increases program costs.	Extends construction of design-build contract with associated increase in project costs •DSC design cost •Inefficiencies •Construction costs related to DSCs (i.e., larger foundations) •Additional potholing	T	4	4	3	28	Guan	1. Define process for resolving DSCs to clear locations for foundation installation 2.Develop "playbook" of responses to RFIs associated with responding to DSCs 3. Add additional potholing crews to increase production and deal specifically with DSCs. 4. Organize PCEP staff to expedite responses to RFIs. 5. BBI to empower field supervision to identify and respond to obstacles	Completion of Segment 4	Schedule graded against forecast foundation completion of Dec 2020 - A. Christofes 4/13/2020		1.JPB and BBII continue to have regular working sessions between JPB OE and BBII Field Engineers to resolve conflicts. 2. RSE continues to provide field support on utility locating to help resolve conflicts. 3. BBII will be increase design resources to support re-design required due to DSCs 4. JPB will perform expedited reviews on DCNs to shorten overall cycle of design. 5. BBII will continue to keep stockpile of long cages to deal with DSCs 6. Add weekly foundation schedule meeting to review foundation schedule and outstanding items that may impact the schedule. 7. Add regular workshops led by Assistant RE and OE leads to resolve remaining conflicts. 8. Added bi-weekly meetings with fiber utilities to help resolve difficult to resolve RFIs. Segment 3 and 4 foundations are now complete and the focus has shifted to the Segment 1 and 2 remaining foundations. - L. Guan – 1/4/2021
313	Elect.	Construction	Sub-optimal contractor sequencing, when progressing design and clearing foundation locations may result in construction inefficiencies	Contractor claims for increase in construction and design costs, and reduced production rates extending construction duration	T	5	3	1	20	DB	1. Positively identify known utilities in advance of foundation construction. 2. Pothole foundation locations when all design elements have been taken into consideration including line of sight, adjustment of poles, etc. 3. Conduct workshop with BBI to identify improved productivity. 4. Conduct frequent coordinated meetings between BBI and JPB staff and consultants to address issues on foundation locations and to make timely decisions.	Completion of Segment 4	None		The contractors continue to have issues with conflicts with OCS foundations, with some attributing to the sequencing described in the Risk. - L. Guan 11/16/2020
240	Elect.	ROW	Property not acquired in time for contractor to do work. Property Acquisition not complete per contractor availability date <>Fee <>Easement <>Contract stipulates that if parcels are not available by contract date, there is only a delay if parcels are not available by the time contractor completes the Segment	•Potential delays in construction schedule		3	2	4	18	Fitzpatrick	1. Tie delivery date of each parcel to date work is listed as starting in the segment and work area in which the parcel is located 2. Select time to initiate eminent domain proceedings to avoid delay. 3. Attempt to negotiate right-of-entry or possession and use agreement.	Completion of foundation construction for all segments.	Added to Risk Register per Risk Refresh - 7/12/2016		Bayshore is the one remaining risk. We are resolved TPS-1 (pending final written agreement) and TPS-2 - B. Fitzpatrick 1/15/2021
267	Elect.	Construction	Additional property acquisition is necessitated by change in design.	New project costs and delays to schedule.	T	3	2	4	18	Fitzpatrick	1. Project delivery team to work with contractor to ID new parcels well before they are needed for construction 2. Expedite development of plats and legals 3. Enter into work directives for appraisal and acquisition before parcels are identified 4. Work with project team to integrate property acquisition schedule into overall project schedule.	Completion of Construction	Most acquisition is for easements, some foundations not on JPB property, maximum time impact of 3 months. Inefficiencies but not major impact. - 12/21/2018		We continue to look for new parcels in the design packages and the number seems to be dwindling. Of course, until all poles re potholed, this risk still exists - B. Fitzpatrick 11/24/2020 No change. - B. Fitzpatrick 1/15/2021

Program Risk Register

Version Date: January 22, 2021 - Top Risks

	1	2	3	4	5
	LOW	MEDIUM	HIGH	VERY HIGH	SIGNIFICANT
Probability	< 10%	10% - 50%	50% - 75%	75% - 90%	> 90%
Cost	< $500 K	$500 K - $2 M	$2 M - $10 M	$10 M - $20 M	$20 M - $60 M
Schedule	< 1 Month	1 - 3 Months	3 - 6 Months	6 - 12 Months	> 12 Months

ID	RBS		RISK DESCRIPTION	EFFECT(S)	TYPE	IMPACT			PRIORITY	OWNER	MITIGATION ACTIONS	RETIREMENT DATE(S)	NOTES	A-C	STATUS & REMARK(S)
	FUNC. (P)	FUNC. (S)				PROBABILITY	COST	SCHEDULE	GRADING						
209	E	Elect.	Construction	TASI may not have sufficient number of signal maintainers for testing.	• Delays to construction/testing. • Delays to completion of infrastructure may delay acceptance of vehicles	T	3	2	3	18	Guan	1. Communicate staffing requirements for track protection with TASI. - Complete 2. Revise language in TASI contract to clearly describe required support for EMUs and electrification. - Complete 3. Discuss TASI resource requirements associated with bids by leading contractor or contractors with TASI management. - Complete 4. Maintain ongoing dialogue with TASI regarding requirements of contractors. - In progress 5. Issue advance notice to TASI to enable them to adjust to changes in the construction schedule. 7. Build into TASI budget for signal maintainers and flagging for next contract year. - Complete	Completion of Integrated Testing	Reassign to L. Guan - 6/18/2018			Planning and discussion of cutovers continue for Segment 4. Discussions include potential use of shutdowns or combining cutovers. - Lin G. 12/28/2020
273	T	Elect.	Construction	Contractor generates hazardous materials, that necessitates proper removal and disposal in excess of contract allowances and expectations.	Delay to construction while removing and disposing of hazardous materials resulting in schedule delay, increased construction costs, and schedule delay costs.	T	5	2	1	18	DBOM		Completion of Construction	None		Risk is being realized. CMB has authorized an amount from contingency. No changes. - L. Guan 11/16/2020
318	J	EMU	Construction	Change of vehicle sub-suppliers results in additional first article inspections at cost to JPB (i.e., COVID, bankruptcy)	PCEP incurs additional cost to validate supplier and product, including repeat FAIs as needed.	T	5	1	2	15	Cameron	1 Discourage substitutions: key suppliers require PCEP approval 2 Discourage substitutions: require additional design reviews, inspections and documentation 3 Seek reimbursement from Contractor for PCEP additional expenses (not specifically addressed by Contract terms) 4) Conduct inspections post arrival in USA. 5) No additional substitutions noted by Stadler. Others possible during multi-year manufacturing phase.	Delivery of all Vehicles	Revised and regraded per Risk Assessment Committee 10/30/2020.			On 10/16 Stadler announced that two of their suppliers have gone bankrupt due to the pandemic. They have contracted alternate suppliers. Repeat FAIs will be necessary. -G. Cameron 10/20/2020 No change. -G. Cameron 11/23/2020 No change. -G. Cameron 12/28/2020
263	J	Interface	Construction	Collaboration across multiple disciplines to develop a customized rail activation program may fail to comprehensively address the full scope of issues required to operate and maintain an electrified railroad and decommission the current diesel fleet.	Delay in testing of EMUs. Delay in Revenue Service Date. Additional costs for Stadler and BBII due to overall schedule delays.	T	2	3	3	12	Gilardi	1. Develop a schedule of activities associated with rail activation. 2. Assign a rail activation committee. 3. Conduct/delegate activities on rail activation plan/schedule. 4. Maintain progress tracking on all activities. Completed 6. Develop rail activation document (J. Moore). Using Houston plan as a model. 7. Conduct initial EMU testing in Pueblo. 8. Delay EMU deliveries as a result of decision to procure 7-car trains. 9. Hire rail activation plan manager - currently Sal Gilardi 10. Hire necessary supporting staff	Start of Phased Revenue Service	Reassigned to S. Gilardi per Risk Assessment Committee 2/28/2020			The schedule for the delivery of EMU's has slipped due to the effects of COVID-19 which includes: manufacturers going out of business, sick workers and the availability of workers to enter into the country. LTK/Stadler to update delivery schedule. This item is being carried on the Rail Activation Risk matrix through the Rail Activation Committee. - S. Gilardi 11/23/2020 No change. Waiting for an updated schedule from Stadler (LTK). - S. Gilardi 12/28/2020
304	E	EMU	Physical Site	Solution to FRA concerns over bike storage impeding path to emergency exit windows path results in increased costs and potential rework.	Protracted negotiations with FRA to achieve original design	T	4	1	2	12	Cameron	1. Conduct negotiations with FRA to achieve desired configuration. 2. LTK seeking information from other agencies as to their experiences with onboard bike storage – Complete 3. Refine placement of bicycle racks 4. Passageways between stored bikes identified to provide improved access to exit windows 5. Discussing monthly with FRA 6. FRA to see installation on cars in SLC week of April 20th 7. Add barrier per July 2020 FRA recommendation.	FRA 'Sample Car Inspection' and Conditional Acceptance of First Trainset	Regraded from 1-2-2 to 4-2-2 per Risk Assessment Committee 10/30/2020			Cost rating decreased from 2 to 1 based on final cost estimate from Stadler. Mitigation added. -G. Cameron 12/28/2020

Appendix F PCEP Summary Interface Schedule