

**FEDERAL TRANSIT ADMINISTRATION  
PROJECT MANAGEMENT OVERSIGHT PROGRAM**

FTA Region IX

**BART Silicon Valley Phase II Extension Project  
Santa Clara Valley Transportation Authority  
Cities of San Jose and Santa Clara, CA**

Status as of May 14, 2021

**SCOPE, COST, SCHEDULE, RISK AND CONTINGENCY REVIEW REPORT**

OP 32C Project Scope Review

OP 33 Capital Cost Estimate Review

OP 34 Project Schedule Review

OP 40 Risk and Contingency Review

**Draft** – June 18, 2021

**Final** – July 20, 2021

**PMOC Contract Number:** 69319519D00021

**Task Order:** 69319520F300035

**Project Number:** 1

**Project Type:** Expedited Project Delivery Pilot Program

**Project Phase:** EPD Pilot Program 120-Day Detailed Review

**OPs Referenced:** OP 1, 25, 32C, 33, 34 and 40

**Atkins North America, Inc.**

7604 Technology Way, Suite 400

Denver, CO 80237

**PMOC Lead:** Jena Montgomery, 720.475.7107, [Jena.Montgomery@atkinsglobal.com](mailto:Jena.Montgomery@atkinsglobal.com)

PMOC Assigned to Project Since August 2020

PMOC Lead Assigned to Project Since August 2020

### **Third Party Disclaimer**

This Project Management Oversight Contractor (PMOC) report and all supporting reports and back up materials contain the findings, conclusions, professional opinions and recommendations stemming from a risk-informed evaluation and assessment, prepared solely for the Federal Transit Administration (FTA). This report shall not be relied upon by any party, except FTA or the project Sponsor, in accordance with the purposes of the evaluation and assessment as described below. For projects funded through FTA's Major Capital Investment (New Starts) program, FTA and its PMOCs use a risk-informed process to review and reflect upon a Sponsor's scope, schedule, and cost, and to analyze the Sponsor's project development and management. This process is iterative in nature. The results represent a "snapshot in time" for a particular project under the conditions known at that point. The evaluation or assessment and related results may subsequently change due to new information, changes in circumstances, additional project development, specific measures a Sponsor may take to mitigate risks, Sponsor's selection of strategies for project execution, etc.

## **EXECUTIVE SUMMARY**

### **Purpose**

The purpose of this Scope, Cost, Schedule, Risk, and Contingency Review Report is to provide the Federal Transit Administration (FTA) with the Project Management Oversight Contractor's (PMOC's) assessment of the Bay Area Rapid Transit (BART) Silicon Valley Phase II Extension (BSVII) project. The Santa Clara Valley Transportation Authority (VTA) is the Project Sponsor and the PMOC has reviewed their Risk and Contingency Management, including risk assessment, project scope, capital cost estimate, and schedule reviews. These assessments will inform PMOC's upcoming Readiness for Expedited Project Delivery Pilot Program (EPD) Project Selection, which will be one input to FTA's determination regarding VTA's EPD application.

### **Project Description**

The BSVII project is a six-mile extension of BART commuter rail beyond the current end of line at Berryessa/North San Jose station through downtown San Jose to Santa Clara. Approximately five miles will be tunnel and one mile at grade, with the at grade section including one station and the future Newhall Yard Maintenance Facility. The underground section includes three stations and two additional, mid-tunnel, ventilation, and emergency egress facilities. Forty-eight vehicles will be paid for with project funds but are included in the procurement for BART FTA Core Capacity grant program fleet upgrades.

VTA submitted an EPD application on April 7, 2021 according to the instructions identified in the Notice of Funding Opportunity (NOFO) published in the Federal Register July 28, 2020. The proposed budget of \$6,941 million (Year of Expenditure [YOE]) has been approved by the VTA board and was included in the application. VTA's proposed revenue service date (RSD) in the application materials is May 2030.

### **Baseline**

The PMOC followed guidance outlined in FTA OP 20, 21, 22, 23, 24, 32c, 33 and 34 with regards to the completeness and reliability of the Sponsor's project scope, cost and schedule; to assess its usefulness as a management tool; to assess the extent to which the project scope, cost and schedule reflects the project objectives, management practices and method of project delivery through a review of the documents provided by VTA. PMOC's review has been based upon the documents included in the April 7, 2021 EPD (as augmented through April 23, 2021 in the online portal) as well as supporting documents provided for the risk assessment. This PMOC report has a status date of May 14, 2021, meaning documents received after that date have not been reviewed. Key documents made available to the PMOC and which the PMOC has reviewed in part or whole in developing this EPD review are listed in Appendix B.

VTA presented an updated project schedule in March 2021 with progress updated through March 1, 2021 with a target (early) RSD of May 7, 2030 and a proposed FFGA (late) RSD, after contingency, of September 15, 2032.

VTA presented a cost estimate in support of their EPD Pilot Program application based upon an estimate at completion of \$6,941 million (YOE) including finance charges of \$389.7 million (YOE).

### **Synthesis of Findings**

The Sponsor, VTA, through their general engineering and program management consultants, collectively known as Silicon Valley Transit Consultants, have developed design documents to approximately 10-20% level of maturity, consistent with pre-RFP designs for design build (DB) and progressive design build (PDB) procurements. VTA has demonstrated further design and procurement progress since the EPD Configuration Drawings. However, the cost estimate evaluated by PMOC was based on that approximately 10% design. VTA has commenced a bottom up cost estimate revision that is anticipated to be completed in late summer or fall 2021.

Listed below are highlights with reference to scope, cost and schedule uncertainty, potential ambiguity, and risk:

1. Highly aggressive estimate and schedule ‘stripping’ of latent contingency and allowances pushing realistic estimate assumptions into ‘risk’ resulting in a disproportionate contingency to base cost and schedule.
2. No documented commitment by any of the third-party utility owners to the project schedule or cost to undertake the relocations. Master agreements address general cost sharing terms but do not attribute costs to specific relocations. Estimates were instead based on Phase I costs.
3. Highly ambitious design period for coordinating the four major contract packages and settlement of lines of design responsibility at the many interface points.
4. Highly ambitious tunnel boring production rates in very challenging ground conditions with large settlement property impacted projections requiring significant ground improvements and monitoring.
5. Heavy reliance on integration and collaboration with BART and the design builders in station fit out and systems installations including ventilation and smoke extraction.
6. An underlying strategy of design, design coordination and construction risk transfer to the Design Builders, similar to Warm Springs and Silicon Valley Berryessa Extension (SVBX) Phase 1, rather than risk sharing, collaboration, partnering and risk retention emphasized by respondents in the latest Request for Industry Feedback (RFIF) submittals.

Table 1 below provides a summary of the results of the cost and schedule risk analysis:

**Table 1 Executive Summary Risk Results**

Executive Summary	Cost Risk Results		OP 40 Contingency
<b>BART Silicon Valley Phase II Extension Project</b>  Risk Workshop Date : 05/10/2021 to 05/12/2021 Project Phase : EPD Application 120 Day review Project Type : Metro Regional Rail Project Delivery Method : Design Build	Sponsor Cost Estimate	\$6,941 M	Recommended
	P-Value of Grantee Cost	< P10 (10%)	
	P65 Cost	\$9,148 M	
	<b>Schedule Risk Results</b>		
	Sponsor RSD Date	09/15/2032	Recommended
	P-value of Grantee Date	< P10 (10%)	
	P65 Date	02/02/2034	
	125% of remaining duration of critical path	06/21/2034	
<i>All costs quoted above include a sum of \$389.72 Million in Finance Costs [YOE]. No risk is applied to Finance Charges.</i>			

The PMOC provided a One Page Summary (OPS) to FTA ahead of this formal report which supports and provides details of the findings in the OPS; please refer to Appendix C.

Completing the project scope to the time and cost proposed by the Sponsor (VTA) is highly dependent upon the assumption of the private utility companies performing all work to the project timelines, the successful coordination and indeed collaboration between VTA, BART, and the four large DB contracts and the success of the tunnel mining operations. VTA has identified 65 risks in their current risk register dated March 30, 2021. The FTA PMOC has recommended the addition of a further 23 risks. Table 2 below provides a summary of the Top Risks identified by both PMOC and the Sponsor.

**Table 2 Top Risks Identified**

PMOC TOP 10		VTA TOP 10	
BSV-143	Cost Escalation higher than anticipated	BSV-084	Timing of completion of BART's CBTC implementation
BSV-096	Testing and Commissioning delays due to various factors	BSV-096	Testing and Commissioning delays due to various factors
PMOC_4	Failure to agree GMP within estimate on PDB	BSV-005	Unanticipated or inadvertent damage to historic buildings / Utilities
BSV-138	Multiple design interfaces between four DB/PDB contracts	BSV-138	Multiple design interfaces between four DB/PDB contracts
BSV-171	Lack of adequate interface management between CP's	BSV-041	Differing ground conditions [tunnel and adits excavation]
PMOC_26	TBM assumed mining rate may be overly ambitious	BSV-133	Tie-in between BSV Phase I and Phase II
PMOC_27	Time required to establish and then perform ground improvements	BSV-134	Insufficient Staging and Laydown underground station sites.
BSV-066	Multiple contract interfaces	BSV-066	Multiple contract interfaces
BSV-055	PDB (CP2) changes design impacting utility relocations	BSV-055	PDB (CP2) changes design impacting utility relocations
BSV-053	Needed Right of Way is not available for critical path Construction	BSV-139	Procurement delays for construction long-lead items (e.g. TBM)
RED RISKS ARE COMMON TO PMOC AND VTA			

Table 3 below shows a summary of the results of the cost and schedule risk analysis:

**Table 3 Summary Risk Analysis Results**

	Base (w/ Cont)	Base (w/o Cont)	Stripped & Adjusted	Cost Risk (YOE)	Schedule Risk
VTA EPD Application (Cost) & P65	\$ 6,102	\$ 4,796	-	\$ 6,941	-
VTA EPD Application (Schedule) & P65	09/15/2032	05/7/2030	-	-	09/15/2032
PMOC P40	-	-	\$ 6,495	\$ 8,104	09/13/2033
PMOC P50	-	-	\$ 6,495	\$ 8,486	11/04/2033
PMOC P65	-	-	\$ 6,495	\$ 9,148	02/02/2034
PMOC P80	-	-	\$ 6,495	\$ 10,029	05/16/2034
PMOC Recommended (25% of SABS)	-	-	-	\$ 9,148	06/21/2034
<i>All costs YOE (\$ Millions) and include Finance Costs</i>					

**PMOC Conclusions**

The PMOC is of the opinion the proposed scope of work is overly optimistic in the time frame and at the cost proposed given the numerous and complex contract interfaces, design coordination and construction coordination interfaces and the very challenging known ground conditions to be encountered on this large diameter single tunnel approach.

The PMOC is concerned with respect to the optimistic schedule and derived cost impacts. The PMOC notes the very considerable contract interfaces and coordination required both physically and contractually and the high involvement of management and coordination that will be required of VTA and their internal project team and consultants.

**PMOC Recommendations**

In light of the conclusions as summarized above:

1. The PMOC has reviewed schedule activity durations and concurrency of design and construction contracts together with the procurement timelines necessary to implement the proposed strategy. PMOC recommends an adjustment to the VTA RSD of 18 months resulting in a revised RSD, before contingency, of November 7, 2031 and that the base cost before contingency is increased by \$1,037 million (YOE) to account for over stripping, overly optimistic tunnel production rates, low standard cost category (SCC) 80 staff estimates, overly optimistic inflation rates and additional consequential increases in costs associated with the adjusted schedule duration.
2. PMOC recommends the Project Readiness to be conditional upon VTA obtaining additional contingency capacity to support the significant and understated risk apparent at this stage of the project’s development.
3. PMOC recommends the P65 cost is adopted at \$9,148 million, an increase over the VTA EPD application of \$2,206 million. PMOC recommends the RSD including contingency adopts the Stripped and Adjusted Base Schedule (SABS) plus 25% equating to a revised RSD of June 21, 2034, a 21-month addition over the EPD Application.

## **Final Report Status**

The June 18, 2021 draft version of this report was provided to VTA for review after a briefing regarding the results to executive and project management on June 24, 2021. An initial informal response was provided June 30, 2021, followed by a letter and written response from VTA on July 12, 2021. A FTA meeting with VTA was conducted on July 16, 2021 to discuss the risk assessment results and VTA's response to the draft report. The differences in professional opinion remain; however, it was deemed by FTA that the PMOC assessment and results were sound and unchanged by the VTA's rebuttal. The assessment followed FTA's process and was based upon the best information available and the risk status of this complex project at this point in time. As the procurements progress and VTA reaches agreement with a Tunnel and Trackwork Progressive Design Builder and Design Builders for the other three contract packages regarding risk sharing, cost, and schedule, additional certainty will be achieved for the project cost estimate and schedule. At such time, PMOC will undertake additional technical reviews and reassess the findings as appropriate at FTA's request.

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## **1.0 INTRODUCTION**

### **1.1 Purpose**

The purpose of this Scope, Cost, Schedule, Risk, and Contingency Review Report is to provide the Federal Transit Administration (FTA) with the Project Management Oversight Contractor's (PMOC's) assessment of the Bay Area Rapid Transit (BART) Silicon Valley Phase II Extension (BSVII) project. The Santa Clara Valley Transportation Authority (VTA) is the Project Sponsor and the PMOC has reviewed their Risk and Contingency Management, including risk assessment, project scope, capital cost estimate, and schedule reviews. These assessments will inform PMOC's upcoming Readiness for Expedited Project Delivery Pilot Program (EPD) Project Selection, which will be one input to FTA's determination regarding VTA's EPD application. PMOC's review has been based upon the documents included in the April 7, 2021 EPD, as augmented through April 23, 2021, as well as supporting documents provided for the risk assessment. This report has a status date of May 14, 2021, meaning documents received after that date have not been reviewed. Items provided after that cutoff date may be considered after the completion of the EPD Pilot Program 120-day detailed review for next steps in PMOC oversight of the project as appropriate.

### **1.2 Project Background**

This project dates back to the 2001 Comprehensive Agreement between VTA and BART and the Major Investment Study that recommended the Silicon Valley Rapid Transit Corridor Project (SVRTCP). The extension to Silicon Valley was originally envisioned as one project. Over the years it was broken to multiple phases due to funding availability. The extension to Warm Springs Station, considered a precursor project to the SVRTCP was completed in March 2017. The Phase I extension to Berryessa/North San Jose Station was completed and opened for revenue service in June 2020.

SVRTCP progressed through a combined Draft Environmental Impact Statement (EIS) and Environmental Impact Report (EIR) in accordance with the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) requirements, released for public comment in April 2004. VTA continued the SVRTCP environmental review under CEQA only and a Final EIR was certified by the VTA Board of Directors in December 2004. A Final Supplemental EIR to address project design refinements was certified by VTA Board of Directors in June 2007, at which time VTA requested and received FTA concurrence to resume the NEPA process. In June 2010, FTA issued the Record of Decision (ROD) for Phase I. BSVII entered New Starts Project Development in March 2016. FTA signed the ROD for BSVII in June 2018 as the culmination of the NEPA process which included the 2004 Draft EIS (including Phase I and Phase II), a 2010 Final EIS (including Phase I and Phase II), and a 2018 Final Supplemental EIS for BSVII.

BSVII was advanced to approximately 65% design as a twin-bore design configuration, then suspended to focus necessary resources on Phase I. In 2014 VTA identified a large single-bore tunnel as a potential option to reduce disruption to existing infrastructure and businesses through downtown San Jose. This was adopted as the preferred project configuration in April 2018 by both the VTA and BART boards of directors.

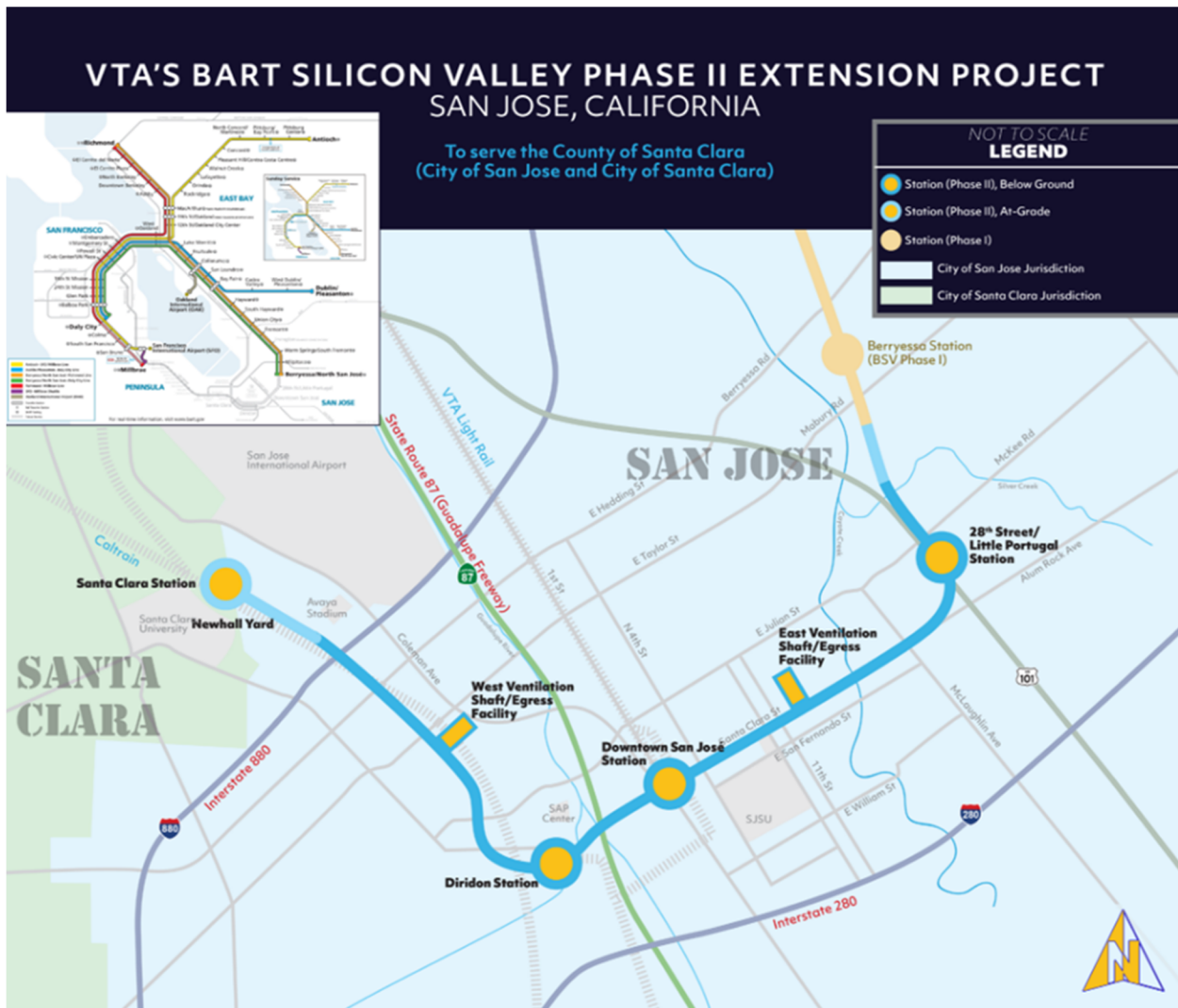
In November 2018 VTA responded to FTA's September 12, 2018 Notice of Funding Opportunity (NOFO), providing their expression of interest for FTA's EPD Pilot Program. On April 7, 2021 VTA submitted their funding request application in response to FTA's July 28, 2020 NOFO with the required documentation for FTA's evaluation and determination. BSVII has pre-award authority consistent with their acceptance into New Starts Project Development in March 2016 and having completed their environmental clearance. FTA allocated \$125 million to the project in August 2019 and another \$100 million in January 11, 2021.

### **1.3 Project Description**

BSVII is an approximately 6.0-mile extension of the BART system from the existing terminus at the Berryessa/North San Jose BART Station to the proposed Santa Clara Station in the City of Santa Clara. BSVII includes a total of four stations: three below-grade (28th Street/Little Portugal Station, Downtown San Jose Station, and Diridon/Arena Station) and one at grade (Santa Clara Station). BSVII also includes two mid-tunnel ventilation/emergency egress facilities and the Newhall Yard maintenance facility. Forty-eight vehicles will be paid for with project funds but will be included in the procurement for BART FTA Core Capacity grant program fleet upgrades.



**Figure 1 Project Area**



### 1.4 Project Status

BSVII is in a project development phase while progressing their design and procurement documents for multiple DB packages. VTA submitted an application for the EPD Pilot Program on January 8, 2021. VTA was subsequently notified that the application documentation submitted did not adequately present the required 30-percent level of design and engineering as a complete package. After coordinating with FTA regarding information to supplement the application, VTA submitted a new application on April 7, 2021. FTA notified VTA on May 14, 2021 that a complete application had been received and would be moved into the 120-day statutory application detailed review period. The project is currently in the EPD Pilot Program 120-day Detailed Review Phase.

VTA previously issued Requests for Industry Feedback (RFIF) for the Tunnel and Trackwork, Systems, and Stations packages. The RFIF for Newhall Yard & Maintenance Facility and Santa Clara Station is active and responses are due on May 7, 2021. VTA previously issued the RFQ for

Tunnel and Trackwork (December 2020) and issued the RFQ for Systems on February 26, 2021. The RFQs for the Newhall Yard and Santa Clara Station and Stations are under development.

VTA continues to develop the RFP packages for issuance for the four major construction contract packages. The Tunnel & Trackwork (CP2) RFP is targeted for release in July 2021.

## **1.5 Project Stakeholders**

VTA is the BSVII Program Sponsor and proposed FTA grant recipient. Other entities involved in the planning, design, construction, and commissioning of BSVII include:

- BART, Program partner and BSVII operating agency
- VTA's consolidated consultant team, Silicon Valley Transit Consultants (SVTC)
- PDB/DB Contractors
- City of San Jose
- City of Santa Clara
- Google, private sector transit-oriented development (TOD) partner and financial contributor

## **1.6 PMOC Review Activities**

The PMOC is performing in parallel a PMP Review (OP 20), Capacity and Capability Review (OP 21), Safety and Security Management Review (OP 22), Right of Way Review (OP 23), Quality Assurance and Quality Management Review (OP 24), Scope Review (OP 32c), a Cost Review (OP 33) and a Schedule Review (OP 34) which together form the key inputs into the Risk and Contingency Review that will provide guidance to the FTA and VTA regarding project risk and adequacy of cost and schedule contingency. The PMOC is tasked to conduct a Risk and Contingency Review in compliance with OP 40c..

EPD reviews were conducted based upon 30% engineering and design being complete as defined in the EPD NOFO. PMOC focused the review on major areas of potential scope, cost, and schedule risk. As a result of the EPD process, no findings had been shared with the Sponsor nor was there any opportunity for reconciliation with the Sponsor regarding PMOC's recommended adjustments to their baseline schedule or capital cost estimate prior to the risk assessment.

Documents received after May 14, 2021 have not been reviewed or accounted for in the PMOC's evaluation. Items provided after that cutoff date may be considered after the completion of the EPD Pilot Program 120-day detailed review for next steps in PMOC oversight of the program as appropriate. A complete list of documents received and reviewed may be found in Appendix B.

## **Final Report Status**

The June 18, 2021 draft version of this report was provided to VTA for review after a briefing regarding the results to executive and project management on June 24, 2021. An initial informal response was provided June 30, 2021, followed by a letter and written response from VTA on July 12, 2021. A FTA meeting with VTA was conducted on July 16, 2021 to discuss the risk assessment results and VTA's response to the draft report. The differences in professional opinion remain;

however, it was deemed by FTA that the PMOC assessment and results were sound and unchanged by the VTA's rebuttal. The assessment followed FTA's process and was based upon the best information available and the risk status of this complex project at this point in time. As the procurements progress and VTA reaches agreement with a Tunnel and Trackwork Progressive Design Builder and Design Builders for the other three contract packages regarding risk sharing, cost, and schedule, additional certainty will be achieved for the project cost estimate and schedule. At such time, PMOC will undertake additional technical reviews and reassess the findings as appropriate at FTA's request.

### **1.6.1 Purpose and Objective**

#### **OP 40: Risk and Contingency Review**

The goal of the Risk and Contingency Review is to evaluate a Sponsor's risk identification and assessment process and to evaluate the Sponsor's Contingency Management Plan. Based on the evaluation, the PMOC recommends any necessary changes to the Sponsor for risk identification, assessment, and mitigation. The PMOC may also recommend changes to the Sponsor's Risk and Contingency Management Plan. The PMOC shall independently develop a risk analysis to provide a thorough analysis of the Sponsor's project.

#### **OP 32C: Project Scope Review**

The purpose of the OP 32C review is to verify that the scope of the project represented by the totality of all documentation, including environmental documents, basis of design and design criteria, third-party agreements, Real Estate Acquisition and Management Plan, and contract plans and specifications is internally consistent, defined to a level appropriate for the project development phase and applicable project delivery method, consistent with the estimated cost and schedule.

The objective of the OP 32C review is to assess the Sponsor's definition of the project scope for adequacy and completeness given the phase; for internal consistency; for compliance with applicable laws regulations, policies, etc.; bid-ability and constructability.

PMOC assessment considers the following requirements. The Civil, Structural, Architectural, Electrical, Mechanical, Power, Signal and Communications, Trackwork, Sitework and other plan documents must possess a comparable level of definition, clarity, presentation, and cross-referencing. Design, construction, system, and vehicle interfaces must be well known and defined. Design Reports, Concept of Operations Report, and configuration studies must be adequate and complete. Work descriptions and definitions used in designs and specifications must be consistent and uniformly applied. The project phasing must be adequate, and the project must be constructible. Adequate construction access and staging areas must be defined.

#### **OP 33: Capital Cost Estimate Review**

Congress and FTA's good stewardship require that a Sponsor's cost estimates be reliable before entry into FFGA. PMOC is conducting this review at the request of FTA, providing an evaluation of the scope, schedule, and cost to confirm the estimate's reliability.

FTA's objective is to assess the consistency of cost estimating information, understand its characteristics, evaluate the methodologies, and confirm that the estimate adequately reflects the overall project scope, the estimated quantities shown on the design documents, the anticipated market conditions, the risk elements associated with the project, and the project schedule. This procedure is applicable to Design-Bid-Build, DB and other delivery methods. The review results should help the Sponsor with decisions regarding the level of cost control measures, appropriateness and reasonableness of contingency provisions, and mitigations required; in addition, the results will assist FTA with decisions regarding project advancement and funding.

#### **OP 34: Project Schedule Review**

Competent schedule management is necessary for sound project planning and control of time, costs and risks. Congress and FTA's good stewardship require that a Sponsor's schedule be reliable prior to FFGA. PMOC is conducting this review at the request of FTA, providing an evaluation of the scope, schedule, and cost to confirm schedule reliability.

FTA's objective is to determine whether the Sponsor's schedule management and project schedule are sufficient to plan and control the project time at the programmatic and contract level and complement the management of scope, cost, and risk.

## **2.0 OP 40: RISK AND CONTINGENCY REVIEW**

### **2.1 Summary of Status from other OPs**

#### **2.1.1 Details of Proposed Project Scope and Design Document Status**

Based on review of the Sponsor's provided documentation as well as input received during workshops and meetings, PMOC is of the opinion that BSVII design had the following levels of maturity as associated with the cost estimate submitted with the EPD application.

##### **Profile 1 (CP1 – Systems)**

- SCC 10 - Civils works – 30% average design
- SCC 50 - Systems works – 30% average design

##### **Profile 2 (CP2 – Tunnels and Trackwork)**

- SCC 10 Civils works – 15% average design
- SCC 10 Track installation works – 30% average design
- SCC 20 Civil works – 15% average design
- SCC 40 Civil works – 15% average design
- SCC 50 Systems related works – 30% average design

##### **Profile 3 (CP3 – Newhall Yard and Santa Clara Station)**

- SCC 20 Santa Clara Station – less than 10% average design
- SCC 20 Balance – 15% average design
- SCC 30 Facility components – 30% average design
- SCC 40 Civil works – 15% average design
- SCC 50 Systems related works – 30% average design

##### **Profile 3 (Program-wide Right of Way (ROW), Vehicles, and Professional Services)**

- SCC 60 ROW – 15% average design
- SCC 70 Vehicles – 60% average design
- SCC 80 Professional services – 15% average design

##### **Profile 4 (CP4 – Underground Stations)**

- SCC 20 All works – 15% average design
- SCC 40 Civil works - 15% average design

VTA has demonstrated through supplemental memoranda and sharing images of the project design, including models and plans and reports, numerous virtual workshops that they are aggressively progressing the design. However, the above list constitutes the determinations as relevant to the cost risk model. PMOC's conclusion regarding design maturity varies from VTA's because the project and site-specific elements are what constitute or dominate design maturity. The use of standard drawings this early in the design development to quantify design maturity skews the picture in PMOC's opinion. Although design has advanced, there are still substantial

requirements and design decisions that will not be closed until there is concurrence from the PDB and DB providing validation of the proof of concepts which VTA has progressed.

### 2.1.2 Environmental Clearance

FTA signed the ROD for BSVII in June 2018 as the culmination of the NEPA process which included the 2004 Draft EIS (including Phase I and Phase II), a 2010 Final EIS (including Phase I and Phase II), and a 2018 Final Supplemental EIS for BSVII. VTA has been coordinating with FTA’s environmental specialist regarding any environmental re-evaluation requirements. PMOC has been told that mitigation requirements are not expected to change substantially with the EPD configuration.

VTA is incorporating the environmental mitigation commitments and requirements into the appropriate contract documents to be included in the requests for proposals.

### 2.1.3 Project Delivery Method, Contract Packaging and Procurement Status

BSVII design and construction have been broken into four major construction contract packages. Below Table 4 are detailed descriptions of the scope included in each package.

**Table 4 Contract Packages**

Package Number	Construction Contract Package Name	Delivery Method	RFQ Status	RFP Solicitation Date
CP1	Systems	Design Build	Live	October 2021
CP2	Tunnel and Trackwork	Progressive Design Build	Selected	July 2021
CP3	Newhall Yard, Santa Clara Station and Parking Garage	Design Build	August 2021	March 2022
CP4	Stations and Support Facilities	Design Build	June 2021	February 2022

*\*These dates are as reported in the February 2021 Project Schedule*

#### CP1 – Systems Installations Design Build

CP1 is a DB Contract for the provision of all Systems for 4.7 miles of underground track alignment; 1.3 miles of at-grade track alignment including Newhall Yard and Santa Clara Station; one at-grade station (Santa Clara Station); three underground stations (28th Street Station, Downtown San José Station, Diridon Station); outfitting of two mid-tunnel ventilation facilities; testing and start-up; two systems interface coordination managers seconded to VTA to oversee interface, integration and coordination efforts between Project contract packages to minimize VTA’s exposure to claims; support for BART’s Rail Acceptance Officer (testing, start-up, California Public Utilities Commission (CPUC) certification, etc.) starting 10-12 months prior to revenue service availability.

#### CP2 – Tunnels and Trackwork

CP2 is a PDB Contract for the design and construction of approximately 4.7 miles of minimum 43’ interior diameter tunnel; procurement of a minimum 48’ diameter tunnel-boring machine (TBM); station structural concrete within tunnel for two underground stations and two mid-tunnel ventilation facilities (e.g. station and emergency egress platforms); internal concrete work including emergency walkways, track slabs, invert, partition walls, etc.; east and west portals;

support of excavation (SOE) for the 28th Street/Little Portugal station, Downtown San José Station and Diridon Station; tunnel liner knockout panels for adit connections and entrances; adits to the tunnel and platforms; trackwork from the BSV Phase I tie-in to the east portal per BART standard criteria; and associated utility relocations, as required.

### **CP3 – Newhall Yard and Santa Clara Station**

CP3 is a DB Contract for final design and construction of Newhall Yard & Maintenance Facility (excluding train control systems); vehicle maintenance shops, car wash/cleaner buildings, maintenance and engineering shops, yard control tower, wheel truing and blowdown facilities; complete build-out of the end-of-the-line Santa Clara Station (excluding train control systems), including two at-grade platforms with an underground concourse and pedestrian undercrossing connection to the Santa Clara Caltrain Station; Newhall Yard trackwork, including turnouts, crossovers and mainline trackwork to west portal; a 500-stall parking garage for Santa Clara Station; associated utility relocations, as required; and final site flatwork, landscaping, etc.

### **CP4 – Underground Stations**

CP4 is a DB Contract for the complete build-out of three underground stations, ancillary facilities and two mid-tunnel ventilation facilities (excluding train control systems). This work includes rail operations facilities within the stations; the 28th Street/Little Portugal Station (excluding demolition and SOE which is included in Contract 2); Downtown San José Station (excluding SOE which is included in Contract 2); Diridon Station (excluding SOE which is included in Contract 2); the 13th Street mid-tunnel ventilation facility; the Stockton Avenue mid-tunnel ventilation facility; a 1,200-stall parking garage for 28th Street/Little Portugal Station; final site flatwork, landscaping, etc.; and associated utility relocations, as required.

## **2.2 Project Cost Summary**

The capital cost estimate (as submitted with the April 7, 2021 EPD application) is \$6,941 million YOE (inclusive of \$389.72 million finance costs). Table 5 below provides PMOC's summary of VTA's submitted estimate showing contingency and inflation values and percentages for reference.

**Table 5 Summary VTA Base Cost Estimate**

Standard Cost Category	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	YOE Dollars Total (X000)	% Contingency (of 10-90)	YOE Stripped Estimate (X000)
10 GUIDEWAY & TRACK ELEMENTS	\$ 1,079.48	\$ 286.25	\$ 1,365.73	\$ 1,525.28	6.4%	\$ 1,205.59
20 STATIONS, STOPS, TERMINALS, INTERMODAL	\$ 1,156.99	\$ 234.39	\$ 1,391.38	\$ 1,593.12	5.2%	\$ 1,324.74
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	\$ 199.89	\$ 35.07	\$ 234.96	\$ 274.55	0.8%	\$ 233.57
40 SITEWORK & SPECIAL CONDITIONS	\$ 152.89	\$ 28.00	\$ 180.88	\$ 202.36	0.6%	\$ 171.04
50 SYSTEMS	\$ 337.86	\$ 58.09	\$ 395.95	\$ 471.27	1.3%	\$ 402.13
<b>Construction Subtotal (10 - 50)</b>	<b>\$ 2,927.10</b>	<b>\$ 641.81</b>	<b>\$ 3,568.91</b>	<b>\$ 4,066.58</b>	<b>14.3%</b>	<b>\$ 3,337.06</b>
60 ROW, LAND, EXISTING IMPROVEMENTS	\$ 200.26	\$ 109.31	\$ 309.57	\$ 321.66	2.4%	\$ 208.08
70 VEHICLES (number)	\$ 165.60	\$ 7.10	\$ 172.70	\$ 205.03	0.2%	\$ 196.60
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	\$ 1,180.07	\$ 71.77	\$ 1,251.84	\$ 1,406.94	1.6%	\$ 1,326.29
<b>Subtotal (10 - 80)</b>	<b>\$ 4,473.03</b>	<b>\$ 829.98</b>	<b>\$ 5,303.01</b>	<b>\$ 6,000.21</b>	<b>18.6%</b>	<b>\$ 5,068.03</b>
90 UNALLOCATED CONTINGENCY	\$ -	\$ -	\$ 475.78	\$ 551.24		\$ -
<b>Subtotal (10 - 90)</b>	<b>\$ 4,473.03</b>	<b>\$ 829.98</b>	<b>\$ 5,778.80</b>	<b>\$ 6,551.46</b>		<b>\$ 5,068.03</b>
100 FINANCE CHARGES	\$ -	\$ -	\$ 323.45	\$ 389.72		<i>Inflation Value</i>
<b>Total Project Cost (10 - 100)</b>	<b>\$ 4,473.03</b>	<b>\$ 829.98</b>	<b>\$ 6,102.24</b>	<b>\$ 6,941.18</b>		<b>\$ 838.94</b>
<b>Total Contingency</b>						<i>Inflation % O/A</i>
Allocated		\$ 829.98	\$ 829.98	\$ 1,483.43		<b>13.7%</b>
Unallocated			\$ 475.78	\$ 551.24		
<b>Total Contingency</b>		<b>\$ 829.98</b>	<b>\$ 1,305.77</b>	<b>\$ 2,034.67</b>	<b>29.2%</b>	

Below in Table 6 is provided an overall summary of the base cost estimate (BCE) as submitted by VTA without contingency, the VTA Stripped and Adjusted Base Cost Estimate (SABCE). PMOC has segregated this estimate by VTA’s proposed main contract packages derived from their estimate backup which has been used as a starting point for analysis by profile in the FTA Top-Down cost model assessment. Some interpolation has been necessary where figures did not match the SCC Build Main summary due to ‘in progress’ adjustments and latent contingency stripping by VTA. To facilitate the most accurate assignment of BETA factors and profile specific global adjustments the PMOC has utilized four profiles corresponding to the contract package scopes as described above:

- **Profile 1** – CP1 Systems Installations DB
- **Profile 2** – CP2 Tunnels and Trackwork
- **Profile 3** – CP3 Newhall Yard and Santa Clara Station and Program Wide SCC 60, 70 & 80
- In addition to CP3, this profile includes the Project Wide elements of SCC 60 through 80. This is to avoid adding a 'linked' workbook and these project wide elements do not overlap the specifics of CP3 which are contained within SCC 10-50
- **Profile 4** – CP4 Underground Stations



**Table 6 Summary BCE (Base Year \$ w/o Contingency) by Profile**

Standard Cost Category	Profile 1	Profile 2	Profile 3	Profile 4	Total
All Costs BY\$ (X000) w/o Contingency before Adjustments					
	CP1 Systems	CP2 Tunnels and Track	CP3 Newhall Yard & Santa Clara Station	Underground Stations	All Scope
10 GUIDEWAY & TRACK ELEMENTS	\$ 75.28	\$ 1,004.20	\$ -	\$ -	\$ 1,079.48
20 STATIONS, STOPS, TERMINALS, INTERMODAL	\$ -	\$ 296.21	\$ 113.29	\$ 747.49	\$ 1,156.99
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	\$ -	\$ -	\$ 199.89	\$ -	\$ 199.89
40 SITEWORK & SPECIAL CONDITIONS	\$ -	\$ 91.21	\$ 24.76	\$ 36.92	\$ 152.89
50 SYSTEMS	\$ 295.82	\$ 30.94	\$ 11.10	\$ -	\$ 337.86
<b>Construction Subtotal (10 - 50)</b>	<b>\$ 371.11</b>	<b>\$ 1,422.55</b>	<b>\$ 349.03</b>	<b>\$ 784.41</b>	<b>\$ 2,927.10</b>
60 ROW, LAND, EXISTING IMPROVEMENTS	\$ -	\$ -	\$ 200.26	\$ -	\$ 200.26
70 VEHICLES (number)	\$ -	\$ -	\$ 165.60	\$ -	\$ 165.60
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	\$ -	\$ -	\$ 1,180.07	\$ -	\$ 1,180.07
<b>Subtotal (10 - 80)</b>	<b>\$ 371.11</b>	<b>\$ 1,422.55</b>	<b>\$ 1,894.96</b>	<b>\$ 784.41</b>	<b>\$ 4,473.03</b>
<b>Percentage (%) of total costs</b>					
SCC 10-50	8.3%	31.8%	7.8%	17.5%	
SCC 60-80			34.6%		

The PMOC recommends several adjustments to the VTA BCE as above Table 6 prior to risk application to form the SABCE. These adjustments are categorized into:

1. Direct Cost adjustments
2. Time related (schedule) adjustments
3. Latent contingency adjustments

Total adjustments amount to \$728.17 million (Base Year \$) as detailed in Table 7 below:

**Table 7 Summary PMOC Adjustments**

Adjustment Title	Adj Value BY\$
Project Impacted running costs for 18 month schedule extension	\$ 403.56
SCC rate and staffing costs	\$ 151.00
HAZMAT allowances	\$ 5.00
Over stripping of estimate / latent contingency	\$ 168.61
<b>Total of Adjustments [Base Year \$ X000]</b>	<b>\$ 728.17</b>

Adjustments have been calculated by and allocated to one of the four Profiles. Table 8 below shows the allocation of PMOC recommended adjustments to the Profiles.

**Table 8 Summary PMOC Adjustments by Profile**

Standard Cost Category	Profile 1	Profile 2	Profile 3	Profile 4	Total
	All Costs BYS (X000) w/o Contingency before Adjustments				
	CP1 Systems	CP2 Tunnels and Track	CP3 Newhall Yard & Santa Clara Station	Underground Stations	All Scope
<b>DIRECT COSTS ADJUSTMENTS</b>					
10 GUIDEWAY & TRACK ELEMENTS	\$ -	\$ -	\$ -	\$ -	\$ -
20 STATIONS, STOPS, TERMINALS, INTERMODAL	\$ -	\$ -	\$ -	\$ -	\$ -
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	\$ -	\$ -	\$ -	\$ -	\$ -
40 SITEWORK & SPECIAL CONDITIONS	\$ -	\$ 2.00	\$ 3.00	\$ -	\$ 5.00
50 SYSTEMS	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Construction Subtotal (10 - 50)</b>	<b>\$ -</b>	<b>\$ 2.00</b>	<b>\$ 3.00</b>	<b>\$ -</b>	<b>\$ 5.00</b>
60 ROW, LAND, EXISTING IMPROVEMENTS	\$ -	\$ -	\$ -	\$ -	\$ -
70 VEHICLES (number)	\$ -	\$ -	\$ -	\$ -	\$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	\$ -	\$ -	\$ 151.00	\$ -	\$ 151.00
<b>Subtotal (10 - 80)</b>	<b>\$ -</b>	<b>\$ 2.00</b>	<b>\$ 154.00</b>	<b>\$ -</b>	<b>\$ 156.00</b>
<b>SCHEDULE IMPACTED ADJUSTMENTS</b>					
10 GUIDEWAY & TRACK ELEMENTS	\$ -	\$ 126.02	\$ -	\$ -	\$ 126.02
20 STATIONS, STOPS, TERMINALS, INTERMODAL	\$ -	\$ 53.04	\$ 29.23	\$ 23.68	\$ 105.96
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	\$ -	\$ -	\$ 13.78	\$ -	\$ 13.78
40 SITEWORK & SPECIAL CONDITIONS	\$ -	\$ 11.80	\$ -	\$ -	\$ 11.80
50 SYSTEMS	\$ 26.07	\$ -	\$ -	\$ -	\$ 26.07
<b>Construction Subtotal (10 - 50)</b>	<b>\$ 26.07</b>	<b>\$ 190.85</b>	<b>\$ 43.01</b>	<b>\$ 23.68</b>	<b>\$ 283.61</b>
60 ROW, LAND, EXISTING IMPROVEMENTS	\$ -	\$ -	\$ -	\$ -	\$ -
70 VEHICLES (number)	\$ -	\$ -	\$ -	\$ -	\$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	\$ -	\$ -	\$ 119.94	\$ -	\$ 119.94
<b>Subtotal (10 - 80)</b>	<b>\$ 26.07</b>	<b>\$ 190.85</b>	<b>\$ 162.95</b>	<b>\$ 23.68</b>	<b>\$ 403.56</b>
<b>LATENT CONTINGENCY ADJUSTMENTS</b>					
10 GUIDEWAY & TRACK ELEMENTS	\$ -	\$ 104.82	\$ -	\$ -	\$ 104.82
20 STATIONS, STOPS, TERMINALS, INTERMODAL	\$ -	\$ 17.56	\$ -	\$ 40.97	\$ 58.53
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	\$ -	\$ -	\$ 2.62	\$ -	\$ 2.62
40 SITEWORK & SPECIAL CONDITIONS	\$ -	\$ (0.27)	\$ -	\$ (0.09)	\$ (0.36)
50 SYSTEMS	\$ 3.01	\$ -	\$ -	\$ -	\$ 3.01
<b>Construction Subtotal (10 - 50)</b>	<b>\$ 3.01</b>	<b>\$ 122.10</b>	<b>\$ 2.62</b>	<b>\$ 40.88</b>	<b>\$ 168.61</b>
60 ROW, LAND, EXISTING IMPROVEMENTS	\$ -	\$ -	\$ -	\$ -	\$ -
70 VEHICLES (number)	\$ -	\$ -	\$ -	\$ -	\$ -
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Subtotal (10 - 80)</b>	<b>\$ 3.01</b>	<b>\$ 122.10</b>	<b>\$ 2.62</b>	<b>\$ 40.88</b>	<b>\$ 168.61</b>
<b>SUMMARY</b>	<b>\$ 29.07</b>	<b>\$ 314.96</b>	<b>\$ 319.57</b>	<b>\$ 64.56</b>	<b>\$ 728.17</b>

The final adjustment recommended by PMOC is for the general rate of inflation used by VTA. VTA have used an inflation rate of 2.72% per annum. In the PMOC’s opinion this is overly optimistic and, supported by market research into current trends and future forecasts at the date of the FTA risk workshop, the PMOC recommends the inflation rate is increased to 3.50% per annum and remain as specified in the SCC workbook issued by FTA. This results in an adjustment to the Sponsors estimate (before the application of risk) of an additional \$185.06 million. The application of the inflation increase on the PMOC adjustments adds an additional \$29.4 million inflation.

Table 9 below summarizes the PMOC’s adjustments and inflation uplift by Profile to provide a revised estimate YOE, before the application of risk, at \$6,105 million.

**Table 9 PMOC SABCE (YOE) by Profile w/o Finance Charges**

Standard Cost Category	Profile 1	Profile 2	Profile 3	Profile 4	Total
	All Costs YOES (X000) w/o Contingency including Adjustments				
	CP1 Systems	CP2 Tunnels and Track	CP3 Newhall Yard & Santa Clara Station	Underground Stations	All Scope
10 GUIDEWAY & TRACK ELEMENTS	\$ 86.76	\$ 1,423.39	\$ -	\$ -	\$ 1,510.15
20 STATIONS, STOPS, TERMINALS, INTERMODAL	\$ -	\$ 433.56	\$ 168.58	\$ 970.39	\$ 1,572.52
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	\$ -	\$ -	\$ 264.11	\$ -	\$ 264.11
40 SITEWORK & SPECIAL CONDITIONS	\$ -	\$ 120.97	\$ 32.07	\$ 42.54	\$ 195.57
50 SYSTEMS	\$ 406.61	\$ 38.35	\$ 13.87	\$ -	\$ 458.84
<b>Construction Subtotal (10 - 50)</b>	<b>\$ 493.38</b>	<b>\$ 2,016.27</b>	<b>\$ 478.62</b>	<b>\$ 1,012.93</b>	<b>\$ 4,001.20</b>
60 ROW, LAND, EXISTING IMPROVEMENTS	\$ -	\$ -	\$ 210.36	\$ -	\$ 210.36
70 VEHICLES (number)	\$ -	\$ -	\$ 206.42	\$ -	\$ 206.42
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	\$ -	\$ -	\$ 1,687.32	\$ -	\$ 1,687.32
<b>Subtotal (10 - 80)</b>	<b>\$ 493.38</b>	<b>\$ 2,016.27</b>	<b>\$ 2,582.72</b>	<b>\$ 1,012.93</b>	<b>\$ 6,105.30</b>

With the addition of VTA Finance charges at \$389.72 million (YOE) to the \$6,105 million revised estimate YOE, this results in a total estimate at \$6,495 million (YOE) before the application of risk. This compares to a Sponsor estimate YOE before contingency at \$5,458 million, a resulting recommended increase of \$1,037 million (YOE).

### 2.3 Project Schedule Summary

PMOC has received VTA’s latest basis of schedule dated April 16, 2021. The latest Program schedule the PMOC has received from VTA, and against which the PMOC’s analysis and commentary has been performed, comprises ten sub-schedules each updated by the Sponsor to capture the “February 2021 Update” and all with a common data date (progress updated through) March 1, 2021. Schedules are in Oracle P6 software and are referenced P0509-01 through 10 named as follows:

1. Program Management and Administration
2. Right of Way Acquisition
3. Design
4. Advertise, Bid and Award
5. Utilities
6. Permitting
7. Construction
8. Vehicles
9. Testing and Commissioning
10. Summary

These schedules are opened together forming the Integrated Master Project Schedule (IMPS) in the Sponsor file named “MPS February 2021 Update 03-30-2021.xer.” No other schedules have been provided to the PMOC.

Table 10 below shows the key project milestones.

**Table 10 Key VTA Schedule Milestones**

<b>Milestone Planned Date</b>	
<b>General Key Milestones</b>	
Contract 1_Systems Design Bid Ready & Review	20-Jul-21
Contract 2_Tunnel & Trackwork Design Bid Ready & Review	7-Jul-21
Contract 3_Newhall Yard and Santa Clara Station Design Bid Ready & Review	31-May-22
Contract 4_Stations and Support Facilities Design Bid Ready & Review	16-Jul-21
Start of Revenue Service <i>[Note: stated as April 30 on IMPS]</i>	7-May-30
<b>Construction Contracts Key Milestones</b>	
<b>Contract 1_Systems</b>	
Contract 1 NTP Systems	27-Apr-22
Track Testing Completion	1-Feb-29
Systems Testing Completion Turn Over to BART	1-Feb-29
<b>Contract 2_Tunnel and Trackwork</b>	
Contract 2 NTP Tunnel & Trackwork	8-Apr-22
Order TBM	30-Jun-22
Deliver TBM	7-Jul-23
Start of Tunneling	9-Oct-23
Start of Trackwork	24-Aug-26
<b>Contract 3_Newhall Yard and Santa Clara Station</b>	
Contract 3 NTP Newhall Yard and Santa Clara Station and Parking Garage	29-Jun-23
Start of Santa Clara Station Fit-Out	9-Mar-23
Santa Clara Station Parking Garage Construction Completion	3-Jul-28
Newhall Yard Trackwork Completion	28-Mar-28
<b>Contract 4_Stations</b>	
Contract 4 NTP Stations and Support Facilities	27-Jul-22
Diridon Station Fit-Out Completion	19-May-28
28th Street Station Parking Garage Construction Completion	16-May-28
DTSJ Station Fit-Out Completion	23-Oct-28
28th Street Station Fit-Out Completion	25-Jan-29

VTA has identified the projects critical path in their IMPS as running primarily through the CP2 Tunnel/Track contract package until it shifts to the CP1 system installation and testing activities starting in December 2027. Procurement of the TBM, tunneling, structural concrete work in the tunnel, and track installation are critical path activities. Subsequently, the critical path shifts to systems installation and testing.

VTA have not yet developed staging and maintenance and protection of traffic (MPT) plans which they have said are in process of development and will be discussed with the City of San Jose and City of Santa Clara along with other impacted stakeholders and the communities once finalized. Input is expected from the CP2 contractor which is unlikely to be prior to award in the second quarter of 2022. MPT will be required for ventilation shaft utility relocations in streets, ground improvement access shafts and ventilation shaft SOE at a minimum.

### **3.0 BASELINE FOR RISK ASSESSMENT**

#### **3.1 Sponsor Cost Contingency**

##### **Identification of Latent and Patent Contingency**

The PMOC has identified no areas requiring adjustment or deletion to remove Latent Contingency (latent being hidden contingency in rates, quantities, or allowances). However, the PMOC has identified, as part of their recommended adjustments, an excessive removal of latent contingency as described below.

##### **Sponsor Contingency Calculation**

The Project Sponsor arrived at the estimated amount of allocated contingency for the project by applying a considered percentage addition to calculated estimate line items although these appear to have been unrelated to risk and purely based on considering estimating uncertainty.

The Sponsor's allocated contingency was not supported by their Monte Carlo risk analysis as a quantitative analysis. Allocated contingency was informed through the application of percentages on each SCC level 2 addressing uncertainty in estimating source, pricing, and quantification.

A Monte Carlo (bottom-up) cost risk analysis was carried out to calculate unallocated contingency based on identified 'discrete' cost and schedule risks. Risks contained in the VTA risk register were given a range (minimum and maximum) and a uniform distribution applied. Risk probability percentile was then used to create the Monte Carlo model. To the risk register generated risk value was added an allowance for schedule delay adopting the distribution of schedule risk taken from the schedule risk analysis and calculated by application of indirect running cost delays with an inflationary allowance. This is, in the PMOC's opinion, a crude estimation of risk and with the lack of variability applied to the allocated contingency provides a narrow range of potential overall cost risk exposure.

Table 11 below provides a summary of VTA's allocated and unallocated contingency by SCC at base year dollars and YOE dollars.

Allocated contingency amounts to 19% of SCC categories 10-80. Unallocated contingency amounts to a further 11% on SCC categories 10-80. Total contingency amounts to 29% as a percentage of SCC categories 10-80.

PMOC makes following observations regarding the Sponsor's allocated contingency as set out in Table 11.

- SCC 60, ROW, has an allocated contingency of 55% yet VTA have stated that they believe the majority of ROW has been identified in the Real Estate Management Plan (RAMP) and indeed only minor additional temporary construction easements are expected as work proceeds to cover any construction related additional working space.
- SCC 70, Vehicles, only has a 4% allocated contingency applied which is significantly below FTA guidance for a project in this stage of design and longevity

- SCC 80, Professional Services, only has a 6% allocated contingency applied which is significantly below FTA guidance for a project in this stage of design and longevity

**Table 11 Summary of Sponsor Contingency by SCC (L2)**

Sponsor Contingency Summary								
Standard SCC Codes		Base year Dollars (\$ X000)				YOE year Dollars (\$X000)		
SCC	Category	Estimate Total	Allocated Contingency	Estimate w/o Contingency	% Contingency	Estimate Total	Allocated Contingency	Estimate w/o Contingency
10	GUIDEWAY & TRACK ELEMENTS (route miles)	1,365,735	286,254	1,079,481	27%	1,525,284	319,695	1,205,590
10.06	Guideway: Underground cut & cover	97,919	14,907	83,013	18%	109,359	16,648	92,711
10.07	Guideway: Underground tunnel	1,146,971	253,299	893,672	28%	1,280,964	282,890	998,073
10.08	Guideway: Retained cut or fill	50,867	7,722	43,145	18%	56,809	8,624	48,185
10.09	Track: Direct fixation	53,760	7,928	45,832	17%	60,040	8,855	51,186
10.11	Track: Ballasted	4,526	671	3,855	17%	5,055	749	4,305
10.12	Track: Special (switches, turnouts)	11,692	1,726	9,965	17%	13,058	1,928	11,130
20	STATIONS, STOPS, TERMINALS, INTERMODAL (number)	1,391,378	234,393	1,156,985	20%	1,593,121	268,379	1,324,742
20.01	At-grade station, stop, shelter, mall, terminal, platform	76,832	11,330	65,502	17%	87,972	12,973	74,999
20.03	Underground station, stop, shelter, mall, terminal, platform	978,345	172,636	805,709	21%	1,120,200	197,667	922,533
20.04	Other stations, landings, terminals: Intermodal, ferry, trolley, etc.	145,207	22,262	122,944	18%	166,261	25,490	140,771
20.06	Automobile parking multi-story structure	85,270	12,582	72,688	17%	97,634	14,406	83,227
20.07	Elevators, escalators	105,724	15,582	90,142	17%	121,054	17,842	103,212
30	SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	234,962	35,073	199,890	18%	274,546	40,981	233,565
30.03	Heavy Maintenance Facility	160,100	24,029	136,070	18%	187,072	28,077	158,994
30.05	Yard and Yard Track	74,863	11,043	63,819	17%	87,475	12,904	74,571
40	SITEWORK & SPECIAL CONDITIONS	180,881	27,996	152,886	18%	202,357	31,320	171,038
40.01	Demolition, Clearing, Earthwork	33,180	8,696	24,484	36%	37,119	9,729	27,391
40.02	Site Utilities, Utility Relocation	133,555	17,213	116,342	15%	149,412	19,256	130,155
40.07	Automobile, bus, van accessways including roads, parking lots	14,147	2,087	12,060	17%	15,826	2,335	13,492
50	SYSTEMS	395,951	58,091	337,860	17%	471,269	69,141	402,128
50.01	Train control and signals	97,802	15,185	82,617	18%	116,406	18,074	98,333
50.03	Traction power supply: substations	162,068	23,898	138,170	17%	192,896	28,444	164,452
50.04	Traction power distribution: catenary and third rail	24,109	3,557	20,552	17%	28,696	4,234	24,461
50.05	Communications	49,739	7,333	42,405	17%	59,200	8,728	50,472
50.06	Fare collection system and equipment	39,076	5,097	33,980	15%	46,510	6,066	40,443
50.07	Central Control	23,156	3,020	20,136	15%	27,561	3,595	23,966
Construction Subtotal (10 - 50)		3,568,907	641,806	2,927,102	22%	4,066,577	763,891	3,483,897
60	ROW, LAND, EXISTING IMPROVEMENTS	309,572	109,315	200,258	55%	321,664	113,585	208,080
60.01	Purchase or lease of real estate	294,904	105,961	188,943	56%	306,423	110,100	196,323
60.02	Relocation of existing households and businesses	14,668	3,354	11,314	30%	15,241	3,485	11,756
70	VEHICLES (number)	172,698	7,098	165,600	4%	205,029	8,426	196,603
70.02	Heavy Rail	172,698	7,098	165,600	4%	205,029	8,426	196,603
80	PROFESSIONAL SERVICES (applies to Cats. 10-50)	1,251,836	71,765	1,180,071	6%	1,406,944	80,657	1,326,286
80.01	Project Development	149,473	0	149,473	0%	167,993	0	167,993
80.02	Engineering (not applicable to Small Starts)	210,913	20,313	190,600	11%	237,046	22,830	214,216
80.03	Project Management for Design and Construction	337,839	25,090	312,749	8%	379,699	28,199	351,500
80.04	Construction Administration & Management	352,795	16,800	335,995	5%	396,507	18,881	377,626
80.05	Professional Liability and other Non-Construction Insurance	43,621	2,077	41,544	5%	49,025	2,335	46,691
80.06	Legal, Permits; Review Fees by other agencies, cities, etc.	58,422	2,782	55,640	5%	65,661	3,127	62,534
80.07	Surveys, Testing, Investigation, Inspection	26,558	1,265	25,294	5%	29,849	1,421	28,428
80.08	Start up	72,216	3,439	68,777	5%	81,164	3,865	77,299
Subtotal (10 - 80)		5,303,014	829,984	4,473,030	19%	6,000,214	932,822	5,027,257
90	UNALLOCATED CONTINGENCY	475,784			11%	551,244		
Subtotal (10 - 90)		5,778,798				6,551,459		
100	FINANCE CHARGES	323,447				389,722		
Total Project Cost (10 - 100)		6,102,245			29%	6,941,181		

The PMOC concludes that the imbalance resulting from VTA’s allowances assigned to SCC 70 and, in particular, SCC 80 is forming a misleading risk profile overall across the SCCs and suggests the overall contingency is low.

### 3.2 Stripped and Adjusted Base Cost Estimate (SABCE)

In reviewing the VTA cost estimate, the PMOC has highlighted several recommended adjustments to form a SABCE ready to be used in the Top-Down risk assessment and transferred to the

associated Profile tables in the Top-Down cost risk workbook. The adjustments have been categorized into three headings:

- A. Direct adjustments
- B. Time related (schedule) adjustments
- C. Latent contingency adjustments

VTA has submitted their EPD application based upon an estimate at completion of \$6,941 million (YOE). The application contained \$389 million in finance costs. The FTA PMOC believes, based on current detail provided, the base estimate is overly optimistic and should be increased by \$1,037 (YOE) to account for low estimates, excessive stripping of contingency, additional schedule duration and low base inflation. The cost adjustments can be summarized as follows:

- A. Direct adjustments (\$156 million BY\$) for:
  - Allowance for Hazardous Material removal (\$2 million)
  - Low staffing rates and staffing shortfalls (\$154 million)
- B. Time related (schedule) adjustments (\$404 million BY\$) to account for PMOC recommended 18-month schedule adjustment broken down by Profile in Table 12 below.

**Table 12 PMOC Summary Time-Related Cost Adjustments**

	CP1 - Systems	CP2 - Tunnels and Track	CP3 - Newhall Yard and Santa Clara Station	Underground Stations	Base year Dollars
	Profile 1	Profile 2	Profile 3/ 5	Profile 4	Total
<b>10 GUIDEWAY &amp; TRACK ELEMENTS (route miles)</b>		\$ 126,015,628	\$ -	\$ -	\$ 126,015,628
10.06 Guideway: Underground cut & cover		\$ 6,831,458			\$ 6,831,458
10.07 Guideway: Underground tunnel		\$ 106,386,058			\$ 106,386,058
10.08 Guideway: Retained cut or fill		\$ 5,325,795			\$ 5,325,795
10.09 Track: Direct fixation		\$ 5,091,752			\$ 5,091,752
10.11 Track: Ballasted		\$ 535,341			\$ 535,341
10.12 Track: Special (switches, turnouts)		\$ 1,845,223			\$ 1,845,223
<b>20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)</b>		\$ 53,043,971	\$ 29,231,905	\$ 23,681,826	\$ 105,957,703
20.01 At-grade station, stop, shelter, mall, terminal, platform			\$ 8,085,598		\$ 8,085,598
20.03 Underground station, stop, shelter, mall, terminal, platform		\$ 53,043,971		\$ 13,260,993	\$ 66,304,964
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.			\$ 15,176,351		\$ 15,176,351
20.06 Automobile parking multi-story structure			\$ 4,486,330	\$ 4,486,330	\$ 8,972,661
20.07 Elevators, escalators			\$ 1,483,626	\$ 5,934,503	\$ 7,418,129
<b>30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS</b>		\$ -	\$ 13,780,361	\$ -	\$ 13,780,361
30.03 Heavy Maintenance Facility			\$ 10,497,903		\$ 10,497,903
30.05 Yard and Yard Track			\$ 3,282,458		\$ 3,282,458
<b>40 SITEWORK &amp; SPECIAL CONDITIONS</b>	\$ -	\$ 11,795,208	\$ -	\$ -	\$ 11,795,208
40.01 Demolition, Clearing, Earthwork		\$ 1,888,942			\$ 1,888,942
40.02 Site Utilities, Utility Relocation		\$ 8,975,852			\$ 8,975,852
40.07 Automobile, bus, van accessways including roads, parking lots		\$ 930,414			\$ 930,414
<b>50 SYSTEMS</b>	\$ 26,066,059	\$ -	\$ -	\$ -	\$ 26,066,059
50.01 Train control and signals	\$ 6,373,962				\$ 6,373,962
50.03 Traction power supply: substations	\$ 10,659,869				\$ 10,659,869
50.04 Traction power distribution: catenary and third rail	\$ 1,585,591				\$ 1,585,591
50.05 Communications	\$ 3,271,597				\$ 3,271,597
50.06 Fare collection system and equipment	\$ 2,621,537				\$ 2,621,537
50.07 Central Control	\$ 1,553,503				\$ 1,553,503
<b>Construction Subtotal (10 - 50)</b>	\$ 26,066,059	\$ 190,854,807	\$ 43,012,267	\$ 23,681,826	\$ 283,614,959
<b>80 PROFESSIONAL SERVICES (applies to Cats. 10-50)</b>	\$ -	\$ -	\$ 119,942,441	\$ -	\$ 119,942,441
80.02 Engineering (not applicable to Small Starts)			\$ 8,169,382		\$ 8,169,382
80.03 Project Management for Design and Construction			\$ 43,870,464		\$ 43,870,464
80.04 Construction Administration & Management			\$ 57,604,875		\$ 57,604,875
80.05 Professional Liability and other Non-Construction Insurance			\$ 5,827,463		\$ 5,827,463
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.			\$ 2,341,446		\$ 2,341,446
80.07 Surveys, Testing, Investigation, Inspection			\$ 2,128,811		\$ 2,128,811
80.08 Start up			\$ -		\$ -
<b>TOTALS (Base year Dollars)</b>	\$ 26,066,059	\$ 190,854,807	\$ 162,954,708	\$ 23,681,826	\$ 403,557,400

C. Latent contingency adjustments (refer VTA spot memo dated May 14, 2021 titled Latent contingency basis in EPD estimate):

- PMOC disagrees with contract profit reduced by 2% for each Contract Package (CP). CP1, CP3 and CP4 were adjusted from 13% to 11%. CP2 was adjusted from 15% to 13%. (\$63.2 million add back); market responses and industry inflationary pressures do not support this proposed reduction
- PMOC disagrees with TBM production rate increase by 14% (\$13.2 million add back); TBM production rate already overly optimistic
- PMOC disagrees with time-related cost savings based on improved TBM production rate (\$7.2 million add back); TBM production rate already overly optimistic
- PMOC disagrees with precast concrete tunnel lining unit price decrease (\$51m add back); significant risk in PCC lining rate due to special breakouts and reinforced sections likely to be required for corbel attachment, adit access and crossing of Silver Creek fault, and casting/production facility location is unknown
- PMOC disagrees with any reduction on base estimate geotechnical items and allowances; geotechnical allowances as estimated appear reasonable before contingency (\$38.4 million add back)

The VTA figures above total \$173 million (BY dollars) and do not align to the difference between the backup and the Build Main summary by approximately \$4.39 million (\$173.00 - \$168.6). BSVII Basis of Cost Estimate, Section 5.1.8, lists the same areas where latent contingency was shifted to allocated contingency, still not aligning with the calculated difference by SCC between the backup and the Main Build summary. Therefore, PMOC added the missing amounts back in consistent with the “arithmetic error” between the Build Main summary and the backup, which isolated it to SCC10-50 and distributed it proportionally across the contract packages. Table 14 demonstrates how the PMOC adjustment was allocated to the CPs and SCCs.

The proposed adjustment at \$168.6 million equates to approximately \$196 million YOE. Table 13 below summarizes the latent contingency add back by SCC level 2 by Profile.

**Table 13 PMOC Summary Latent Contingency Adjustment**

	CP1 - Systems	CP2 - Tunnels and Track	CP3 - Newhall Yard and Santa Clara Station	Underground Stations	Base year Dollars
	Profile 1	Profile 2	Profile 3/ 5	Profile 4	
<b>10 GUIDEWAY &amp; TRACK ELEMENTS (route miles)</b>		\$ 104,816,324	\$ -	\$ -	\$ 104,816,324
10.07 Guideway: Underground tunnel	\$ -	\$ 104,816,324	\$ -	\$ -	\$ 104,816,324
<b>20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)</b>		\$ 17,558,607	\$ -	\$ 40,970,083	\$ 58,528,690
20.03 Underground station, stop, shelter, mall, terminal, platform	\$ -	\$ 17,558,607	\$ -	\$ 40,970,083	\$ 58,528,690
<b>30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS</b>		\$ -	\$ 2,619,931	\$ -	\$ 2,619,931
30.03 Heavy Maintenance Facility	\$ -	\$ -	\$ 1,780,971	\$ -	\$ 1,780,971
30.05 Yard and Yard Track	\$ -	\$ -	\$ 838,960	\$ -	\$ 838,960
<b>40 SITEWORK &amp; SPECIAL CONDITIONS</b>		\$ (271,950)	\$ -	\$ (90,650)	\$ (362,601)
40.02 Site Utilities, Utility Relocation	\$ -	\$ (271,950)	\$ -	\$ (90,650)	\$ (362,601)
<b>50 SYSTEMS</b>	\$ 3,008,071	\$ -	\$ -	\$ -	\$ 3,008,071
50.01 Train control and signals	\$ 741,997	\$ -	\$ -	\$ -	\$ 741,997
50.03 Traction power supply: substations	\$ 1,712,483	\$ -	\$ -	\$ -	\$ 1,712,483
50.05 Communications	\$ 553,591	\$ -	\$ -	\$ -	\$ 553,591
<b>Construction Subtotal (10 - 50)</b>	\$ 3,008,071	\$ 122,102,981	\$ 2,619,931	\$ 40,879,433	\$ 168,610,416



### 3.3 Escalation and Inflation Review

VTA has estimated the cost of the project using 2020 as the base year and stated an internal RSD of May 7, 2030. The RSD after contingency was stated in the VTA RCMP and the IMPS schedule as September 15, 2032. The total cost included in the VTA EPD submission for inflation is \$839 million (\$6,941 – \$6,102 million).

An annual escalation rate of 2.72% was used by VTA within its Inflation Worksheets for 2021 to arrive at this inflation value.

VTA have issued quarterly market saturation study reports with the most recent copied to the PMOC being Bulletin No. 8.1 dated May 3, 2021 covering the period through December 2020. This report recommended an increase in annual inflation, termed ‘compound annual growth rate’ (CAGR) in the May 2021 market saturation study (MSS) report to 2.95%.

No sensitivity analysis was performed by VTA on inflationary impact (material, labor or equipment) sensitivities or potential spikes in particular trades. No account was taken in the most recent market saturation report of potential TOD driven local inflation, labor shortages, materials shortages and sub-contractor bidding preferences which may arise through the planned extensive and concurrent development notably around Diridon Station and 28th Street Station.

The PMOC notes the May 2021 MSS was prior to:

- The Presidential inauguration.
- The release under emergency approvals by the CDC of now three COVID-19 vaccines and the significant opening up of the economy which is continuing to occur in all sectors.
- The now current President’s proposed infrastructure stimulus packages.
- Supply and demand driven materials shortages and labor wage pressures, increasing gas prices and shortages of computer chips increasing new and used vehicle prices; and
- Engineering News Record’s most recent reports of significant inflationary pressures well above the historic average 3.50% level.

The PMOC further notes:

- The Los Angeles Olympics schedule-driven infrastructure program is soon to command dominance in the California construction market and
- The continuing and increased expenditure of the California High Speed Rail project as the valley-to-valley engineering gains momentum with the environmental clearances increasingly reaching their RODs

In the PMOC’s opinion, the 2.72% inflation rate applied is insufficient to cover reasonable inflation over the planned duration of the project given the potential current inflationary bubble being experienced and, in the PMOC’s opinion, the likelihood inflation will continue to stay above average historic levels for the next 1-2 years and possibly longer.

This period of higher than average inflationary coincides with the main bidding period for all main construction packages. VTA have stated fixed price bids are to be requested for contracts lasting

up to 7 years in duration. VTA, however, have not stated any clear policy on financing zero-cash-flow through escrow accounts, payment in advance of completion for work planned to be completed, escalation formula adjustments or other such risk mitigation measures to reduce contractor exposure.

The PMOC recommends a 3.50% annual inflation allowance is applied to the base year dollar values. This adjustment equates to \$185 million when applied to the VTA base year dollar estimate prior to the addition of PMOC adjustments as outlined above.

Table 14 below summarizes the inflated adjusted SABCE and the Sponsor contingency summary.

**Table 14 Summary PMOC Inflated Adjusted SABCE**

Sponsor Contingency Summary with PMOC Adjustments											
Standard SCC Codes		Base year Dollars (\$ X000)					YOE year Dollars (\$X000)				
SCC	Category	Estimate Total	Allocated Contingency	Estimate w/o Contingency	Cost Adjustments	Adjusted Estimate	Estimate Total	Inflation Adjustment	Infl Adj. YOE Estimate	YOE PMOC Adjustments	Adjusted Estimate
<b>10 GUIDEWAY &amp; TRACK ELEMENTS (route miles)</b>											
		1,365,735	286,254	1,079,481	230,832	1,310,313	1,205,590	38,527	1,244,116	266,037	1,510,153
10.06	Guideway: Underground cut & cover	97,919	14,907	83,013	6,831	89,844	92,711	2,963	95,673	7,873	103,547
10.07	Guideway: Underground tunnel	1,146,971	253,299	893,672	211,202	1,104,874	998,073	31,895	1,029,968	243,413	1,273,382
10.08	Guideway: Retained cut or fill	50,867	7,722	43,145	5,326	48,470	48,185	1,540	49,725	6,138	55,863
10.09	Track: Direct fixation	53,760	7,928	45,832	5,092	50,923	51,186	1,636	52,822	5,868	58,690
10.11	Track: Ballasted	4,526	671	3,855	535	4,390	4,305	138	4,443	617	5,060
10.12	Track: Special (switches, turnouts)	11,692	1,726	9,965	1,845	11,811	11,130	356	11,485	2,127	13,612
<b>20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)</b>											
		1,391,378	234,393	1,156,985	164,486	1,321,472	1,324,742	52,044	1,376,786	195,735	1,572,521
20.01	At-grade station, stop, shelter, mall, terminal, platform	76,832	11,330	65,502	8,086	73,587	74,999	2,946	77,946	9,622	87,567
20.03	Underground station, stop, shelter, mall, terminal, platform	978,345	172,636	805,709	124,834	930,543	922,533	36,243	958,776	148,549	1,107,325
20.04	Other stations, landings, terminals: intermodal, ferry, trolley, etc.	145,207	22,262	122,944	15,176	138,121	140,771	5,530	146,301	18,060	164,360
20.06	Automobile parking multi-story structure	85,270	12,582	72,688	8,973	81,661	83,227	3,270	86,497	10,677	97,174
20.07	Elevators, escalators	105,724	15,582	90,142	7,418	97,560	103,212	4,055	107,267	8,827	116,094
<b>30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS</b>											
		234,962	35,073	199,890	16,400	216,290	233,565	10,518	244,083	20,026	264,109
30.03	Heavy Maintenance Facility	160,100	24,029	136,070	12,279	148,349	158,994	7,160	166,154	14,994	181,147
30.05	Yard and Yard Track	74,863	11,043	63,819	4,121	67,941	74,571	3,358	77,929	5,033	82,961
<b>40 SITEWORK &amp; SPECIAL CONDITIONS</b>											
		180,881	27,996	152,886	16,433	169,318	171,038	5,555	176,592	18,981	195,573
40.01	Demolition, Clearing, Earthwork	33,180	8,696	24,484	1,889	26,373	27,391	890	28,280	2,182	30,462
40.02	Site Utilities, Utility Relocation	133,555	17,213	116,342	8,613	124,955	130,155	4,227	134,382	9,949	144,331
40.07	Automobile, bus, van accessways including roads, parking lots	14,147	2,087	12,060	930	12,990	13,492	438	13,930	1,075	15,004
<b>50 SYSTEMS</b>											
		395,951	58,091	337,860	29,074	366,934	402,128	20,355	422,483	36,356	458,839
50.01	Train control and signals	97,802	15,185	82,617	7,116	89,733	98,333	4,977	103,310	8,898	112,208
50.03	Traction power supply: substations	162,068	23,898	138,170	12,372	150,542	164,452	8,324	172,777	15,471	188,248
50.04	Traction power distribution: catenary and third rail	24,109	3,557	20,552	1,586	22,138	24,461	1,238	25,700	1,983	27,682
50.05	Communications	49,739	7,333	42,405	3,825	46,231	50,472	2,555	53,027	4,783	57,810
50.06	Fare collection system and equipment	39,076	5,097	33,980	2,622	36,601	40,443	2,047	42,490	3,278	45,768
50.07	Central Control	23,156	3,020	20,136	1,554	21,690	23,966	1,213	25,179	1,943	27,122
<b>Construction Subtotal (10 - 50)</b>											
		3,568,907	641,806	2,927,102	457,225	3,384,327	3,337,062	126,998	3,464,060	537,135	4,001,195
<b>60 ROW, LAND, EXISTING IMPROVEMENTS</b>											
		309,572	109,315	200,258	0	200,258	208,080	2,285	210,365	0	210,365
60.01	Purchase or lease of real estate	294,904	105,961	188,943	0	188,943	196,323	2,156	198,480	0	198,480
60.02	Relocation of existing households and businesses	14,668	3,354	11,314	0	11,314	11,756	129	11,885	0	11,885
<b>70 VEHICLES (number)</b>											
		172,698	7,098	165,600	0	165,600	196,603	9,813	206,415	0	206,415
70.02	Heavy Rail	172,698	7,098	165,600	0	165,600	196,603	9,813	206,415	0	206,415
<b>80 PROFESSIONAL SERVICES (applies to Cats. 10-50)</b>											
		1,251,836	71,765	1,180,071	270,942	1,451,013	1,326,286	45,966	1,372,253	315,067	1,687,320
80.01	Project Development	149,473	0	149,473	0	149,473	167,993	5,822	173,815	0	173,815
80.02	Engineering (not applicable to Small Starts)	210,913	20,313	190,600	39,862	230,462	214,216	7,424	221,640	46,354	267,994
80.03	Project Management for Design and Construction	337,839	25,090	312,749	95,874	408,623	351,500	12,182	363,682	111,487	475,169
80.04	Construction Administration & Management	352,795	16,800	335,995	113,473	449,468	377,626	13,088	390,714	131,953	522,667
80.05	Professional Liability and other Non-Construction Insurance	43,621	2,077	41,544	5,827	47,371	46,691	1,618	48,309	6,777	55,086
80.06	Legal; Permits; Review Fees by other agencies, cities, etc.	58,422	2,782	55,640	2,341	57,981	62,534	2,167	64,701	2,723	67,424
80.07	Surveys, Testing, Investigation, Inspection	26,558	1,265	25,294	2,129	27,422	28,428	985	29,413	2,476	31,888
80.08	Start up	72,216	3,439	68,777	11,436	80,213	77,299	2,679	79,978	13,299	93,277
<b>Subtotal (10 - 80)</b>		<b>5,303,014</b>	<b>829,984</b>	<b>4,473,030</b>	<b>728,168</b>	<b>5,201,198</b>	<b>5,068,031</b>	<b>185,063</b>	<b>5,253,093</b>	<b>852,202</b>	<b>6,105,295</b>

### 3.4 Sponsor Schedule Contingency

The basis of schedule (Revision No. E dated April 16, 2021) refers to ‘Schedule Contingency.’ More specifically, it states that the IMPS does not include any allocated contingencies with regards to activity durations.

With the April 2021 EPD application submission, the Program duration from EPD application to the RSD (early) of May 2030 is 110 months.

In the risk and contingency management plan (RCMP) (Revision No. 0.C dated April 16, 2021) VTA have calculated the schedule contingency required to achieve 25% of their IMPS (which

VTA have stated is stripped and adjusted) as 28-month which when added to the Baseline Schedule Completion RSD (early) of May 2030 results in an RSD (late) of September 2032.

In the PMOC's opinion the unallocated contingency as currently presented in the VTA schedule, and before the PMOC's recommended adjustments, is insufficient to buffer schedule uncertainty and the identified risks.

### **3.5 Stripped and Adjusted Base Schedule (SABS)**

The PMOC has carefully considered the issues described in this report. The PMOC has reviewed allowances for normal weather and other delays, the multiple work zones and the early developing Newhall Yard staging and phasing, details of which have only recently been developed and provided to the PMOC.

The project schedule is highly influenced by input required from the CP2 PDB tunnels and trackwork contractor relating to:

- Time for on-boarding after the CP2 Notice to Proceed (NTP), office establishing, BIM model integration, initial critical design progression and stakeholder approvals of proposed means and methods and validation of critical construction working and access space (potentially requiring additional property, temporary or permanent) overall space proofing and tunnel diameter confirmation
- Utility owner (public and private) ability to meet the schedule required access dates for utility relocations (no schedule or cost commitments understood to have been provided by any Utility owner at this time)
- Negotiations, and potential unforeseen impacts to design progression, to reach a lump sum price for the CP2 scope (by the proposed NTP2 milestone)
- Design interfaces yet to be fully worked through between CP2, CP1(systems), CP3 (Newhall Yard notably phasing and handover and site earth fill to make up levels) and CP4 (contractual interfaces at tunnel / underground station fit outs)
- Tunnel boring machine type, manufacturer, detailed specification, and related manufacturing and delivery period
- Tunnel concrete liner design, joint waterproofing, the seismic isolation design detailing, and the special reinforced sections and ductile iron sections required at adit breakouts and at the Silver Creek fault crossing
- Spoil (muck) treatment and disposal strategy
- Tunnel, station box and ventilation facility buoyancy control
- Approach (means and methods) of tunnel structural fit out with particular reference to the attachment of the horizontal slab corbels to the concrete tunnel liner
- Dewatering, ground de-pressurization, ground treatment, ground stabilization and overall ground and property (including existing utilities) monitoring
- Construction staging areas and subsequent sharing / release to other contractors
- Sequence, interface, and access to follow on contractors particularly in completion of the underground station structures and systems installations

All the above activities, and these are a sample of issues to be urgently resolved once the CP2 contractor is on-boarded, highly influence the entire project schedule, construction interfaces and risk sharing.

The IMPS is highly influenced by the tunnel mining productivity rate. A reduced advance rate provides additional time for relocation of utilities, ground treatment and construction of SOE for portals, approach works, stations and ventilation facilities and reduces the risk of interface delays should the tunnel mining be delayed. In the PMOC's opinion the VTA baseline schedule assumes an overly ambitious tunnel mining rate which in turn results in significant lack of float at the critical interfaces making the entire project highly risky and exposed to contractual claims for delay and disruption. The procurement of CP1, CP3 and CP4 against these highly ambitious access dates from the tunnel mining is likely to result in contractual disputes from the outset whilst making the negotiation of a lump sum for the CP2 PDB contract increasingly challenging.

At this still early stage in the design and procurement process the PMOC believes historic norms must be applied and a conservative approach to risk taken. In this regard the PMOC is of the opinion that:

- VTA have overly stripped the project schedule
- The tunnel mining rate is overly optimistic and inconsistent with similar large diameter tunnels in urban environments
- With the significant critical means and methods to be developed as the CP2, and the other construction packages, proceed through the procurement process schedule contingency must be based on a robust baseline schedule

After careful consideration the PMOC recommends an overall adjustment to the VTA RSD (as reported in the latest schedule submitted March 2021 with progress updated through March 1, 2021), of **18 months** resulting in a revised RSD, before contingency, of November 7, 2031.

There follows a description of adjustments made to the VTA schedule, both critical and non-critical path (and before the application of risk) to provide a 'stripped and adjusted base schedule'.

### **Critical Path Impacting Adjustments**

1. VTA IMPS allowance for mobilization after NTP1 of CP2 fails to allow sufficient time to establish an integrated office environment, BIM system model transfer and integration, staffing establishment and logistics. This period typically takes 3 to 6 months however with the PDB approach and advancements in remote working seen under the COVID-19 restrictions PMOC has constrained its proposed additional time to **1 month** (note 2 months activity duration but only 1 month critical path impact) for the minimum required prior to a realistic start-up in the VTA project office.
2. VTA IMPS allows slightly less than 12 months from award of a TBM contract to a delivery to the Newhall Yard site covering design, manufacture, factory testing and delivery (Order placed June 28, 2022 through delivery on June 30, 2023). VTA have included a very high risk (95% probability) in their risk register (ref. 9/30/20 Risk ID BSV-139) of a delay in the manufacturing period. The note included against this risk states "The team estimated a

22-month duration for procurement. Very high likelihood of a 4 to 6-month delay to the current plan.” In the PMOC’s opinion this base duration is too low and has increased the duration by **3 months** to 15 months commensurate with feedback from typical industry procurement timelines.

3. VTA IMPS is based on a tunnel daily production rate (6 days / week) of between 40 and 50 feet per day and calculates to an overall average of 44 feet per day. References to similar large diameter tunnels have been provided by VTA in two reports:
  - Constructability review report Rev.0, August 17, 2020 (see Table 15 below) and
  - Project Spot memo: Supplemental Risk Information dated May 17, 2021 see Table 16 below)

**Table 15 Large TBM References (from 2020 Constructability Report)**

U.S. Project Name	Length (miles)	TBM Diameter (feet)	State	Tunneling Status	TBM Type	Comments
SR99 Bored Tunnel	1.75	57	WA	Complete	1 x EPB	TBM damage
Thimble Shoal Tunnel	1	43	VA	Starting 2021	1 x EPB	Construction started 2017
Port of Miami Tunnel	2 x 0.8	43	FL	Complete	1 x EPB/Slurry	Two tunnels, one TBM
Hampton-Roads Bridge Tunnel	2 x 1.5	45	VA	Starting 2021	1 x Slurry	Two tunnels, one TBM

International Project Name	Length (miles)	TBM Diameter (feet)	Country	Tunneling Status	TBM Type	Comments
Tokyo Outer Ring	2 x 5.6	53	Japan	Ongoing	2 x EPB	Hydrostatic head up to 7 bar
Galleria Santa Lucia	4.69	52	Italy	97% complete	1 x EPB	
Changjiang Yangtse River Crossing	2 x 4.4	50	China	Complete	2 x Slurry	Water pressure up to 6.5 bar
Yangtze River Tunnel	4.4	51	China	Complete	1 x Slurry	
Bei Heng Motorway	4	51	China	Complete	1 x Slurry	
Elbe Crossing	2 x 3.7	47	Germany	Design complete	Pressurized Face	
Tuen Mun - Chek Lap Kok Link, Hong Kong	3.5	57	China	Complete	1 x Slurry	Only 2,120 feet at 57.6-foot diameter, then converted to 46 foot-diameter
Brixlegg Tunnels	3.4	43	Austria	Complete	1 x Slurry	
New Ahmed Hamdi Tunnel	3.3	43	Egypt	88% complete	1 x Slurry	Suez Canal Crossing
Suez Crossing Ismailia	2 x 2.9	43	Egypt	Complete	2 x Slurry	

**Table 16 Large TBM References (from May 2021 Risk Spot Memo)**

Past Large-bore (>36' Diameter) Tunnel Projects

Project	Advance Rate (ft / week)
Barcelona	57.4
Hamburg Elbtunnel	68.6
Maskau I & 2	103.3
Kuala I & II	127.8
Westerschelde I & II	172.9
Shanghai I & II	238.7
Katzenberg Ost & West	261.1
Yangtze River Tunnel	275.8
Alaskan Way Viaduct Replacement (SR-99)	280
Waterview Connection	321.3
Madrid M30	328.3
Sparvo Tunnel	367.5
Caltanissetta Tunnel	413

VTA BSV EPD Schedule	
	Advance Rate (ft / week)
VTA BSV	247

TBM references provided in Table 15 above from the 2020 Constructability report did not provide production rates. TBM references provided in Table 16 above from the 2021 risk spot memo report provided production rates per week but no details were provided of what the definition of a ‘week’ was. In neither table were background details expanded to provide location, environment, ground conditions, issues encountered, whether the production rates included or excluded stoppages and so on.

The PMOC has investigated from web articles and other sources additional details of each of the named tunnel references. Table 17 below provides a summary of the findings:

**Table 17 Large TBM Research by PMOC**

Name	Location	Status	TBM Dia [Ft]	Length Ft	Type	Env of X'ing	Drive Rate Source	Adv / Wk	Equiv / Day based on 6d/Wk	Comments / Notes
Alaska Way	USA	Complete	57	9270	Highway	URBAN	VTA	280	47	Drive rate incorrect - likely excl stoppages
							Wikipedia	41	7	Researched actual incl break down / recovery
Thimble Shoal [Chesapeake Bay 2nd Parallel tunnel]	USA	Ongoing	42	5,280	Highway	SEA	PMOC / Internet		NO DETAILS	TBM ready but 2 years delayed due to permitting and portal design works
Port of Miami	USA	Complete	43	7,800	Highway	SEA	PMOC / Internet	105	18	2 drives, one TBM, 3,900 each way ; planned advance rate was 25 ft / day
Hampton Roads	USA	Not started	45						NO DETAILS	Not relevant
Tokyo Outer Ring	Japan	Ongoing	53	29,568	Highway	URBAN	PMOC / Internet		NO DETAILS	Oct 2021 : News reports additional collapses / Project threatened with cancellation - latest Feb 2021 "Tunnelling blamed for Tokyo sinkholes"
Galleria Santa Lucia	Italy	Ongoing	52	24,763	Highway	ALPINE	PMOC / Internet	234	39	
Changiang Yantse River Crossing	China	Complete	50	23,232					NO DETAILS	
Yangtze River Tunnel	China	Complete	51	23,232	Highway	RIVER	VTA	276	46	
Bei Heng Motorway	China	Complete	51	21,120	Highway	RIVER	PMOC / Internet	510	85	
New' Elbe Crossing	Germany	Not started	47	19,536	Highway	RIVER			NO DETAILS	
Tuen Mun - Chep Lap Kok Link	Hong Kong	Complete	57	16,404	Highway	SEA	PMOC / Internet		NO DETAILS	2 year construction delay quoted in press
Brixlegg	Austria	Complete	43	17,952					NO DETAILS	NATM not TBM ?
New Ahmed Hamdi	Egypt	Ongoing	43	17,424	Highway	CANAL			NO DETAILS	Tunnel enlargement of old tunnel / Not relevant
Suez Crossing	Egypt	Complete	43	15,312	Highway	CANAL	PMOC / Internet	396	66	Best advance rate quoted
Barcelona	Spain	Ongoing / Complete		Varies	Rail	URBAN	VTA	57	10	
Hamburgh Elbe	Germany				Highway	RIVER	VTA	69	11	Can not find reference
Maskau 1 + 2							VTA	103	17	Can not find reference
Kuala 1 & 11	Malaysia	Ph 1 Complete ; Phase 2 ?	NO DETAILS	NO DETAILS	METRO	URBAN	VTA	128	21	Quote from web article : "We had two standard slurry machines on that project and we did suffer about 50 sinkholes and escape of slurry to the surface. This did cause disruption to the city streets and delays in tunnelling."
Western scheldt 1 & 11	Netherlands	Complete		21,648	Highway	ESTUARY	VTA	239	40	Quoted as immersed tube not TBM
Katzenberg Ost & West	Switzerland	Complete	37	29,475	RAIL	ALPINE	VTA	261	44	Wikipedia Quoted Dia 37 feet - twin tunnels not Large Bore
Waterview Connection	N. Zealand	Complete	43	7,874	Highway	ALPINE	VTA	321	54	Twin tunnels each 2.5km long ; only 'just large bore'
Madrid M30	Spain	Complete	49	23,661	Highway	NOT CLEAR	VTA	328	55	
Sparvo	Italy	Complete	51	7,917	Highway	ALPINE / FIELDS	VTA	368	61	Twin bores [one machine; each 7917m long - first drive 12 months]

Appears VTA quoted 'peak drive rate' not average drive rate ; WEB Article says 'peak values achieved on 2nd bore [same machine] were 24/m per day = 78 ft / day ; Web article states first bore 12 months = av 25ft / day

An analysis of Table 17 above provides the following observations:

- Out of all the tunnel references provided by VTA in their two reference documents provided to the PMOC only four are in urban environments and out of these only two are rail tunnels (Barcelona [Spain] and Kuala I & II [Malaysia])
- Barcelona is quoted by VTA with a daily production rate of 10 feet per day; Kuala I & II is quoted by VTA with a daily production rate of 21 feet per day
- Barcelona is known to be fraught with delays and problems
- Referencing Kuala I & II a recent article on the 'web' stated: "We had two standard slurry machines on that project and we did suffer about 50 sinkholes and escape of slurry to the surface. This did cause disruption to the city streets and delays in tunneling."
- Two large diameter tunnels, similar to the size proposed for BSVII, have been completed in the USA over recent years and both referenced by VTA above: Port of Miami highway tunnel and SR99 highway tunnel (Alaska Way Seattle). PMOC has researched Port of Miami tunnel and calculated an approximate average overall daily production rate achieved of 18 feet per day. Seattle SR99 was quoted by VTA as achieving a daily production rate of 47 feet per day however PMOC suggests this was excluding the significant stoppages that occurred and "rescue" operation to replace the main bearing. When the overall duration from TBM launch to TBM final breakthrough is calculated the actual average daily production rate equates to just 7 feet per day.

- Tunnel references to under water and / or under mountain / hill / rural terrain, especially in countries having lesser environmental and safety regulations compared to that of the USA, are in the PMOC’s opinion not directly comparable. In addition, the BSVII project has several critical interfaces which many of the quoted references above do not have being typically A to B drives.
- The first tunnel referenced in the 2020 constructability report (now removed from the most recent May 2021 memo), the Tokyo Outer Ring highway tunnel, was reported in February 2021 in press articles as “*continuing to suffer reports of sinkholes.*”

The PMOC has also reviewed the responses to questions and outreach conducted by VTA over the period August 2020 through March 2021. Specific to the CP2 Tunnels and Trackwork contract package six tunnel consortia responded to RFIF requests and attended interviews with VTA. As part of the responses each provided indicative TBM overall mining durations (before risk and, in some cases, it appeared, excluding normal maintenance allowances). Table 18 below lists the CP2 RFIF mining duration responses. Please note those respondents chosen as bidders for CP2 are marked\*; PMOC was notified of the selection and announcement during the FTA risk workshop.

**Table 18 CP2 Mining Duration Responses from VTA RFIF Process**

Consortia lead	Overall Mining Duration [Months]
Bechtel	30.0
Ferrovial	24.5
Tutor	54.0
CBNA *	24.0
Dragardos	45.0
Kiewitt *	46.0 excludes stoppages add say 2 m (44+2)
Arconia *	22.0
	245.5
average	35.1 months
<i>if discount the 22/24 months as low ball</i>	
	175
average	43.8 months
average of 'average'	39.4 months

By comparison, the overall mining duration included in the VTA IMPS is 24.7 months.

The VTA IMPS assumes and includes 3 planned maintenance interventions to inspect and replace as needed TBM cutters and conduct other TBM routine maintenance. These are highlighted in Table 19 below at the Stockton Street ventilation facility, at the 13th Street ventilation facility and at the 28th Street station box. The total tunnel drive is 24,929 feet. The VTA IMPS calculates the overall daily production rate at 43.97 feet / day (including allowance stated for the three planned maintenance interventions).

The PMOC considers this average overall planned production rate overly optimistic and well above comparable projects as detailed above. Table 19 below provides, against each drive, the PMOC’s opinion of an ambitious production rate of between 25 and 30 feet per day ignoring initial



break through and first 300 feet of drive. PMOC also considers the baseline schedule should include for planned maintenance interventions on average after each mile driven or at least at each intersection with a ventilation or station structure. The PMOC therefore recommends maintenance interventions be included at:

1. Stockton Street Ventilation Facility
2. Diridon Station
3. DTSJ Station
4. 13th Street Station
5. 28th Street Station

Taking the recommended reduced tunnel production rate and additional proposed planned maintenance interventions into consideration the PMOC recommends an average overall daily production rate of 27.73 feet / day. This equates to an overall mining duration of approximately 38.5 months compared to VTA’s proposed 24.7 months and the average ‘of averages’ from the RFIF process of 39.4 months. The PMOC considers this is still very ambitious, is likely to result in challenges to negotiate with the selected CP2 contractor and anticipates further risk to be negotiated on top of this adjusted production rate. The resulting recommended adjustment to the schedule critical path is **14 months**.

**Table 19 Mining Productivity Analysis and Adjustment Summary**

TUNNEL DRIVE		VTA PLAN			PMOC RECOMMENDED PLAN			
		6 day working week			6 day working week			
From	To	Feet	Duration Days	Ft / day	Ft / day	Mining duration	Intervention Duration	Total Dur
<i>Break through Head Wall and Eye</i>			16			16		16
West Portal	First 300ft	300	13	23	10	30		30
First 300ft	Stockton WVSF	4,800	120	40	25	192		192
	Distance driven before maintenance	5,100						-
<i>PLANNED MAINTENANCE / TRANSITION (Stockton WV facility)</i>			20				20	20
Stockton WVSF	Diridon Sta	4,365	109	40	30	146	18	164
Diridon Sta	DTSJ Sta	3,819	76	50	30	127	18	145
DTSJ Sta	EVSF	3,909	78	50	30	130		130
	Distance driven before maintenance	12,093						-
<i>PLANNED MAINTENANCE / TRANSITION [13th Street EV facility]</i>			20				20	20
EVSF	28th Street Sta	4,984	100	50	30	166		166
	Distance driven before maintenance	4,984						-
<i>PLANNED MAINTENANCE / TRANSITION [28th street]</i>			18				24	24
28th Street Sta	East Portal	2,752	55	50	30	92		92
NOTE KEY: Planned working day durations for Interventions to conduct routine maintenance on the TBM cutter head which may be under hydrostatic pressure to permit man access to TBM face / excavation chamber or in open air (as planned in 28th Street station box)			VTA	PMOC	EXTRA PMOC OVER VTA			
	Wk days [6/WK]		625	999				999
			0	0				625
			625	999			extra work days added	374
	wk d/wk		6	6			work days per week	6
	cal weeks		104.17	166.49			working [cal]weeks	62.33
	weeks / month		4.33	4.33				4.33
	months		24.06	38.45			month added	14.39
	years		2.00	3.20			years added	1.20
			VTA			PMOC		
		Ft driven	Total drive days	Av / Day		Total drive days	Av / Day	
		24,929	567	43.97		899	27.73	

The resulting overall impact to the VTA IMPS critical path from the above recommended adjustments is **18 months**.

## Non-Critical Path (Before Risk) Impacting Adjustments

1. VTA IMPS is missing any successor to the FTA EPD process award. Change logic to tie with NTP's of each contract - FTA/FFGA will 'not stop' VTA releasing RFP's to market. VTA have pre-award authority equivalent to a standard Capital Investment Grants project in Project Development phase that has completed NEPA. Note that the PMOC has no risk included for VTA failure to progress activities where pre-award authority exists
2. VTA IMPS does not include any additional geotechnical investigations. The likelihood of further investigations in the adit locations was stated as high and in order to potentially apply risk a placeholder activity is required in the schedule. Add an activity for boreholes at all station adits during first 6 months of the CP2 NTP/ through CP2 NTP/2 period as a placeholder and link to (make predecessor to) PDB NTP/2
3. VTA IMPS includes summary schedule logic for parcel acquisitions with multiple instances of latent contingency which requires 'stripping'. Change all ROW property acquisitions durations to reflect a 90 day 'quick take' process in place of 'effective possession period' (Effective possession duration adjusted to 3 months = 65 working days; Relocation duration adjusted to 6 months = 130 working days)
4. VTA IMPS is outdated as regards procurement and engagement of the CP construction managers. Extend durations of procurement of all CM's to tie with NTP of each construction package (3-month lag Finish to Start to allow for mobilization)
5. VTA IMPS period of CP1 procurement overlap with CP2 is believed too aggressive. Extend duration of CP1 procurement by 3 months to provide additional time for bidding and stagger receipt of bids
6. VTA IMPS period for review of CP1 bids believed too aggressive. Review period unrealistic for this size package taking into account BIM model coordination and incorporation of best and final offers process (BAFO) with feedback from CP2. Extend review period to 7 months
7. VTA IMPS significantly overlaps the TBM delivery and assembly with the construction of the west portal approaches and west cut and cover approach structures. Three months is allowed for the TBM assembly which is shown to take place in parallel with the portal area excavations and approach structures ground improvements and site preparations. In the PMOC's opinion and given the ground improvement and dewatering required and the fact that the TBM assembly ground slab will be required to support logistics in and out of the tunnel for some considerable time, this logic is unrealistic. The PMOC has changed the schedule logic to reflect this preparation work must be completed before the TBM assembly and site testing can commence. This logic change adds 3 months to the base schedule but has not resulted in a critical path impact due to embedded leads and lags in the VTA IMPS.
8. VTA IMPS shows significant overlap of tunnel structural concrete fit out with tunnel mining operations. PMOC is of the opinion the overlap shown is overly ambitious taking account of the challenges in soil ballast placement in the tunnel invert sections, fixing of the corbel support structures and the many interface constraints at ventilation shafts, station and ventilation shaft adit connections and station box locations. PMOC has adjusted tunnel concrete fit out durations adding 6 months overall duration to these operations. However,

no impact is shown to the critical path as the recommended reduced tunnel mining production rate induces float in these otherwise critical / near critical activities.

9. VTA IMPS has no activity for 'special trackwork'. PMOC has added for the purposes of risk identification. No impact to the project critical path.
10. Additional activities have been added into the PMOC's summary schedule reflecting VTA's most recent phasing and staging plans for Newhall Yard as well as including site fill operations. These have the effect of delaying commencement of CP3 Newhall Yard and Santa Clara contract works but have no impact to the project critical path.
11. VTA IMPS has no successor to vehicle manufacture and delivery. VTA have advised testing and start up can be undertaken using the existing fleet. Make RSD successor to vehicle procurement.
12. Various logic and duration changes were introduced to expand the very high-level detail contained in the VTA IMPS for underground station fit out and associated interfacing with systems installations, testing and start-up. None of these logic changes impact to the project critical path.

All adjustments described above have been applied to the FTA PMOC's summary schedule developed from the sponsor's IMPS. This summary schedule is described in more detail under the 'schedule risk assessment' section which follows below in this report.

## **4.0 RISK IDENTIFICATION**

### **4.1 Introduction**

The BSVII is a project in the new FTA EPD Pilot Program. The risk assessment on the BSVII has been conducted following the FTA OP 40c Risk and Contingency Management guidance modified where necessary to align with the EPD process. The project is a ‘mega project’ and is at an early stage of design.

The PMOC has completed a Scope, Cost and Schedule review in parallel with preparing for and conducting the OP 40c risk assessment. PMOC has also completed a review of the Sponsors PMP in addition to reviewing the Sponsors capacity and capability, safety and security management, quality assurance and quality management procedures and property acquisition plan.

Design is progressing at a pace commensurate with establishing and validating alignment, space and capacities ahead of procurement of a main civils works contractor to undertake the tunneling and trackwork under a PDB form of contract targeted for appointment in the second quarter of 2022.

This section of the report details the risk identification process, the FTA compressed risk workshop and the results of the cost and schedule risk assessment. The PMOC has also reviewed the Sponsors Risk and Contingency Management Plan (RCMP). The risk assessment builds from the SABCE and SABS described in the previous section of the report.

Following this section, the PMOC presents their cost and schedule risk assessment, results and recommendations for contingency capacity and risk mitigation.

### **4.2 Overview of Process**

The PMOC has received project documentation from the Sponsor through their ongoing monitoring role however the risk assessment is based on final documentation, and latest revisions of previously issued documentation, received on or before May 14, 2021.

A compressed FTA risk workshop was held over six 2-hour virtual “TEAMS” sessions on Monday May 10, Tuesday May 11, and Wednesday May 12, 2021. Prior to the risk workshop information and Question and Answer sessions were provided by the Sponsor to inform the PMOC of scope, cost, and schedule. The sessions included a review of the Sponsors Building Information Management (BIM) interactive integrated design Model. The information sessions included status presentations on utility relocation proposals, property acquisitions, ground improvements and structural design proposals in addition to space proofing and fire/life/safety and evacuation modelling proposals.

The PMOC has reviewed the Sponsors risk register. As a result of reviews, the PMOC team has proposed some different assessments to the current risks (probability and / or impact) and added additional risks to the Sponsors risk register. The output risk register from the FTA risk workshop is included as Appendix F.

### **4.3 FTA Risk Workshop**

The risk workshop was held “virtually” over three days. The attendees at the workshop are included as Appendix D and the workshop agenda is included as Appendix E. Two 2-hour “virtual” sessions were held each day. Format of the risk workshop was as follows:

#### **Session 1**

- Introductions and Opening Remarks
- Project introduction and virtual site visit

#### **Session 2**

- Baseline Scope, Project Management, and Contracting Scheme
- Baseline Schedule

#### **Session 3**

- Baseline Cost
- Schedule and Cost Contingencies

#### **Session 4**

- “My top risk” round table
- VTA Risk Register – recent updates
- VTA Risk Register – top 10 risks

#### **Session 5**

- Conclude discussions on VTA Top Risks
- Presentation by VTA on basis for ground improvement cost estimation, potential innovations by DB’s and further clarifications on PMOC scope, cost and schedule review
- PMOC proposed top 10 risks discussion.

#### **Session 6 a/b**

- Reserved for follow-up topics from previous sessions.
- Wrap-up, Next actions, Closing Formalities.

PowerPoint presentations provided by the Sponsor are included as Appendix G and the PMOC’s summary PowerPoint presentations from the workshop are included as Appendix H. The SABCE and SABS are presented in the Quantitative section of this report immediately following this section.

The review of the PMOC’s observations and recommended changes to the Sponsors risk register were discussed in summary during the 3<sup>rd</sup> day of the workshop (Session 5). Workshop time constraints limited discussions to only the most significant risks including the PMOC’s proposed adjusted “Top Risks.” PMOC proposed additional risks were presented but not further discussed.

The PMOC took account of discussion, new information, comments, and responses to questions during the 6-session (1 ½ day) risk workshop and has used this to inform the risk assessment presented in the Quantitative section of this report. All assessments are pre-mitigated and the PMOC provides recommendations at the end of this report and actions to be taken to mitigate risk.

### 4.3.1 My Top Risk

At the start of session 4, Day 2, the PMOC requested each ‘attendee’ to provide their ONE Top Risk the objective being to initiate discussion and provide the workshop with an opening statement of the greatest threats on the minds of the project team and PMOC review team. Duplicates were allowed. The results are shown below in Table 20.

**Table 20 My TOP Risk**

#### My TOP Risk - FTA RISK WORKSHOP DAY 2

REF	RISK
1	TUNNEL MINING PRODUCTIVITY [ADVANCE RATE]
2	TIME FOR DESIGN AND APPROVAL
3	CONFIGURATON AND COODINATION OF BIM MODEL WITH SYSTEMS AND EQUIPMENT
4	CONFIGURATION WITH NEW HALL YARD SYSTEMS AND OPERATIONAL
5	TUNNEL BORING MACHINE MINING DURATION
6	COORDINATION BETWEEN CONTRACTS STAFF
7	MANAGEMENT AND COODINATION OF SCOPE AND RESPONSIBILITY FOR DESIGN INTEGRATION BETWEEN CONTRACT PACKAGES
8	TESTING AND COMMISISONING DELAYS INADEQUATE CONTINGENCY IN SCHEDULE
9	TUNNEL MINNING ADVANCE RATE
10	TUNNEL BORING RATE
11	DIFFERING SITE CONDITIONS AND THIRD PARTY UTILITY RELO
12	SINGLE BORE TUNNEL
13	INTERFACES MANAGEMENT
14	TESTING AND COMMISISONING TIME FRAMES
15	TUNNEL MINING RATE
16	INTERFACES OF CP1 SYSTEMS WITH OTHER THREE CP's
17	EMERGENCY VENTILATION SYSTEMS AND PROVISIONS REQUIRED FOR EMERGENCEY ESCAPE
18	CONTRACT INTERFACES
19	DESIGN INTERFACES
20	TOD REQUIREMENTS AT STATIONS
21	DESIGH INTERFACES BETWEEN THE 4 MAIN CP'S
22	CONSTRUCTION INTERFACES BETWEEN THE 4 MAIN CP'S
23	TESTING AND COMMISISONING DELAYS
24	TOD COORDINATION
25	CONSTRUCTION CONTRACT INTERFACES
26	3RD PARTY COORDINATION
27	ROW ACQUISITION
28	CAPTURING THE CURRENT GOOD COMPETITIVE CONSTRUCTION MARKET
29	ABILITY TO SUCCESSFULLY NEGOTIATE A LUMP SUM FOR THE CP2 PDB IN 6 MONTHS (NTP/1 TO NTP/2)

Out of the 29 responses, five (5) related directly to concerns over the proposed tunnel production rate. Underlying trends pointed to a consensus in risk exposure to overall program duration for design and construction and the challenges in coordination and interfaces between the four main construction packages.

### 4.3.2 Scoring of Risks

The Sponsors risk register adopted a 5x5 risk matrix to score and rank risks which is shown for reference in Table 21 below.

**Table 21 VTA Risk Matrix**

Very High (VH)	5	10	15	20	25
High (H)	4	8	12	16	20
Medium (M)	3	6	9	12	15
Low (L)	2	4	6	8	10
Very Low (VL)	1	2	3	4	5
	Very Low (VL)	Low (L)	Medium (M)	High (H)	Very High (VH)
THREAT LEVEL (Max of Cost or Schedule) -->					

The Sponsors risk register adopted Impact and Probability levels as shown for reference in Table 22 below. In the PMOC opinion risk impact levels are reasonable although are likely to produce a risk distribution resulting in a larger number of risks rated ‘high’ given the longevity and monetary size of the project.

**Table 22 VTA Risk Matrix Legend: Impact & Probability Levels**

Severity	Probability Range	Cost Range	Schedule Range	Level
Very High	> 90%	> 50 M	> 6 months	5
High	75% - 90%	20 M - 50 M	4 - 6 months	4
Medium	50% - 75%	10 M - 20 M	2 - 4 months	3
Low	10% - 50%	5 M - 10 M	1 - 2 months	2
Very Low	< 10%	< 5 M	< 1 month	1
None	0%	0	0	0

Comments and observations of the PMOC captured prior to and at the risk workshop discussions are included against each risk in the risk register. The output risk register from the risk workshop is included as Appendix F and the PMOC’s summary PowerPoint presentations from the risk workshop are included as Appendix H.

### 4.3.3 Distribution of Risks

The VTA most recent risk register dated March 31, 2021 and submitted to the PMOC at the end of April 2021 contains 85 live risks. The FTA PMOC adjusted risk register adds 27 new risks resulting in a total of 112 current risks. Seven (7) risks out of the 112 total risks were subsequently considered ‘duplicate’ by the PMOC, 4 of these ‘duplicate’ risks being PMOC added risks.

**Figure 2 Risk Distribution by FTA Category (No.)**

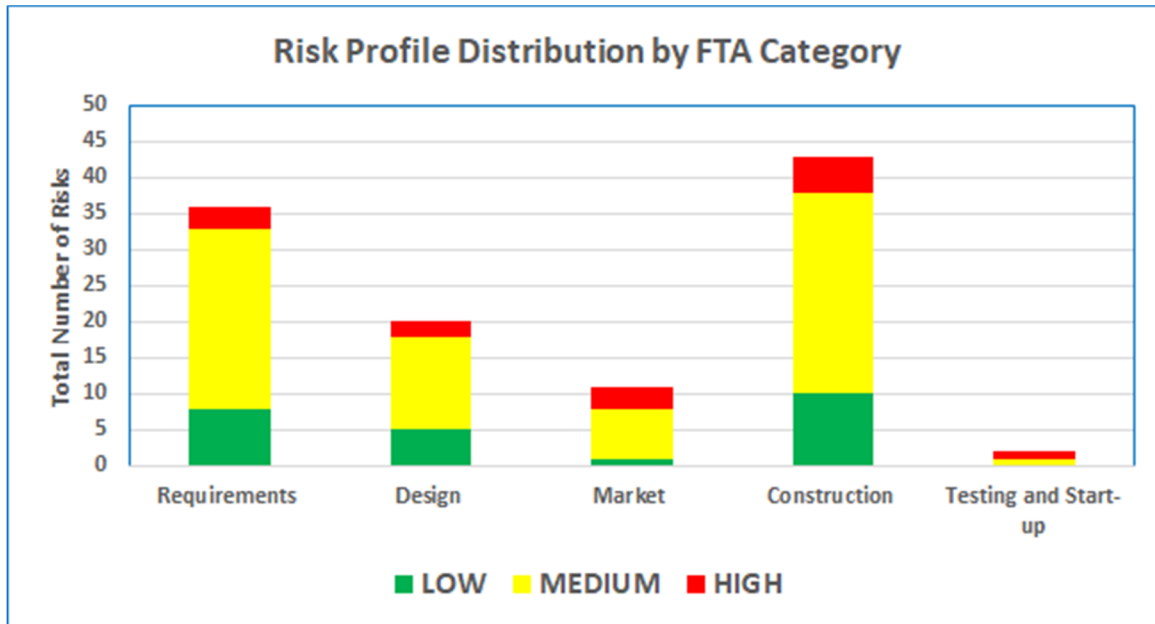
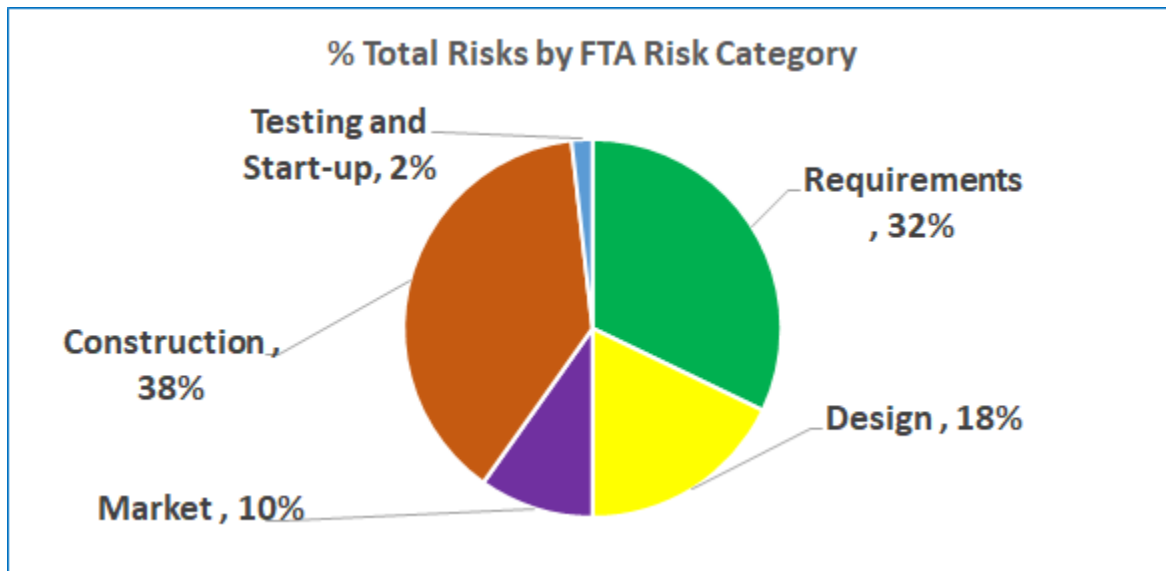


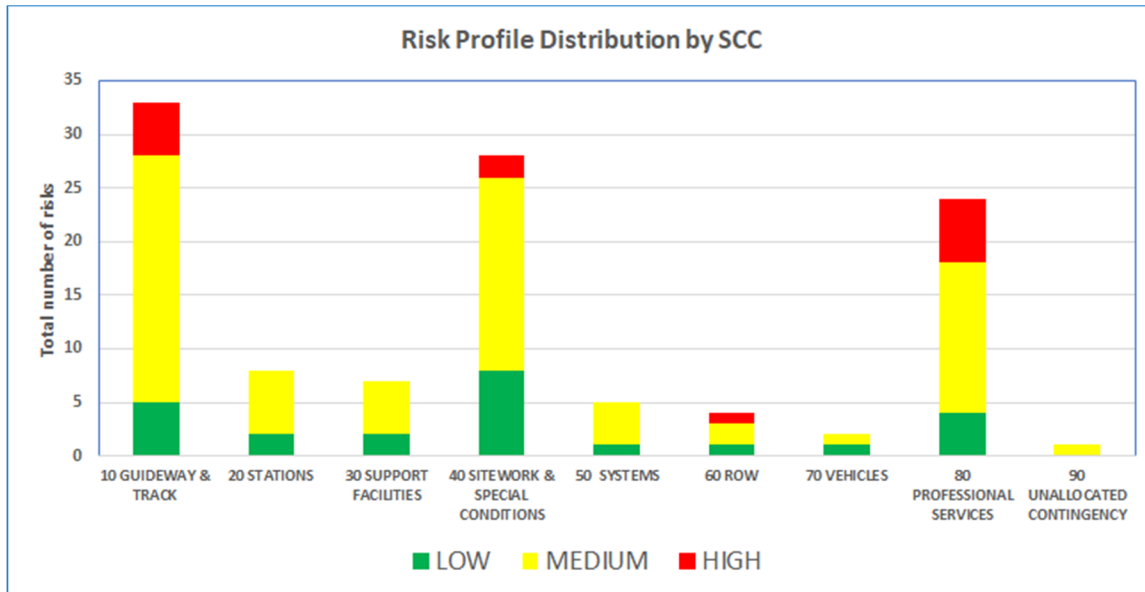
Figure 2 above shows the risks per FTA category and demonstrates a well-balanced distribution of risks. Figure 3 below shows risks per FTA risk category by percentage of the total number of risks. Figure 4 shows the risk distribution by VTA impact category by FTA SCC code and demonstrates BSVII risk dominating in SCC 10, 40 and 80.

**Figure 3 Risk Distribution per FTA Risk Category (%)**





**Figure 4 Risk Distribution per FTA SCC**



#### 4.3.4 Top Project Risks

PMOC has identified 14 risks as “High.” VTA have identified 10 risks as “High.” Four “High” risks are common to PMOC and VTA.

Table 23 below provides a complete listing of PMOC and VTA “High” (Red) risks in rank order (by PMOC assessment) of highest to lowest. A ‘blue’ shading indicates a change to the VTA current assessment by the PMOC.

**Table 23 Project Risks Rated as “High”**

Risk ID	FTA SCC	FTA Risk Type	Risk Title	VTA Prob (%)	PMOC Prob [%]	VTA Cost Impact	PMOC Cost Impact (C)	VTA Schedule Impact	PMOC Schedule Impact	VTA Risk Score	PMOC Risk Score
BSV-143	10.07	M	Cost Escalation higher than anticipated [Including Market forces / over heating]	60%	95%	4	5	0	2	6	20
BSV-096	80.08	S-UP	Testing and Commissioning delays due to various factors	60%	80%	3	3	5	5	12	16
PMOC_4	10.07	M	Failure to agree GMP within estimate on PDB / CP2 causes delays / extra costs	0%	80%	0	5	0	3	0	16
BSV-138	80.02	D	Multiple design interfaces between four DB/PDB contracts leads to poor design integration, errors, delays and disputes	80%	50%	3	5	5	5	16	15
PMOC_26	10.07	C	TBM assumed mining rate may be overly ambitious	0%	80%	0	5	0	0	0	12
PMOC_27	10.07	C	Time required to establish and then perform jet and compensation grouting may be under estimated [note also potential street closure constraints and ROW issues]	0%	80%	0	5	0	0	0	12
BSV-171	80.02	M	Lack of adequate interface management between CP's affecting program cost certainty in PDB process	20%	80%	4	3	2	3	6	12
BSV-045	10.07	C	Potential for serious catastrophic failure of TBM mechanical failure during construction	5%	20%	5	5	5	5	5	10
BSV-053	60.01	R	Needed Right of Way is not available for critical path Construction	30%	20%	3	5	4	5	8	10
BSV-055	40.02	D	Progressive Design Builder changes design impacting utility relocations already designed and/or constructed by Utility Owner.	50%	20%	2	4	5	5	12	10
BSV-066	80.03	C	Multiple contract interfaces leading to construction delays and risk of disputes.	95%	20%	4	5	5	5	25	10
PMOC_6	80.03	R	VTA / BART staffing costs inadequate	0%	50%	0	4	0	0	0	10
PMOC_12	40.03	C	Higher than anticipated contaminated materials in mining / stations / shafts etc. [esp. Diridon Station]	0%	90%	0	3	0	1	0	10
PMOC_16	80.05	R	OCIP cost and annual deductibles exceed estimate allowances	0%	90%	0	3	0	0	0	10
BSV-005	40.04	D	Unanticipated or inadvertent damage to historic buildings, critical utility & other structures due to construction, vibration, and/or settlement.	60%	25%	5	5	2	2	12	8
BSV-041	10.07	C	Differing ground conditions encountered during tunnel and adits excavation from the ones assumed during Preliminary Engineering	60%	30%	4	4	3	3	12	8
BSV-139	10.07	D	Procurement delays for construction long-lead items (e.g. TBM)	95%	20%	0	4	4	3	10	8
BSV-134	10.07	C	Insufficient Staging and Laydown Areas at the underground station sites.	80%	40%	2	2	3	3	12	6
BSV-084	50.05	C	Timing of completion of BART's Train Control Modernization Program (CBTC) implementation in line with BSVII.	80%	10%	4	4	3	3	16	4
BSV-133	50.01	C	Tie-in between BSV Phase I and Phase II	80%	40%	2	2	3	1	12	4

Risks numbered “PMOC\_xx” and shown in Red text have been added by the PMOC. PMOC has raised four (4) new “High” rated risks and recategorized four (4) current VTA risks as “High.” PMOC suggests six (6) risks identified by VTA as “High” are of a lesser severity for these reasons.

- BSV-005: Extensive ground improvement, property protection and monitoring is priced in base estimate and ‘risky’ which should significantly mitigate property damage
- BSV-041: Existing ground conditions are well understood; ground improvement measures priced in estimate are designed to work with these known challenging ground conditions. PMOC has recharacterized this risk (under PMOC\_27) as time and cost to perform ground improvements is the greater risk.
- BSV-139: PMOC has recommended an adjustment to the TBM procurement duration and the residual risk of further delays is reduced

- BSV-134: PMOC has reduced this risk since laydown areas are well understood and site constraints known. Cost and schedule adjustments have been recommended to take account of known constraints
- BSV-084: PMOC’s understanding is potential delays and additional costs to the project as a result of CBTC implementation by BART is a lower risk now that a decision milestone date (November 2022) has been agreed between VTA and BART.
- BSV-133: The tie-in to the existing Phase 1 track and systems is understood to not be of as high a concern to the VTA team as this risk suggested before additional coordination with BART was conducted.

#### 4.3.5 Top Risks by FTA SCC

Below is provided a listing of identified risks ranked as “High” (Red) risks by FTA SCC. A ‘blue’ shading indicates a change to the VTA current assessment. Where VTA have identified a risk as “High” (Red) and FTA have lowered that risk to a lesser category the VTA “High” risk is shown.

#### SCC 10 Guideway and Trackwork

The PMOC has recharacterized VTA risk BSV-041 ‘Differing ground conditions’ as PMOC\_26 reduced TBM mining production rate (in compensating and managing the known significantly challenging ground conditions) and PMOC\_27 time and cost to perform jet grouting and other ground improvement and property protection measures.

PMOC ranks future escalation (and associated market driven labor, material and plant costs and availability) as the potentially greatest threat which may impact both cost and time. This is then followed by the challenges in reaching an agreement on a lump sum and risk allocation with the successful CP2 contractor whilst maintaining schedule and design coordination.

**Table 24 SCC 10 “High” Risks**

Risk ID	FTA SCC	FTA Risk Category	Risk Title	VTA Prob (%)	PMOC Prob [%]	VTA Cost Impact	PMOC Cost Impact (C)	VTA Schedule Impact	PMOC Schedule Impact	VTA Risk Score	PMOC Risk Score
BSV-041	10.07	C	Differing ground conditions encountered during tunnel and adits excavation from the ones assumed during Preliminary Engineering	60%	30%	4	4	3	3	12	8
BSV-045	10.07	C	Potential for serious catastrophic failure of TBM mechanical failure during construction	5%	20%	5	5	5	5	5	10
BSV-134	10.07	C	Insufficient Staging and Laydown Areas at the underground station sites.	80%	40%	2	2	3	3	12	6
BSV-139	10.07	D	Procurement delays for construction long-lead items (e.g. TBM)	95%	20%	0	4	4	3	10	8
BSV-143	10.07	M	Cost Escalation higher than anticipated [Including Market forces / over heating]	60%	95%	4	5	0	2	6	20
PMOC_4	10.07	M	Failure to agree GMP within estimate on PDB / CP2 causes delays / extra costs	0%	80%	0	5	0	3	0	16
PMOC_26	10.07	C	TBM assumed mining rate may be overly ambitious	0%	80%	0	5	0	0	0	12
PMOC_27	10.07	C	Time required to establish and then perform jet and compensation grouting may be under estimated [note also potential street closure constraints and ROW issues]	0%	80%	0	5	0	0	0	12

#### SCC 20 Stations, Stops and Shelters

No “High” risks have been identified in SCC 20 by either VTA or the PMOC. Most of the risk is seen to lie with CP2. There is high risk of the CP1 (systems installations) and CP4 (underground stations) being delayed by the CP2 (tunnels and trackwork) contract but these costs and schedule

impacts are assumed to be the result of and attributable to CP2 which is where risk mitigation would reside.

### SCC 30 Support Facilities

No “High” risks have been identified in SCC 30 by either VTA or the PMOC. CP4 (Newhall Yard and Santa Clara station) may be constrained by release of the Newhall Yard site by CP2. The Yard and facility layout is said to be agreed in principle with BART and the Santa Clara station has undergone a simplification from that proposed in the initial design proposals. Utility relocations, specifically the large Sprint fiber optic duct bank on Newhall Yard connecting to the point of preference facility, is stated by VTA as not impacting either CP2 or CP4 construction operations. The point of preference facility will be avoided, and the duct bank will now be the responsibility of the CP2 contractor as enabling works for the West Portal. Inflation and / or an extended CP4 overall contract duration may result from delays in handover of the construction areas from CP2.

### SCC 40 Site Works

PMOC and VTA share a common “High” risk that the CP2 PDB contractor, due to selected means and methods, chosen constructability and / or design detailing, may require late changes to partially or fully designed and potentially already relocated utilities. This is particularly at risk in the Stockton Street and 13th Street ventilation facility locations although could occur at any portal, portal approach, station, or ventilation facility location.

The VTA proposed “High” risk relating to property damage is considered a lower risk since the extensive ground improvements and monitoring planned and costed by VTA should significantly mitigate this potential risk. PMOC has applied standard BETA to the ground improvements base costs noting the need for contingency in this category. Design is currently at an early stage and the PMOC anticipates significant effort will be applied to mitigate this risk by the CP2 PDB in collaboration with the VTA team. Risk is more related to pricing uncertainty than unforeseen conditions.

The PMOC considers dealing with Contaminated material may be more costly and potentially constraining than VTA have envisaged and recommend this is ranked as a “High” risk to draw attention to action required to further identify areas of exposure and explore methods for dealing with contaminated ground and muck.

**Table 25 SCC 40 “High” Risks**

Risk ID	FTA SCC	FTA Risk Category	Risk Title	VTA Prob (%)	PMOC Prob [%]	VTA Cost Impact	PMOC Cost Impact (C)	VTA Schedule Impact	PMOC Schedule Impact	VTA Risk Score	PMOC Risk Score
BSV-055	40.02	D	Progressive Design Builder changes design impacting utility relocations already designed and/or constructed by Utility Owner.	50%	20%	2	4	5	5	12	10
PMOC_12	40.03	C	Higher than anticipated contaminated materials in mining / stations / shafts etc. [esp Diridon Station]	0%	90%	0	3	0	1	0	10
BSV-005	40.04	D	Unanticipated or inadvertent damage to historic buildings, critical utility & other structures due to construction, vibration, and/or settlement.	60%	25%	5	5	2	2	12	8

## SCC 50 Systems

The most significant risk to the CP1 systems installations is design integration with CP2, CP3 and indeed CP4 and adequate and timely construction access to complete the CP1 scope of works. Delays to access are most likely to occur by late handover of work areas and concurrent activities of the CP2 tunnels and trackwork contractor.

The PMOC has applied ‘normal’ risk exposure to systems installations, testing and start-up activities in both costs, through application of BETA, and schedule duration exposure risk assessments. PMOC and VTA have identified Testing and Commissioning as a “High” risk and this is included under SCC 80.08.

Design integration is at an early stage. Integration and collaboration with BART Operations is stated as progressing well and significant efforts will be required in achieving design configuration between the four construction packages. Lessons have been learned from Warm Springs and Phase I of the BART extensions and a greater collaborative effort is being seen between VTA and BART project teams.

PMOC suggests two (2) risks identified by VTA as “High” are of a lesser severity as described above: BSV-084 (CBTC) and BSV-133 (Phase I tie-in).

**Table 26 SCC 50 “High” Risks**

Risk ID	FTA SCC	FTA Risk Category	Risk Title	VTA Prob (%)	PMOC Prob [%]	VTA Cost Impact	PMOC Cost Impact (C)	VTA Schedule Impact	PMOC Schedule Impact	VTA Risk Score	PMOC Risk Score
BSV-084	50.05	C	Timing of completion of BART's Train Control Modernization Program (CBTC) implementation in line with BSVII.	80%	10%	4	4	3	3	16	4
BSV-133	50.01	C	Tie-in between BSV Phase I and Phase II	80%	40%	2	2	3	1	12	4

## SCC 60 ROW

PMOC believes VTA have potentially understated the risk of additional ROW being identified as the CP2 PDB contractor progresses detailed design of property protections, utility relocations and construction working space required to construct the large underground facilities.

In addition, the property market is historically seen as a high-risk cost area which may, depending on the market and economy, benefit or stress the projects budget and contingency. In inner city high value locations property values and negotiations with landowners have also significantly delayed projects in dealing with local politics, large landowners, relocations impacting local work force and powerful community action groups. BSVII is understood to be supported by both cities and the multiple stakeholders but economic and political external influences can quickly change commitments and previously collaborative partners and landowners’ positions. PMOC has applied recommended BETA factors to base cost and risk to schedule duration commensurate with the level of current design. PMOC views ROW in general a “High” risk.

**Table 27 SCC 60 “High” Risks**

Risk ID	FTA SCC	FTA Risk Category	Risk Title	VTA Prob (%)	PMOC Prob [%]	VTA Cost Impact	PMOC Cost Impact (C)	VTA Schedule Impact	PMOC Schedule Impact	VTA Risk Score	PMOC Risk Score
BSV-053	60.01	R	Needed Right of Way is not available for critical path Construction	30%	20%	3	5	4	5	8	10

**SCC 70 Vehicles**

No “High” risks have been identified in SCC 70 by either VTA or the PMOC.

VTA have stated that vehicle delivery and commissioning pose no risk to project RSD. Existing fleet will be used to support testing, commissioning, and start-up if there are delays in the manufacture or delivery of BSVII vehicles.

PMOC does consider risk exists in vehicle costs and procurement and has applied a greater risk factor than that applied by VTA to SCC 70.

**SCC 80 Professional Services**

SCC 80 collects and groups many time related impacting program risks.

VTA and PMOC share three (3) common “High” risks in this category. PMOC has suggested a reduced likelihood of contract interface delays than VTA against risk # BSV-066, multiple contract interfaces, as PMOC has reduced tunnel productivity as a recommended schedule adjustment which has in turn introduces float at all ventilation and station / tunnel interfaces. PMOC has in addition recommended a further schedule adjustment in increasing the overlap between tunnel mining and tunnel structural fit out to reduce interface risk. Nevertheless, PMOC acknowledges that even after these recommended adjustments interface issues remain a significant management challenge for VTA.

VTA’s most recently issued risk register adds risk # BSV-171, shown below, but PMOC believes this is understated and has recommended this is elevated to a “High” risk as the probability of delays and additional costs due to interface management in this highly complex and integrated project is seen as one of the major challenges to be faced by the VTA project team as the project progresses into engineering and detailed design.

PMOC has introduced two new risks rated as “High” in this category.

- PMOC has included cost adjustment to SCC 80 in arriving at the SABCE. Notwithstanding this recommended adjustment, VTA/BART staffing levels will be challenged in performing the significant configuration management effort required, which VTA have stated during discussions and presentations will include management of the project BIM integrated design model.
- PMOC has been informed during discussions and through documentation including text included in the most recent RCMP that an OCIP (Owner Controlled Insurance Program) program is proposed but details and the costs of this are still in early stages of formulation. Prior project experience points to this project being well suited to an OCIP however effort and cost in management of such programs and cost of deductibles often exceed Sponsor

estimations, albeit final costs may well be lower than that which would have been incurred under a CCIP (Contractor Controlled Insurance Program).

**Table 28 SCC 80 “High” Risks**

Risk ID	FTA SCC	FTA Risk Category	Risk Title	VTA Prob (%)	PMOC Prob (%)	VTA Cost Impact	PMOC Cost Impact (C)	VTA Schedule Impact	PMOC Schedule Impact	VTA Risk Score	PMOC Risk Score
BSV-096	80.08	S-UP	Testing and Commissioning delays due to various factors	60%	80%	3	3	5	5	12	16
BSV-138	80.02	D	Multiple design interfaces between four DB/PDB contracts leads to poor design integration, errors, delays and disputes	80%	50%	3	5	5	5	16	15
BSV-171	80.02	M	Lack of adequate interface management between CP's affecting program cost certainty in PDB process	20%	80%	4	3	2	3	6	12
BSV-066	80.03	C	Multiple contract interfaces leading to construction delays and risk of disputes.	95%	20%	4	5	5	5	25	10
PMOC_6	80.03	R	VTA / BART staffing costs inadequate	0%	50%	0	4	0	0	0	10
PMOC_16	80.05	R	OCIP cost and annual deductibles exceed estimate allowances	0%	90%	0	3	0	0	0	10

### SCC 90 Unallocated Contingency

No “High” risks have been identified in SCC 90 by either VTA or the PMOC.

The VTA risk register contains one (1) risk in this category (BSV-029) concerning VTA’s ability to finance potential cost increases. PMOC has not adjusted this risk although highlights that the considerable variance in risk assessment (cost and schedule) developed in this report may raise this to a ‘High’ risk going forwards.

### SCC 100 Finance Costs

No risks have been identified in SCC 100 by either VTA or the PMOC. Risks associated with the amount of and / or costs of finance are EXCLUDED from this risk assessment.

### 4.3.6 Remaining Risks

As shown in Table 29 below, 74 risks were classified as ‘Medium’ and 24 risks were classified as ‘Low’.

**Table 29 Total Number of Risks by VTA Impact Classification**

VTA Risk Impact Class	# of Risks	% of Total
LOW	24	21%
MEDIUM	74	66%
HIGH	14	13%
<i>Total includes 7 'potential duplicate risks'</i>		

The output risk register from the FTA risk workshop is included as Appendix F.

## **5.0 RISK ASSESSMENT**

### **5.1 Introduction**

This section of the report provides a more detailed summary of the risk analysis results for both schedule and cost. All results are reported against the baselines SABCE and SABS established in the previous sections. The reader's attention is particularly directed towards the list of assumptions and exclusions as listed below.

### **5.2 Assumptions/Qualifications/Exclusions**

#### **5.2.1 General**

The Quantitative Schedule and Cost Risk Analysis (QRA) is based on credible ranges of possible schedule and cost deviations.

The risk study does not deal with extreme events such as wars, serious earthquakes, stock market crashes, or multiple deaths / injuries from site accident(s) / Acts of God and any further resurgence of the global COVID Pandemic, COVID-19 variant or the like.

The risk assessment assumes VTA will progress utility relocations, property acquisitions, the procurement of the four main construction packages and CP Construction Manager appointments in parallel to the 120-day EPD review process in alignment with the current VTA IMPS and regardless of any adverse reaction to interim communication of results from this risk assessment.

The risk assessment does not include any uplift for the project being classified as 'mega'. Research indicates significant cost increases have occurred on major infrastructure projects closely correlated with the number of external stakeholders and TOD. OP 40c provides background and warnings as to the risks impacting 'mega' projects. Not all 'mega' projects run significantly over budget and / or schedule and with an experienced Agency as is VTA in collaboration with BART no additional BETA has been applied related to 'mega' status that would impact the P65 cost and schedule assessment.

Ground control, avoidance of settlement and management and control of adverse property damage given the large diameter tunnel in these known challenging ground conditions in the highly urban and historic environment is a major risk on this project. The alignment is known for irrigational wells and oil wells and VTA have conducted extensive ground investigations and location surveys to map past obstructions of all types that could impede tunneling and SOE operations. Accuracy and completeness of historic records cannot be guaranteed. It should be noted that the P65 values, cost or schedule, will not buffer a risk similar to that which occurred on SR99 Alaska Way Tunnel (Seattle) and tunnel production risks applied do not take account of such catastrophic delays which would be classified as an 'extreme event'.

No risks have been identified in SCC 100 by either VTA or the PMOC. Risks associated with the amount of and / or costs of finance are EXCLUDED from this risk assessment.

The Sponsor is advised to carefully consider insurance strategy, insurance coverage, insurance coverage limits and exposure of the Sponsor Agency, Cities and State to all types of residual risk.



## 5.2.2 Assumptions

The following assumptions apply to the risk assessment.

1. Recent communications have identified VTA has only two qualified bidders for the CP1 systems contract. The risk assessment assumes CP1 systems contract will attract greater than two qualified bidders and resulting compliant offers and that VTA will revise bid documentation and strategy as needed to ensure a competitive bidding environment is achieved.
2. Cooperative agreements are yet to be signed with the Cities of Santa Clara and San Jose and some Agreements remain outstanding with the multiple impacted Utility Owners. Regardless of any agreements which are now in place, PMOC understands that VTA has currently no commitment to cost or schedule from Utility owners. The risk assessment is based on standard BETA factors for cost and normal schedule delay exposure and assumes a timely and pro-active approach to engaging Utility owners in progressing utility relocation design and construction as far as a possible in advance of the main construction works. Given this assumption and the time available in the schedule PMOC has assumed these Agreements and enabling works are not “High” risk.
3. The risk assessment assumes new vehicles are not required for systems testing or startup which will be undertaken using the existing BART fleet if necessary.
4. The project design and space proofing is understood to allow for the potential future incorporation of platform screen doors (PSD) however neither the estimate or risk assessment allows for the introduction and incorporation of PSD’s.
5. The risk assessment assumes if BART should introduce CBTC cost and / or schedule impacts will not impact systems installations, systems testing or the RSD of the BSVII directly.
6. PMOC has not been made aware of other concurrent City projects, impacting TOD or any interface constraints arising from future connecting projects (e.g. California High Speed Rail). The assumption is no concurrent or interfacing projects will adversely constrain the base scope of this project
7. The BSVII has significant interfaces with TOD at Diridon and 28th Street station locations. It is assumed, and PMOC has been advised, concurrent TOD will not be allowed to impact progression of base scope and any additional costs of schedule delays which may arise through requests and agreements to incorporate TOD scope will be paid for by the impacting TOD.
8. Construction sequencing and maintenance of traffic plans is understood to be awaiting appointment of the CP2 PDB. VTA have stated MPT plans are being progressed in a preliminary fashion such that principles have been communicated with relevant impacted stakeholders and 3rd parties and a rudimentary plan will be included in the RFP documents as a starting point for the design builders. VTA have stated a high level of support for the project exists along the alignment. The assumption is that the eventual construction sequencing and maintenance of traffic plans (MPT) will be agreed to by the Cities of San Jose and Santa Clara and any impacted communities, businesses, or impacted property owners.

9. Any betterment agreed to the main streets and utilities throughout the alignment will not be allowed to adversely impact the cost and / or schedule of the base scope of BSVII.
10. Construction noise and vibration can be managed within acceptable limits without the need for extraordinary mitigation measures impacting productivity and means and methods.
11. Noise and vibration in the completed project can be achieved without the need for isolated slab track construction (as described in the Record of Decision mitigation commitments).
12. Analysis assumes the allocation of risks to the party best able to control them.
13. VTA has been coordinating with FTA's environmental specialist regarding any environmental re-evaluation requirements. PMOC has been told that mitigation requirements are not expected to change substantially with the EPD configuration, on which PMOC analysis was based.
14. The Sprint Fiber Optic relocation in Newhall Yard was downgraded to a lower risk based on VTA assuring the PMOC that this relocation work would not impact the project schedule in any way.
15. PMOC was not provided a ROW parcel plan that overlaid the project alignment and has not be able to review or ascertain if the proposed property limits are reasonable for constructing the project. VTA have raised a "High" risk that laydown areas may be inadequate but not specifically that identified ROW may be inadequate to construct the project (BSV-134 refers). PMOC has recommended this risk is reduced given it is a known condition and will be more of a cost issue. PMOC acknowledges a residual risk that the PDB for CP2 may request additional ROW depending on means and methods proposed but has assumed from advise provided by VTA in presentations and responses to questions and that this is a low risk in terms of probability. In any event PMOC assumes that a key area of early feedback from all bidders for the CP2 package will be to confirm the ROW is indeed adequate as currently proposed and if not, adequate time will be provided for VTA to acquire any further ROW without this becoming critical to construction access. PMOC has recommended however, the current general risk referencing insufficient ROW, risk # BSV-053, is elevated to a 'High' risk until the CP2 confirms the ROW is indeed sufficient.
16. PMOC has been told that environmental mitigation requirements are not expected to change substantially with the EPD configuration. PMOC has assumed no risk of further legal challenges to the ROD including any means and methods, remote fabrication yards or in connection with the emerging muck disposal strategy and that the contractors will be constrained to work within the approved ROD. PMOC also assumes no DB Alternative Design Concepts will be entertained that in any way compromise the ROD.

### **5.3 Schedule Risk Analysis**

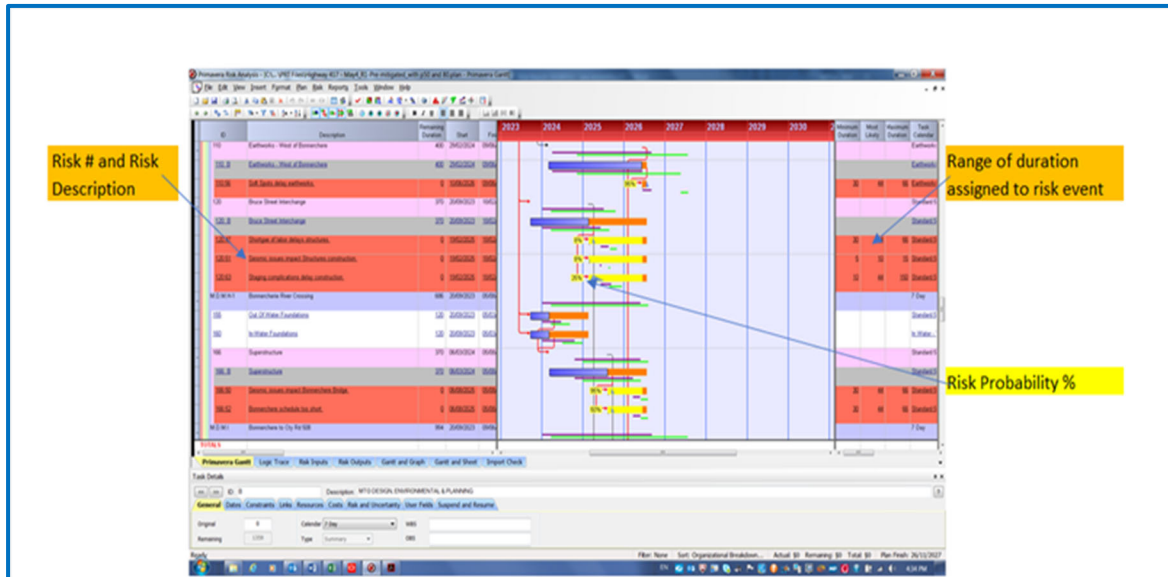
#### **5.3.1 Overview of Modeling Technique and Software**

Schedule and Risk simulation software used for the analysis is Oracle Primavera Risk Analysis (previously Pertmaster). Primavera Risk Analysis is a simulation tool which reads the probabilistic data (activity risk ranges, probabilities of risks occurring and correlations) from the Primavera schedule and runs multiple iterations on the data to calculate float and critical paths. The software program summarizes the input data providing various graphical and tabular reports including the

most familiar cumulative ‘S’ curve, providing varying confidence levels against associated start and / or completion dates.

The schedule risk model has risks assigned from the risk register to activities within the schedule. A key showing risk assignments together with their risk reference number, probability and duration range is shown as below in Figure 5. Some risks are assigned to more than one activity and the same risk may have been assigned a different duration variance than another. Where more than one risk is assigned to a single activity it indicates these risks can happen at the same time and will not be cumulative in their impact.

**Figure 5 Schedule Risk Input Data Key**



The schedule risk model showing input values is provided in Appendix M.

### 5.3.2 Schedule Risk Analysis Model

The PMOC developed a summary schedule from the VTA IMPS received in April (data date March 1st, 2021) to form a schedule risk model of suitable size, characteristics, and structure to assign uncertainty and risks to schedule activities and perform a Monte-Carlo analysis. The summary schedule is included as Appendix K and the critical path is extracted and included as Appendix L.

The summary schedule mirrors the VTA IMPS as closely as possible however the VTA IMPS is lacking in detail in some WBS elements and the PMOC has filled in detail necessary to form a complete schedule against which to assign risks. The summary schedule removes all finish constraints and any start constraints that would adversely impact the risk model.

The project is at an early stage of design and the PMOC recognizes the schedule is a developing tool the construction and interfacing of the main contract packages dependent on choice of constructability and means and methods which will come after the appointment of the CP2 (tunnels and trackwork) PDB and then develop in detail and in collaboration with the other main

construction packages and VTA and BART’s overall goals and objectives. Risk allocation will play an important role in this developing IMPS since transferred risks will be incorporated in base project durations as then contractual undertakings, buffer float will be added to represent shared risk at critical interfaces and contingency allocated for retained Sponsor risk. At this stage the summary schedule, incorporating PMOC recommended adjustments, forms a base schedule envisaged as a realistic starting point for negotiations with, in the first instance, the CP2 PDB, but also in portraying realistic access dates for interfacing contracts. The principle of the summary schedule is that it forms a base, where if risks do not transpire and innovations are realized, it supports a possibility of achieving the quoted early date for a RSD as established in the SABS.

The summary schedule includes a 6-day working week calendar applied to tunnel production rates as is incorporated in the VTA IMPS. Utility and ‘event’ outages are not specific and indeed unknown at this stage and overall durations and risk applied must account for such constraints.

The PMOC has assigned risks from the PMOC adjusted risk register as output from the FTA risk workshop as shown in Appendix F.

The schedule risk model (Appendix M) shows the adjusted baseline with the P65 value for each activity below it and includes tabular data of the P65 start and finish dates comparing the adjusted baseline (SABS), after risk and uncertainty, for each activity.

The risk model is designed to focus on the risk in not achieving the overall RSD. The schedule model shows the assignment of risks impacting the same activity at the same time, avoiding duplication of risk impact. Some risks are assigned to schedule activities to create ‘independence’ and therefore reliability in schedule risk prediction is assured at the RSD. However, because some risks that may impact the schedule at any time have to be assigned more generally the risk profile of any one schedule activity extracted from the risk model in isolation may not be representative of that activities true risk. All risk analysis results reported below are aligned to the collective impact on the RSD only.

### 5.3.3 Schedule Risk Analysis Results

Table 30 shows the schedule risk analysis result stating with a 65% confidence the RSD being at or less than February 2, 2034. This compares to the Sponsor RSD ‘late’ date, after contingency, of September 15, 2032.

**Table 30 P65 Schedule Risk Assessment**

	RSD [before Risk]	Risk P65 Months	RSD [incl Risk]	% Contingency [P65]
<b>VTA</b>	7-May-30	28.3	15-Sep-32	26.3%
<b>PMOC</b>	7-Nov-31	26.9	2-Feb-34	21.4%
<b>Delta</b>	17.71		16.29	

Figure 6 shows the relationship of the PMOC adjusted RSD of November 7, 2031 to the Sponsor proposed RSD of May 7, 2030 and the OP 40c recommended contingency at 25% of the adjusted

base June 6, 2034. The diagram then shows the resulting PMOC actual risk assessment giving a RSD of February 2, 2034 at the P65. PMOC recommends at this stage of project development the RSD is taken to be June 6, 2034 reflecting the FTA guidance of 25% of the adjusted base duration from date of the risk workshop (May 12, 2021) through early RSD (November 7, 2031).

**Figure 6 Schedule Risk Results Summary Graphic**

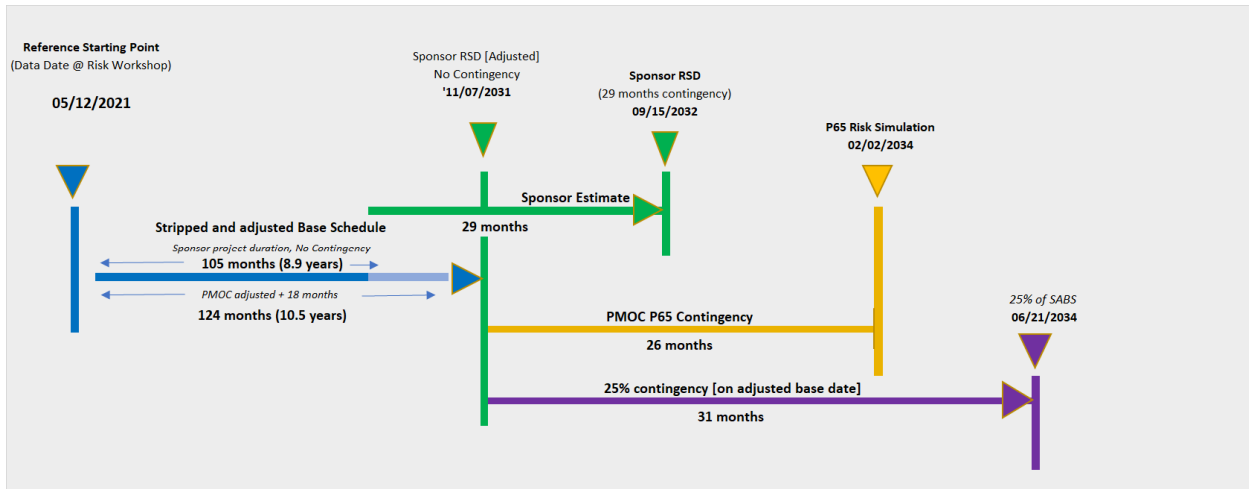


Figure 7 shows the schedule duration sensitivity to the overall risk assessment (i.e. it is not specific to the P65).

**Figure 7 Schedule Duration Sensitivity Chart**

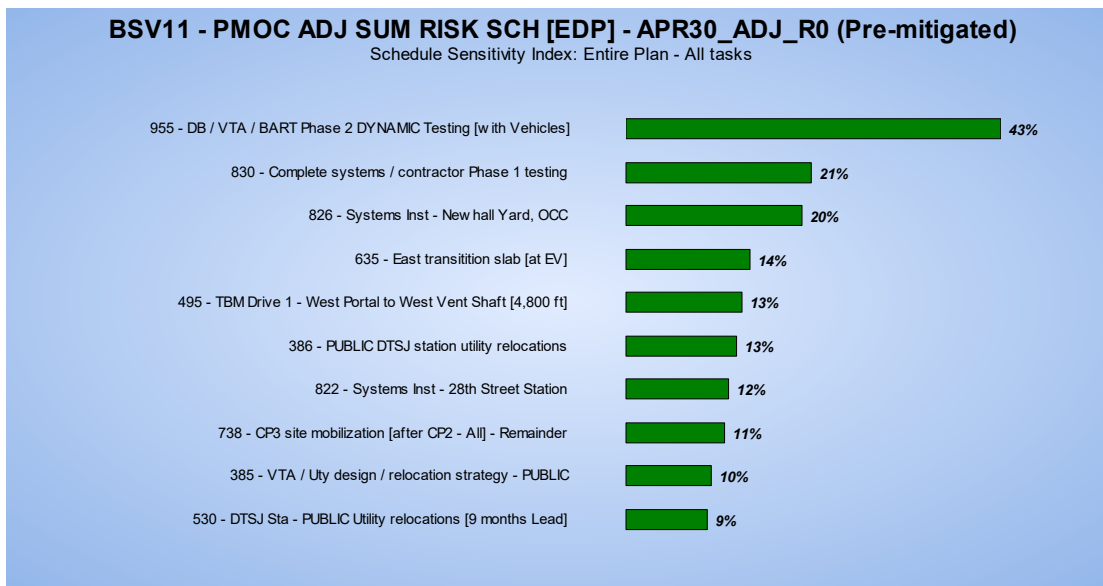
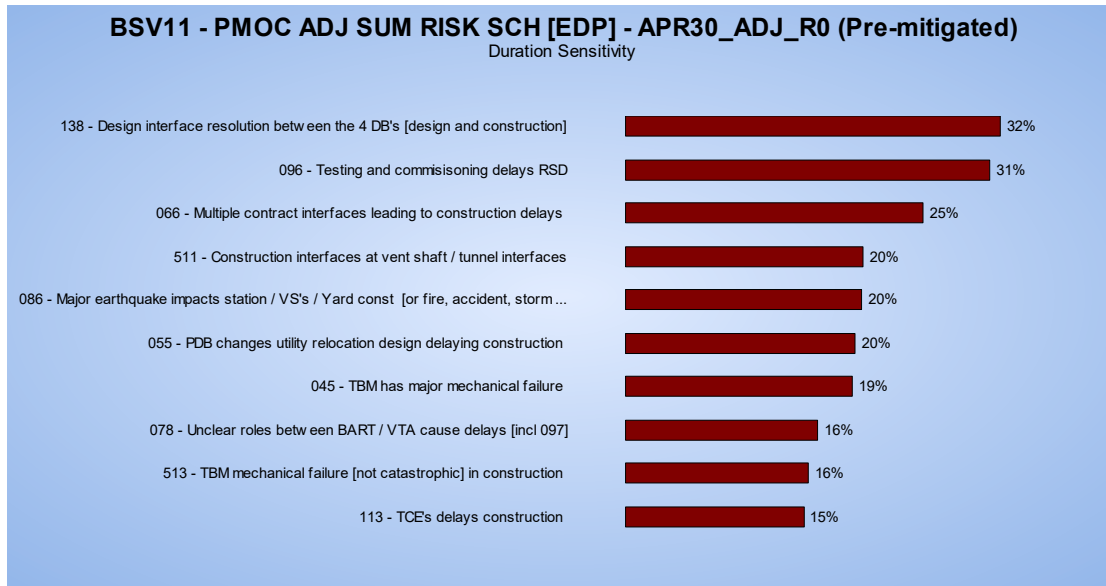


Figure 8 below shows duration sensitivity of individual assigned risks to the overall schedule risk assessment range (not the P65 output).

**Figure 8 Schedule Risk Sensitivity Chart**



The PMOC ran several scenarios to understand and measure the impacts of the known specific risks to the overall model results. Table 31 shows the scenario analysis results. The equivalent contingency is the calculated percentage of days lost between the Risk Informed RSD and the PMOC adjusted RSD (before Risk).

Figures in Table 31 are approximate and for comparative purposes only since the Monte Carlo model run as a whole will produce results reflective of all risks. This project is complex given the relationship of tunnel drive to portal, portal approach, station, and ventilation facility SOE and tunnel structural fit out. The 28th Street Station fit out structural works awaiting completion of mining operations to allow access to the invert slab by the CP4 contractor plays a significant role in the critical path to the project RSD. Subsequent interrelationships with trackwork installations, systems installations and station final fit out all feeding into final integrated testing also make a complex series of constraints and interrelationships in this project schedule.

**Table 31 Risk Scenario Sensitivity Analysis**

Deterministic Plan		Cal Days	Weeks	Months	
Workshop Date		12-May-21			
RSD (PMOC Adj early)		7-Nov-31	3,831	547	126
	Risk Informed RSD	Days Late	Weeks Late	Months Late	Equiv Contingency to meet RSD Pvalue
<b>All Risks</b>					
P10	24-Feb-33	475	68	16	12%
P30	19-Jul-33	620	89	20	16%
P50	4-Nov-34	1093	156	36	29%
<b>P65</b>	<b>2-Feb-34</b>	<b>818</b>	<b>117</b>	<b>27</b>	<b>21%</b>
P80	5-Jul-34	971	139	32	25%
<b>Run 1 - Early risks prior to placement of TBM Order</b>					
P10	9-Feb-32	94	13	3	2%
P30	30-Mar-32	144	21	5	4%
P50	13-May-32	188	27	6	5%
<b>P65</b>	<b>18-Jun-32</b>	<b>224</b>	<b>32</b>	<b>7</b>	<b>6%</b>
P80	4-Aug-32	271	39	9	7%
<b>Run 2 - Only those risks assigned to CP2 which incl tunnel drive</b>					
P10	25-Feb-32	110	16	4	3%
P30	13-May-32	188	27	6	5%
P50	26-Jul-32	262	37	9	7%
<b>P65</b>	<b>21-Sep-32</b>	<b>319</b>	<b>46</b>	<b>11</b>	<b>8%</b>
P80	29-Nov-32	388	55	13	10%
<b>Run 3 - Only those risks impacting CP1 Systems, Testing &amp; Start-up</b>					
P10	23-Mar-32	137	20	5	4%
P30	30-Jun-32	236	34	8	6%
P50	19-Sep-32	317	45	10	8%
<b>P65</b>	<b>15-Nov-32</b>	<b>374</b>	<b>53</b>	<b>12</b>	<b>10%</b>
P80	31-Jan-33	451	64	15	12%

Table 31 shows that the risks associated with early risk prior to placement of TBM order (Run 1) which include utility relocation risk, ROW risk and critical contract procurement (CP2) impact the overall analysis in isolation by approximately 7 months at the P65. Tunnel and systems related risk show as similar impacting overall duration of approximately 1 year each at the P65.

## 5.4 Cost Risk Analysis

### 5.4.1 Top-Down Cost Model Version and Project Specific Adaptations

A cost risk analysis has been developed adopting the FTA OP 40 Top-Down risk model v5.16a.

The PMOC has added project specific workbook TABS into the base model including Sponsor Build-Main sub-project worksheets, schedule analysis results, calculation sheets supporting recommended adjustments and collection tables to capture adjustments through to the applicable sub-project ‘profile’.

The PMOC has added a summary front TAB gathering analysis results and facilitating the inclusion / exclusion of recommended cost adjustments and global BETA factor adjustments. The summary TAB incorporates the recommended global BETA adjustments to specific ‘profiles’ and the global PMOC inflation adjustment. The adjustments can be switched on / off to immediately see, test and verify the impact on the overall analysis through the results and graph incorporated into the summary front TAB.

Specific Profiles introduced for the BSVPII are described below.

Please refer to Appendix J for the BETA assignment per ‘Profile’. Base cost adjustments are described and included in prior sections of this report.

#### **5.4.2 Profiles Assigned to the FTA Top-Down Cost Risk Model**

PMOC has assigned four (4) profiles within the Top-Down model. These align exactly with the four (4) estimate summary components as presented by VTA in their estimate workbook. This approach allows the allocation of specific BETA factors to the proposed four main civils contracts. To avoid adding further profiles to the model SCC 60 through SCC 80 project wide costs are incorporated in profile 3. (CP3).

The four (4) profiles are as follows.

##### **Profile 1 – CP1 Systems Installations Design Build**

DB Contract for the provision of all Systems for 4.7 miles of underground track alignment; 1.3 miles of at-grade track alignment including Newhall Yard and Santa Clara Station; one at-grade station (Santa Clara Station); three underground stations (28th Street Station, Downtown San José Station, Diridon Station); outfitting of two mid-tunnel ventilation facilities; testing and start-up; two systems interface coordination managers seconded to VTA to oversee interface, integration and coordination efforts between Project contract packages to minimize VTA’s exposure to claims; support for BART’s Rail Acceptance Officer (testing, start-up, CPUC certification, etc.) starting 10-12 months prior to revenue service availability.

##### **Profile 2 – CP2 Tunnels and Trackwork**

PDB Contract for the design and construction of approximately 4.7 miles of minimum 43’ interior diameter tunnel; procurement of a minimum 48’ diameter TBM; station structural concrete within tunnel for two underground stations and two mid-tunnel ventilation facilities (e.g. station and emergency egress platforms); internal concrete work including emergency walkways, track slabs, invert, partition walls, etc.; east and west portals; SOE for the 28th Street/Little Portugal station, Downtown San José Station and Diridon Station; tunnel liner knockout panels for adit connections and entrances; adits to the tunnel and platforms; trackwork from the BSV Phase I tie-in to the east portal per BART standard criteria; and associated utility relocations, as required.

##### **Profile 3 – CP3 Newhall Yard & Santa Clara Station and Program Wide SCC 60, 70, & 80**

DB Contract for final design and construction of Newhall Yard & Maintenance Facility (excluding train control systems); vehicle maintenance shops, car wash/cleaner buildings, maintenance and engineering shops, yard control tower, wheel truing and blowdown facilities; complete build-out of the end-of-the-line Santa Clara Station (excluding train control systems), including two at-grade platforms with an underground concourse and pedestrian undercrossing connection to the Santa Clara Caltrain Station; Newhall Yard trackwork, including turnouts, crossovers and mainline trackwork to west portal; a 500-stall parking garage for Santa Clara Station; associated utility relocations, as required; and final site flatwork, landscaping, etc.



This profile also includes the Project Wide elements of SCC 60 through 80. This is to avoid adding a 'linked' workbook and these project wide elements do not overlap the specifics of CP3 which are contained within SCC 10-50

#### **Profile 4 – CP4 Underground Stations**

DB Contract for the complete build-out of three underground stations, ancillary facilities and two mid-tunnel ventilation facilities (excluding train control systems). This work includes rail operations facilities within the stations; the 28th Street/Little Portugal Station (excluding demolition and SOE which is included in Contract 2); Downtown San José Station (excluding SOE which is included in Contract 2); Diridon Station (excluding SOE which is included in Contract 2); the 13th Street mid-tunnel ventilation facility; the Stockton Avenue mid-tunnel ventilation facility; a 1,200-stall parking garage for 28th Street/Little Portugal Station; final site flatwork, landscaping, etc.; and associated utility relocations, as required.

#### **5.4.3 FTA Top-Down Cost Risk Model**

##### **Overview**

The FTA Top-Down model uses Beta factors as a multiplier of the cost of individual project elements to determine the cost for the worst plausible probable scenario cost, taken as the 'upper bound'.

The Beta factors are applied to the SABCE that excludes any contingency (representing a 10th percentile, lower bound, confidence level). With the two known points, lower bound and upper bound, it is possible using a beta-pert distribution to characterize the risk profile for each project cost element and to estimate the risk exposure at any confidence level between the 10th and 90th percentile confidence levels. The Beta factor is a composite number made up of individual assessed risk values, for each cost elements, at different stages of the project. The Beta factors are applied at SCC level 2 (i.e. 10.01, 10.02 etc.).

The FTA Top-Down model is based on characterization of risk under five discrete categories, referencing the project risk register which is coded to SCC, and is enhanced where appropriate by the application of generic BETA factors applied for specific project risk exposures applying to more than one SCC element. The FTA Top-Down model provides guidelines on assignment of 'normal Beta factors.' Adjustments, where appropriate, are as described below. The five risk categories are:

1. Requirement's risk
2. Design Risk
3. Market Risk
4. Construction Risk
5. Post-Construction Risk

A summary description of each risk category is provided below for reference:

## **Requirement Risk**

Requirement Risk is the component of the Beta factor that relates to the risk that occurs at the early conceptual stage of the project and is comprised primarily of scope risk. At this stage the risk can be fairly high because the scope of the project has not been defined. Typically, these risks are associated with basic elements such as the length of a project, the performance requirement (i.e. TOD interactions, cooperative agreements specifically cost sharing, horizontal and vertical alignment, tunnel diameter, fire/life/safety and evaluation model status, vehicle number and performance, etc.), the number of elements (i.e. stations, interchanges), the type of technology, the type of structures, etc. Risks characterized as ‘Requirements Risks’ in the Risk Register would generally influence the addition and size of a Requirements Risk BETA as that ‘risk’ would not be included in the generic standard BETA of other risk categories.

## **Design Risk**

Design Risk is the component of the Beta factor that relates to the risk that occurs during the “design” phase. The BETA model assumes the following design completions for the project which reflect PMOC’s assessment of design maturity aligned to the capital cost estimate included in the EPD application:

### **Profile 1 (CP1 – Systems)**

- SCC 10 - Civils works – 30% average design
- SCC 50 - Systems works – 30% average design

### **Profile 2 (CP2 – Tunnels and Trackwork)**

- SCC 10 Civils works – 15% average design
- SCC 10 Track installation works – 30% average design
- SCC 20 Civil works – 15% average design
- SCC 40 Civil works – 15% average design
- SCC 50 Systems related works – 30% average design

### **Profile 3 (CP3 – Newhall Yard and Santa Clara Station)**

- SCC 20 Santa Clara Station – less than 10% average design
- SCC 20 Balance – 15% average design
- SCC 30 Facility components – 30% average design
- SCC 40 Civil works – 15% average design
- SCC 50 Systems related works – 30% average design

### **Profile 3 (Program-wide ROW, Vehicles, and Professional Services)**

- SCC 60 ROW – 15% average design
- SCC 70 Vehicles – 60% average design
- SCC 80 Professional services – 15% average design

#### **Profile 4 (CP4 – Underground stations)**

- SCC 20 All works – 15% average design
- SCC 40 Civil works - 15% average design

PMOC has applied additional BETA to at grade (Santa Clara station) reflecting the concept nature of the revised design layout and configurations. In addition, PMOC has applied additional BETA to elevators and escalators in consideration of the concept architectural station interior layouts presented in the project scope presentations provided by the Sponsor.

PMOC has applied additional BETA to utility relocations and hazardous material treatment and disposal as reflected through the risk register and PMOC commentary.

PMOC has applied additional BETA to special trackwork anticipating challenging and costly crossovers at stations and entering and exiting transitions between side by side and stacked configurations absent of manufacturer quotations and design still at an early stage.

Trackwork Systems design risk at 30% takes into consideration the incorporation of BART standard detailing and specifications but also notes the BSVPII contains innovative components which will require special detailing currently in the early stages of design and yet to be reviewed, validated, accepted, and progressed by the CP1 DB contractor.

Vehicles design risk at 60% takes into consideration incorporation of current BART fleet specifications and established approved operational technology and train control. It assumes any incorporation of CBTC and related technology advancements would be funded by BART outside of this project where over contingency provisions. In this regard, the projects design and space proofing is understood to allow for the potential future incorporation of platform screen doors (PSD) however neither the estimate or risk assessment allows for the introduction and incorporation of PSDs.

#### **Market Risk**

Market Risk is the component of the Beta factor that relates to the risk that occurs after the project design is completed and the contract is out to tender. The Market or bidding risk will continue to exist until a firm price has been provided and a contract agreement executed. Typically, the market bid risk is not as high as the Requirement or Scope risk; however, depending on the stability of certain markets, it could have a significant impact on certain project cost elements, such as those that would be affected by oil, steel, concrete, and labor prices.

PMOC has recommended and incorporated a global adjustment to the inflation rate used. In addition, PMOC has incorporated a ‘market adjustment’ to the CP2 (Profile 2) contract scope to reflect anticipated challenging commercial negotiations in reaching a lump sum price noting the significant risk transfer, sharing and retention to be worked through between NTP/1 and NTP/2. The PMOC is of the opinion that the lack of commercial incentives for the CP2 PDB given by this time the commitment to a TBM contract and the interrelated design coordination then critical to the projects overall progression will limit VTA’s ability to negotiate a lump sum within base estimate allowances.

## **Construction**

### ***Early Construction Risk***

Early Construction Risk is the component of the Beta factor that relates to the risk that occurs at the start of construction. Most construction risk occurs at the start of construction when the contractor mobilizes and encounters many risks. These risks typically include unexpected soil conditions, utility relocation conflicts, timing and cost of utility relocations, property clearance and access to property, mobilization issues, material availability, etc.

The BSVPII is highly dependent on early clearance of ROW and utility relocations ahead of the critical portal, approach works, station and ventilation shaft SOE's and then box excavations. In addition, ground improvements and establishment of the extensive monitoring program will require implementing in parallel with the early works proceeding the main civils construction.

### ***Mid Construction Risk***

Mid Construction Risk is the component of the Beta factor that relates to the risk that occurs during the term of the contract. These risks are typically associated with scheduling, weather conditions, construction operations, labor relations, traffic staging, etc.

The BSVBII has a significant peak in construction operations in tunnel construction and fit out quickly succeeded by station and ventilation facility structural completions and related architectural and systems installations. Any delay in tunnel mining operations has an immediate knock-on impact to the rest of the project. The current schedule strategy envisages all tunnel operations served from the Newhall site west portal. Any incident in the tunnel blocking or disrupting logistics (e.g. fire, flood, safety incident, collapse etc.) effectively delays the project and this risk persists for some considerable period over the project construction period.

PMOC has incorporated global adjustments to CP1 (Profile 1 Systems) and CP4 (Profile 4 Underground stations) to account for the significant interface risk and potential claim exposure that may result from a delay in tunnel mining and / or tunnel structural fit out by the CP2 PDB contractor. A higher allowance is applied to CP4 than to CP1 reflecting the more direct and indeed more challenging to mitigate exposure risk to underground station construction than that to the Systems contract CP1. Exposure to delays in access to the Newhall Yard and even Santa Clara station may attract claims exposure by the CP3 contractor however this lesser risk is viewed as covered in the standard BETA values.

### ***Late Construction Risks/Testing Risks***

Late Construction Risk is the component of the Beta factor that relates to the risk that occurs at the end of construction. Usually associated with the final approvals, punch lists, testing, commissioning and/or handover conditions. These risks are typically higher in transit projects as compared to highway projects due to the complexity of integration of the "system" and vehicle elements of transit projects.

The SVBPII comes on the back of Warm Springs and SVBX phase 1 the latter of which suffered significant delays in testing and start-up. Lessons have been learned and closer collaboration

between BART and VTA is noted however this is a common risk to many current and previous complex transit extension projects around the world.

**Post Construction**

Post-Construction Risk is the component of the Beta factor that relates to the risk that occurs after substantial completion and allows for agreement of claims and settlement of change orders and final accounts.

**Schedule Cost of Delay**

Taking consideration of PMOC recommended and incorporated adjustments to the project schedule standard BETA has been assumed to allow for the recommended 25% schedule contingency at this stage of project development. No further BETA adjustments have been made to reflect a greater level of risk at this time.

**Third Party Utility Cost**

With no Third-Party estimations of costs for utility relocations and some Utility owner agreements not yet in place there remains a risk of potential cost and schedule impacts to the project over and above standard BETA suggested norms. Requirements BETA has been increased to account for this specific risk.

**Summary BETA Adjustments to Reflect Specific Risks**

Appendix J shows the BETA factor adjustments applied to SCC’s by Profile.

**5.4.4 Cost Risk Analysis Results**

Table 32 shows the cost risk analysis result stating with a 65% confidence the cost at completion being at or less than \$9,148 million including financing costs.

**Table 32 P65 Cost Risk Assessment**

	SABCE	Risk P65	Total with Risk	% Contingency [P65]
<b>All costs in \$ Millions [YOE]</b>				
<b>VTA</b>	\$ 5,458	\$ 1,483	\$ 6,941	27.2%
<b>PMOC</b>	\$ 6,495	\$ 2,653	\$ 9,148	40.8%
<b>Delta</b>	\$ 1,037	\$ 1,169	\$ 2,206	

Table 33 shows the stripped and adjusted base cost (SABCE) in relation to the Sponsor estimate and the risk protection afforded by the Sponsor contingency relative to the SABCE.

**Table 33 Sponsor Relative Contingency Against SABCE**

<b>Project name:</b>	BART Silicon Valley Project Phase 2 (BSVP11)
<b>FTA review milestone:</b>	Expedited Project Delivery submission May 2021
<b>Sponsor:</b>	Valley Transportation Authority (VTA)
<b>Date of review:</b>	12 May 2021
<b>Version 5.16a Workbook:</b>	BSVII_OP40_v16a_May20_R02.4
<b>YOE 10-80 Baseline and Adjustments Summary</b>	
<b>Item</b>	<b>Base Evaluation</b>
<b>Estimate</b>	
Sponsor Estimate	<b>6,551,459</b>
Sponsor Total Contingency Amount	1,483,428
Sponsor Total Contingency %	29%
Sponsor Stripped Estimate	<b>5,068,031</b>
PMOC Inflation Adjust. on Sponsor Estimate	185,063
PMOC Direct Cost Adjustments	181,367
PMOC Duration Adjustments	473,844
PMOC Latent Contingency Deduct	196,992
PMOC Adjusted Estimate	<b>6,105,295</b>
<b>Risk Protection on Adjusted Estimate</b>	
Total Contingency Amount	<b>446,163</b>
Total Contingency %	<b>7%</b>

Table 34 is extracted from the Top-Down model ‘Risk Assessment Analysis’ and shows the associated SABCE and corresponding risk exposures for each assigned profile.

**Table 34 Profile Cost Risk Exposures**

YOE Risk Assessment Detail (\$,000) Model Version 5.16a SCC 100 Finance Charges not included					
YOE Sponsor values	Overall	Profile 1	Profile 2	Profile 3	Profile 4
Sponsor total estimate (SCC 10-90) (8%ile)	6,551,459				
Sponsor stripped estimate (SCC 10-80)	5,068,031	CP1 - Systems Instalations	CP2 - Tunnels and Trackwork	CP3 - Newhall Yd and Santa Clara Sta. & SCC 60-80	CP4 - Underground stations
		436,495	1,596,381	2,134,173	900,981
<b>YOE PMOC values</b>					
Inflation Adjustment on Sponsor Estimate	185,063	20,526	54,214	75,208	35,115
Direct Cost Adjustments	181,367	0	2,310	179,056	0
Duration Adjustments	473,844	32,595	221,980	191,088	28,181
Latent contingency Deduct / Add	196,992	3,761	141,382	3,199	48,649
Adjusted, Inflated estimate	<b>6,105,295</b>	<b>493,377</b>	<b>2,016,268</b>	<b>2,582,725</b>	<b>1,012,925</b>
<b>FTA target (65%ile)</b>					
Contingency recommendation amount in target	8,757,808	695,961	2,924,783	3,634,963	1,502,101
Target contingency %	2,652,512	202,584	908,515	1,052,238	489,175
	43%	41%	45%	41%	48%
<b>Risk analysis</b>					
Lower bound	6,105,295	493,377	2,016,268	2,582,725	1,012,925
Lower report range value= (40%ile)	7,713,866	616,231	2,567,222	3,220,836	1,309,577
Median report range value= (50%ile)	8,096,419	645,448	2,698,250	3,372,593	1,380,127
Upper mid report range value= (65%ile)	8,757,808	695,961	2,924,783	3,634,963	1,502,101
Upper range reporting amount (80%ile)	9,639,303	763,285	3,226,705	3,984,647	1,664,665
Upper bound	16,118,268	1,258,112	5,445,824	6,554,819	2,859,514

As noted above figures exclude finance costs. Reported P65 cost is \$9,148 million including finance costs of \$390 million (\$8,757.81 + \$389.72 = \$9,147.53 million).

Figure 9 shows the Probability Distribution extracted from the Top-Down “Risk Distribution Report Graphics TAB”.

**Figure 9 Probability Distribution**

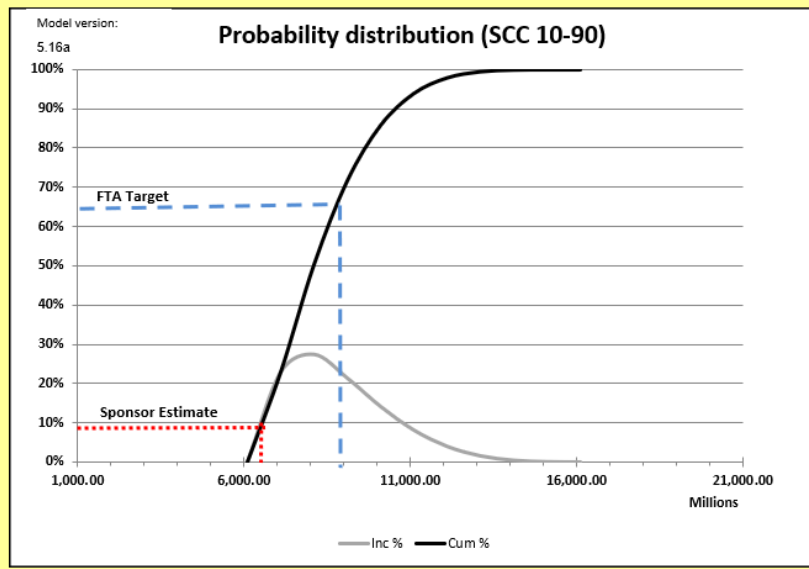
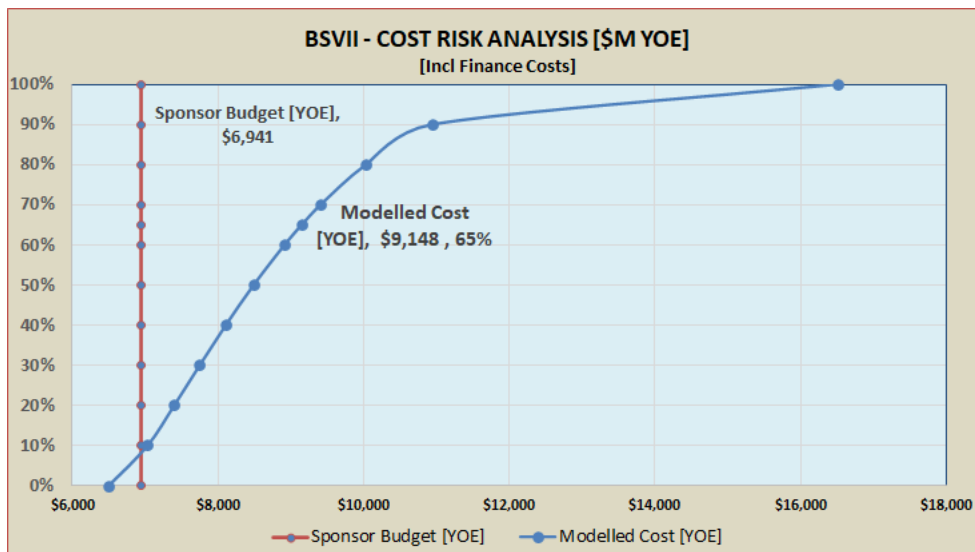


Figure 9 shows the Sponsors proposed estimate of \$6,551 million (YOE, excluding finance charges) as insufficient to meet the predicted risk exposure as developed by the PMOC.

Figure 10 shows the Probability Distribution including finance costs followed by tabular data in Table 35 corresponding to the graph.

**Figure 10 Probability Distribution (with finance costs)**



**Table 35 Probability Distribution Tabular Data (with finance costs)**

P Value	Sponsor Budget [YOE]	Sponsor SABCE [YOE]	PMOC Adj Estimate [YOE]	Modelled Cost [YOE]
0%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 6,495
10%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 7,028
20%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 7,395
30%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 7,745
40%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 8,104
50%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 8,486
60%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 8,911
<b>65%</b>	<b>\$ 6,941</b>	<b>\$ 5,458</b>	<b>\$ 6,495</b>	<b>\$ 9,148</b>
70%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 9,407
80%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 10,029
90%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 10,939
100%	\$ 6,941	\$ 5,458	\$ 6,495	\$ 16,508



## **6.0 RISK MITIGATION**

### **6.1 Primary Mitigation**

The VTA risk register includes:

- Risk owners assigned to all risks
- Contains action items and response / status for actions listed
- Contains date showing when last updated
- Contains notes on mitigation actions status

PMOC has not been supplied with the individual action plan sheets for each risk, there is no history trend log showing the success, or not, of risk mitigation efforts to date (i.e. through a change in rating from High to Low for example) and there are no ‘measurable’ deliverables identified against each action (although they may exist separately in the risk database).

*The PMOC recommends and requests:*

- 1. Risk mitigation plans with a clear deliverable for each sub-component of the plan, an owner for each mitigation action to implement the plan and a target date for completion of each action’s deliverable is developed for each Intolerable and Substantial risk.*
- 2. Risk mitigation plans are updated monthly and formerly reported to the Project Director in a monthly risk report which would include any additions, deletions or changes to the status of risks listed in the risk register.*
- 3. Minutes of the regular monthly risk meetings on the project to review the status and actions of all Intolerable and Substantial risks are copied to the PMOC*
- 4. The Sponsor updates their cost and schedule risk analysis quarterly unless a significant change in risk exposure (up or down) occurs in which case risk exposure and contingency impact should be developed immediately.*

### **6.2 Secondary Mitigation**

The most recent Sponsor RCMP received by the PMOC is Rev. C dated April 16, 2021 contains no proposals for secondary risk mitigation. (PMOC notes this section was deleted in the most recent RCMP but had been previously incorporated)

*The PMOC recommends:*

- 1. VTA review PMOC’s schedule adjustments to the TBM mining production rate and the impact on contract package interfaces. This adjustment has a significant impact on the risk profile of the project as a whole.*
- 2. VTA consider progressing tunnel and facility design to further prove concepts notably in construction working space, traffic management and staging and to identify any additional ROW required and / or utilities requiring relocations.*
- 3. VTA consider escrow account to fund cash flow reducing contractor financing risk*
- 4. VTA consider escalation clauses and formula to avoid excessive inflation risk being added to contracts in this uncertain market and economic conditions*

### 6.3 Contingency

In the PMOC's opinion contingency should be increased in alignment with early stages of design of tunnel elements awaiting CP2 PDB input.

*The PMOC recommends:*

- 1. VTA revise their approach to cost risk modelling to reflect uncertainty on unallocated contingency*
- 2. VTA advance their schedule risk model through an independent summary schedule to more accurately reflect risk exposure and opportunity currently overly influenced by missing activities, inconsistent detail and logic discrepancies in the developing IMPS*
- 3. VTA introduce buffer float at key interfaces in the CP2 tunnels and trackwork activities to recognize intermediate uncertainty and better account for interface risk in dates provided to successor works packages*

## **7.0 RISK AND CONTINGENCY MANAGEMENT PLAN**

### **7.1 Introduction**

The most recent Sponsor RCMP received by the PMOC is Rev. C dated April 16, 2021.

The Sponsor RCMP contains following structure:

- Definitions
- Overview
- Risk Management Process
- Insurance requirements
- Primary mitigation
- Cost and schedule risk management
- Contingency management
- Iterative risk management

The most recent previous version provided to the PMOC was Rev. B dated September 30, 2020.

### **7.2 PMOC Observations**

#### General

- Cross references should be provided to related and interfacing project procedures.

#### Definitions

- Further definitions are required to elaborate on relationship with trends, potential changes, pending changes and approved changes.
- Separate definitions should be provided for allocated and unallocated contingency; PMOC notes more elaborate descriptive is provided in Section 5, cost and schedule risk management
- Definitions of Hold Points should be added

#### Overview

- No organization chart is provided to define reporting lines of the risk manager through the organization
- No relationship or definition exists on project risk reporting and evaluation and enterprise risk management and reporting
- No reference is made to a risk management committee or how risks are reported up to the VTA Board
- The RCMP does not establish a clear baseline for risk in the opening sections in terms of overall project objectives, scope boundaries, budget, key dates and does not contain any listing of assumptions, exclusions and qualifications impacting contingency and risk assessments. PMOC notes baselines are described in Section 5, cost and schedule risk management but a summary of these should be included earlier in the RCMP.
- The RCMP does not define or refer to VTA's overall risk appetite or risk tolerance

## Risk management process

- How independence in risk characterization and reporting is achieved is not described.
- No relationship to the discipline or department leads is shown or described except to be generally coordinated through the BSVII program administrator and the risk manager
- No relationship, role, responsibility, ownership or reporting of risk by the DB / PDB contractors is described except in general terms
- The RCMP contains no description of risk transfer, sharing or retention strategy with the DB contractors and how an integrated risk management approach is to be achieved aligning contractors, project risk management, program risk management and enterprise risk management. General mention of risk meetings with contractors is made in RCMP section 2.1 but given this project is to be DB essentially managed and coordinated by the CM's and DB's a much stronger process is required in the RCMP to describe how this will all work together. It would be expected, for example, each CM would be required to identify and lead risk manager who in turn would report up to the VTA program risk manager.
- A cut-off date for monthly risk assessment and monthly cadence of review and updating risk qualitative and quantitative assessment to support regular reporting of risk management, risk mitigation and contingency exposure and draw down is not discussed in any detail.

## Insurance requirements

- Insurance strategy and details are extremely broad and general and describe a 'typical' OCIP structure and are not specific to the BSVII and are lacking in detail necessary to support the impending Contract Package procurements
- PMOC notes responses to recent RFIF's noted general acceptance to an OCIP but required further details and clarifications of risk allocation
- The RCMP refers to an OCIP insurance, safety and claims procedures manuals. It appears these have not been progressed. Specific policy descriptive and allocation of risk is therefore assumed yet to be developed in detail.

## Primary mitigation

- Management of contingency requires better definition and cross reference to change control and management and overall cost and schedule management. PMOC has not been copied a Trend Register, Pending Change Log, Potential Change Log or Approved Change Log and has seen no 'issues' register.
- The RCMP should set out a risk mitigation strategy typically contained in a 'claims avoidance plan' and an 'excess profit avoidance plan'. Excess profit avoidance is defined as "avoidance of transfer of risk better shared or retained by the owner for to transfer would encourage high mark-up to cover the eventuality of the risk occurring". This strategy will be key to a successful risk matrix and collaborative working relationship adopting the PDB approach proposed for CP2 tunnels and trackwork. The transfer of very low probability risk with very high impact or risk which cannot be managed by a contractor is a recipe for exposure to extremely high costs and typically does not result in risk transfer as intended

if in the event the risk materializes. These strategies can also dovetail into risk management and allocation between 3rd party stakeholders and 3rd party utility owners through risk sharing and allocation described in 3rd party and cooperative agreements

- No clear monthly review process is established describing the multiple departments and 3rd parties that will be involved in regular assessment of risks. Regular review and cut off processes require better definition
- The four-square risk matrix approach does not provide references to individual risk numbers and does not align to the scoring and ranking of risks ; that is the risk matrix and risk heat map do not align to the four-square risk matrix. It is, in the PMOC's opinion, a confusing and not standardized approach to view risks.
- Summary of primary risk mitigations is generalized
- Tabulated risk descriptive and risk mitigation plans would be better presented in individual risk mitigation and action plans (as was the approach on BSVI) with a summary provided of key risks impacting cost and schedule objectives

#### Cost and Schedule Risk Management

- This section is generally well developed however PMOC has seen no update to these cost or contingency projections which are now over 6 months out of date. The March 2021 RCMP shares no update beyond the EPD submitted application
- In the PMOC's opinion cost and schedule contingency requires re-evaluation in accordance with recommendations contained in this report. VTA have stated that the cost and schedule contingencies will be updated in line with the full estimate update planned for 3Q2021

#### Contingency Management

- Cost and schedule contingency draw down requires further analysis once the recommendations in the PMOC's risk assessment have been further considered
- Cost and contingency management should be performed regularly, ideally monthly but at a minimum, quarterly. (RCMP states 'periodically')
- The cost or schedule contingency management draw down curves (Figure 7 and Figure 8 in the RCMP) do not appear to recognize the expected transfer of risk to DB contractors as is expected under lump sum fixed price DB contracts. This would suggest a greater risk sharing and retention than the current VTA documents describe.

#### Iterative Risk Management

The process is well described but general and, as stated above, provides no definitive regular reporting timelines or cadence for risk updates. Specifically, under RCMP section 7.3,

*“Updates to the RCMP will be made as major Project/Program milestones are achieved. Examples of these major milestones include:*

- *At design deliverables*
- *At awards of major contracts*
- *At mid-point of construction*

- *Other intermediate stages of construction”.*

The Sponsor provided no dates associated with the iterations.

## **8.0 OP 32C: PROJECT SCOPE REVIEW**

### **8.1 PMOC Review**

This section documents PMOC's review of the project scope based upon supplied sponsor documents. VTA chose to exercise an abundance of caution with respect to protecting the confidentiality of documents that will be included as part of the RFP packages. Therefore, PMOC conducted reviews on summaries and presentation materials VTA used to demonstrate the design development when necessary.

#### **8.1.1 Project Delivery Method, Contract Packaging**

The main work groups are planned to be packaged into the following four large construction packages:

- Systems CP1 (DB)
- Tunnel and Trackwork CP2 (PDB)
- Newhall Yard, Santa Clara Station and Parking Garage CP3 (DB)
- Stations and Support Facilities CP4 (DB)

VTA's *Project Delivery & Procurement Plan* for BSVII specifically states that all local, state, and Federal requirements must be adhere to, and the delivery method that VTA has chosen of DB & PDB meets the requirements of all local, state & Federal regulations and circulars, as provided in FTA's *Best Practices Procurement Manual* (BPPM) and *FTA Circular 4220.1F guidance*.

VTA has stated in its *Project Delivery & Procurement Plan* for BSVII (2.1.4) the construction work for BSVII will be packaged into contracts that are best suited to satisfy BSVII objectives and optimize work scopes and costs, while minimizing risks and interferences among work packages with respect to schedule and budget. The proposed contracting strategy is based on consideration of size, scope, geography, design requirements for civil, systems and major structures, constructability, and general pricing of the packages.

VTA has stated in its *Project Delivery & Procurement Plan* for BSVII the determining factors for their procurement methodology. In addition, the PMOC team agrees with the contract methodology of PDB for CP2 although notes and agrees with responses to RFIF process for CP1 and CP4 suggestions that consideration should be given of one or both of these packages also being PDB given the integration of design and fast track nature of the program. VTA has not indicated whether they took those suggestions under consideration and performed any cost-benefit analysis or evaluation. PDB is growing in popularity on large complex projects as a method to get the DB contractor on earlier when Employers requirements are still developing especially where a DB's specific means and methods and associated innovation proposals impact schedule, cost and indeed, the base design

VTA have stated they will own and coordinate the BIM model and ensure coordination and configuration of design and clash detection. Notwithstanding, the latest documentation suggests that all of the interface management responsibility is placed on the CP1 contractor, who does not have a contractual relationship with the other contractors. The PMOC has not seen any plans that

indicate how VTA is overall responsible to ensure that the interface management occurs and is structured correctly to ensure integration of all disciplines.

In section VTA's *Project Delivery & Procurement Plan* for BSVII 3.6.3 VTA Risk Management, VTA is implementing an Owner Controlled Insurance Program (OCIP) for BSVII. VTA has estimated that an OCIP will save BSVII approximately \$30 million. PMOC's prior project experience points to this project being well suited to an OCIP however effort and cost in management of such programs and cost of deductibles often exceed Sponsor estimations, albeit final costs may well be lower than that which would have been incurred under a CCIP.

Text in the *Project Delivery and Procurement Plan* suggests most of the risks are to be placed with the DB contractors (the VTA Risk Register gives no details on proposed transfer, sharing or risk retention). In addition, the interface risks of all of the construction contracts (CP2, CP3 & CP4) is described as to be placed on the CP1 DB contractor. There is not enough detail in current plans or procurement documents that indicate how the CP1 contractor will be able to manage the other contractors' contracts with VTA and be able to enforce any interface disputes or solutions. VTA is currently working on the details of the CP1 interface responsibilities.

The PMOC Team has yet to see design levels at 30%, and correspondence and status information received and presented to the PMOC during reviews has confirmed generally design is targeted to reach 30% in 3Q2021 coinciding and supporting the RFP process for the CP's. At this point the estimate and schedule will be refreshed and aligned to this design milestone with an anticipated target release of updated cost and schedule status late summer to fall 2021. The exception to this is scope under CP2 (Tunnels and Trackwork) where VTA has stated design is on hold at between 10% and 15% level pending the engagement of the PDB targeted for spring 2022. PMOC is concerned this will essentially lose 6-9 months of valuable design time, delay interface design coordination with CP1 and CP4 and site access planning for CP3 to Newhall Yard given the dependencies around means and methods of the selected PDB contractor and will likely impact the commencement of construction and the ordering of the TBM.

VTA has a detailed risk registered that is in line with a lot of the PMOC's top risk for the project. VTA continues to address the uncertainties with technical analyses and associated reports. With respect to the major uncertainties, the CP2 PDB will need to progress more with the tunnel design and site explorations to mitigate major uncertainties in the project. As PMOC already noted the interface management responsibility is described to lie with the CP1 contractor when the design interfaces will be under revision while the PDB is in Stage 1 design development and early works, all while there is no contractual relationship between CP1 and CP2 design builders. Design of CP1 will impact detailed design of CP4. VTA have presented to the PMOC the extensive efforts to space proof tunnels, stations and ventilation facilities based on BART standard equipment specifications and standards. Until the CP1 DB is onboarded and confirmed the space proofing this remains a risk and will constrain design development and coordination.

VTA has indicated in their *Project Delivery & Procurement Plan* for BSVII (2.1.4) will be packaged into contracts that are best suited to satisfy BSVII objectives and optimize work scopes and costs, while minimizing risks and interferences among work packages with respect to schedule



and budget. During the PMOC review process VTA have made scope transfers between CP4 (underground stations) and CP2 (tunnels and trackwork) to place SOE, adit construction and ventilation facility complete structures to reduce interface risk and improve coordination aligned to means and methods of CP2. PMOC expects to see further scope transfers between packages as is common as strategy develops and feedback from the RFIF and RFP processes continues.

VTA has facilitated requests for industry feedback and held meetings with the proposed bidders and had an industry review of their construction packages. VTA has completed an RFIF S20183 Systems (CP1); RFIF S20174 Tunnel & Trackwork (CP2); RFIF S21019 Newhall Yard & Santa Clara Station (CP3) & RFIF S20209 Stations (CP4). With respect to CP 1, there are only two potential bidders for this scope of work. For the most part, responses to the potential RFP's being let has been positive.

VTA's Third Party agreements with the local municipalities, state & Federal agencies are currently finalizing the cooperative agreements, which define the review period, maintenance of traffic requirements, and approvals. Transit Oriented Developments (TOD) have also been agreed to with Google, as another third party organization and other developmental agreements are not expected to impact the project schedule, as VTA will progress the design leaving a demarcation point for other development to occur at a later time if required.

VTA has performed a statement of qualification (SOQ) review and has approved all the proposed bidders to proceed with bidding on the project.

VTA's *Project Delivery & Procurement Plan* for BSVII procurement follows industry practice and federal requirements. The Contract Packages describes the requirements for the contractors and identifies the timeframe of the deliverables and long lead items. The PMOC Team has not had the opportunity to review the procurement contracts, but VTA's procurement plan is compliant with industry practice and FTA Circular 4220.1F.

### **Third Party Procurement Contracts**

VTA has held meetings with the proposed bidders and had an industry review of their construction packages. The agency has widely marketed the project and have received a large interest in their program, though the only exception appears to be with the CP 1 contract, where there is currently only two potential bidders. VTA is exploring options to increase this number.

Currently, VTA has no 3rd Party agreement for procurements of long lead items. VTA is considering BART procuring the running rail, as BART has a business relationship with the specialized manufacturer of this type of trackwork. Until that decision is finalized, it is assumed the requirement and responsibility fall on the CP2 contractor.

VTA is currently finalizing the RFPs and cooperative agreements with the local municipalities and agencies. The PMOC Team cannot determine any conflicts in schedule until the cooperative agreements have been signed and sent to the PMOC for review.

The VTA *Project Delivery & Procurement Plan* for BSVII complies with all Buy America and Federal requirements.

Not all utility contracts have been completed and signed. Numerous master utility relocation agreements are executed, and the remaining are progressed to final drafts that will be ready to execute shortly. Subsequently, the detailed agreements for individual relocations will need to progress based on preliminary designs that BSVII plan to include in the RFP documentation.

VTA will provide all geotechnical data and site investigation to all the CP contractors. VTA have stated they are not expecting CP's to conduct further site investigations apart from specific to station and ventilation facility adits to support localized final design and approach to ground improvement and settlement control related to specific means and methods.

The PMOC Team has yet to see the documents that describe the following terms and scope, as VTA is working on finalizing these documents: General Conditions, Supplementary Conditions, and Division 1 of the Specifications adequately describe, for bidding construction contractors, project site access; schedule; unit prices; provisions for increased and decreased compensation through incentives and liquidated damages; the construction contractor's design/engineering scope of work; mobilization costs; cash flow in general including pay schedule; requirements for bonds, insurance, taxes; maintenance and warranty provisions; contractor field management and supervision; socioeconomic requirements related to bidding; and weather impacts or concerns and protection of the work.

The VTA program and procurement plan takes all of the following into consideration. Though market conditions are highly volatile now since we are currently experiencing COVID-19.

1. Market conditions for the state/regional/local construction economy for the general contractors/subcontractors on public works and private.
2. Market conditions for the national construction economy for transit general contractors/subcontractors.
3. Availability of labor for various trades such as electricians, etc.
4. Availability of major materials at the bulk commodity level (fuel, cement, steel, copper, plywood/lumber, etc.) and the finished component level (traction power supply and distribution, train control elements, vehicles, microprocessor equipment, etc.)
5. Availability of construction equipment/sequencing/timeframe requirements for specially designed, or project specific equipment such as cranes, launching girders, pre-mix plants, barges, etc.

Access and occupancy of project construction sites:

1. Local community restrictions and accommodations are assumed to be addressed in the cooperative agreements with the CSJ and CSC.
2. Though VTA's staging plan focuses on the use of the Newhall Yard property, the PMOC has not seen the potential contractor's maintenance of traffic or mobilization plans to make a meaningful determination. VTA is progressing a preliminary maintenance of traffic plan in the RFP documentation that will be included as a starting point for the design builders.

The following details have not been shared with PMOC in the EPD application materials: site availability in terms of hours per day, days per week, months or seasons during a year, considering

ongoing operations for transit, railroads, pedestrians, bicycles, and roadway traffic; impacts such as transportation, social and economic conditions; constraints due to public spaces, historic and archaeological resources, air quality, noise and vibration, contaminated materials and natural resources, among others. VTA has been discussing the same topics with the local jurisdictions during design development and have reported to PMOC that these will be included in the RFP documents.

VTA is advancing preliminary utility relocation designs, but each location will be progressed to final design either by the design builder (storm and sanitary sewer) or by the utility owner (all other utility types). Master utility relocation agreements for most utilities have been executed, but not the specific agreements by location. The master utility relocation agreements did not address schedule commitments or requirements or provide estimates for the proposed relocation works.

Potential waste sites for the disposal of HAZMAT, and tunnel and excavation muck disposal sites have been identified and contact information will be provided in the RFP documentation for use at contractor's option.

VTA is advancing the design and agreements with Pacific Gas & Electric (PG&E) (in conjunction with BART, who is the ultimate power customer during operations) for TBM power supply for use at contractor's option.

### **8.1.2 Design Relative to Site and Geotechnical Conditions**

Pre-construction site reconnaissance visits have not been conducted by VTA with prospective bidders since the project has not reached that phase and restrictions through then COVID-19 Pandemic have limited any interactions and in-person gatherings over the last 18 months. However, VTA staff and consultants have reportedly been on site during the design phase to observe existing conditions.

VTA designs are being advanced based on completed boundary and existing conditions surveys, which have been completed over the life of the project. As of April 31, 2021, one site was still subject to access limitations; otherwise, access had been obtained for all environmental site assessments and geotechnical evaluations.

Geotechnical investigations have been conducted by VTA on this project over many years. There are a substantial number of borings covering the project. Investigations are not yet complete but with over 1,000 borings, they are more than sufficient at this phase of design to characterize the subsurface conditions for most of the project. Additional investigations are scheduled for the near term at Santa Clara Station and Diridon Station. The selected progressive design builder may also determine additional investigations are warranted before they will agree to what is planned to be a negotiated or joint Geotechnical Baseline Report.

The copious number of borings mean this project is less likely than most to encounter unexpected subsurface conditions. However, the conditions do not make for easy construction. The geotechnical data identified high groundwater combined with the mixed alluvial materials. The Sponsor has investigated methods to keep the tunnel, station boxes, and portals from floating, but will leave means and methods to the selected design builder. Similarly, VTA has acknowledged

that multiple means of ground treatment might be needed at the station adits, but the final selection of ground improvement will be left to the design builder.

The Geotechnical Data Report has been compiled in two volumes, one with the historic data collected over the life of the project and the second with the most recent investigations. Laboratory testing has continued, and borehole logs are being updated accordingly.

The Obstructions Report has been progressed through an internal Inter Disciplinary Review (IDR) in May 2021. The Property Protection Study will go through an IDR as well as an over-the-shoulder (OTS) review by a technical advisory panel prior to the CP2 RFP. As the property protection study has progressed over recent months additional property acquisition needs have been refined in parallel and will be progressed through the certification process once the requirements are confirmed.

Local seismic conditions and codes have been taken into account. The Silver Creek Fault crossing draft report, including recommended design criteria, has been submitted to BART for concurrence. BART requested and VTA complied to have a technical peer review of the report and associated criteria. The tunnel liner design through the fault zone is an area of potential innovation, so VTA is leaving additional design to the progressive design builder.

Taking the urban and historic environment with built public and private infrastructure and facilities into account the project has prioritized progressing the property protection options. PMOC considers the amount of money included for monitoring and ground improvement as well as the settlement risks in VTA's risk register as confirmation that VTA also acknowledges this as one of the most substantial risk elements. The avoidance and mitigation of settlement will continue to be a concern through construction and the risk remains VTA's until it is contractually shared or delegated to the progressive design builder.

The horizontal and vertical alignment of the track and tunnel have reportedly been refined in response to buried structures and utilities over the past several months. The alignment was advanced to be frozen and considered prescriptive for the procurement process including CP1, CP2, and CP4.

No allowance was specified in the cost estimate for hazardous materials. VTA indicated that the removal and disposal of hazardous materials was included in the earthwork costs and quantities for the project, but the details could not be substantiated in the estimate by PMOC.

### **8.1.3 Third Party Agreements**

VTA originally identified seven (7) third-party agreements as critical:

1. BART IL #42
2. BART IL #35
3. Peninsula Corridor Joint Powers Board PCJPB / Caltrain
4. AT&T
5. Comcast
6. Sprint

## 7. PG&E

PMOC requested FTA determination of criticality for 5 additional agreements:

1. UPRR Master
2. City of San Jose (expired)
3. City of Santa Clara
4. FAA
5. Caltrans (expired)

Upon further evaluation:

UPRR – FTA determined no critical agreement was needed for EPD application, as pertinent terms were covered in the original Purchase and Sale agreement.

FAA – FTA determined that substantial coordination prior to the 7460-1 Notification, but no formal agreement required at this phase.

Leaving 10 critical agreements for execution prior to the application per the NOFO, which are listed immediately below and selectively discussed in detail below the list:

1. BART IL #42
2. BART IL #35
3. Peninsula Corridor Joint Powers Board PCJPB / Caltrain
4. AT&T
5. Comcast
6. Sprint
7. PG&E
8. City of San Jose
9. City of Santa Clara
10. Caltrans

### **Caltrans**

PMOC review began based upon the expired SVX agreement and VTA's request to Caltrans to generate a new agreement in similar format and content.

PMOC was not informed of VTA modified approach until after a different agreement was executed and provided. Measure B Master Agreement was used for the framework, with an amendment executed related to BSVII. Three crossings were added as separate projects.

PMOC concerns with this approach:

1. Crossings are not standard highway improvement projects, which is what the agreement was established for.
2. This agreement specified the need for a project-specific cooperative agreement or amendment to the Master Measure B Agreement at later date. (This is what PMOC would have expected to be completed to meet the intent of the NOFO for EPD application and FFGA.)

Construction cooperative agreements will be required at a later date for each of the crossings.

Additional correspondence from Caltrans was provided indicating that the project approval was based on the 2010 project report. When PMOC questioned the validity of that project definition, VTA acknowledged that report was out of date and indicated VTA would be updating in parallel with the upcoming cooperative agreement.

VTA has been negotiating a draft cooperative agreement with Caltrans and anticipates execution in June 2021 for incorporation into the RFP for CP2.

### **City of San Jose (CSJ)**

The agreement for SVX was executed covering BSVII but expired in 2018.

When accelerating to meet the NOFO execution requirement it was done at the expense of including certain details that could have protected VTA's (and therefore FTA's) interest. The executed master agreement does not commit CSJ to a set duration for review of project submittals. It also does not establish the milestones or frequency of design submittals for CSJ review.

VTA is currently negotiating CSJ Cooperative Agreement #1 – Scope & Requirements Definition and Pre-DB Procurement City Reviews. This agreement might be approved by San Jose City Council in June 2021 to be incorporated into the RFP for CP2.

### **City of Santa Clara (CSC)**

PMOC has similar concerns related to lack of detail as in CSJ executed master agreement.

VTA is currently negotiating CSC Cooperative Agreement #1 – Scope & Requirements Definition and Pre-DB Procurement City Reviews. This agreement might be approved by Santa Clara City Council in June 2021 to be incorporated into the RFP for CP2.

### **City Agreements Combined**

As interim measure to document VTA's readiness to submit and meeting the intent of the NOFO, FTA requested a detailed plan for each Master City Agreement regarding the anticipated follow-on cooperative agreements to clarify future details. Steps to execution were expected to be laid out with timeframes, allowing FTA to understand the process VTA anticipates as well as monitor progress while the EPD application may be under review.

Especially important for the scope and requirements definition agreements because there is no float between the need-by date and the anticipated execution date and no time allowing for incorporation of terms into the RFP after that need-by date. PMOC acknowledges the need-by date is based on the first RFP, which is Contract Package 2 – Tunnel and Trackwork, planned for late July 2021 release. Terms specific to the other contract packages could lag slightly but also could complicate the process with additional agreements or amendments.

### **Google/P3 and TOD agreements**

The existing Google/P3 agreement includes a financial commitment and locations for construction staging. Next steps will need to address more detail for construction staging milestones/needs/constraints in a joint agreement between VTA/CSJ/Google.

### **Project Labor Agreement**

The new VTA leadership and Board of Directors are evaluating the scope of the PLA. There are policy level decisions which need to be made and might impact the BSVII-specific agreement. If the agreement is not executed prior to the RFP, labor provisions will be included by other means in the RFP documentation. Any changes to those provisions with the executed agreement will require either an addendum to the RFP documentation or a modification to the contract depending on the timing of execution. PMOC notes that the Project Labor Agreement was deleted from the latest version of the plan, but it should be addressed as it is a required third-party agreement.

**Table 36 Third-Party Agreements**

Agreement/ Permit/ Other	Owner	VTA/VTA's Consultant team Owner	Critical/ Non-Critical	Status	Expected Execution
Master Utility Relocation Agreement	AT&T	Utilities Lead	Non-Critical	Executed	10/16/2020
Comprehensive Agreement	BART	VTA General Manager (GM)/ Counsel	Non-Critical	Executed	11/19/2001
Operations & Maintenance (O&M) Agreement	BART	VTA GM/ Counsel	Non-Critical	Executed	05/22/2020
Implementation Letters	BART	VTA GM/ Counsel	Critical	Executed	09/01/2020
Master Agreement	City of San Jose	Third Party Manager	Critical	Executed	10/16/2020
Cooperative Agreement #1	City of San Jose	Third Party Manager	Non-Critical	Draft	05/28/2021
Cooperative Agreement #2	City of San Jose	Third Party Manager	Non-Critical	For design reviews during DB	01/07/2022
Cooperative Agreement #3	City of San Jose	Third Party Manager	Non-Critical	For construction	04/08/2022
Master Agreement	City of Santa Clara	Third Party Manager	Critical	Executed	10/29/2020
Cooperative Agreement #1	City of Santa Clara	Third Party Manager	Non-Critical	Draft	05/28/2021
Cooperative Agreement #2	City of Santa Clara	Third Party Manager	Non-Critical	For CP3 Pre-RFP review	01/07/2022
Cooperative Agreement #3	City of Santa Clara	Third Party Manager	Non-Critical	For design reviews during DB	01/07/2022
Cooperative Agreement #4	City of Santa Clara	Third Party Manager	Non-Critical	For construction	03/03/2023
Master Utility Relocation Agreement	Comcast	Utility Lead	Non-Critical	Executed	11/03/2020
Cooperative Agreement	PCJPB	Third Party Manager	Critical	Executed	11/02/2020
Master Utility Relocation Agreement	PG&E	Utility Lead	Non-Critical	Executed	01/14/2020
Engineering Utility Agreement	T-Mobile (Sprint)	Utility Lead	Non-Critical	Executed	10/30/2020
Cooperative Agreement	Caltrans	Third Party Manager	Critical	Executed	10/30/2020
Cooperative Agreement for DB	Caltrans	Third Party Manager	Non-Critical	Draft	04/30/2021



Agreement/ Permit/ Other	Owner	VTA/VTA's Consultant team Owner	Critical/ Non-Critical	Status	Expected Execution
Master Utility Relocation Agreement	Level 3 Communications, LLC	Utility Lead	Non-Critical	Draft	04/30/2021
Master Utility Relocation Agreement	MCI Communications Services, LLC (Verizon)	Utility Lead	Non-Critical	Draft	05/14/2021
Master Utility Relocation Agreement	XO Communications Services, LLC.	Utility Lead	Non-Critical	Draft	05/20/2021
Master Utility Relocation Agreement	Zayo Group LLC	Utility Lead	Non-Critical	Draft	04/30/2021
Encroachment Permit	Caltrans	Contractor	Non-Critical	For construction	09/15/2023
Joint Use and Maintenance Agreement	Caltrans	VTA GM/ Counsel	Non-Critical	For operations	11/24/2027
Encroachment Permit	City of San Jose	Contractor	Non-Critical	For construction	07/11/2022
Encroachment Permit	City of Santa Clara	Contractor	Non-Critical	For construction	06/14/2023
Other	FAA	VTA/ Contractor	Non-Critical	For construction	08/26/2022
PSA	UPRR	VTA GM/ Counsel	Non-Critical	Executed	12/15/2004
Encroachment Permit Application	Valley Water	Third Party Manager	Non-Critical	Draft	06/18/2021
Programmatic Agreement and Treatment Plan	State Office of Historic Preservation	VTA GM/ Counsel	Non-Critical	Executed	05/09/2018
Permit	Bay Area Air Quality Management District	Third Party Manager	Non-Critical	For operations	02/16/2027

Source: BSVII Third Party Agreement Management Plan Rev 0.C April 18, 2021.

VTA has planned next steps and is working diligently to negotiate agreements with third parties which will establish the project design and construction requirements, define betterments, identify review costs and timeframes, and define responsibilities and costs for inspection and testing. In the meantime, the BSVII baseline schedule and estimate are based on allowances for the third-party costs and design review interfaces.

#### **8.1.4 SCC 10 Guideway and Track Elements**

BSVII has a unique track alignment configuration in a large single-bore tunnel. The two-track main line is side-by-side from the east portal through the 28th Street/Little Portugal Station and a mid-tunnel ventilation facility at 13th Street. The track transitions from the 13th Street facility to a stacked configuration, which is maintained through the Downtown San Jose and Diridon Stations. Between Diridon Station and the Stockton Avenue ventilation facility the tracks again transition to side-by-side, which is maintained through the ventilation facility and west portal into the at-grade portion containing the Newhall Yard & Maintenance Facility and Santa Clara Station at the end of line.

The track installation is primarily direct fixation (roughly 27,500 RF), comprised of track and rail-slab construction in the tunnel and track slab at Santa Clara Station. Ballasted track will also be constructed (roughly 3650 RF) at grade. Approach slabs, bumping posts and rail lubricators are included in the scope for SCC 10.11, Track: Ballasted. A total of 16 crossover switches and turnouts comprise special trackwork in SCC 10.12

Noise and vibration analysis that was conducted during NEPA resulted in a mitigation commitment for Isolated Slab Track (IST) in various locations within the proposed tunnel to reduce ground borne noise levels. The Sponsor is currently revising analysis based on the proposed configuration and is assuming the requirement will be eliminated, therefore there is no cost allowance in the estimate for this mitigation. Although this could be considered a scope omission, PMOC has applied the same assumption and is not recommending a cost adjustment for IST as identified in the MMRP.

VTA has progressed a design concept used for space proofing access, egress, refuge areas, ventilation, emergency evacuation, walkways, vehicle dynamic envelope, lighting, and systems including communications, train control, and traction power. The design will require confirmation by the design builder to take over the existing design and progress as engineer of record.

Design is progressing at a pace commensurate with establishing and validating alignment, space and capacities ahead of procurement of a main civils works contractor to undertake the tunneling and trackwork under a PDB form of contract targeted for appointment in the second quarter of 2022.

The ventilation and evacuation routes have not been approved by the Fire Life Safety committee and will need design builder confirmation to take over the design and progress as the engineer of record.

### **8.1.5 SCC 20 Stations, Stops, Terminals, Intermodals, and SCC 30 Support Facilities: Yards, Shops, and Admin Buildings**

The at-grade Santa Clara Station is the BSVII terminus adjacent to the Caltrain Santa Clara Station.

The 28th Street/Little Portugal Station is underground cut-an-cover construction with side platform configuration.

Downtown San Jose (DTSJ) and Diridon stations are both stacked platform stations with the platforms in the single bore tunnel and the station entrance, adits, back-of-house and ventilation/egress facilities location in off-street cut-and-cover headhouses.

The cost estimate evaluated by PMOC included the excavation and SOE, permanent box structure and station fit-out for the two off-line underground stations as part of the stations contract package. VTA has since implemented a (no cost and no schedule impact) configuration change to move the following scope of work at both stations to the tunneling package:

- deep shaft excavation
- deep shaft SOE
- Initial support of adits
- Ground improvement for adit excavation
- Adit Excavation

VTA considered also shifting the permanent station box structure from CP4 to CP2 but determined to leave that with the CP4 contractor.

There are two mid-tunnel egress and ventilation facilities (under SCC 20.04 Other stations, landing, terminals) which will be cut-and-cover construction and included in the CP2 scope of work.

Newhall Yard & Maintenance Facility is adjacent to the Santa Clara Station and the west portal. The yard has recently been re-designed to fit within the property which VTA already owns and was formerly a UPRR facility. VTA has attained BART approval of the new configuration for the yard and the Santa Clara Stations and the design will progress accordingly.

### **8.1.6 SCC 40 Sitework and Special Conditions**

Utility relocation designs are currently underway for inclusion in the procurement documents. VTA has reported 98 (locations) of utility relocations, which are grouped by owner and by location, not a count of individual facilities. VTA have provided the PMOC with the Utility conflict matrix noting location, size, owner for each utility proposed to be impacted. The list is extensive.

Coordination with utility owners is still underway, ramping up to final design by those owners. Cost sharing differs by owner, but when in public ROW, the cost is generally shared 50/50 for the majority of utility agreements. The schedules for the final design and relocation activities at individual locations are still to be determined and agreed to by the owners. What has been shared

with utility owners: BSVII program schedule, milestones for utility design completion, RFP process, and construction start.

Four additional communications companies have been recently identified requiring master relocation agreements due to proposed impacts to existing facilities. The agreement with Level 3 has been executed, but the agreement had not been provided PMOC or FTA as of the status date of this report. VTA reported the Zayo and MCI agreements will be executed in late May or June 2021. Although Verizon owns both MCI and XO Communications a separate master utility relocation agreement will be required for each due to their functioning as independent companies. The XO Communications agreement will be based upon the MCI agreement once executed.

Per the *BSVII Third Party Agreement Management Plan Rev 0.C* April 18, 2021:

*After the Master Utility Agreements are in place, individual directives for preliminary design, final design, and construction of relocations at various locations will be issued by VTA based on cost estimates provided by the utility companies and verified independently by VTA. Individual Notices to Proceed for design and construction activities will be tracked in PICS.*

*The design and construction of utility relocations and/or rerouting work will be performed by third party utility owners and their subcontractors or under contract to VTA. Design and construction performed under contract to VTA will be completed in accordance with the private third-party utility company's standards.*

Sanitary and storm sewer relocations will be the responsibility of the project, whereas all other utilities will be relocated by the respective owners.

VTA has recently adjusted their approach to utility relocations in that the designs are being advanced by the project consultants instead of waiting until the design builders are on board and could experience substantial delays due to coordination with utility owners. This is an appropriate approach and as long as VTA continues to progress the designs and execute the relocation requests/notices with the utility companies it will be a commendable mitigation strategy for potential schedule delays.

### **8.1.7 SCC 50 Systems**

#### **SCC 50.01 Train Control and Signals**

As described in the SCC Workbook, train control and signals scope includes five new train control zones across four stations and multiple interlockings.

VTA is currently carrying enough costs for either a conventional train control system or a standalone Communication Based Train Control (CBTC) system. This is based on the unit pricing that VTA experienced during SVBX Phase I and includes the unit pricing for the BART/Hitachi CBTC contract, which includes an option for BSVII. As the PMOC was told by VTA during the risk workshop, BART will need to make a decision on what train control technology BSVII needs to install by November of 2022. BART is about to retrofit 80 existing vehicles with the CBTC onboard equipment. Hitachi will be working on the retrofitting.

Using New York Metropolitan Transit Authority (MTA) as a comparison project for implementing, integrating and safety certifying their CBTC system. The earliest that MTA was able to remove their traditional train control systems was one year after all their vehicles had the onboard equipment. Bear in mind, MTA has experience on multiple lines with CBTC and it is still taking them a year to remove their traditional train control system after initiating and testing CBTC.

Looking at the current VTA schedule and decision point for BART (November 2022), PMOC believes it unlikely that all 80 cars will be outfitted with CBTC, tested and commissioned, and safety certified on a route. Bear in mind, the CPUC will have to concur that CBTC is safe as a standalone. BART will also initiate the option with Alstom to have Hitachi installed onboard equipment at the factory prior to delivery of new vehicles. Having said all of this, it is not unreasonable that CBTC can be ready prior to revenue service, but VTA's program schedule decision making point makes it improbable that CBTC will be installed on BSVII as a standalone train control system. It might be prudent for VTA to investigate whether they can push back the decision-making point to allow BART additional time to safety certify CBTC with CUPC.

VTA and BART have indicated that all yards will operate with tradition train control system. The train control system will interface with the new Newhall Yard for dispatching trains from the yard.

Standard details and components were given more credence by the PMOC with respect to systems and design maturity than other disciplines. This is because the design must meet BART standards and requirements and the associated costs are based on established history.

With respect to a contingency plan if BSVII does not install CBTC, it is unclear to PMOC who bears responsibility for the potential overlay. PMOC analysis assumes that BSVII will not require project budget to cover it; per the information provided by VTA that will be a local cost covered separately.

### **SCC 50.03 Traction Power Supply: Substations**

The Traction Power Substations (TPSS) are located at each of the four passenger stations, at Newhall Yard, and at the West Portal. Gap breaker stations (providing sectionalization) are located within three project facilities: one each in the East METVTF and West MEVTF and two at the Newhall Yard. Scope is in Systems contract package.

### **SCC 50.04 Traction Power Distribution: Third Rail**

System wide construction of the third rail or traction power contact rail. The contact rail includes the contact rail, jumpers, insulators, and coverboard. Part of Tunnel and track contract package and Newhall yard contract packages.

### **SCC 50.05 Communications**

System wide construction and installation of communication equipment for passenger information and train operations, located in all four stations, Train Control room and Newhall Yard control tower. Scope is part of Systems contract package.

## SCC 50.06 Fare Collection System and Equipment

Fare collection equipment will be located in entrances to all four stations, includes installation of fare payment and ticket entry gate equipment. Scope is part of Systems contract package.

### 8.1.8 SCC 60 ROW, Land, and Existing Improvements

The RAMP is developed to a level of detail consistent with the design phase of the project. Although the EPD pilot program does not include a milestone for entry into engineering, PMOC finds the RAMP to be complete commensurate to that level. Land acquisition activities have been progressed per the RAMP and applicable policies and procedures. Preparatory activities for relocations have begun to meet VTA's plan for sufficient time to relocate owners and tenants.

ROW exhibits shared with PMOC for the January 2021 ROW workshop identified property in the following categories:

1. Tunnel Easement
2. Tunnel Easement (Exclusion Zone Only)
3. VTA-Owned Property
4. Proposed Fee Take
5. Permanent Easement (Tieback)
6. Construction Staging Area/Temporary Construction Easement
7. Overlapping Easement
8. Utility Easement

Survey documents have not been shared with PMOC, however VTA has reported progress on surveys with their schedule progress updates. Although PMOC has not obtained the survey documents, VTA has demonstrated via virtual presentations that the property information and survey data are fully coordinated with the design drawings for guideways and buildings, site features, utilities, streets, railroads, site access, construction easements and staging areas.

Property acquisitions are being certified based on the proposed project footprint and tunnel zone of influence; therefore, excess property has not been specifically identified on any right of way plans shared with PMOC.

VTA has planned and implemented environmental site assessments as necessary in advance of property acquisition activities.

VTA has identified the acquisitions and relocations shown in Table 37 (per Spot Memo 15: Right-of-Way Acquisitions dated April 23, 2021):

**Table 37 Right-of-Way Acquisitions and Relocations**

<b>Land</b>	
Full Parcel Takes	10
Tunnel Easements	57
Partial Takes (including partial fees, non-tunnel easements, and/or a combination, and other interests)	12
<b>Relocation</b>	
Residential	8
Business	35

VTA is negotiating the tunnel easement language with BART and will request approval for all acquisitions in a single action based upon preliminary linework. The final linework based on design refinements prior to the CP2 RFP is planned to be complete in May.

### **8.1.9 SCC 70 Vehicles**

As per BART’s Rail Fleet Management Plan FY2020 to FY2036 (DRAFT Revision D September 2019):

“VTA will have capital responsibility for 60 cars associated with the Phase I extension to Berryessa and 60 associated with the Phase II extension to Santa Clara, with BART having capital responsibility for the remainder of the fleet.” [p62]

“BART has not yet finalized a contract for a subsequent procurement of 425 ‘E’ cars, but their reliability, availability and maintainability requirements will be as specified for the current contract of 775.” [p60]

VTA has included 48 of the 60 Phase II vehicles in the scope of this project and the remaining 12 will be paid for entirely with local funds.

BART has an established vehicle procurement program for the fleet expansion. Updates to the specifications, testing and inspection plans, maintenance and training requirements will be addressed as needed in the future.

The upcoming BART procurement could be impacted by the buyout of their current vehicle manufacturer; configuration changes being implemented based on current fleet performance; and supplier cost increases.

VTA has not provided a bus fleet management plan and although the project will impact bus routes in the vicinity of proposed stations, BSVII does not include the purchase of any new buses.

### **8.1.10 SCC 80 Professional Services**

- Scope for SCC80 includes program-wide elements as well as work associated with the four major contract packages. Nearly every SCC80 sub-section consists of efforts by VTA staff, BART staff, and professional services consultants. SCC80.06 will also include the necessary professional services consultants performing reviews on behalf of third parties and third-party staff. Please refer to the PMOC’s recommended cost adjustment related to SCC80 (later in this report) for additional analysis of the allocation of costs and the Sponsor’s staffing plans for BSVII.

## **9.0 OP 33: CAPITAL COST ESTIMATE REVIEW**

### **9.1 Introduction**

The PMOC followed guidance outlined in FTA OP 33 to verify the cost of the project through a review of the documents provided by the Sponsor, VTA, as listed in Appendix B.

This project is presented by the Sponsor under the EPD pilot program. PMOC has worked with the procedures where possible but time and expedited approach has not allowed a complete review as under a traditional submission. Effort has been concentrated in identifying any major shortfalls and deficiencies in the presented estimate and associated back-up.

The PMOC received the estimate in its original format and subsequent cost estimate backup files beginning in August of 2020 through May 2021. Please reference Appendix B for detailed dates of documents received and reviewed along with their revision history.

Due to the accelerated nature of the PMOC review, this report will not include developing independent cost estimates for General/Supplementary Conditions/Division 1 for the three largest construction contracts and the systems work.

### **9.2 Estimate Status**

1. By the AACE Cost Estimating Classification System, the Estimate falls broadly under a “Class 3 estimate” which is defined as design development, budget authorization, and feasibility. The maturity level of project definition deliverables is generally between 10% and 40% and would equate to a Schematic level of design. Some elements are less mature, for example the Santa Clara Station, the Newhall Yard operations and maintenance facilities and vehicle storage yard, and some are more advanced such as Systems installations adopting BART standard detailing and specifications. The bulk of the quantified elements of the estimate reflect the main civil works of the tunnel, ventilation facilities and underground station structures and station architectural works which were all at generally a 10% to 15% level of design when adopted for the submitted estimate.
2. The original civil works estimates SCC 10-50 were provided in 2019 Q4 dollars. Project elements aligned to SCC 60-80 were provided in 2020 base year dollars. To accommodate SCC workbook requirements and align all the SCC codes to a common base year the Sponsor escalated the SCC 10-50 elements to 2020 Q1 dollars by multiplying with a factor of 1.0068 ( $=1+0.0272/4$  adopting a 2.72% annual inflation rate for 2019 to 2020).

For reference, Table 38 is provided the AACE cost estimate classification table.



**Table 38 AACE Cost Estimating Classification System**

Estimate Class	Maturity Level of Project Definition Deliverables	End Usage	Methodology	Design Development / Estimating Contingency		Expected Accuracy Range
	(Expressed as % of complete definition)	(Typical purpose of estimate)	(Typical purpose of estimate)	(Typical estimating method)	(Typical allowance)	(Typical variation in low and high ranges)
Class 5	0% to 2%	Functional area, or concept screening	Program or Rough order of Magnitude (RoM)	SF or m2 factoring, parametric models, judgment, or analogy	20% +	L: -20% to -30% H: +30% to +50%
Class 4	1% to 15%	Schematic design or concept study	Concept or Feasibility	Parametric models, assembly driven models	15% to 20%	L: -10% to -20% H: +20% to +30%
<b>Class 3</b>	<b>10% to 40%</b>	<b>Design development, budget authorization, feasibility</b>	<b>Schematic Design</b>	<b>Semi-detailed unit costs with assembly level line items</b>	<b>10% to 15%</b>	<b>L: -5% to -15% H: +10% to +20%</b>
Class 2	30% to 75%	Control or bid/tender, semi-detailed	Design Development	Detailed unit cost with forced detailed take-off	5% to 10%	L: -5% to -10% H: +5% to +15%
Class 1	65% to 100%	Check estimate or pre bid/tender, change order	Construction Documents	Detailed unit cost with detailed take-off	0% to 5%	L: -3% to -5% H: +3% to +10%

### 9.3 Methodology

The PMOC followed guidance provided in FTA OP 33, Capital Cost Estimate Review, dated September 2015 in the review of the Project Sponsor’s cost estimate. The PMOC’s review had the following objectives:

- Evaluate Sponsor’s project control organizational structure, systems and software
- Evaluate Sponsor’s cost escalation methodology
- Ensure the Capital Cost Estimate (CCE) is mechanically correct and complete
- Ensure the CCE is consistent with industry and engineering standards and practice
- Ensure consistency with project scope
- Identify the method of estimation being used is appropriate
- Ensure the CCE is mapped correctly onto the SCC Main Worksheet

For the cost portion of the PMOC review, a sampling of larger ticket items with the rationale that 20% of the scope will carry 80% of the cost was taken. Such items will fall along the critical path of the proposed schedule and are time-based, such as the tunnel boring machine. While the whole estimate was reviewed for the included work content, more of a concentration of effort was given to the larger items whose costs were significant. This approach was taken to understand the level of accuracy while trying to identify large cost items that represented most of the type of work that was reflected in the project. In doing so, shortages and/or overages that may have more of an impact on the overall costs could be identified.

## **9.4 PMOC Observations**

### **Summary of Findings as Related to PMOC Review of the Cost Estimate**

The Sponsor has submitted their EPD application based upon an estimate at completion of \$6,941 million (including finance charges). The FTA PMOC is of the opinion, and based on the details provided, that the estimate is overly optimistic and should be increased by \$1,037 million (YOE) to account for overly optimistic inflation, excluded scope (in the base estimate), under estimation of SCC80 staffing costs, overly optimistic schedule and over stripping of the base estimate transferring base costs to contingency and thereby suppressing contingency norms related to the base. The recommended cost adjustments, details of which can be found in the OP 40 section of this report, can be summarized as follows:

1. Direct adjustments (\$156 million BY\$) for:
  - Allowance for Hazardous Material removal (\$5 million)
  - Low staffing rates and staffing shortfalls (\$151 million)
2. Time related (schedule) adjustments totaling \$404 million BY\$ to account for PMOC recommended 18-month schedule adjustment
3. Latent contingency adjustments totaling \$169 million BY\$ to account for over stripping of base and allocation to contingency
4. Inflation adjustment on base estimate at \$185 million and an additional \$96 million when applied to the PMOC adjustments resulting in an overall total inflation adjustment of \$309 million based on a 3.50% annual rate of inflation

In summary and in performing the review the PMOC has verified that:

1. Sponsor's estimating and project controls organization is experienced, has the necessary capacity and capability to perform the work,
2. Scope was accounted for in the estimate,
3. The PMOC checked the estimate mathematically summed. Discrepancies described below were encountered.
4. Estimate was Coded to FTA SCC cost accounts, however there were minor details that were noted to be out of place during the PMOC's review of the contract package alignment to the FTA Standard Cost Categories:
  - a. Noise Dampers found under 10.07 should be under 10.13 to align with accurate SCC breakdown and analysis.

- b. There is no backup data to show how the totals for SCC80.08 were achieved, there is simply a lump sum of \$68.8M in for Start-up Costs in the SCC Workbook Build Main tab.
  - c. In the 05 – 06-17-20 – Option 1a – R5 workbook Bid Package by SCC tab, the dollar amounts for BP-02, BP-03, and BP-04 do not have costs for 80.03 Project Management for Design and Construction; BP-01 is the only contract package that feeds into the total project costs column.
5. Inflation calculation was consistent with FTA methodology and used the FTA standard workbook inflation calculation sheet based on approximate base year annual expenditure inflated using compound annual inflation rates, however inflation was in the PMOC’s opinion underestimated
  6. Through sampling of data, quantities, labor, equipment and material rates, (noting quotations where provided) correctly rolled into summary sheets with consistent mark-ups and sales tax applied as appropriate,
  7. Estimate took account of contract packaging strategy, constructability, project constraints, prevailing market conditions and any project labor agreements and / or local union hall agreements
  8. Estimate and mark-ups made provision for Insurance, bid and performance bonds as described in the draft terms and conditions and
  9. Identification of latent [hidden] and patent [exposed] contingency was identified and adjusted to form the Sponsors proposed SABCE, however, was in the PMOC’s opinion over-stripped

#### **9.4.1 Characterization of Significant Uncertainties**

The most significant area of estimating uncertainty relates to TBM mining rate productivity. Utility relocations are highlighted given that there is currently no undertaking from any of the Utility Owners to comply with City Ordinance as to cost or indeed to relocate in accordance with the project schedule requirements.

In summary, the items in the estimate which the PMOC considers remain of higher uncertainty are summarized below in Table 39.

**Table 39 Cost Characterization of Uncertainties**

Cost characterization of significant estimating uncertainties			
Ref	Estimate Item / Section	Probability	Impact
1	Utility relocations, uncertainty	Probable	Critical
2	Procurement delays for long-lead items (e.g. TBM)	Remote	Critical
3	Productivity rate of TBM during construction	Probable	Catastrophic
4	Unanticipated damage to historic buildings and critical structures due to construction	Probable	Critical
5	Timing of BART's CBTC in line with BSVII	Remote	Serious
6	Multiple design interfaces/staffing/coordination	Probable	Serious
7	Cost escalation higher than anticipated [overheating of current market forces]	Probable	Moderate
8	Professional services [SCC80] generally, VTA/BART staffing costs inadequate	Probable	Critical
9	Muck disposal costs and trucking fees	Remote	Moderate
10	Systems cost [SCC 50] does not reflect current design	Remote	Moderate

**9.4.2 Reliability of Cost Estimate**

The PMOC was presented summary estimate back-up but not detailed quantity take-offs. The estimate was produced by multiple teams from different consultants. The overall structure of the cost estimate was found to be traceable to the associated work in the project and the PMOC did not find any significant missing areas of scope unaccounted for.

There is discrepancy between the SCC Workbook updated and provided to the PMOC in January of 2021 and all supporting back-up and detailed estimate totaling \$168.6 million BY\$ which PMOC initially categorized as a mathematical error. It was later assumed this difference was due to the deletion of latent contingency which the Sponsor made on the estimate but without corresponding mathematical flow through to the summary sheets. This latent contingency adjustment was detailed in a response to questions from the PMOC at the risk workshop and subsequently detailed in the Spot memo: Latent Contingency Basis in EPD Estimate dated May 14, 2021, explaining where, in the Sponsors opinion, latent contingency has been removed from project costs.

A total provided in the Spot Memo referenced above for latent contingency amount to \$173 million. The proposed Sponsor reallocation to contingency from the base estimate were provided as:

- Contractor profit: \$63.2M
- Tunnel boring machine production rate: \$13.2M
- Time-related indirect costs savings based on improved TBM production rate: \$7.2M
- Precast concrete tunnel lining: reduced tunnel lining unit price: \$51M
- Geotechnical items and allowances: reduced the geotechnical items by 15% due to initially conservative allowances and unit pricing for geotechnical items: \$38.4M

PMOC offers following observations on the proposed reduction of base estimate for latent contingency:

- **Profit allowance reduction** – CP1 13% / CP2 15% are in the PMOC’s opinion fair and reasonable allowances given current market conditions and the high risk nature of this project likely to attract additional profit addition and should not be stripped further ; Sponsors claim of keen market response is questioned given CP1 current limit of only two qualified bidders. PMOC further notes on the CP2 contract over 50% of respondents did not buy into VTA’s tunnel production rate / schedule.
- **TBM production rate and time related costs** – refer to PMOC proposed adjustment. The mining rate is believed to be overly optimistic.
- **Precast concrete tunnel lining rate** – PMOC questions Sponsor proposed reduction in PCC ring rate. PMOC was informed they had not allowed ‘special CI break out panels’ at Adit connections, nothing was allowed for crossing of Silver Creek fault and the corbel design will require significant additional reinforcement in the PCC linings at top and bottom levels. PMOC experience is that PCC rates vary considerably. Tunnel linings are very ‘specialist’ and in this case will likely require special double or even triple gasketed joints for waterproofing. PMOC has received no estimates from Sponsor from suppliers to support rate reductions or any more comprehensive research into typical rates for comparative tunnels.
- **Ground improvements allowance reduction** – PMOC has checked back Sponsors proposed Jet Grout quantities per location and found they were reasonable and reflective of planned minimal volumes by Sponsor in supporting responses to PMOC questions. However current allowances are not viewed as conservative or indeed containing latent contingency in any way conservative and claim latent contingency. The back-up Sponsor provided was not supported by location specific detailed quantification. Feedback to PMOC questions at the Sponsors BIM model presentation was that ground treatment was likely to be more extensive than originally envisaged notably around station adits. Feedback at the risk workshop was that the likelihood of a combination of jet grouting, soil mixing and / or freezing would be required. All the respondents to the RFIF process have emphasized the challenges with these very large adit connections and indeed the complications about design and responsibility between CP2 and CP4.

### 9.4.3 Statement of Potential Range of Cost

Based on the AACE Class 3 estimate classification of -10% through +20% Table 40 below provides the corresponding calculation on base year and YOE dollars. These ranges reflect base uncertainty and not risk.

**Table 40 Potential Range of Costs**

Potential Range of Costs (\$ Millions) Excl Finance Charges							
SABCE		Base Year \$			YOE \$		
Base Yr \$	YOE	Lower	Most Likely	Upper	Lower	Most Likely	Upper
\$ 5,201	\$ 6,105	\$ 4,681	\$ 5,201	\$ 6,241	\$ 5,495	\$ 6,105	\$ 7,326
<i>Based on AACE Class 3 Estimate Classification</i>							

**9.5 PMOC Review**

**9.5.1 Estimate structure and composition**

PMOC reviewed the Sponsor Basis of Cost Estimate Revision No. C dated September 30th, 2020. This basis of cost stated a total project cost including finance charges of \$6,739 million (YOE). Finance costs were included as \$188 million. The Sponsors EPD submission was for \$6,941 million based on an increase in finance charges from \$188 million to \$390 million. Supplemental cost memo’s and updated workbooks have been received from the Sponsor between September 2020 and May 2021 however the PMOC has not received an updated Basis of Cost aligned to the submitted EPD application.

The Basis of Cost Estimate includes:

- A summary of program costs by FTA cost category
- Descriptive of the estimate development setting out responsibilities and the estimating breakdown structure adopted for SCC 10-50
- Summary estimate detail, basis and source by FTA cost categories
- Detailed descriptive of the basis of estimate
- Explanation estimating elements covering the BART scope
- Escalation methodology and formulation into the program budget

Appendices include:

- Craft labor rates
- Construction equipment rates
- Materials summary
- Cost estimate detail
- Cost estimation materials and finishes
- Right of Way base costs
- FTA SCC workbook

The estimate is definable into the four main contract packages and program wide elements. Since the submission of the initial Basis of Cost Estimate the scope included within each contract package has changed and these amendments have been passed through to the PMOC in updated workbooks attached to Spot cost memoranda.

The PMOC is concerned as to the age and source of SCC 10-50 of this estimate workbook being from 2019.

PMOC cannot be confident all adjustments have been correctly incorporated and that summary totals reflect ongoing adjustments or indeed that the “Profile” totals aligned to the four main contract packages are precisely correct given the number of ongoing changes the PMOC has received from the Sponsor.

### 9.5.2 Cost Data Reviewed

Please refer to Appendix B for list of documents reviewed.

### 9.5.3 Level of design completion

The PMOC is of the opinion that the estimate was based on design definition, alignment, associated plans and sections, layouts and quantities where available to the following level of completion:

- CP1 – Systems 30%
- CP2 – Civil 15%
- CP2 – Track 30%
- CP3 – Yard and Facilities 30%
- CP3 – Santa Clara Station < 15%
- CP4 – Underground stations 15%
- Vehicles – 60%
- ROW – 15%
- SCC 80 – 15%

The Sponsor has provided PMOC with several Spot memo cost updates specific to cost estimate checks that have been performed in the process of trend analysis.

As an example, *BSVII Spot Memo 21 – Cost Estimate Update* gives order of magnitude cost ranges that each design refinement listed could potentially change the overall cost of the estimate. It provides a brief description, a location, a contract package impact, and a note giving reason to why each design impact might be a cost impact to the overall project. These line items are weighted by a scale of [-5 to -1] for a cost savings and [+1 to +5] for additional costs, however, the scale is not linear in nature and falls short of a way to predict pricing changes from original estimate as shown in Figure 11.

**Figure 11 Cost Impact Ranges**

Possible Cost Decreases					Possible Cost Increases				
-5	-4	-3	-2	-1	+1	+2	+3	+4	+5
\$30M to \$40M	\$20M to \$30M	\$10M to \$20M	\$5M to \$10M	\$0 to \$5M	\$0 to \$5M	\$5M to \$10M	\$10M to \$20M	\$20M to \$30M	\$30M to \$40M

The PMOC carried out a cross checking of sampled elements of the project estimate with the project scope contained in the design documents to determine degree of correlation between the design deliverables and proposed estimate adjustment. Limited sketches, basis of design, estimate, schedule, etc. were provided and reviewed by the PMOC. The level of detail provided in the memo

was not sufficient to allow PMOC to allocate the identified increases/decreases to any specific Contract Package, nor compare/relate/associate the line items to EBS/WBS.

The Sponsor adopted the midpoint of an adjustment range, e.g. for a \$10-20M impact, \$15M was used as an order of magnitude to quantify their proposed changes in the base estimate. This was compiled prior to the Risk Workshop in May, 2021, when it was understood that the Sponsor had been updating their estimate on an on-going basis and scope items that appeared missing from current estimate submission would be included in subsequent revisions. Essentially a Trend analysis.

Based on the estimate ranges used in Spot Memo 21, the Sponsor's assertion that a cumulative change of only \$3M overall is not supported by the PMOC. When using the midpoint of each applied range for each identified item, PMOC calculated the total increase to be \$10M. Backup for the cost impacts can be found in Appendix O, Sponsor and PMOC Cost Adjustments. Further this analysis speaks to the fact that the level of detail provided to the PMOC by the Sponsor is not sufficient for PMOC to incorporate or take account of these items as adjustments to base cost as their relationship with the entire estimate is unclear. It would be more relevant to await the Sponsor's cost estimate based on the RFP plans. Any adjustments would lend too much credibility to what was included as ROM's and were not comprehensive of all design updates since the cost estimate was completed in June 2020.

PMOC will take the cost summary memo as indicating the level of design development has still not been reflected in the cost estimate and keep the contingency levels at those appropriate to a 10-20% design maturity, or a schematic level of design. This will avoid double counting any increases from the Sponsor adjustments, as the PMOC will apply 10-20% BETA factors to the risk model.

#### **9.5.4 Project Controls Organizational Structure Specific to Estimating**

VTA and its Consultants have estimating responsibilities for the entire Project, although the development of the BSVII EPD estimate submission has required input from many groups, including BART.

In addition to the construction cost estimate for SCC 10-50 and 80.02, VTA's Consultant Team are coordinating the planning and development of the estimate and providing Project-wide guidelines and procedures.

Within VTA's Consultant Team, the estimate for SCC 10 through 50 and SCC 80.02 was prepared by a Joint Venture (JV) between Mott MacDonald and PGH Wong Engineering and their subconsultants (MMW-PGH Wong JV). BKF Engineers prepared the utilities estimate.

#### **9.5.5 Cost Estimate Structure / Quality / Level of detail**

PMOC has noted development of the construction estimate and schedule by the Sponsor attempted to follow a parallel development to ensure that the construction approach and schedule considerations were included in the estimate. Due to multiple parties compiling information together and with remote working conditions and extensive revision history of the documentation,



the PMOC observes the updates do not entirely reflect the details across the entire estimate breakdown in following along with the schedule.

The Sponsor's approach to the estimate was to prepare an estimate in the same manner as a contractor. The estimating team is comprised of estimating professionals who have performed bottom-up, production-based estimates as contractors utilizing estimating software common to the construction industry. A project wide estimate breakdown structure was adopted as set out in the Basis of Estimate. The estimating process adopted industry standard coding and included the use of the following aids and industry software:

- Construction Specifications Institute (CSI) coding structure to align the estimate with project specifications
- HCSS, B2W and Sage Estimating System software
- Standard electronic estimating templates
- Project specific database of unit rates for labor, plant and materials

The Sponsor aligned the estimate to the FTA Standard Cost Categories (SCC) line items with the estimate line items by detailed spreadsheet coding and sorting.

Workshop presentations were provided by the Sponsor to further explain source, composition, and structure of the estimate for the PMOC. Questions were tabled and Sponsor has provided PMOC back-up where requested. Separate meetings were held as the PMOC progressed their review of the Sponsors schedule to review cost alignment reviewing schedule assumptions and activity durations of critical items matched the Basis of Cost assumptions.

The estimate has been broken down into the four main civils works contract packages and the program wide elements (SCC 60-80) as follows:

- **Contract 1 (CP1) Systems** – includes the system elements to be installed throughout the Project, such as system wide engineering, system wide conductors, system wide equipment/fixtures (e.g. large emergency ventilation fans, tunnel lighting, communication systems, bulk power supply stations, traction power, line electrical, radio, Train Control, other related systems and equipment), and Newhall Yard Maintenance Facility systems.
- **Contract 2 (CP2) Tunnel and Trackwork** – includes the bored tunnel construction; procurement of the Tunnel Boring Machine (TBM), long tunnel conveyors and tunnel liners; tunnel interior structures fit out including station platforms; portals, Mid-Tunnel Egress, Ventilation and Track Transition Facilities (METVFs), and 28th Street/Little Portugal Station utilities, enabling works, SOE installation, excavation and support and for portals and METVFs permanent structure fit out including building services, civil site restoration and demobilization; mainline trackwork including contact rail; compensation grouting; care and maintenance in tunnel for Contract 1 Contractor during system wide installation and testing.
- **Contract 3 (CP3) Newhall Yard Maintenance Facility and Santa Clara Station and Parking Garage** – includes the Newhall Maintenance and Operations Yard and buildings,

yard track and contact rail, civil site restoration and demobilization, and the full construction of the Santa Clara Station and parking garage.

- **Contract 4 (CP4) Stations and Support Facilities** – includes Downtown San José (DTSJ) and Diridon Stations utilities and enabling works; entry headhouse and platform end ventilation and egress shaft SOE installation; excavation and support; permanent structure fit out including building services, civil site restoration and demobilization; ground improvement for adit, adit excavation support, adit lining, and adit fit-out; 28th Street /Little Portugal Station permanent structure fit out including building services, civil site restoration and demobilization; building underpinning in vicinity of shafts at DTSJ and Diridon stations, if necessary.

In addition to these four main civils works construction contract packages the estimate separates program elements as follows:

- **Right-of-Way (ROW) costs** – VTA provided the Real Estate acquisition, relocation and easements estimates.
- **Vehicle costs** – VTA provided the Vehicles estimates.
- **Design Integration** – VTA’s Consultant Team provides coordination of the design and the improvements to be installed throughout the entire Project. The design work through the time of the FTA EPD Pilot Program grant request has been performed by the MMW-PGH Wong JV.
- **Project Management (PM)/Construction Management (CM) Services** – VTA’s Consultant Team provides the overview and coordination of project controls (cost and schedule), administration, information technology, document control, and other support services to the Project. Support services include, but are not limited to, coordination of ROW, third party and procurement services. VTA is in the process of procuring Construction Management Services for each main construction package. Other Consultants are also expected to be engaged to provide the internal VTA team management support, coordination, and administration.
- **BART Scope** – BART provides services and equipment to the Project, including Project and Design Oversight and Management, Testing, Commissioning and Start-up. BART will supply equipment, will provide special BART related operational software and hardware, will provide liaison with BART design, construction and operational departments, and support and then perform integrated systems testing and start-up. BART will also provide oversight services for BART-administered contracts, including implementation of core system modifications, modifications required to the Operation Control Center (OCC), installation and implementation of automated fare collection equipment, and procurement of revenue vehicles and associated specialty hardware.

Table 41 below provides the estimate breakdown structure:

**Table 41 Estimate Breakdown Structure**

Level 1	Level 2	Level 3	Level 4	Bid Item Description
SCC Code	Work Area	Bid Package Number	Bid Item Number	
40.01	030	3	000100	Remove Concrete Sidewalk
4	3	1	6	<No of Digits (Total 14)

**9.5.6 Characterization or Stratification of Cost Items**

The PMOC has characterized in Table 42 the Sponsors estimate approximately into:

1. **Unit pricing** – Unit costs are used when items in an estimate can be measured or quantified and a cost applied to labor, materials, and equipment used.
2. **Cost Estimate Relationships (CER)** – A CER is a way to use a previous cost of an item to determine or predict that of another, e.g. Phase 1 utilized to calculate Phase 2 costs.
3. **Lump Sums** – A lump sum is a dollar amount allotted to an item within an estimate as an allowance.

The stratification of the cost items shows that for SCC10-80:

- Unit Costs - 42%
- CER - 48%
- Lump Sums - 10%

In SCC 10, Guideway and Trackwork, nearly 79% of the total make-up of the estimate is derived from a bottom-up detailed engineering approach. This is described in the Sponsor’s memo regarding cost estimating methods.

In SCC 20.06, Automobile parking / multi-story structure, all the pricing is from a dollar per parking stall referenced by historical figures of parking structures in cities around the Bay area.

In SCC 50, Systems, is depicted as lagging in design with the estimate generally based on adjusted Phase I costs (through CER) along with the inclusion of several lump sums / allowances covering Signals, Communications, and the Central Controls. PMOC were informed VTA instructed the estimating team to carry \$20 million for the VTA’s contribution for work at the BART Central Controls facility based on prior experience.

In SCC 80, Professional services, estimates reflect a combination of spent-to-date costs, CER’s and unit costs related to FTE staffing estimations. Spent-to-date costs have been incurred under Project Development and are captured in 80.01.

**Table 42 Sponsor Estimate Stratification**

Standard SCC codes		Estimate BY\$		Unit Prices		CER		Lump Sums	
SCC	Category	Estimate w/o Contingency	% Contingency	Unit Pricing Total	Unit Price % of Total	CER Pricing Total	CER Price % of Total	Lump Sum Pricing %	Lump Sum Pricing Total
<b>10</b>	<b>GUIDEWAY</b>	<b>\$ 1,079,481,417</b>	<b>27%</b>	<b>\$ 849,972,841</b>	<b>79%</b>	<b>\$ 121,560,434</b>	<b>11%</b>	<b>\$ 107,948,142</b>	<b>10%</b>
10.06	Guideway: Underground cut & cover	\$ 83,012,924	18%	\$ 58,109,047	70%	\$ 16,602,585	20%	\$ 8,301,292	10%
10.07	Guideway: Underground tunnel	\$ 893,671,854	28%	\$ 714,937,483	80%	\$ 89,367,185	10%	\$ 89,367,185	10%
10.08	Guideway: Retained cut or fill	\$ 43,144,509	18%	\$ 30,201,156	70%	\$ 8,628,902	20%	\$ 4,314,451	10%
10.09	Track: Direct fixation	\$ 45,831,683	17%	\$ 36,665,346	80%	\$ 4,583,168	10%	\$ 4,583,168	10%
10.11	Track: Ballasted	\$ 3,854,955	17%	\$ 3,083,964	80%	\$ 385,496	10%	\$ 385,496	10%
10.12	Track: Special (switches, turnouts)	\$ 9,965,493	17%	\$ 6,975,845	70%	\$ 1,993,099	20%	\$ 996,549	10%
<b>20</b>	<b>STATIONS, STOPS</b>	<b>\$ 1,156,985,214</b>	<b>20%</b>	<b>\$ 731,149,299</b>	<b>63%</b>	<b>\$ 314,125,946</b>	<b>27%</b>	<b>\$ 111,709,970</b>	<b>10%</b>
20.01	At-grade station, stop, shelter, mall, terminal, platform	\$ 65,501,795	17%	\$ 39,301,077	60%	\$ 19,650,539	30%	\$ 6,550,180	10%
20.03	Underground station, stop, shelter, mall, terminal, platform	\$ 805,709,279	21%	\$ 563,996,495	70%	\$ 161,141,856	20%	\$ 80,570,928	10%
20.04	Other stations, landings, terminals: Intermodal, ferry, trolley, etc.	\$ 122,944,311	18%	\$ 73,766,586	60%	\$ 24,588,862	20%	\$ 24,588,862	20%
20.06	Automobile parking multi-story structure	\$ 72,687,930	17%	\$ -	0%	\$ 72,687,930	100%	\$ -	0%
20.07	Elevators, escalators	\$ 90,141,900	17%	\$ 54,085,140	60%	\$ 36,056,760	40%	\$ -	0%
<b>30</b>	<b>SUPPORT FACILITIES</b>	<b>\$ 199,889,600</b>	<b>18%</b>	<b>\$ 127,158,877</b>	<b>64%</b>	<b>\$ 39,977,920</b>	<b>20%</b>	<b>\$ 32,752,803</b>	<b>16%</b>
30.03	Heavy Maintenance Facility	\$ 136,070,386	18%	\$ 95,249,270	70%	\$ 27,214,077	20%	\$ 13,607,039	10%
30.05	Yard and Yard Track	\$ 63,819,215	17%	\$ 31,909,607	50%	\$ 12,763,843	20%	\$ 19,145,764	30%
<b>40</b>	<b>SITWORK &amp; SPECIAL CONDITIONS</b>	<b>\$ 152,885,625</b>	<b>18%</b>	<b>\$ 25,616,941</b>	<b>17%</b>	<b>\$ 25,680,355</b>	<b>17%</b>	<b>\$ 101,588,329</b>	<b>66%</b>
40.01	Demolition, Clearing, Earthwork	\$ 24,483,849	36%	\$ 19,587,080	80%	\$ -	0%	\$ 4,896,770	20%
40.02	Site Utilities, Utility Relocation	\$ 116,342,054	15%	\$ -	0%	\$ 23,268,411	20%	\$ 93,073,643	80%
40.07	Automobile, bus, van accessways including roads, parking lots	\$ 12,059,722	17%	\$ 6,029,861	50%	\$ 2,411,944	20%	\$ 3,617,917	30%
<b>50</b>	<b>SYSTEMS</b>	<b>\$ 337,859,714</b>	<b>17%</b>	<b>\$ -</b>	<b>0%</b>	<b>\$ 255,212,425</b>	<b>76%</b>	<b>\$ 82,647,289</b>	<b>24%</b>
50.01	Train control and signals	\$ 82,617,205	18%	\$ -	0%	\$ 41,308,602	50%	\$ 41,308,602	50%
50.03	Traction power supply: substations	\$ 138,169,726	17%	\$ -	0%	\$ 138,169,726	100%	\$ -	0%
50.04	Traction power distribution: catenary and third rail	\$ 20,551,910	17%	\$ -	0%	\$ 20,551,910	100%	\$ -	0%
50.05	Communications	\$ 42,405,373	17%	\$ -	0%	\$ 21,202,686	50%	\$ 21,202,686	50%
50.06	Fare collection system and equipment	\$ 33,979,500	15%	\$ -	0%	\$ 33,979,500	100%	\$ -	0%
50.07	Central Control	\$ 20,136,000	15%	\$ -	0%	\$ -	0%	\$ 20,136,000	100%
Construction Subtotal (10 - 50)		<b>\$ 2,927,101,571</b>	<b>22%</b>	<b>\$ 1,733,897,958</b>	<b>59%</b>	<b>\$ 756,557,080</b>	<b>26%</b>	<b>\$ 436,646,533</b>	<b>15%</b>
<b>60</b>	<b>ROW, LAND, EXISTING IMPROVEMENTS</b>	<b>\$ 200,257,543</b>	<b>55%</b>	<b>\$ -</b>	<b>0%</b>	<b>\$ 200,257,543</b>	<b>100%</b>	<b>\$ -</b>	<b>0%</b>
60.01	Purchase or lease of real estate	\$ 188,943,227	56%	\$ -	0%	\$ 188,943,227	100%	\$ -	0%
60.02	Relocation of existing households and businesses	\$ 11,314,317	30%	\$ -	0%	\$ 11,314,317	100%	\$ -	0%
<b>70</b>	<b>VEHICLES (48)</b>	<b>\$ 165,600,000</b>	<b>4%</b>	<b>\$ -</b>	<b>0%</b>	<b>\$ 165,600,000</b>	<b>100%</b>	<b>\$ -</b>	<b>0%</b>
70.02	Heavy Rail	\$ 165,600,000	4%	\$ -	0%	\$ 165,600,000	100%	\$ -	0%
<b>80</b>	<b>PROFESSIONAL SERVICES</b>	<b>\$ 1,180,070,906</b>	<b>6%</b>	<b>\$ 149,472,740</b>	<b>13%</b>	<b>\$ 1,030,598,165</b>	<b>87%</b>	<b>\$ -</b>	<b>0%</b>
80.01	Project Development	\$ 149,472,740	0%	\$ 149,472,740	100%	\$ -	0%	\$ -	0%
80.02	Engineering (not applicable to Small Starts)	\$ 190,599,926	11%	\$ -	0%	\$ 190,599,926	100%	\$ -	0%
80.03	Project Management for Design and Construction	\$ 312,749,024	8%	\$ -	0%	\$ 312,749,024	100%	\$ -	0%
80.04	Construction Administration & Management	\$ 335,994,984	5%	\$ -	0%	\$ 335,994,984	100%	\$ -	0%
80.05	Professional Liability and other Non-Construction Insurance	\$ 41,543,516	5%	\$ -	0%	\$ 41,543,516	100%	\$ -	0%
80.06	Legal, Permits, Review Fees by other agencies, cities, etc.	\$ 55,639,944	5%	\$ -	0%	\$ 55,639,944	100%	\$ -	0%
80.07	Surveys, Testing, Investigation, Inspection	\$ 25,293,544	5%	\$ -	0%	\$ 25,293,544	100%	\$ -	0%
80.08	Start up	\$ 68,777,228	5%	\$ -	0%	\$ 68,777,228	100%	\$ -	0%
Subtotal (10 - 80)		<b>\$ 4,473,030,020</b>	<b>19%</b>	<b>\$ 1,883,370,698</b>	<b>42%</b>	<b>\$ 2,153,012,789</b>	<b>48%</b>	<b>\$ 436,646,533</b>	<b>10%</b>

**9.5.7 Mechanical Check of the Estimate**

The PMOC mathematically summed all lump-sum prices as appropriate, unit price and quantity calculations, and cost estimating relationships to confirm the sponsor’s total cost estimate. There appears to be some errors in calculating subtotals in CP2 Tunnel and Track Work and this will require the sponsor reform the pricing workbook of the EPD Rev 5 Draft. Supplemental documentation does not provide enough detail and assumptions to show how dollar amounts relate to the overall estimate.

PMOC also highlights discrepancies between detailed backup and summary workbook due to late latent contingency adjustments as described above.

Each contract package was evaluated for completeness and cross-referenced with their respective back-up data workbooks provided by the Sponsor. Each summed into the main estimate SCC Main tab and into the FTA Standard Cost Categories, but no SCC category matched its respective summation into the Build Main tab in the SCC Workbook. In summary, formulas within a workbook totaled correctly, but separate documents did not add up together.

### 9.5.8 Comparison with Industry and Engineering Standards

During the PMOC review process, unit prices were sampled, and quantities were assessed for conformance to industry standards, regional variations, or other unique characteristics.

The Sponsor referenced standard or Davis-Bacon wage rates that coincide with northern California, which have been referenced in the Basis of Cost Estimate Appendix A. (Craft Labor rates). The PMOC has verified rates conform with local Union wages.

In the Basis of Estimate the Sponsor noted that estimating quantities were derived from a combination of early plan sets and drawings, architectural renderings of stations and tunnels and directly from the BIM model where detail was progressed sufficiently to do so.

Informal presentations and review workshops were held between the PMOC and Sponsors estimating team to review the capturing of sampled individual bid/contract package content and walk through how data had been extracted and to verify alignment to constructability as well as checking appropriate usage of SCC codes.

Samples for Concrete and Steel have been checked where used in differing, more normal, conditions to ensure local conditions and difficulty factors were considered in the individual estimated units. This included rebar and tonnage of delivered steel as well as precast and cast in place (CIP) concrete forms, liners, and structures. Specifically:

- **Concrete pricing:** While Bid item 20.03.310.4.001200 - Concrete CIP at Diridon - West Vent & Egress appears high at \$1,168/CY, these were not out of the ranges for industry standards as compared to RS Means and other cost databases when supplied material costs were compared. [Please refer to Table 6]. Due to the complexity of the project, mostly due to underground location, labor productivity would decrease, adding to the overall installed cost per item. The average cubic yard of concrete can range from \$481.75 to upwards of \$1,693.99 depending on reinforcing, forming, finishes, admixtures, and pumping, with the average close to \$1,087/CY installed. [reference materials chart]. PMOC concludes rate used at \$1,168/CY is comparable to industry standard at \$1,087/CY.
- **Steel pricing:** Comparing the price of steel material and installed using line item 10.06.812.2.242000 Excavation & Temporary Support-Temporary Support & Materials-Internal Steel in Appendix N (estimate backup data) lists the quantity of 1,384,404 lbs for a price of \$3,643,888.19. The cost of the steel material and labor involved to install or erect on site is derived from the Sponsors estimate at approximately \$2.63 per pound or \$5,264.20 per ton. This is common and typical in the current market, however, the price of steel in Q1 and Q2 of 2021 has increased dramatically and production is at an all-time high to meet demand. Per RS Means, structural steel tubing ranges \$1.76 to \$2.54 and a

W12x190 is \$322.75/LF which equates to 1.70 per pound. To this, add for slow productivity for site conditions, project complexity, tight labor market and specifically add for galvanization \$0.38 per pound. Price range for ton of steel: \$4,157 - \$5,404. PMOC concludes rate used at \$5,264.20 per ton is comparable to industry standard at \$4,157 - \$5,404 per ton.

### 9.5.9 Correspondence with Scope Review

Sampled quantities provided in the estimate were cross checked against those indicated in the design documents for the corresponding work. Those were found to be consistent and in line with the documents and were therefore determined to be accurate.

A general overview of the estimate was performed as a “sanity check” of the included items of work with their associated costs. This was done to verify the accuracy of the estimate to ensure that major work components were accounted for with an associated cost. In turn, this aided in the determination of any cost deficiencies and potential risks.

### 9.6 Review of estimate by FTA SCC code

Provided below is a summary of sampling reviews and associated commentary carried out by the PMOC:

#### 9.6.1 SCC 10 – Guideway and Trackwork

Running Tunnel Ground Improvement costs range from \$520/CY to \$2,300/CY, depending on the location and approach. Sponsor stated lower rate was used for Jet Grouting assumed to be from street level whilst higher rate was used for Jet Grouting assumed to be from within station, ventilation or tunnel structures to surrounding ground. Pressure grouting ranges from \$687.87 to \$1,227.51/CY and a slurry wall is priced at \$2,377.26/CY. Table 43 below shows an overview by location of base year ground improvement total costs. No back-up detail or quotations were provided to the PMOC.

**Table 43 Base Year Ground Improvement Costs**

Location	Ground Improvement - EPD Estimate	
Running Tunnel	\$42,437,256	81,600CY @ \$520.06/CY
Diridon West	\$13,472,840	(Vent) 3,900CY @ \$2,225.35 + (Egress) 2,140CY @ \$2,240.18
Diridon Headhouse	\$39,077,678	(Adit #1 and #2) 8,820CY @ \$2,215.29 x2 each
Diridon East	\$9,499,675	(Vent) 2,680CY @ \$2,233.56 + (Egress) 1,560CY @ \$2,252.40
DTSJ Headhouse	\$18,284,783	(DTSJ Adit) 6,270CY @ \$2,218.53 + (Diridon Vent) 1,950CY @ \$2,243.38
DTSJ Johnny Vs	\$15,786,406	7,120CY @ \$2,217.19/CY
DTSJ East	\$4,555,292	(Vent) 1,270CY @ \$2,262.69 + (Egress) 730CY @ \$2,303.66
Total	\$143,113,930	

\* Totals exclusive of escalation and contingency.

## 9.6.2 SCC 20 – Stations, Stops, Terminals

PMOC reviewed substructures and superstructure core and frames for Underground Stations and Ventilation / Emergency Egress Facilities

- PMOC reviewed bulk quantities for the underground stations, ventilation facilities. Bulk quantities for SOE, excavation and concrete were checked and found to be in the correct order of magnitude. Rates used for excavation, concrete and steel were checked and again found to be in the expected range of cost.
- The budget for Stations and Stops per the Sponsor’s estimate is \$1.593B in YOE dollars. The PMOC noted Bid item 20.03.610.2.220000 - Excavation and Support - SOE -4ft Slurry, Deep appears high at \$362.83 per SF for the Underground Station - 28th Street Headhouse. This number is inconsistent with the SOE 4ft Slurry at West Mid-Tunnel - Vent and Egress Shaft at \$291.58 per SF and still dissimilar from East Mid-Tunnel - Vent and Egress Shaft at \$360.38/SF. This is due to the excavation approach used at each location.

PMOC reviewed Structure and Architectural finishes estimate of above ground (Santa Clara Station) and below ground stations and makes following observations:

- 20.01 – Santa Clara Station – At Grade Station included square foot costs that appeared on the higher end such as steel (ornamental and structural) at a rate over \$16,900 per ton, glazing at a rate of \$285 per SF, and flooring at nearly \$78 per SF. When the extravagant finishes and architectural work is taken into consideration as shown on the Architectural renderings and notes, these are appropriate costs for the design of the station.
- There appears to be a lack of vendor or subcontract quotes and the Sponsor should look into obtaining them prior to the next estimate submission on items such as the light-weight curved GFRC concrete panels at DTSJ Johnny V entrance at grade and the exposed roof structure of SCSTA comprised of laminated and formed timber members constructed in open-frame mesh with a roof membrane of translucent PTFE with a special Teflon coated finish.
- Regarding Diridon Station, the columns prescribed in the atrium space that go from grade at the main entrance, through the concourse, B2, B3, and to what appears to be the ceiling of the upper platform are noted to be one-piece metal with circular columns. The unit cost is not apparent and in the body of the estimate lists only lump sums. Again, a quote from an industry professional is recommended on these items.

## 9.6.3 SCC 30 – Support Facilities: Yards, Shops, Administration Buildings

**SCC 30.03 Heavy Maintenance Facility** – The PMOC also raised concerns over the yard layout and design, with train control costs for the yard amplified due to the anticipated need for greater routing flexibility and control for operations requirements. TPSS are priced at \$138M in BSVII and \$44M per Phase I, yet the quantity is relatively the same number of TPSS. If Phase I pricing was used in obtaining in current Phase II pricing, there is a large disparity in the unit costs. This should be evaluated. During the Risk Workshop, the Sponsor assured that the budget for Communications and SCADA was acceptable, and the amount was agreed to by BART.

Currently the budget for the Newhall Yard including trackwork is \$234M. A previous Light Rail Heavy Maintenance Shop that stored 60 LRVs, constructed in 2014, cost approximately \$154M with similar scope and property size, and it utilized right-of-way purchased from an existing Class 1 Railroad, which continues to operate adjacent to the Light Rail Maintenance Facility. Comparing these similar facilities, the PMOC finds that VTA’s budget estimate is in line with the current cost of constructing a heavy maintenance facility.

#### **9.6.4 SCC 40 – Siteworks and Special Conditions**

##### **SCC 40.02 Utilities**

The total SCC budget cost of the utility relocation is \$149 million YOE, or 3.66% of the project construction budget (SCC 10-50 YOES). Although this is a small percentage of the projected cost, it was reviewed because of the potential risks in this category. The design drawings do not identify utilities at this stage of the project. According to VTA, the cost of the utility relocation will assume that all utilities in the street ROW will be relocated. VTA used current utility maps to identify the utility relocations with respect to the alignment, however, these were not provided with the documents for review and verification.

Utility Owner claim of liability is based on VTA’s Enabling Statute which gave VTA certain rights within the public right of way. Over the years VTA has negotiated claim agreements that have established precedent for the following cost relationships:

- AT&T 50/50 Claim in Public Right-of-Way
- Comcast 50/50 Claim in Public Right-of-Way
- PG&E 50/50 Claim in Public Right-of-Way
- San Jose Water Co. 100% VTA Cost
- T-Mobile (Sprint) 100% VTA Cost

Note that these cost relationships only apply to public right of way. Should the Utility have established land rights within the public right of way or on private property VTA assumes 100% of the liability. EPD Cost Estimate is conservative in that it assumes VTA 100% liability. VTA will update claim of liability assumptions when Utility Owners have completed their final designs and submitted cost estimates and claim of liability under the agreements with VTA.

#### **9.6.5 SCC 50 – Systems**

Currently the systems budget for BVSII is \$396M. This amount indicates the direct cost of installing a traditional train control signaling system, which VTA has previous experience in understanding the costs, as VTA recently installed a traditional train control system in Phase 1. VTA & BART agreed that a decision whether to install a Communication Based Train Control (CBTC) System or a traditional train control system, which is currently reflected in the budget, will be made by November 2022. With respect to the cost of installing a CBTC System, it is less costly than installing a traditional train control system. BART has negotiated a fixed price with Hitachi on their CBTC system for their current alignment and vehicles, which also includes the on-board equipment on the new procured vehicles required for Phase II. The potential issues are if there is a need for both a traditional train control system and a CBTC system, the current budget



is not sufficient, even with contingency funds included. The PMOC finds as long as only one train control system is chosen, the current allocated budget for the train control system is in line with VTA & BART negotiated fixed price and is sufficient.

#### **9.6.6 SCC 60 – Right of Way**

*Please refer to PMOC OP 23 review for commentary and analysis of ROW costs.*

#### **9.6.7 SCC 70 – Vehicles**

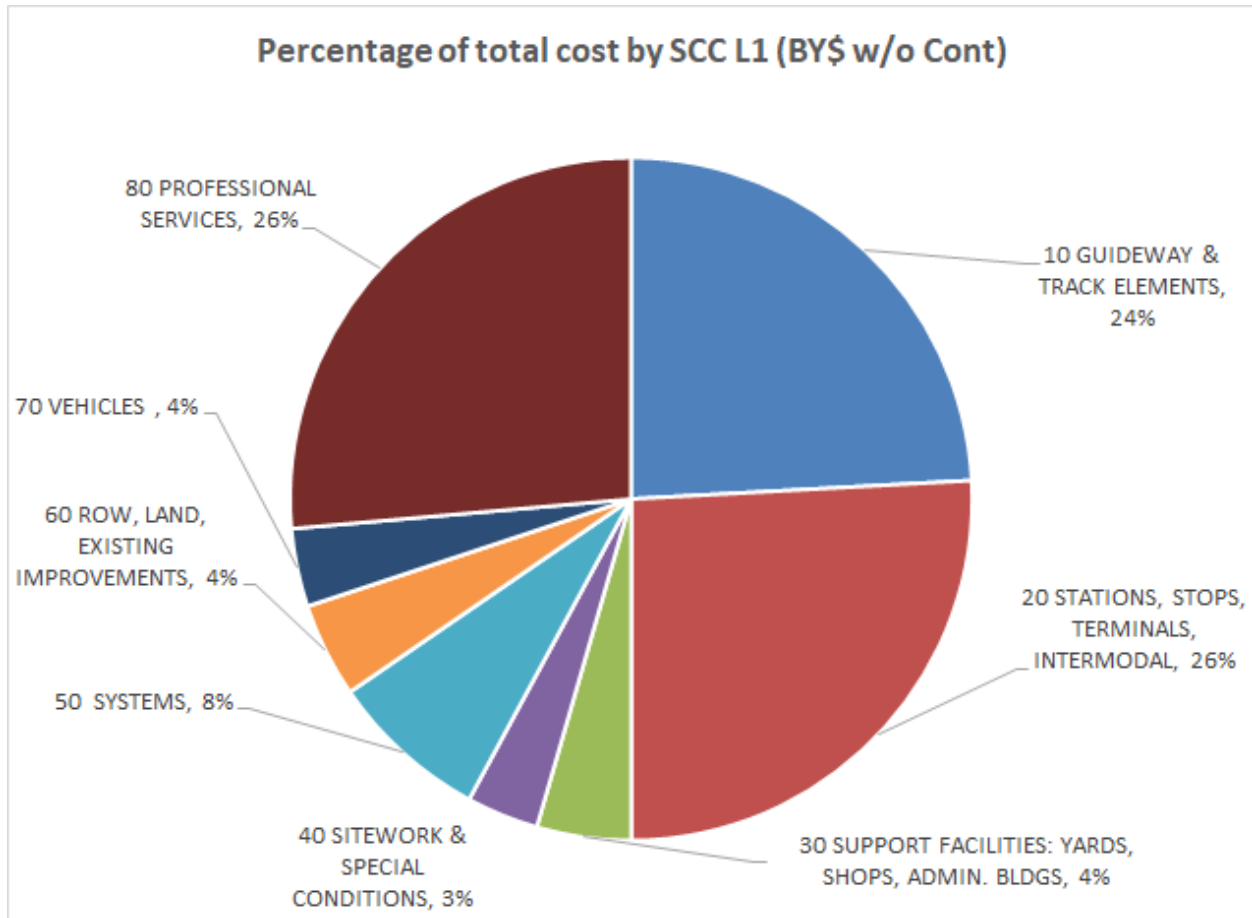
##### **SCC 70.02 Heavy Rail**

Currently the vehicle procurement budget is \$173,M. The cost is in line with BART’s vehicle procurement fixed price contract, including option vehicles, with Alstom/Bombardier. The PMOC finds that the allocated budget for the vehicles is sufficient.

#### **9.6.8 SCC 80 – Professional Services**

A general “overview” of the total estimate under SCC 80 was performed. The PMOC gave it a sanity check to ensure that all major components appear and are represented by costs. Figure 12below shows Professional Services account for 26% of SCC 10-80. For a complex long tunnel project this is not generous.

**Figure 12 Percentage of Total Cost by SCC Code L1**



After further discussion and presentations of the project scope and details at the Risk Workshop held May 10-12, 2021, the PMOC determined that the proposed staffing levels are too optimistic, and multipliers need to be adjusted to Table 8 (Table 44) and Figure 1 (Table 45) extracted from the Sponsors Basis of Estimate report and Table 1 (Table 46) extracted from the Spot memo #2 SCC 80 Costs BSVII Staffing Plans and Organization Charts (April 14, 2021) as below.

**Table 44 Table 8 from Basis of Cost**

**Table 8 - Professional Service Costs Assumptions**

CATEGORY	ASSUMPTION	BASE COST W/O CONT.
<b>Professional Services</b>	159 FTE, \$75/hr., 2.6 LM, 8 years	\$ 516,915,360
VTA services	Summary	\$ 152,798,880

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CATEGORY	ASSUMPTION	BASE COST W/O CONT.
<b>VTA (BSVII)</b>	23 FTE, \$75/hr., 2.6 LM, 8 years	\$ 74,773,920
<b>VTA (Other)</b>	24 FTE, \$75/hr., 2.6 LM, 8 years	\$ 78,024,960
BART services	Summary	\$ 106,284,000
<b>Proj. mgmt./design/const</b>	15 FTE, \$200/hr., 8 years	\$ 50,016,000
<b>Systems testing/integration</b>	45 FTE, \$200/hr., 3 years	\$ 56,268,000
<b>Third Party services</b>	\$8m/yr., 8 years	\$ 64,000,000
VTA Provided Costs	Sub-Total	\$ 839,998,240

VTA provided costs have been split to SCC minor categories assuming certain percentages as shown in Figure 1 - Professional Service Costs by SCC Minor Category below:

**Table 45 Figure 1 from Basis of Cost**

**Figure 1 - Professional Service Costs by SCC Minor Category**

Category	Assumption	Cost	Percentage Split						Total	
			SCC 80.02	SCC 80.03	SCC 80.04	SCC 80.05	SCC 80.06	SCC 80.07		SCC 80.08
Professional Services	159 FTE, \$75/hr, 2.6 LM, 8 years	\$ 516,915,360		30.0%	65.0%	2.5%			2.5%	100.0%
<b>VTA services</b>	<b>Summary</b>	<b>\$ 152,798,880</b>								
VTA (BSVII)	23 FTE, \$75/hr, 2.6 LM, 8 years	\$ 74,773,920		70.0%		15.0%	5.0%	5.0%	5.0%	100.0%
VTA (Other)	24 FTE, \$75/hr, 2.6 LM, 8 years	\$ 78,024,960		70.0%		15.0%	5.0%	5.0%	5.0%	100.0%
<b>BART services</b>	<b>Summary</b>	<b>\$ 106,284,000</b>								
Proj. mgmt./design/const	15 FTE, \$200/hr, 8 years	\$ 50,016,000		95.0%		5.0%				100.0%
Systems testing/integration	45 FTE, \$200/hr, 3 years	\$ 56,268,000						20.0%	80.0%	100.0%
Third Party services	\$8m/yr, 8 years	\$ 64,000,000		5.0%		5.0%	75.0%	10.0%	5.0%	100.0%
<b>VTA Provided Costs</b>	<b>Sub-Total</b>	<b>\$ 839,998,240</b>								

**Table 46 Table 1 from Cost Memo #2: SCC 80 Costs**

**Table 1 – FTE Summary (VTA, BART, PM/CM support)**

FTE Summary										
FY -->	2022	2023	2024	2025	2026	2027	2028	2029	2030	
<b>Total</b>	<b>228.2</b>	<b>237.4</b>	<b>245.1</b>	<b>249.3</b>	<b>249.9</b>	<b>247.2</b>	<b>247.8</b>	<b>130.9</b>	<b>99.5</b>	
<b>PW</b>	<b>106.7</b>	<b>105.2</b>	<b>103.2</b>	<b>100.6</b>	<b>95.3</b>	<b>93.5</b>	<b>88.3</b>	<b>53.6</b>	<b>45.6</b>	
VTA	29.8	30.8	30.3	29.8	29.8	29.8	29.8	28.4	20.8	
BART	6.2	6.2	6.2	6.2	6.2	6.2	9.2	9.2	9.2	
Prof Svcs PM/CM	70.7	68.2	66.6	64.6	59.3	57.5	49.3	16.0	15.5	
<b>CP-1</b>	<b>26.5</b>	<b>30.7</b>	<b>33.1</b>	<b>34.8</b>	<b>36.0</b>	<b>36.0</b>	<b>38.5</b>	<b>20.0</b>	<b>14.8</b>	
VTA	3.3	3.9	3.6	3.6	3.6	3.6	3.6	3.5	2.6	
BART	2.2	2.2	2.2	2.2	2.2	2.2	5.2	5.2	5.2	
Prof Svcs PM/CM	21.0	24.6	27.3	29.0	30.2	30.2	29.7	11.3	6.9	
<b>CP-2</b>	<b>33.5</b>	<b>37.0</b>	<b>39.1</b>	<b>40.8</b>	<b>42.6</b>	<b>41.8</b>	<b>42.3</b>	<b>19.4</b>	<b>12.9</b>	
VTA	3.3	3.9	3.6	3.6	3.6	3.6	3.6	3.5	2.6	
BART	2.2	2.2	2.2	2.2	2.2	2.2	5.2	5.2	5.2	
Prof Svcs PM/CM	28.0	30.9	33.2	34.9	36.8	36.0	33.5	10.7	5.1	
<b>CP-3</b>	<b>26.1</b>	<b>29.6</b>	<b>32.1</b>	<b>33.7</b>	<b>35.0</b>	<b>34.9</b>	<b>36.9</b>	<b>18.4</b>	<b>13.2</b>	
VTA	3.3	3.9	3.6	3.6	3.6	3.6	3.6	3.5	2.6	
BART	2.2	2.2	2.2	2.2	2.2	2.2	5.2	5.2	5.2	
Prof Svcs PM/CM	20.7	23.5	26.2	27.9	29.2	29.0	28.0	9.7	5.4	
<b>CP-4</b>	<b>35.5</b>	<b>34.9</b>	<b>37.7</b>	<b>39.4</b>	<b>41.0</b>	<b>41.0</b>	<b>41.9</b>	<b>19.5</b>	<b>13.0</b>	
VTA	3.3	3.9	3.6	3.6	3.6	3.6	3.6	3.5	2.6	
BART	2.2	2.2	2.2	2.2	2.2	2.2	5.2	5.2	5.2	
Prof Svcs PM/CM	30.0	28.8	31.8	33.6	35.2	35.2	33.1	10.8	5.2	

The SCC 80 costs include for all contracted and in-house professional, technical and management services related to the design and construction of fixed infrastructure (Cats. 10 - 50) during the engineering, construction, testing, and start-up phases of the project. This includes environmental work; surveying; geotechnical investigations; design; engineering and architectural services; materials and soils testing during construction; specialty services such as safety or security analyses; value engineering, risk assessment, cost estimating, scheduling, Before and After studies, ridership modeling and analyses, auditing, legal services, administration and management, etc. by agency staff or outside consultants. Provisions for professional liability insurance and other non-construction insurance should be included in 80.05.

**Staffing Numbers**

The Staffing Plan by Discipline by Year (Table 46 – Table 1 from Cost memo #2: SCC 80 Costs) indicates:

1. Quality staff total of 5 FTEs, all assigned to project wide functions, for entire project duration including manager, auditors, inspection staff and given that the contractors have their own quality programs, one person overseeing each contract’s quality program is very modest. PMOC considers that this should be twice that number or 10 FTEs total.
2. Project Controls has 14 total FTEs, 6 project wide functions, 2 each over each of the contracts. However, the plan indicates 15% of their time is project controls, with no indication of where the remainder of each person’s time will go, seemingly low for time allotment and distribution.

3. Architecture has 13.5 total FTEs, 20% are project wide functions, 10% are CP2, 10% are CP3, 60% are CP4, yet org charts for these contracts have no architecture positions or in project wide staff.
4. Tunnel Structures positions have a total of 7.67 FTEs, 20% project wide functions, 60% CP2, 20% CP1 with no distribution of FTEs in CP 3 or CP4 application of structures. Contractors will all have Tunnel Structures staff, but with a project of this nature demanding this type of expertise across the board and oversight/collaboration by so few staff, this appears to be inconsistent and understaffed.

Overall, it appears as if VTA's organizational charts do not reflect the distributions in this table. No architectural, tunnel/structural staff are indicated in organizational charts. The distribution of FTE total budgets seems illogical. There are 13.5 FTEs listed as architectural, 20% project wide functions, 10% CP2, 10% CP3, and 60% CP4. This would seem to indicate approximately 8 architectural staff as CP4, yet the CP4 org chart lacks any architectural positions, rather, they are primarily PM, contracts staff, office engineers, etc. Tunnel-structural engineers are indicated as 7.67 FTEs initially, tapering down to 3-5 FTEs. 20%, or about 1.5 of these FTEs are PW, with about 4.5 FTEs on CP2, while the rest of the contracts share about 1 FTE. In the PMOC's opinion base staff estimations are too low and considers additional staff will be required to coordinate and support this challenging and complex project.

### **Staffing Charge/Wage Rates**

In supplementary information supplied by the Sponsor, the PMOC found that the multiplier rate for the staffing decreased to support a previous dollar figure. BSVII Spot Memo 2 – SCC 80 Costs dated April 14th, 2021 (submitted to the PMOC on April 19, 2021) states that the labor multiplier used for the staffing estimate is 2.4 instead of 2.6 from the Basis of Cost Estimate. This amounts to an almost 8% reduction in multiplier which when multiplied over thousands of manhours presents a significant delta in OH, profit, and fringe benefits. This indicates that in order to capture any additional staffing, the rates had to decrease in order to support a prior staffing cost number.

The \$75/Hour figure used by the Sponsor seems low for the senior staff they have in place. Checking similar position titles across the country, many of the staff would be paid in excess of \$100/HR and the average rates for staff across the board increased by 10% when adjusted for Santa Clara County. This was verified across several position titles including cost estimators, schedulers, structural engineers, project managers, et al from intermediate level to senior level, to supervising to chief.

The PMOC recommends increasing this wage rate from \$75.00 to \$82.50/hour, multiplier remaining at a 2.6 multiplier, to increase the assumed yearly hours as 2,080 per year, and to increase the DB costs from 6.5% to 8%.

Table 47 below is extracted from the Cost memo #2: SCC 80 Table 2 showing costs at BY\$ and YOES for SCC80 costs based on a 2.4 multiplier. The following Table 48 is extracted from the Sponsors Basis of Cost based on a 2.6 multiplier. It is not possible with information provided to reconcile the two tables.

**Table 47 FTE Staffing Summary using the 2.4 Multiplier from Spot Memo 2**

<b>SCC 80 Summary (in \$M)</b>		
<b>SCC 80 Summary (in \$M)</b>	<b>Base Cost</b>	<b>YOE</b>
<b>Total</b>	<b>\$1,313.10</b>	<b>\$1,406.94</b>
<b>Overall Contingency</b>	<b>\$115.24</b>	<b>\$124.82</b>
<b>PW</b>	<b>\$586.73</b>	<b>\$622.25</b>
VTA	\$110.52	\$122.93
BART	\$21.18	\$23.91
Prof Svcs PM/CM	\$161.64	\$176.08
Insurance	\$40.50	\$45.20
Third Parties	\$10.80	\$12.05
Expended Through FY 2021	\$242.08	\$242.08
<b>CP-1</b>	<b>\$126.84</b>	<b>\$138.09</b>
VTA	\$10.26	\$11.41
BART	\$9.41	\$10.77
Prof Svcs PM/CM	\$68.68	\$75.72
Final Design (DB)	\$24.09	\$24.47
CP1 Preconstruction (T&M)	\$3.60	\$3.67
Third Parties	\$10.80	\$12.05
<b>CP-2</b>	<b>\$204.51</b>	<b>\$217.88</b>
VTA	\$10.26	\$11.41
BART	\$9.41	\$10.77
Prof Svcs PM/CM	\$81.43	\$89.34
Final Design (DB)	\$92.61	\$94.30
Third Parties	\$10.80	\$12.05
<b>CP-3</b>	<b>\$118.34</b>	<b>\$129.57</b>
VTA	\$10.26	\$11.41
BART	\$9.41	\$10.77
Prof Svcs PM/CM	\$65.29	\$71.86
Final Design (DB)	\$22.58	\$23.47
Third Parties	\$10.80	\$12.05
<b>CP-4</b>	<b>\$161.44</b>	<b>\$174.33</b>
VTA	\$10.26	\$11.41
BART	\$9.41	\$10.77
Prof Svcs PM/CM	\$79.66	\$87.39
Final Design (DB)	\$51.31	\$52.71
Third Parties	\$10.80	\$12.05

**Table 48 FTE Staffing Summary using the 2.6 Multiplier from Basis of Cost Report**

Category	Assumption	Base Cost w/o Contingency
		Basis of Cost 2.6 Multiplier
Professional Services	159 FTA, \$75/hr, 2.6 LM, 8 years	\$516,915,360
VTA Services	Summary	\$152,798,880
VTA (BSVII)	23 FTE, \$75/hr, 2.6 LM 8 years	\$74,773,920
VTA (Other)	24 FTE, \$75/hr, 2.6 LM 8 years	\$78,024,960
BART Services	Summary	\$106,284,000
Proj. Mgmt/Design/Const	15 FTE, \$200/hr, 8 years	\$50,016,000
Systems Testing/Integration	45 FTA, \$200/hr, 3 years	\$56,268,000
Third Party Services	\$8m/yr, 8 years	\$64,000,000
VTA Provided Costs	Sub-Total	\$839,998,240

**SCC80 Cost Adjustment**

With the wage rate increase from \$180 to \$200 per hour, increase of 1.5% for DB costs, and addition of (5) FTE professionals to fill in areas of the staffing that were lacking such as auditing, reviewing, quality control, quality enforcing, and surveilling over 8 years, the increase in SCC 80 for Contracts 1-4 and overall project-wide would be an increase to the base cost of the estimate of \$151 million. (BY\$). This would also address the large risk of the interfacing of contracts and additional staff and support in the design phase to increase coordination and management.

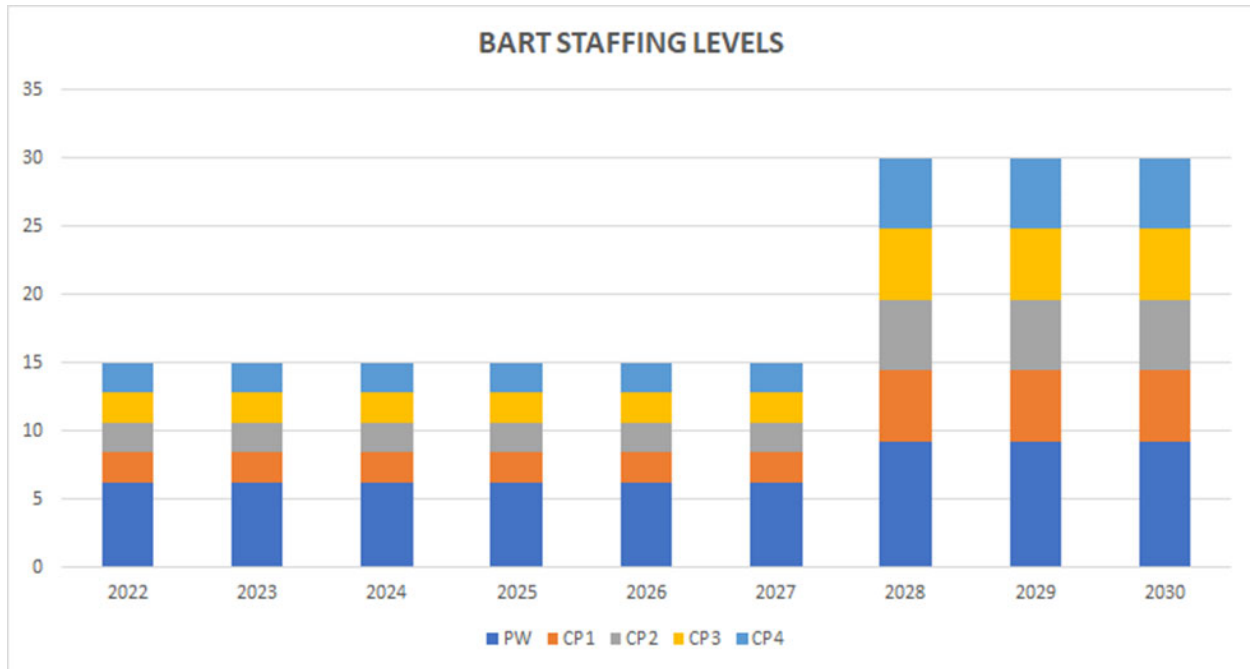
**Commentary on BART costs included under SCC80**

Figure 13 below is extracted from the BSVII Cost memo #2 of BART proposed FTE staffing plan. (refer Table 46 – Table 1 from Cost memo #2: SCC 80 Costs above)

BART shows a “doubling of their team” in the final three years of construction comprising systems installation, completion of Yard and Shop, Systems testing, commissioning and BART Phase 3 start-up in readiness for start of Revenue Operations.

PMOC is of the opinion BART will need additional staff when developing plans (to interpret the BFS and Design Basis) as this is where their problems started in Phase I (using the wrong BART staff), review design plans, meet with designers, oversee/review equipment spec development, help prepare/review testing requirements, reporting, scheduling, etc. The Cost memo #2: SCC80 also stated that the primary BART operations staff were going to moonlight on BSVII. These are senior BART officials, deeply engaged in day-to-day operations. PMOC’s opinion is that BART will need additional full time personal to support the BSVII project and that current estimations are inadequate.

**Figure 13 BART Staffing Costs as Shown in Cost Memo #2**



### 9.7 General/Program Wide Items

**Use of allowances** – The use of allowances was evaluated for reliability with respect to the scale of the work covered and known project risks.

- SCC 80 Professional Services – this section’s costs contain allowances using a percentage of the total construction costs for each cost category – these percentages seem low compared to industry standards and history of similar work in the area. (phase 1)
- General – Craft labor rates include a 5% allowance for overtime added to the base wage rate
- General – Scheduling, storm water control, traffic control, quality control, construction safety monitoring, and other General Condition-related work includes line items as allowances. This varies per contract package and the mark-up applied is between 12-15%.

### Allocated Contingency

Allocated contingency is expressed as a percentage of the estimate construction cost by SCC. The following Table 49 shows the allocated contingency included in the estimate by SCC category. A more detailed discussion on Contingency appears in the OP 40 section of this report



**Table 49 Allocated Contingency by SCC Category**

SCC	Description	Allocated Contingency %	Total Allocated Contingency (\$M)
10	Guideway & Track Elements	27%	\$286
20	Stations, Stops, Terminals, Intermodal	20%	\$234
30	Support Facilities: Yards, Shops, Admin. Bldgs	18%	\$35
40	Sitework & Special Conditions	18%	\$28
50	Systems	17%	\$58
<b>Subtotal (SCC 10-50)</b>		<b>22%</b>	<b>\$642</b>
60	ROW, Land, Existing Improvements	56%	\$109
70	Vehicles	4%	\$7
80	Professional Services (applies to categories 10-50)	7%	\$71
<b>Total (SCC 10-80)</b>		<b>19%</b>	<b>\$830</b>

The larger amounts include Guideway and Track Elements at 27% and ROW for 56% allowance due to market conditions.

**Evaluation of Contract Package Elements**

Contract package elements were assessed for specific services such as QA/QC and scheduling. Contractors are required to develop and submit their own QAPs for their work as some sort of implementation plan with specific actions like QA audits/surveillances/reviews planned out over a set schedule or calendar. This would be their opportunity as to negotiating a price for their quality implementation under the contract. The General Contractor should hire quality subcontractors to do the work.

Elements of contract language that would reasonably serve as a basis for additional compensation not part of a scheduled payment item might include OCIP, MBE/WBE compliance, liquidated damages, delays, and sound ordinances.

Restrictive schedule or mobilization requirements that would be material pricing elements in developing a bid may occur with staging of the project. The use of purchased property and acquisitions underway may delay starts of critical path items. Bid Package 2 has been noted as the contract that sets all others, as the tunnel boring begins all other activities related and following its course of excavation. The TBM is calculated as tunneling at a rate of 40 linear feet a day, with a 50-hour work week. The PMOC believes this rate is high.

Geotechnical data and pricing approach to changed conditions should be in special provisions or as reference materials. The contractors will be granted the opportunity to check the data provided before committing to a price. This responsibility belongs to the contractor to discern for items such as differing dewatering scenarios, depressurizing wells, etc.

Unit pricing and allowed variability in unit pricing is covered in the special provisions and if it is not addressed in there, the owner has the option to negotiate it with the contractor. Most contracts will have a contingency allowance for these types of hidden costs and would be settled by change order process. CIP concrete, for example, ranges from \$500-2,000/cy depending on how it is formed, where it is located, the amount of rebar included, and finishing as applicable.

## **9.8 Escalation and Inflation Review**

Provisions for escalation and inflation were reviewed per documents received by the Sponsor.

Sponsor has based their inflation calculations as included in the SCC Workbook, on a 2.72% per annum inflation rate over the duration of the project and this has been applied in the inflation tabulation.

As part of the PMOC review, the estimate and corresponding backup documentation was evaluated for uniformity of application of escalation and inflation factors. The application of the escalation factors to overall project costs were reviewed and evaluated regarding the application of inflation rates to the Base Year dollar costs to arrive at Year of Expenditure dollars. While considering the adequacy and reasonableness of the rates and the soundness of the economic forecasts, it should be noted that the Sponsor has not performed any sensitivity analysis to supports its projections.

### **Sponsor proposed Inflation Adjustment**

The Sponsor issued an updated Market Saturation Study 8.1 in May 2021 showing data in support of a mid-point approach to apply cost escalations using a 2.95% factor. The Sponsor contented that by adopting a mid-point approach to apply cost escalation a reduction would be achieved in total escalation. No adjustment was made to the submitted EPD application by the Sponsor.

The Sponsor stated the mid-point approach was updated to better reflect the current market and impact of COVID-19. PMOC also notes from Sponsors Inflation report they are using a different percentage for ROW which PMOC has not factored in but the Sponsors report does not state what it is or how they have applied it. Sponsor states their calculation allows for separate escalation of ROW based on the Sponsor's real estate team forecasts and finance charges included in nominal terms.

The PMOC was able to mathematically check escalation and inflation provisions through a cashflow analysis. PMOC created an approximate mid-point cash flow model based on the four main construction packages and program wide elements as shown in Table 50 below. The model was run to compare the escalation at 2.72%, 2.95% and 3.50% per annum.

**Table 50 PMOC Mid-Point Cash Flow Model**

		CP	NTP	END	VTA BYS
		1	25-Apr-22	30-Jan-29	\$ 371,105,983
		2	6-Apr-22	6-Apr-28	\$ 1,422,554,983
		3	26-Jun-23	14-Jun-28	\$ 349,034,614
		4	25-Jul-22	4-Jan-29	\$ 784,405,991
		PROGRAM WIDE	1-Jan-20	12-Apr-30	
		ROW	2-Jan-19	18-Feb-25	\$ 200,257,543
		VEHICLES	2-Jan-24	1-Feb-29	\$ 165,600,000
80.01		Project Development	2-Jan-19	26-Jun-23	\$ 149,472,740
80.02		Engineering (not applicable to Small Starts)	2-Jan-19	12-Apr-30	\$ 190,599,926
80.03		Project Management for Design and Construction	2-Jan-19	12-Apr-30	\$ 312,749,024
80.04		Construction Administration & Management	1-Jul-21	12-Apr-30	\$ 335,994,984
80.05		Professional Liability and other Non-Construction Insurance	1-Jul-21	12-Apr-30	\$ 41,543,516
80.06		Legal; Permits; Review Fees by other agencies, cities, etc.	1-Jul-21	12-Apr-30	\$ 55,639,944
80.07		Surveys, Testing, Investigation, Inspection	1-Jan-20	4-Jan-29	\$ 25,293,544
80.08		Start up [BART]	30-Jan-29	12-Apr-30	\$ 68,777,228
					<b>\$ 4,473,030,020</b>
		Unallocated contingency	1-Jan-20	12-Apr-30	\$ 475,784,445
		Finance charges	2-Jan-19	12-Apr-30	\$ 323,446,627

PMOC picked out the start / NTP and then calculated the mid-point from start / NTP through Contract completion for each of the CP’s and for the SCC 60-80. Using a 3.50% per annum checks within \$20m to the TOP DOWN MODEL output / adj proposed at 3.50% per annum based on the SCC workbook cash flow calculation as proposed by the Sponsor and which the EPD application has been based adopting 2.72% per annum.

Table 51 below summaries the results of the mid-point sensitivity analysis and the PMOC contents the Sponsors assertions that changing to a mid-point using a higher rate produces a saving is incorrect.

**Table 51 Comparative Analysis of Different Inflation Rates Adopting a Mid-Point Calculation**

\$ 6,929,823,267	at 2.72% pa
\$ 7,008,439,561	at 2.95% pa
\$ 7,202,487,507	at 3.5% pa
\$ 7,181,663,065	TD MODEL USING 3.5% PA AND FTA INFL TAB
\$ 20,824,442	Diff between FTA TD and MID POINT at 3.5% pa
\$ 6,941,180,914	VTA YOY

In summary, the Sponsor-provided base cash flow was used to show how the top-down model in the Inflation tab of the SCC Workbook provided a difference of 0.28% (\$20.8M) when comparing the difference between the FTA top-down model and midpoint analysis at a rate of 3.50%. The

difference is greater, however, when comparing the Sponsor’s YOE overall cost to the midpoint analysis approach with a delta of +3.76% or \$261M.

## Inflation Rate Analysis

The PMOC compared escalation and inflation factors used by the Sponsor to Producer Price Index data from the Bureau of Labor and Statistics (BLS) (<http://www.bls.gov>) and other sources such as Engineering News Record (ENR) quarterly, and the Associated Builders and Contractors news releases to ensure adequate escalation and inflation cost is included to carry the project to the midpoint of construction (the assumed time when contract unit awards will be complete).

Accordingly, the baseline CAGR to the Study is updated, on a quarterly basis, from 2.99 percent to 2.72 percent, and for cost estimation purposes, the midpoint of construction (2024) cost escalation rate equivalent, drops from 3.46 percent to 3.34 percent (see Table 52). Figures used by the Sponsor have been updated numerous times since the submission of the Cost Estimate, its backup documentation, and multiple Market Saturation Studies, using 2.95% to the midpoint of construction analysis.

In a recent article published May 7, 2021, BLS stated that nonresidential construction input prices increased 1.6% for the month. *Bureau of Labor Statistics, U.S. Department of Labor, The Economics Daily, Consumer price index up 4.2 percent from April 2020 to April 2021.*

**Table 52 Baseline Case Cost Escalation Rate**

Individual Baseline Construction Material Annual Cost Escalation Rates

Cost Component / Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Structural Steel	-10.4%	-12.1%	-0.1%	0.8%	-0.6%	-0.2%	-0.1%	0.3%	0.4%	0.2%
Rail Steel	-0.7%	-1.7%	1.5%	2.0%	1.4%	1.1%	1.2%	1.3%	1.1%	1.0%
Concrete	3.9%	2.3%	2.2%	2.6%	2.9%	2.5%	2.1%	1.9%	1.9%	1.8%
Construction Machinery and Equipment	5.0%	0.7%	-0.1%	0.0%	0.6%	0.9%	1.0%	1.1%	1.3%	1.4%
Construction Sand, Gravel, Stone	4.2%	2.5%	2.3%	2.7%	3.0%	2.6%	2.3%	2.1%	1.9%	1.9%
Other Costs (Other Materials and Equipment)	3.4%	3.6%	3.1%	2.9%	2.9%	2.7%	2.6%	2.5%	2.5%	2.5%
Consolidated Labor Escalation Rate	7.0%	5.9%	5.2%	4.6%	4.2%	3.8%	3.4%	3.0%	2.6%	2.2%

Individual Baseline Construction Material Annual Share of Project Cost, as per 2019 Resource-Loaded Cost Schedule

Cost Component / Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Structural Steel	1.2%	1.2%	1.2%	2.3%	2.2%	2.2%	2.1%	2.1%	2.2%	-
Rail Steel	-	-	-	-	-	-	3.2%	4.1%	2.1%	-
Concrete	15.4%	15.4%	15.4%	30.4%	29.4%	29.4%	27.7%	27.5%	29.0%	-
Construction Machinery and Equipment	10.8%	10.8%	10.8%	8.0%	8.0%	7.8%	7.8%	7.5%	7.6%	19.7%
Construction Sand, Gravel, Stone	-	-	-	5.2%	7.0%	6.8%	6.8%	6.6%	6.5%	-
Other Costs (Other Materials and Equipment)	37.6%	37.6%	37.6%	19.1%	18.4%	18.7%	17.4%	17.3%	17.5%	45.3%
Consolidated Labor Escalation Rate	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%

Consolidated Annual Escalation Rate	4.77%	3.68%	3.32%	3.12%	3.09%	2.81%	2.51%	2.29%	2.14%	2.19%
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CAGR - Equivalent Factor Baseline (Over Project Lifecycle)	2.990%	Low Bound >	2.40%	High Bound >	3.58%
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CAGR - Equivalent Factor Baseline (To Midpoint of Construction)	3.463%
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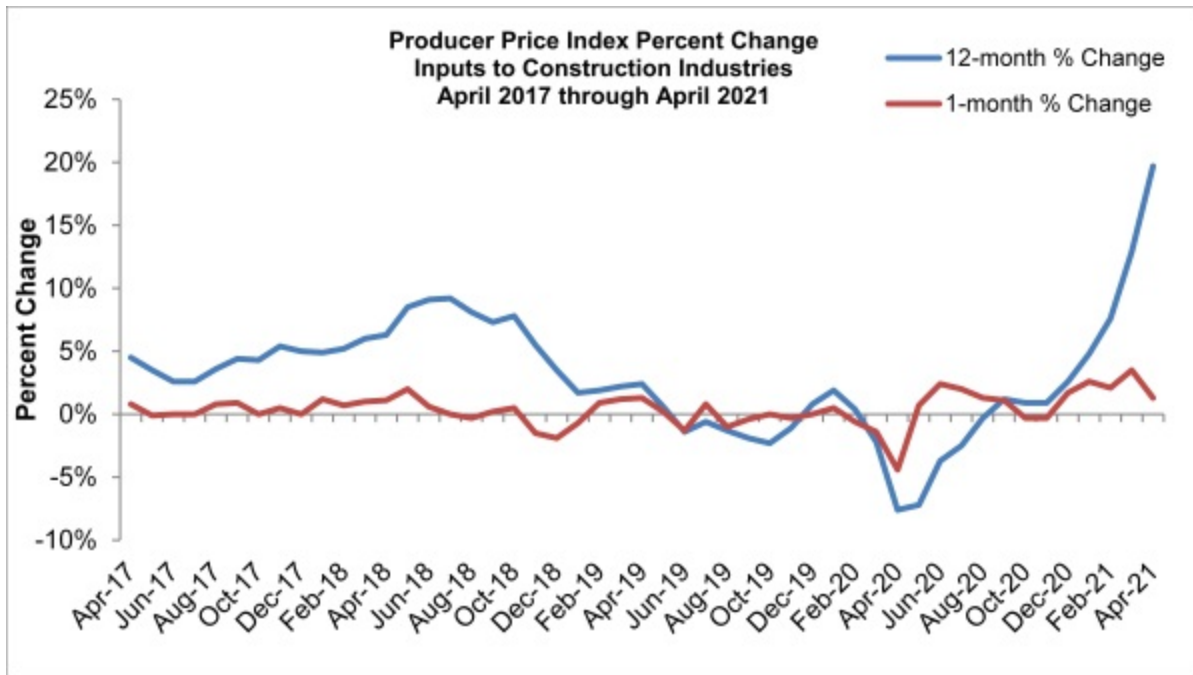
The PMOC finds there will need to be some adjustment to the base escalation of the cost estimate. The inflation/escalation factors are not appropriate and are shy of other published national figures from ENR (5%), BLS (4.16%), and ABC (3.50%) using data from May 2020 to April 2021. ENR in their last weekly construction report indicates that there is a shortage of specialized labor. At a minimum, the Sponsor should consider using an historic 3.50% to the midpoint of construction adjustment to base year dollars to adequately capture the project’s escalation.

**Table 53      Producer Price Index, April 2021**

	<b>1-Month % Change</b>	<b>12-Month % Change</b>
Inputs to Construction	1.3%	19.7%
Inputs to Nonresidential Construction	1.6%	19.2%
Plumbing Fixtures and Fittings	0.5%	2.3%
Fabricated Structural Metal Products	2.6%	12.7%
Iron and Steel	11.5%	57.7%
Steel Mill Products	18.4%	67.0%
Nonferrous Wire and Cable	4.8%	26.2%
Softwood Lumber	6.4%	121.1%
Concrete Products	1.2%	2.7%
Prepared Asphalt, Tar Roofing & Siding Products	1.5%	7.4%
Crude Petroleum	-7.2%	245.2%
Natural Gas	-32.5%	114.6%
Unprocessed Energy Materials	-17.2%	117.7%

Source: U.S. Bureau of Labor Statistics

**Figure 14      Producer Price Index Percent Change**



Source: U.S. Bureau of Labor Statistics

**Inflation Factor Adjustment**

In the PMOC’s opinion the inflation/escalation factors are not appropriate and are shy of other published figures referenced from ENR (5%), BLS (4.16%), and ABC (3.50%) using data from May 2020 to April 2021. Staffing rates are low compared to industry average yearly rates, which exceed \$75 per hour with 2.4% markup.

VTA's inflation included in their EPD submission SCC workbook based on 2.72% per annum annual inflation rate is \$839 million. This is based on the FTA Inflation TAB in the SCC workbook. This inflation TAB has been incorporated into the PMOC's TOP DOWN risk model workbook as a new TAB.

VTA have modified their contract package scope content since the workbook submission moving SOE and ventilation shaft structures into CP2 from CP4. This movement of costs impacts the inflation calculation, but VTA have not provided an updated calculation. It is taken into account through the PMOC CP split to Profiles and associated inflation adjustment in the TOP DOWN model.

The additional inflation calculated on the PMOC SABCE is \$185 million. The additional inflation calculated using VTA's base costs (before PMOC adjustments) is \$240 million. Based on the PMOC's recommended adjustments to form the SABCE and after the addition of risk through the BETA model additional inflation is calculated at \$309 million. (note there is a \$3 million rounding error within the model).

## **10.0 OP 34: PROJECT SCHEDULE REVIEW**

This section summarizes the PMOC's review of the Sponsor's development of the schedule.

### **10.1 Technical Schedule Review**

The BSVII IMPS is a collaborative effort that has been developed and will be managed by VTA's Consultant Team, which is described in the PMP and in the Management Capacity and Capability Plan. In addition, assigned technical leads from VTA, BART, VTA's Consultant Team, and other consultants and contractors will regularly participate and provide monthly schedule updates.

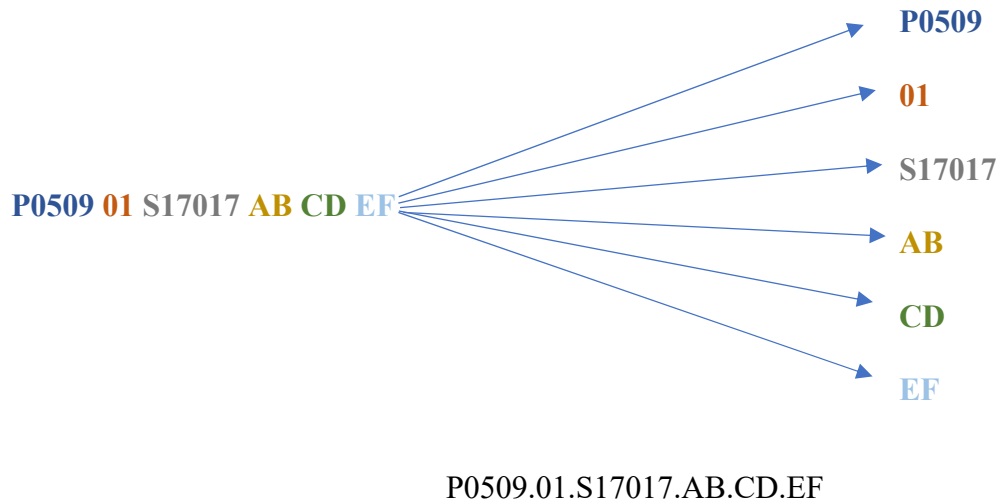
The IMPS has been developed as a Critical Path Method (CPM) schedule per the Project scope identified in the PMP and the Basis of Design report, along with input and verification of Project scope from team leads. The schedule has been cost-loaded (Section 6) and a critical path (Section 7) has been identified from the activity-sequencing to determine the tasks that control the minimum schedule duration necessary to complete the Project. The schedule was developed in Primavera P6 Professional Project Management.

The IMPS will be updated through the end of the previous month with schedule update reporting due by the 15th of the current month. VTA's Consultant Team and VTA staff are responsible for this effort, with input from other responsible leads on schedule revisions and information on the status and progress of the schedule activities. Various consultant and contractor schedules are received, reviewed, corrected if needed, and approved updates are then added to the IMPS. Working meetings with responsible leads and Project Controls staff are held to address comments every month. Similar process will be followed for receiving updates from the contractors of the contract packages. A monthly schedule narrative, including various schedule reports, is then prepared and distributed at the end of the month, at the project summary level according to the Basis of Schedule.

Monthly schedule reports are provided for schedule control needs and external reporting deliverables. Detailed schedule dashboards and reports will be generated monthly in conformance with VTA formal requirements.

The Work Breakdown Structure was set up as follows:

**Figure 15 Work Breakdown Structure**



- Where the Level 0 – P0509 is the project
- Level 1 – 01 is the Work Element
- Level 2 – S17017 is the Contract
- Level 3 – AB is the Task
- Level 4 – CD is the Sub-Task
- Level 5 – EF is the Work Package

It appears the WBS built in the schedule covers all the required pieces of the contract and does leave room for any additional scope that might be added.

The schedule contains all the require sections to cover the scope. The WBS has been created to the scope of work.

### **Basis of Schedule Review**

BSVII Basis of Schedule was prepared to document the schedule preparation methodology as a means of understanding the schedule of the Bay Area Rapid Transit (BART) Silicon Valley Phase II Extension Project (BSVII or the “Project”). This Basis of Schedule describes the schedule development process methodology and approach taken to develop the Integrated Master Project Schedule (IMPS), including Work Breakdown Structure, project delivery and construction packages, and schedule logic.

The management of the schedule will be performed by technical leads from VTA, BART, VTA’s Consultant Team, and other consultants and contractors will regularly participate and provide monthly schedule updates.

Scope, schedule, and cost variables on the Project are supposed to be interdependent however it was found that the cost in the schedule were not the same as those within the cost estimate.

The WBS is to be followed to ensure reporting consistency as outlined in the Cost and Schedule Control Procedure. The contract language shall also follow the WBS for work packages and cost



accounts. There is no inclusion of the SCC codes for the schedule to compare back to the cost estimate.

The major categories for the activities are broken out to include: Project management, Third party coordination, Environmental, Preliminary engineering, Right-of-way (ROW) acquisition, Final design, Utility relocations, Construction, and Testing and start-up. The Final Design is a broad topic and it would be helpful to have this section broken down by the design elements. There is no safety or quality covered in the Basis of Schedule (BOS).

The contingency sections states “After the reviews were complete, reasonable amount of allocated contingencies were added to the durations to get the final schedule” however there is no explanation as to how this contingency was calculated nor spread in the schedule.

The IMPS will be updated through the end of the previous month with schedule update reporting due by the 15th of the current month. VTA’s Consultant Team and VTA staff are responsible for this effort, with input from other responsible leads on schedule revisions and information on the status and progress of the schedule activities. Procedure and control schedules not conforming to the contract specifications will be returned to the respective contractor or consultants for resubmission. There is no discussion as to what means will be employed if the contractor or consultants do not send their updates in a timely manner.

The schedule development claims to be through tradition manners but does state what these traditional manners are. To date there is no Interface management program but the BOS claims the schedule has activities with interfaces between contract packages which is true but how does this relate to the interface management program.

The BOS discusses the different types of activities, relationships, and constraints and how activities in the future will be developed into more detail as the contract packages are approved. A technically complete schedule will have only two open ends, the very first and the very last activities in the schedule. The schedule has open end and constraint dates. The BOS states “there are several sequences of activities that have an overarching effect on the BSVII IMPS and will require the use of constraint dates.”

The BOS discusses the plan for the procurement of contract packages that the milestones will be met and all packages will be released as indicated in the master program schedule however these dates have already been adjusted between the November 2020 schedule and the February 2021 schedule.

The BOS for Construction is broken out by packages, CP 1 is Systems, CP 2 is Tunnels/Track, CP 3 is Newhall Yard and Santa Clara Station and CP 4 is Underground Station. The descriptors for these packages in the schedule are not the same. The schedule breakout is CP1 System, CP 2 Newhall Yard, Santa Clara Station and Parking Garage, and CP 4 Stations and Support Facilities.

The BOS for construction CP 1 does not discuss procurement of the equipment. Sequencing of the reaches is not discussed nor is material staging.

For CP 2 there are bullets for Site Remediation and Environmental and Archeological requirements in reference to the demolition but no details of what is expected.

Testing and Start-up should be part of the critical path and is not mentioned.

There is no discussion as to who the float belongs to; this should be addressed in the BOS and the contract documents.

In conclusion the BOS and the schedule align with one another for the most part but there are a few items which are included in the schedule but not covered in the BOS.

## **10.2 Soundness Check**

- The WBS has been properly structured and is consistent with the scope. The way the cost has been spread within the schedule is questionable as there are sections within the schedule that have no cost assigned to them such as the Testing And Commissioning.
- The construction schedule is the only schedule within the project that has Project calendars. The remaining schedules are utilizing global calendars.
- There is a 2-day Weekend calendar which has no holidays.
- The 5-day night calendar is indicating the only nonwork day (night) as Saturday. This does not equate to a 5-night work week.
- There are two 5-day week calendars. They each have the same naming and neither one of them include any holidays.
- There is a 5-day week calendar (2 Shifts) which is indicating 16 hours per day however has no holidays.
- There is a 6-day week calendar with only Sundays as a nonwork day however this calendar has no holidays.
- There is a 7-day week calendar which contains no holidays.

The schedule contains activities which identify the required work for the scope of the work however many of the activities are extremely high level with large durations. Proper durations applied to activities, along with their proper calendars.

### **Relationships**

- There are open ended activities within the schedule that require either predecessors or successors.
- There are relationships with positive lags.
- There are LOE activities with non-standard relationships such as FS instead of a FF.
- There are activities with reverse logical paths.
- There are activities with predecessors but no start relationships.
- There are activities with successors but no finish relationships.

Some of the float values are extremely high due the issue with open ends. While other activities have high float values even with both a predecessor and a successor. However, the majority of the float values are reasonable.

The critical path is identifiable and begins in the Design & Permitting schedule. The critical path does not contain any of the Right of Way activities. Of the critical activities the only ones that are cost loaded are those in the construction segment of the schedule. The critical path contains many concurrent activities.

Multiple float paths are not clearly identified.

Cost in the schedule do not agree with the cost in the estimates and do not have SCC cost accounts assigned.

### **10.3 Schedule Management Review**

The schedule format is relevant to industry practices with the use of the WBS and the multiply schedule for different portions of the project.

The Sponsor is utilizing Primavera P6 Professional Project Management (P6) scheduling software. The schedule analytics are being performed with Acumen Fuse's 14-point schedule assessment. Both of these soft wares are capably for the size of this project.

The IMPS will be updated through the end of the previous month with schedule update reporting due by the 15th of the current month. VTA's Consultant Team and VTA staff are responsible for this effort, with input from other responsible leads on schedule revisions and information on the status and progress of the schedule activities. Various consultant and contractor schedules are received, reviewed, corrected if needed, and approved updates are then added to the IMPS. Working meetings with responsible leads and Project Controls staff are held to address comments every month. Similar process will be followed for receiving updates from the contractors of the contract packages. A monthly schedule narrative, including various schedule reports, is then prepared and distributed at the end of the month, at the project summary level.

The updating method should be adequate as the IMPS will be updated through the end of the previous month with schedule update reporting due by the 15th of the current month. VTA's Consultant Team and VTA staff are responsible for this effort, with input from other responsible leads on schedule revisions and information on the status and progress of the schedule activities. Various consultant and contractor schedules are received, reviewed, corrected if needed, and approved updates are then added to the IMPS. Working meetings with responsible leads and Project Controls staff are held to address comments every month. Similar process will be followed for receiving updates from the contractors of the Contract packages. A monthly schedule narrative, including various schedule reports, is then prepared and distributed at the end of the month, at the Program summary level.

The BSVII Project Change Request Procedure describes and governs the processes for revising the BSVII Baseline Scope, Schedule and Budget. The BSVII Project Change Request Procedure governs the processing of any change (including design and construction changes), and establishes the processes leading to the approval and/or rejection of change requests.

The Cost and Schedule Control Procedure describes the process for managing, monitoring, and controlling the budget, estimate-at-completion, and schedule for BSVII. One of the objectives of

the Cost and Schedule Control Procedure is to establish the process to analyze and manage the overall Project progress during the design and construction phases. The Project Controls and Reporting Lead is responsible for ongoing evaluation of cost and schedule performance and impacts in accordance with the Cost and Schedule Control Procedure.

The sponsor has provided a draft Configuration Management and Design Change Control Plan. This document describes the methodology used to maintain the Baseline scope, schedule and budget during design and construction.

The sponsor has not incorporated claims avoidance techniques in their Basis of Schedule. There is a section in the PMP titled *Claim Avoidance Procedures*; however, it is a description of the claims management procedure and not processes. PMOC recommends VTA consider adding time impact analysis and claims mitigation processes to the Basis of Schedule.

#### **10.4 Technical Schedule Review**

The schedule contains activities for Environmental Commitments Monitoring MMRP with actual dates indicating completeness as December 2018. In addition to there are activities for Align Design Criteria and Technical Requirements with Environmental Commitment Record (ECR), Develop Mitigation Monitoring & Reporting Program (MMRP) Criteria for all CPs and Environmental Specifications, Site Assessments (ESAs), Contaminant Management Plan and Remedial Action Plan. The Contaminant Management Plan and Remedial Action Plan have time for the public comments.

#### **Engineering Phase**

The engineering phase of the work continues with the development of the Preliminary Design which leads into the Design Bid Ready Packages. The activities for the design are long duration activities and is not detailed out. Value Engineering will be accomplished at the end of the Preliminary Engineering and priority to the Design Bid Ready Packages. The third-party agreements have been broken out by Utilities and by Agencies to the completion of the agreements.

The Right of Way Acquisition within the schedule is showing all the required parcel and whether relocation is required. The activities cover from Survey to Possession and/or relocation. Procurement RFP activities and procurement RFP reviews are in the schedule per contract. The reviews have durations from 1 day to 20 days. Bid and award are well detailed within the schedule for each of the contracts. Construction, system integration and startup and testing have activities in the schedule however they are lacking detail which will added after the contracts are let.

#### **Full Funding Grant Agreement or Small Starts Grant Agreement**

The section in the schedule for consist of seven activities finishing with the Approval of the funding. However, the approval activity and milestone do not tie into any other portion of the schedule with the exception of the summary schedule. Therefore, indicating it isn't a requirement for anything else in the schedule.

Procuring of equipment and materials is per contract for Contracts 1 ,3 and 4. The activities have large durations with very little detail. There are no activities for the procurement of materials for

Contract 2, Tunnel & Trackwork. Bid and award are well detailed within the schedule for each of the contracts.

The construction portion of the schedule is broken out into contract. The contracts are overlapping in work with contract 1: Systems being the first to start and last to complete.

- Contract 1: Systems is then broken into three sections, Summary, Systems, and Testing (Track and Systems). All the activities are at very high level with large durations.
- Contract 2: Tunnel and Trackwork has four sections, Utilities Relocation, Enabling Works, Construction and Fit-Out. Each of these is then subdivided by location of the work. All the activities are at very high level with large durations.
- Contract 3: Newhall Yard, Santa Clara Station and Parking Garage. There are sections, Santa Clara and Yard Civil Contract and Santa Clara Station Parking Structure. The Santa Clara and Yard Civil Contract has the most detail in reference to WBS break out but the duration and activities will require much more break down as the project progresses. The parking structure consist of one activity and an NTP.
- Contract 4: Station and Support Facilities has 6 sections, Summary, Utilities Relocation, Enabling Works, Construction, Fit-Out and 28th Street Station Parking Structure. Each of these is then subdivided by location of the work. All the activities are at very high level with large durations.

There is a LOE in the Program Management and Administration section of the schedule. This activity has a successor of TS.8610: Track testing to turnover to BART and a processor of Cons.2440: System Integration and Testing - Phase III (BART).

There is a separate schedule for Testing and Commissioning and at this time it consists of two activities, one for Revenue Service Phase and one for System Integration and Testing - Phase III (BART). Both of these activities are details under the Testing and Commissioning Plan WBS.

The project schedule is lacking in the close out requirement. There is an activity for the IDR Closeout and then Contract 3 and Contract 4 each have activities for Closeout but the Contract 1 and Contract 2 are lacking any closeout activities. Contract 3 is the only place training is discussed and it is for Training on Operation of All Systems and Equipment. Contract 1 and Contract 4 have activities to prepare, review and update required manuals. There is also nothing at this time storage of all records, and transfer of warranties. The resources/cost assigned to the schedule do not align with the Cost Estimate. All the resources in the schedule are coded as Nonlabor Resource Type. This version of the schedule does not break out material, equipment and labor. There is no indication that labor and material availability have been factored into the durations. There was discussion of using previously completed as-builts from other project with similar scope. The schedule and the Cost Estimate do not agree with one another. There are more dollars in the Estimate than in the schedule.

The Program Budget Professional services were mapped to activities in for SCC 80.20 and SCC 80.04 according to the Cost and Schedule Control Procedure; however, the SCC codes are not available in the schedule.

Scope, schedule, and cost variances will be monitored constantly through bi-weekly and monthly update meetings with all BSVII consultants and Contractors, as facilitated by management and controls personnel. Using this process, cost and schedule performance issues will be identified and resolved or mitigated, and the EAC will be updated continuously to close the gap between baseline and projected costs to complete.

The Basis of Schedule nor the Cost and Schedule Control Procedure does not discuss any software setting.

When the ten schedules are calculated as one schedule, so the inter-schedule relationships are applied there are one hundred fifty-three (153) activities with constraints, one hundred twenty-four (124) activities without predecessors and one hundred seventy-nine (179) without successors. The breakdown of activities is shown in Table 54.

**Table 54 Breakdown of Activities**

Schedule Activity	Number of Occurrences
Projects	1
Activities	2424
Not Started	1725
In Progress	295
Relationships	3969
Completed	404

There are fifteen (15) activities being performed out-of-sequence, and eleven (11) Milestones with invalid relationships.

There is a continues critical path from the current data date to the Start of Revenue Service which is the last activity in the project.

The project is broken into ten (10) different schedules:

- P0509 01 BSV Phase II Project – Professional Services
- P0509 02 BSV Phase II Project – Right of Way Acquisition
- P0509 03 BSV Phase II Project – Design
- P0509 04 BSV Phase II Project – Advertise, Bid & Award
- P0509 05 BSV Phase II Project – Utilities
- P0509-06 BSV Phase II Project – Permitting
- P0509 07 BSV Phase II Project – Construction
- P0509 08 BSV Phase II Project – Vehicles
- P0509 09 BSV Phase II Project – Testing and Commissioning
- P0509 10 BSV Phase II Project – Summary

These different schedules do cover the overall scope of the project in most cases in the high-level manner.

It appears the work scope is accounted for in the schedule however there are areas within the schedule such as Agency Utility Design and Utility Owner Relocation Design, Systems Installation, and Testing and Commissioning which are very high level and contain only two or three activities. Once the design is further along the schedule will require added information.

The critical path is clearly identifiable and at this time logically sound. The same for the near critical items.

There are few activities for environmental documents, but the ESA are represented in each of the contracts.

As expected, because the project is in the EPD Program, Request to Enter Engineering and potential requests for any Letter of No Prejudice are not addressed.

The FFGA has its own section within the Program Management and Administration schedule starting with a Project Justification and ending with EPD Grant Request Approval. This schedule is accurately reflecting the activities up to “Submit EPD Grant Request” have been completed. The Submit EPD Grant Request has a submittal date of 15MAR21 and an approval date of 13JUL21, which have been overcome and would be expected to be revised with future schedule updates.

There is a section with the Program Management and Administration schedule which covers Risk Assessments. This section is broken out into 5 smaller sections, Internal Risk Assessment, CP-1 Risk Assessment, CP-2 Risk Assessment, CP-3 Risk Assessment and CP-4 Risk Assessment. The intern assessment was completed as of 20JUL20. The risk assessments for CP- 1, 2 and 3 should had started in April and shall be completed in September of 2021. The risk assessment for CP-3 is indicating a start in April 2022 and completing in July 2022.

PMP and sub-plan review are included in the schedule as noted below:

- The PMP for construction is indicating it was completed as of January 2020.
- The CCIP/OCIP plans were completed in 2019.
- Contracting Implementation Plan was completed July 2020.
- Develop Risk, Contingency Management Plan completed November 2018.
- Risk, Contingency and Claims Management Plan was completed July 2020.
- Schedule Control Plan was completed December 2017.
- Safety and Security Management Plan was completed March 2018.
- Rail Fleet Management Plan was completed August 2019.
- Financial Plan was completed October 2020.
- Buy American Plan was completed August 2019.
- Station Area Planning was completed August 2019.
- Muck Handling Plan is indicating a completion of March 2021.

- There are some review activities in the schedule but this is an area that will require additional detail. The BOS discusses the durations being “Place Holders” and the durations will be revised prior to the procurement of the contract packages.
- The real estate acquisition section of the schedule has been broken out by parcel numbers and is very detailed.
- There is a section for the FFGA and the correct time frames are in place. There are no other funding sources mentioned in the schedule.

Initial durations for activities in IMPS were established based upon the following:

- The scope of activity
- Consultation with experienced project and task managers on the time required to perform the activity
- Where appropriate, consultation with third parties involved with competing the activity

According to an earlier version of the Basis of Schedule, allocated contingencies were added to (unidentified) select activity durations. The PMOC reviewed the schedule to identify contingency as the Sponsor has stated it was spread throughout the durations. However, there was no clear understanding of how this spread was accomplished and the associated statement was deleted from the latest version of the BOS.



## **11.0 CONCLUSIONS**

### **11.1 Risk**

The PMOC is concerned with respect to the ambitious schedule and derived cost impacts. The PMOC notes the very considerable contract interfaces and coordination required both physically and contractually and the high involvement of management and coordination that will be required of VTA and their internal project team and consultants.

The PMOC disagrees with the stripping of the estimate and suggests a strategy by VTA to move base costs into contingency and then to align the total contingency with FTA recommendations contained in OP 40. The result is a low base SABCE (starting point) and, when risk is then applied adopting the BETA guidelines and recommendations aligned to the design status the resulting risk calculated through the TOP DOWN model is disproportionate (exceeds) to the expected norms and guidance.

PMOC will continue to monitor the project and notify FTA of any major changes in scope, schedule, or cost which might warrant an updated risk assessment at a future milestone.

### **11.2 Scope**

PMOC is of the opinion that the project scope by and large captures the project as defined in the Record of Decision and the Basis of Design and is more loosely consistent with the project as defined when approved to enter Project Development in the Capital Improvement Grants program. This is due to the configuration change after entering Project Development from twin-bore tunnel with cut-and-cover stations in line with the tunnel to the large single-bore tunnel with two underground stations offset with adit connections to the stacked track and platforms.

The PMOC is of the opinion the proposed scope of works is overly ambitious in the time frame and at the cost proposed given the multiple contract interfaces, design coordination and construction coordination interfaces and the very challenging known ground conditions to be encountered on this large diameter single tunnel proposal.

The PMOC is concerned about the potential impact of the considerable TOD proposed around the main station sites. Although VTA have insisted these will not be allowed to influence or impact the base scope given the status of the 3rd party developers and the City and Regional politics it is difficult to envisage how these TOD works can be isolated. Experience of large transit developments in other major cities has shown that where multiple TOD and 3rd party stakeholders are integrated with the base scope significant cost increases and schedule delays occur.

Industry feedback has suggested that the Sponsor procure the Systems and Stations packages as PDB in addition to CP2 due to complicated interfaces. PMOC is of the opinion that further review of the contract packages might be warranted.

PMOC is concerned that the scope of the Utility relocations is still largely unknown, agreements in cost sharing are for the most in place but no commitment to cost or schedule has been negotiated with any of the Utility Owners. PMOC notes the current schematic proposals for utility relocations may still change after the engagement of the PDB (CP2)

PMOC is concerned that the scope and details of ground improvements are largely conceptual. Reasonable cost allowances have been included in the estimate, but they are essentially just allowances. Time included in the schedule is also extremely preliminary based on no supporting back-up and could vary a lot from assumptions and introduce schedule constraints and restrictions if significant in street works are identified, as necessary. No detailed plans exist on proposals for compensation jet grouting or other ground improvement and property protection work. The required temporary works design influenced by the PDB (CP2) may indeed result in significant in street works, additional access shafts and additional temporary or permanent ROW necessary to accommodate property protection works and ground improvements.

PMOC is concerned with the lack of executed third party agreements necessary to establish requirements and schedule commitments.

PMOC is concerned with the lack of definition of testing and commissioning scope, roles, and responsibilities.

PMOC's conclusion regarding design maturity varies from VTA's because the project and site-specific elements are what constitute or dominate design maturity. The use of standard drawings this early in the design development to quantify design maturity skews the picture. PMOC opines design maturity for the various elements as below:

#### **Profile 1 (CP1 – Systems)**

- SCC 10 - Civils works – 30% average design
- SCC 50 - Systems works – 30% average design

#### **Profile 2 (CP2 – Tunnels and Trackwork)**

- SCC 10 Civils works – 15% average design
- SCC 10 Track installation works – 30% average design
- SCC 20 Civil works – 15% average design
- SCC 40 Civil works – 15% average design
- SCC 50 Systems related works – 30% average design

#### **Profile 3 (CP3 – Newhall Yard and Santa Clara Station)**

- SCC 20 Santa Clara Station – less than 10% average design
- SCC 20 Balance – 15% average design
- SCC 30 Facility components – 30% average design
- SCC 40 Civil works – 15% average design
- SCC 50 Systems related works – 30% average design

#### **Profile 3 (Program-wide ROW, Vehicles, and Professional Services)**

- SCC 60 ROW – 15% average design
- SCC 70 Vehicles – 60% average design
- SCC 80 Professional services – 15% average design

## Profile 4 (CP4 – Underground Stations)

- SCC 20 All works – 15% average design
- SCC 40 Civil works - 15% average design

### 11.3 Cost

Sponsor's estimating and project controls organization is experienced, has the necessary capacity and capability to perform the work.

Scope was adequately accounted for in the estimate.

The PMOC checked the estimate mathematically summed. Discrepancies were encountered.

PMOC recommended adjustments are based upon:

- schedule adjustment of 18 months and corresponding additional direct ruining costs and overheads of the CP's and extended SCC80 costs
- estimate to be generally over stripped with base costs transferred and constraints applied to otherwise a corresponding inflated contingency
- staffing rates under SCC80 are low compared to industry average yearly rates
- staffing levels under SCC80 are generally low and recommends that the sponsor provide more details into the determination of FTE for staff-loading and resourcing throughout the duration of the project.
- Sponsor's inflation rate is low and not consistent with market trends and feedback from several state and national benchmarks and industry wide predicted forecasts.

Estimate was Coded to FTA SCC cost accounts, however there were minor details that were noted to be out of place during the PMOC's review of the contract package alignment to the FTA Standard Cost Categories.

Inflation calculation was consistent with FTA methodology and used the FTA standard workbook inflation calculation sheet based on approximate base year annual expenditure inflated using compound annual inflation rates, however inflation was in the PMOC's opinion underestimated.

Through sampling of data, quantities, labor, equipment and material rates, (noting quotations where provided) correctly rolled into summary sheets with consistent mark-ups and sales tax applied as appropriate.

Estimate took account of contract packaging strategy, constructability, project constraints, prevailing market conditions and any project labor agreements and / or local union hall agreements

Estimate and mark-ups made provision for Insurance, bid and performance bonds as described in the draft terms and conditions and

Identification of latent [hidden] and patent [exposed] contingency was identified and adjusted to form the Sponsors proposed SABCE, however, was in the PMOC's opinion over-stripped

## 11.4 Schedule

The PMOC is concerned with respect to the current schedule status and resulting cost impacts. The PMOC notes the very critical interfaces between tunnel and other structures impacting and requiring coordination, and in some cases additional design and cooperation agreements with the main civils works contract. The assignment of risk will be challenging at these interfaces both in terms of design responsibility, working around and taking over temporary supports to excavations and structures, quality of work especially where slabs and walls require water proofing applications and the concurrent working environment given ongoing tunnel mining and fit out by CP2 whilst fit out works continue through CP4. The cost of transfer and indeed sharing of risk could well exceed estimate and contingency allowances.

The schedule is generally developed to 10% design completion.

There is little to no schedule from the utility owners

There is sparse systems detail

- The Systems and Testing has very little to no detail in the February schedule. Systems installation is broken out to the different locations with no other information. The testing is running concurrently after the start of testing which begins approximately a year after the beginning of the installation however it is completing only one week after the last of the installation.
- High reliance on awaiting input from PDB (CP2) on means / methods /staging / phasing
- There is no contingency within the schedule with the exception of the right of way section. The Sponsor stated the contingency was built into the durations by setting the end date based on the need-by date.

## **12.0 RECOMMENDATIONS**

### **12.1 Risk**

1. The PMOC has reviewed schedule activity durations and concurrency of design and construction contracts together with the procurement timelines necessary to implement the proposed strategy. PMOC recommends an adjustment to the VTA RSD of 18 months resulting in a revised RSD, before contingency, of November 7, 2031 and that the base cost before contingency is increased by \$1,037 million (YOE) to account for over stripping, overly optimistic tunnel production rates, low SCC80 staff estimates, overly optimistic inflation rates and additional consequential increases in costs associated with the adjusted schedule duration.
2. PMOC recommends the Project Readiness to be conditional upon VTA obtaining additional contingency capacity to support the significant and understated risk apparent at this stage of the project's development.
3. PMOC recommends the P65 cost is adopted at \$9,148 million, an increase over the VTA EPD application of \$2,206 million. PMOC recommends the RSD including contingency adopts the SABS plus 25% equating to a revised RSD of June 21, 2034, a 21-month addition over the EPD Application.

With reference to the Sponsors RCMP, PMOC recommends:

- Cross references to other procedures to be inserted
- Definitions to be expanded
- Basis of risk to be formally established. Baseline scope, cost and schedule to be inserted in forward section of RCMP. List of assumptions, exclusions and qualifications to be inserted in RCMP
- Organization and reporting lines to be established in RCMP and cross referenced to PMP
- Risk committee to be defined and approach to independent Board reporting established
- OCIP program and clarity of risk ownership, deductibles, caps etc. to be better defined and aligned to RFP documentation
- Relationship and responsibilities of DB CM's and DB's themselves in management and reporting on risk to be established
- Risk mitigation plans to have action deliverables and status reporting which are measurable
- Regular reporting dates and cadence to be inserted in RCMP
- Contingency draw down curves to be reviewed and aligned with expected sharing / transfer / retention of risks through the DB/PDB contracts

### **12.2 Scope**

4. VTA should consider making ROW needs part of the PDB proposal to force proposers to do their due diligence for validation of VTA-proposed ROW early and allow VTA time to complete appropriate acquisitions.

5. PMOC recommends the Sponsor conduct additional constructability and access review for ROW needs against the latest developments for ground improvement and consider including such feedback as part of the PDB proposal.
6. PMOC recommends that the Sponsor clarify reporting relationships, authorities, and dispute resolution for all CP1 scope related to interface and integration management over the other design builders.
7. PMOC recommends that prior to grant award the Cooperative agreements with Caltrans, , City of San Jose (Cooperative Agreement #2 at a minimum) and City of Santa Clara (Cooperative Agreement #3 at a minimum) be executed. The three-party Diridon Station Construction Agreement between Google/CSJ/VTA should also be executed prior to grant award.
8. Increase the complexity of the agreements tracking matrix to acknowledge each cooperative agreement as an entry. Include TOD and construction staging agreements in the matrix to have a centralized database even if TOD designs and work are theoretically excluded from the project.
9. PMOC recommends that in response to industry feedback VTA demonstrate they have performed adequate due diligence evaluation of PDB versus DB for all packages and the packaging scheme is still appropriate based on industry appetites.

### **12.3 Cost**

10. PMOC recommends that the sponsor compare and align the project cost estimate, with its backup documentation and with the schedule to increase confidence of cost estimate.
11. PMOC recommends the sponsor provide a way to tie the estimate backup to the estimate summary and to the SCC Workbook. This should follow a flow chart and not be cumbersome to the reviewer. It should include all SCCs and all construction packages.
12. The FTA PMOC is of the opinion, and based on the details provided, that the estimate is overly optimistic and should be increased by \$1,037 million (YOE) to account for overly optimistic inflation, excluded scope (in the base estimate), under estimation of SCC80 staffing costs, overly optimistic schedule and over stripping of the base estimate transferring base costs to contingency and thereby suppressing contingency norms related to the base.

The recommended cost adjustments, details of which can be found in the OP 40 section of this report, can be summarized as follows:

Direct adjustments (\$156 million BY\$) for:

- Allowance for Hazardous Material removal (\$5 million)
- Low staffing rates and staffing shortfalls (\$151 million)

Time related (schedule) adjustments totaling \$404 million BY\$ to account for PMOC recommended 18-month schedule adjustment

Latent contingency adjustments totaling \$169 million BY\$ to account for over stripping of base and allocation to contingency

Inflation adjustment on base estimate at \$185 million and an additional \$96 million when applied to the PMOC adjustments resulting in a overall total inflation adjustment of \$309 million based on a 3.50% annual rate of inflation

13. PMOC recommends that the sponsor provide more details into the determination of FTE for staff-loading and resourcing throughout the duration of the project. SCC80 requires more back-up information. After a Spot Memo regarding staffing was received and reviewed, the added difficulties of coordination of all contract packages remain and are not addressed.
  - The staffing rates are low and have changed in supporting documentation details.
  - The rate multipliers keep changing in documentation i.e. 2.6 to 2.4 (backed up into previous costs).
  - The Design Development percentage seems low at 6.5%, suggest increasing to 8%.
14. PMOC recommends that the Sponsor revise the midpoint in the inflation tab of the SCC Workbook to Q3 2025 so that the compounded escalation reflects a rate of 20.13%.
15. PMOC recommends that the Sponsor establish separate SCC Workbooks for the separate contract packages. (Either separate workbooks or separate build-main tabs.)
16. PMOC recommends that the Sponsor not rely upon escalation of past unit rates, but instead obtain new quotes from suppliers to update both quantities and unit prices in the revised 2021 estimate.

#### **12.4 Schedule**

17. After careful consideration the PMOC recommends an overall adjustment to the VTA RSD (as reported in the latest schedule submitted March 2021 with progress updated through March 1, 2021), of 18 months resulting in a revised RSD, before contingency, of November 7, 2031.
18. There are duplicated Activity Code Value definitions. All the Activity Code Titles should be unique.
19. Agreement & Permit Matrix dates do not agree with the schedule dates. There should be either an explanation or a correction so that these documents concur.
20. Not all of the schedules have project calendars. Calendars need to be verified and properly assigned to the activities.
21. There are constraints in the schedules. Baseline Schedules should only contain constraints that are specifically called out in the contracts and constrains should not be used instead of relationship logic.
22. The cost in the schedule for ROW contingency do not agree with the cost in the estimate for the Contingencies. The cost in the schedule are higher. Explanation to why the cost for Contingencies in the schedule and the estimate are different.
23. There is no task activity for time contingencies in the schedule. The BOS states the time contingency has been spread throughout the durations but no explanation as to how this was done.
24. The overall cost in the schedule does not agree with the estimate. Explanation of how the moneys are not the same between the schedule and the estimate.

25. Explain how the SCC's codes are to be identified in the schedule cost.
26. Explain how the cost accounts are utilized in the schedule cost as there doesn't appear to be any cost account codes.
27. All the resources appear to be assigned to Non-Labor Resource types. Explain where the labor resources are assigned and how it was determined which activities were given resources.
28. There are summary (LOE) activities with assigned Resources. While it is not necessarily incorrect, it is unusual for summary activities to have resources assigned to them. Since these types of activities have variable durations, resource quantities or costs may vary as well. Also have to be careful of double-counting the same resources when both task and summary have resources assigned.
29. There are sets of duplicate activity descriptions with in each of the schedules. Each description shall be unique by the use of area or location.
30. There are duplicates of WBS code definitions. Each definition shall be unique by the use of area or location.
31. There are different types of Duration Types being utilized on the schedules. There are Fixed Durations and Units/Time duration types. This type is used when the activity is to be completed within a fixed time period regardless of the resources assigned and there is have Fixed Duration and Units duration types. This type is used when an activity has fixed resources with fixed productivity output per time period. Explain as to the different Durations types and why and when they are used.
32. There are task activities with zero durations. This isn't correct for a task activity. Verify if this should be Milestones or require a duration.
33. EPD Grant Request Approval only successor is to the Summary portion of the schedule. It is not tied to any other work. There should be a clear path as to what work can or cannot be performed once the approval is granted or not granted.
34. The schedule contains open ended activities. All activities with the exception of the very first and the very last should have both a predecessor and a successor relationship. The schedules should be driven by relationship logic and not constraints.
35. Out-of-sequence work should be corrected for logic to provide a correct critical/longest path of remaining work.
36. Odd relationship pairs were found. These are activities that share more than one relationship. The only exception to this rule is if a Start-To-Start (SS) relationship is used with a Finish-To-Finish (FF) relationship. Relationships should be verified.
37. There are relationships that are causing Reverse Logic Paths. Activities with a FF predecessor and a SS successor act in a 'reverse' logic manner in that if their duration grows, then the overall logic path 'shortens' in time. This is especially critical for critical path activities. Relationships should be verified.
38. There are activities with predecessor identified but the logic used only constrains the finish of the activity, not its start. Varying the durations of the above activities will not influence project completion. Relationships should be verified.
39. There are activities without finish relationships. These activities do not have any constraint on completion, only on their start. Once started, CPM rules will not consider their



completion important, other than for Project Completion. A delay on these activities will not result in a Project Delay to the current path of activities. These activities are missing a Finish-To-Start or a Finish-To-Finish relationship that would tie the finish of this activity to the timing of successor activities. Relationships should be verified.

40. Agencies have standard turnaround times for reviews and these times are normally written into the contract documents. Review times for the Utility companies should be in the schedule.
41. The activities should be set to coincide with the start and finish times of the working day, such as '08:00' and not at '00:00'. The hours posted for the working day's start and finish time in the activity's calendar were used to determine that the activities are using the wrong time.