CALIFORNIA High-Speed Rail Authority

# SIGNATURE/APPROVAL SHEET

**TO:** Jamey Matalka

**FROM:** Jon Carter

**SUBJECT:** Approval of 2024 Business Plan Capital Cost Basis of Estimate Report

**DESCRIPTION OF ENCLOSED DOCUMENT(S):** 2024 Business Plan Capital Cost Basis of Estimate Report

| REVIEWER | REVIEWER'S INITIALS/DATE: | COMMENTS |
|---|---|---|
| **Signer #1 Name (Print):** Jamey Matalka | Signature on file | |
| **Signer #2 Name (Print):** Brian Annis | Signature on file | |
| **Signer #3 Name (Print):** Bill Casey | Signature on file | |
| **Reviewer #1 Name (Print):** Mohamed Hassan | Signature on file | |
| **Reviewer #2 Name (Print):** Jon Carter | Signature on file | |
| **Author #1 Name (Print):** Waleed Aboukhadra | Signature on file | |
| **Author #2 Name (Print):** Lewis Rand | Signature on file | |

California High-Speed Rail Authority

# 2024 Business Plan

## Technical Supporting Document

## Capital Cost Basis of Estimate Report

March 2024


CALIFORNIA High-Speed Rail Authority

# TABLE OF CONTENTS

# LIST OF FIGURES



# LIST OF TABLES

# ACRONYMS AND ABBREVIATION

| | |
|---|---|
| AACE | Association of the Advancement of Cost Engineers |
| BNSF | Burlington Northern Santa Fe Railroad |
| BP | Business Plan |
| CCNM | César Chávez National Monument |
| EAC | Estimate at Completion |
| EIR | Environmental Impact Report |
| DTX | Downtown Rail Extension |
| FRA | Federal Railroad Administration |
| HMF | Heavy Maintenance Facility |
| LGA | Locally Generated Alternative |
| LMF | Light Maintenance Facility |
| MOWF | Maintenance of Way Facility |
| MOWS | Maintenance of Way Siding |
| OCS | Overhead Catenary System |
| PEPD | Preliminary Engineering for Project Definition |
| PUR | Project Update Report |
| ROW | Right of Way |
| SABCE | Stripped and Adjusted Base Cost Estimate |
| SCC | Standard Cost Category |
| UPRR | Union Pacific Railroad |
| V2V | Silicon Valley to Central Valley Line |
| YOE$ | Year of Expenditure Dollars |

This Page Intentionally Left Blank

# 1 INTRODUCTION

The California High-Speed Rail Authority (Authority) is responsible for planning, designing, building, and operating a high-speed rail system in California. The system will connect and transform California. The Authority's mission is to deliver a safe and reliable high-speed train system that utilizes an alignment and technology capable of sustained speeds of 200 miles per hour or greater. The three principles guiding decisions include (1) Initiate high-speed rail service in California as soon as possible; (2) Make strategic, concurrent investments that will be linked over time and provide mobility, economic, and environmental benefits at the earliest possible time; and (3) position the Authority to construct additional segments as funding becomes available. The Phase 1 system is being designed to run the approximately 494-mile from San Francisco to Los Angeles/Anaheim through the Central Valley in under three hours at speeds capable of over 200 miles per hour. Phase 2 will eventually extend the system to Sacramento and San Diego, totaling 800 miles with up to 24 stations.

The Authority has implemented a building block approach to deliver an electrified high-speed rail system and fulfill the Authority's mission as defined by Proposition 1A, the Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century, which was approved by a majority of voters in 2008.

This 2024 Business Plan Capital Cost Basis of Estimate Report explains the methodology used to the estimate cost for the Central Valley and for the full Phase I system. No major capital costs updates are presented in the 2024 Business Plan relative to what was included in the 2023 Project Update Report, given the Authority covered the major updates to the 2022 Business Plan in the 2023 Project Update Report and developments since then have not necessitated a revision.

As indicated in the 2024 Business Plan, there have been several significant program developments since the *2022 Business Plan* in April 2022, and the release of the *2023 Project Update Report* (PUR) in March 2023:

1. The California Legislature approved the final $4.2 billion in Proposition 1A Bond funds for the high-speed rail program and directed the Authority to provide a comprehensive update in the 2023 Project Update Report of the cost and schedule estimates for the Merced to Bakersfield segment.
2. The Legislature enacted Senate Bill 198 (SB 198), which defined the scope of the "Merced to Bakersfield segment" as a 171-mile electrified dual-track segment usable for high-speed rail service in the Central Valley from Merced to Bakersfield, with a new intermodal station in downtown Merced.
3. The Authority released the 2023 Project Update Report (PUR) in March 2023, which included updated cost estimates for the 119-mile Central Valley Segment (CVS), extending the CVS to a 171-mile high-speed rail segment from Merced to Bakersfield, and updating San Francisco to San Jose project segment.
4. The Board of Directors approval of an Expenditure Authorization request in the March 2023 Board meeting to increase the Expenditure Authorization by $2.073 billion to a new total amount of $20.010 billion, to budget additional funds to complete Construction Packages 1-4.
5. The Board of Directors approval of an Expenditure Authorization request in the January 2024 Board meeting to increase the Expenditure Authorization by $6.084 billion to a new total amount of $26.094 billion, to budget additional funds for newly-awarded federal grants and other budget adjustments from the 2023 Project Update Report.

   Awarded federal grants in 2023 include:

   - **Federal-State Partnership (FSP) Grant** for $3.074 billion for six (6) trainsets and trainset facilities, construction of the Fresno station, final design, and right-of-way acquisition for the Merced to Bakersfield extensions, and funding to extend construction into Bakersfield. The total project cost is $3.842 billion, including state match.

- **Consolidated Rail Infrastructure and Safety Improvements (CRISI) Grant** for $202 million was awarded for the final design, right-of-way acquisition, and construction activities for improvements to six (6) grade crossings. The total project cost is $292 million, including state match.
- **Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant** for $20 million was awarded for Historic Fresno Depot Renovation and Plaza Activation. The project will renovate, modernize, and preserve the Historic Fresno Passenger Depot. The total project cost is $33 million, including state match.
- **Corridor Identification and Development (Corridor ID) Grant** for $500,000. The primary benefit of this award is inclusion in the Corridor ID Program, which represents a prioritization of nationwide passenger rail projects for future support and funding.

In addition, the approved January 2024 Expenditure Authorization incorporates costs included in the PUR estimate but were excluded in the March 2023 Expenditure Authorization. These costs include the following:

- **Track and Systems and related** – Additional costs to build the single track and related systems on the 119-mile segment as required by the federal ARRA grant. A trainset certification facility and the Fresno Historic Depot is also included in this category. (A second track is planned to be constructed concurrently, but since new federal funds are still being sought, no budget adjustment for that is requested at this time.)
- **Other Construction Package (CP) Work** – Includes costs outside the current CP work for ongoing property management, freight rail coordination, and State Route 46 and 99 work with Caltrans.
- **Program Management and Support / Other** – Includes ongoing support contract work for the Central Valley and Program-wide. Additionally includes contingencies and reserves, and project development.

**Table 1** shows the breakdown of the high-level breakdown of the Program Baseline approved by the Board of Directors in January 2024.

**Table 1:** Program Baseline Budget ($ in Billions)

| Scope Element | Amount | Note |
|---|---|---|
| Expenditure Authorization March 2023 | 20.010 | Existing Expenditure Authorization including Contingencies |
| Track & Systems, Trainset Certification Facility, Fresno Historic Depot | 1.451 | These costs were identified in the 2023 PUR, but excluded from the March 2023 Board Expenditure Authorization, due to a focus at that time on the civil construction packages. These adjustments are requested now to carry this full "P65" budget consistent with the risk-based budget for federal grants awards. |
| Other Construction Package Work (including SR-99 & SR-46) | 0.127 | |
| Program Management & Support / Other, including Project Development, Project Reserve, Unallocated Contingency, etc.) | 0.371 | |
| **Subtotal with 2023 PUR Adjustments** | **21.960** | **Subtotal without new Federal Grants scopes** |
| Federal-State Partnership for Intercity Rail Grant Award Scope | 3.842 | Scope of $3.074B FSP-National grant award (high-speed rail trainsets, trainset facilities construction, Fresno station construction, Merced, and Bakersfield extensions final design and ROW acquisition, and Bakersfield interim extension civil works and track and systems construction) |
| CRISI Grant Award Scope | 0.292 | Scope of $202M CRISI grant award for Shafter grade separation projects |
| RAISE Grant for Fresno Historic Depot | - | No net budget change, but reflect award of $20M grant |
| Corridor ID Grant | - | No net budget change, but reflect award of $500K grant |
| Grant Total | 26.094 | New Program Baseline Budget |

# 2 BACKGROUND

In 2022 the California Legislature approved the final $4.2 billion in Proposition 1A Bond funds for the high-speed rail program. The Legislature also enacted Senate Bill 198 (SB 198), which defined the scope of the "Merced to Bakersfield segment" as a 171-mile electrified dual-track segment usable for high-speed rail service in the Central Valley from Merced to Bakersfield, with a new intermodal station in downtown Merced. The cost estimates included in the 2023 Project Update Report reflect the following updates to the program's capital costs that have occurred since the Board's adoption of the 2022 Business Plan:

6. Detailed update of the cost estimate for the 119-mile Central Valley Segment (CVS) between Madera and Poplar Avenue;
7. Updated cost estimate for extending the CVS to a 171-mile high-speed rail segment connecting Merced, Fresno, and Bakersfield; and
8. Updated cost estimate for the San Francisco to San Jose project segment.

In March 2023, the Board of Directors approved an additional funding of $2.073 billion to augment the previously approved Program Baseline to increase the Program Baseline from $17.937 billion (adopted in 2021) to $20.010 billion, that aligns spending with expected program revenues and spending priorities. In January 2024, the Board of Directors approved an additional funding of $6.084 billion due to the major program advancement since March 2023. With this additional budget, the Program Baseline increased from $20.010 billion to $26.094 billion.

It is important to differentiate between the scope that is contained in the Program Baseline and the remaining unfunded program scope included in the Authority's planning documents (i.e., Phase 1). Generally, the Program Baseline scope includes budget authorization for the 119-mile Central Valley Segment including track and systems (single track), the environmental work to clear the full Phase 1 system, design work to Merced and Bakersfield, Right-of-Way acquisition for Merced to Bakersfield Segment, high speed rail trainsets, Trainset Certification Facility, Fresno station design and construction, Fresno Depot design and construction, Bakersfield interim extension civil works and track and systems construction, Shafter grade separation, supporting regional bookend projects and other program wide costs.

The unfunded scope outside the Program Baseline includes project sections and elements that are still in environmental review. The estimating methodology is different depending on the category that contains the scope being estimated.

- For scope contained within the Program Baseline, projects have advanced in design and/or construction, thereby reducing estimating uncertainty. For projects in progress (e.g., under construction or preparation of environmental documents), the estimating methodology is based on determining a project Estimate at Completion (EAC). Projects not yet in progress, however still contained within the Program Baseline, have advanced in design maturity enough to justify a quantities-based methodology as described in Chapter 4: Approach and Methodology.
- For scope outside the Program Baseline, the estimating methodology is based on that which was established under the 2018 Business Plan Cost Estimate and continued to be used in the 2022 Business Plan Capital Cost Basis of Estimate Report, where the Authority expressed capital cost estimates as ranges. These cost ranges were based on the comprehensive update to the capital cost estimate, which was primarily parametric in nature. The ranges are consistent with (AACE)

Class 4 estimates, which reflect risks, opportunities and design uncertainty associated with the stage of project development and complexity to be managed moving forward. The ranges are shown in a Low, Base, and High-cost estimates.

Capital costs of high-speed rail projects evolve as in any major transportation infrastructure project, from early planning and conceptual engineering through preliminary engineering, contract procurement and, ultimately, to final design and construction. This project development and delivery evolution is represented by the Authority's recently implemented Staged Project Delivery process, which is often followed as a best practice in both the public and private sectors. As the project scope, alignment, procurement strategies, delivery mode and other key decisions are finalized—and as environmental mitigation and other project components are more accurately specified—capital cost estimates become more certain and risk factors become more defined, supporting contingency management and schedule confidence.

Capital cost estimates for public transportation projects whose construction spans multiple years are typically shown in (1) current year dollars, where inflation is not a factor, and (2) year of expenditure (YOE) dollars. Year of expenditure dollars illustrate the effect of projected inflation on cost estimates over the duration of a project delivery schedule. The forecast delivery schedule is used as a basis to inflate capital costs from current year dollars to year of expenditure dollars.

For developing the year of expenditure estimates for Central Valley and the full 494-mile Phase 1 system, the Authority assumes the project is financially unconstrained and that after the environmental Record of Decision, the project is ready to advance into final design, early works, and then construction. The cost estimates are loaded into an inflation worksheet which allocates expenditure aligned to the project delivery schedule and is then escalated based on projected future annual inflation factors (inflation factors used can be viewed below in **Table 10**). This is the approach that is used consistently in developing year of expenditure estimates in FRA Grant funded projects.

It is important to note that a financially unconstrained schedule is assumed given that the Authority does not have full funding to complete the program. Absent any other basis for projecting when and over what timeframe additional funding may become available, this is the most reasonable option for calculating year of expenditure estimates. An implementation timetable for delivering the line linking the Silicon Valley to Central Valley and the full 494-mile Phase 1 system can only be developed once the funding is determined and therefore the timing of construction is known.

# 3 CAPITAL COST SUMMARY

The Authority's Board of Directors historically adopts an annual fiscal year budget and a multiyear Program Baseline Budget after the approval of each Business Plan. Since the 2022 Business Plan, which provided an interim update, the Authority provided a significant update on the capital cost forecasts, including the work in Central Valley, the Merced to Bakersfield Segment, and elements of Phase 1 with the completion of the environmental phase from San Francisco to San Jose segment. These major updates were first provided in the 2023 Project Update Report (PUR) and continue to this 2024 Business Plan Basis of Estimate Report; signifying the performance and progress the Authority has achieved in defining the scope and schedule, and thus the cost forecast of delivering a high-speed system in California.

The forecast and estimates prepared for the 2024 Business Plan were developed pursuant the Business Plan statutory requirements and include:

- Capital Cost estimates (shown in range);
- Ridership and revenue forecasts (high, medium, and low);
- Operations and maintenance (O&M) cost estimates (high, medium, and low);
- Life cycle cost estimates (high, medium, and low);
- Cashflow estimate (high, medium, and low); and
- A breakeven analysis (prepared with a Monte Carlo analysis to evaluate three scenarios).

No major capital costs updates are presented in the 2024 Business Plan, given the Authority covered the major updates to the 2022 Business Plan in the 2023 Project Update Report and developments since then have not necessitated a revision. However, as stated in the 2023 Project Update Report, the Palmdale to Burbank section is expected to carry a cost above the baseline estimate, and the same is likely for the Los Angeles to Anaheim section. It is the Authority's practice is to update cost estimates once the design of each segment has reached a level of maturity where associated cost updates benefit from meaningful new information, such as needed environmental mitigations, and not simply an inflation adjustment of past estimates. Given that, costs for those sections will be updated with the Record-of-Decisions (ROD)s to be approved on the following schedule:

- Palmdale to Burbank following Board action on the environmental ROD for this section expected early Spring/Summer 2024
- Los Angeles to Anaheim following Board action on the environmental ROD for this section expected toward the end of 2025.

The following tables reflect a range of uncertainty with the various projects in different project development and delivery phases, starting with the estimate in Year-of-Expenditure (YOE) dollars and followed by a range of potential outcomes between confidence levels of 30 percent to 65 percent ("P30 to P65"). The YOE estimate is a critical part of the risk process. It is based on a Stripped and Adjusted Base Estimate (SABCE) which is a current (base) year number that is free of all latent and patent contingency. Future inflation is applied to the SABCE to account for escalation in costs through the delivery phases from the base year forwards to calculate the YOE. Risk is applied to this inflated (YOE) figure and a range of forecast costs produced from 10% confidence level (P10) to 90% confidence level (P90). Given outcomes are uncertain at this time, the Authority recommends a budget that corresponds to a probability level of contingency that aligns with guidance from the federal government, which is P65; however, the Authority's goal is to manage within the P50 level for all projects (see ***FTA Oversight Procedure 40 – Risk and Contingency Review***).

**Table 2** shows the cost estimates for the full 494-mile system including:

- Merced to Bakersfield Early Operating Segment as a range representing the P30 (Low), P50 (Base) and P65 (High) confidence levels;
- Phase 1 in Northern California presented as ranges, with a Base estimate and range based on AACE guidance appropriate for the design level;
- Phase 1 in Southern California presented as ranges, with a Base estimate and range based on AACE guidance appropriate for the design level; and
- Program Wide costs presented as ranges, with a Base estimate and range based on AACE guidance appropriate for the design level.

**Table 2:** San Francisco to Los Angeles/Anaheim (Phase 1) Capital Cost Estimates (YOE$ in millions)

| Scope Element | Low | Base | High | Expenditures |
|---|---|---|---|---|
| | **Phase 1 Program** | | | **12/31/2023** |
| Merced to Bakersfield | 29,833 | 31,497 | 32,976 | 10,118 |
| Northern California | 21,180 | 27,865 | 35,514 | 707 |
| Southern California | 31,908 | 40,650 | 52,807 | 38 |
| Program Wide | 5,624 | 6,151 | 6,636 | 830 |
| Total | 88,545 | 106,163 | 127,933 | 11,693 |

The tables below show the estimates for the following implementation plan building blocks:

- **Table 3:** 119-Mile Central Valley Segment Cost Estimates ($ in millions).
- **Table 4:** 171-Mile Merced to Bakersfield (and other Phase 1) Capital Costs (YOE$ in millions)
- **Table 5:** Northern California Capital Cost Estimates (millions, YOE$)
- **Table 6:** Southern California Capital Cost Estimates (millions, YOE$)
- **Table 7:** Program Wide Capital Costs (millions, YOE$)

**Table 3** shows the capital projects and the program management support necessary to complete the work on the 119-mile Central Valley Segment at the scope definition that generally matches both the 2022 Proposition 1A Funding Plan and the federal grant scope. The updated cost estimates reflect a greater level of precision, as we have updated and refined the quantities, pricing, and escalation rates used to build an updated estimate.

The risk process is based on extensive efforts undertaken by the Authority's independent risk management team, which consisted of subject matter experts throughout the Authority, and involved multiple risk workshops to support the data used for the modeling. This approach is consistent with the federal guidance mentioned above and industry leading practices.

**Table 3:** 119-Mile Central Valley Segment Cost Estimates ($ in millions).

| Scope Element | P30 | P50 | P65 | Expenditures |
|---|---|---|---|---|
| | Central Valley Segment | | | 12/31/2023 |
| Central Valley Construction | 12,246 | 12,357 | 12,455 | 8,472 |
| Track & Systems 119 Single Track | 3,236 | 3,541 | 3,813 | 1 |
| Program Management & Support (Con) | 728 | 743 | 769 | 505 |
| Project Reserve | 46 | 46 | 46 | - |
| Interim Use | 162 | 162 | 162 | 54 |
| Program Wide Unallocated Contingency | 318 | 368 | 410 | - |
| **Subtotal CVS CON** | **16,736** | **17,217** | **17,655** | 9,032 |
| Project Development, Management, and Support | 575 | 589 | 607 | 546 |
| Total Central Valley Segment | 17,311 | 17,806 | 18,262 | 9,578 |

**Table 4** shows the cost forecast for Merced to Bakersfield (171-Mile Segment) and other Phase 1 Capital Costs including stations, power, and trainsets.

**Table 4:** 171-Mile Merced to Bakersfield (and other Phase 1) Capital Costs (YOE$ in millions)

| Scope Element | P30 | P50 | P65 | Expenditures |
|---|---|---|---|---|
| | Merced to Bakersfield | | | 12/31/2023 |
| Central Valley Segment | 17,311 | 17,806 | 18,262 | 9,578 |
| Project Development Balance | 127 | 127 | 127 | 127 |
| Merced Extension | 3,326 | 3,627 | 3,896 | 23 |
| Merced Extension ROW | 454 | 513 | 565 | - |
| Bakersfield Extension | 2,358 | 2,574 | 2,767 | 14 |
| Bakersfield Extension ROW | 395 | 446 | 492 | - |
| Stations | 1,044 | 1,147 | 1,237 | 11 |
| Track & Systems Balance (Including CVS Second Track) | 2,569 | 2,810 | 3,025 | - |
| Solar and Utility Interconnection | 196 | 214 | 230 | - |
| Trainsets (6 total) | 465 | 516 | 561 | - |
| Maintenance Facility and Driving Simulator | 342 | 382 | 418 | - |
| Program Wide Support and Contingency Balance | 1,249 | 1,336 | 1,396 | 365 |
| Phase1 Transfer (Ph1) | 0 | 0 | 0 | - |
| **Subtotal Merced to Bakersfield:** | **29,833** | **31,497** | **32,976** | 10,118 |
| Project Development Balance (Ph1) | 539 | 545 | 559 | 501 |
| Program Wide Support Balance (Ph1) | 458 | 475 | 490 | 329 |
| Bookend | 1,298 | 1,298 | 1,298 | 745 |
| Total | 32,127 | 33,815 | 35,323 | 11,693 |

## 3.1 Northern California Capital Cost Estimates

**Table 5** shows the cost changes in the San Francisco to San Jose segment, as reflected in the approved environmental document, include increases in right-of-way acquisition costs for the expanded footprints at Millbrae Station and at the light maintenance facility at Brisbane. They also include Caltrain corridor improvements necessary to accommodate 110 mph maximum operating speeds, and related increases in professional services and contingencies. This section is still at the 15 percent design level and, once additional funding is secured, the Authority will advance to the design stage. As design is advanced, cost optimizations (savings) are typically identified through, for example, activities like value engineering. The cost ranges represent the accuracy of the estimate as a Class 4 estimate based on the Association for the Advancement of Cost Engineering (AACE) cost classification system as applied to projects that have advanced to about the 15 percent design level. The following tables provide capital cost estimates for the work occurring in the Northern and Southern California and the overall Phase 1 project.

**Table 5:** Northern California Capital Cost Estimates (millions, YOE$)

| Scope Element | Low | Base | High | Expenditures |
|---|---|---|---|---|
| | **Northern California** | | | **12/31/2023** |
| San Francisco to San Jose | 3,936 | 4,967 | 6,407 | - |
| San Jose to Gilroy | 4,075 | 6,020 | 8,733 | - |
| Gilroy to Carlucci Road | 10,316 | 13,627 | 16,762 | - |
| Central Valley Wye Balance | 1,842 | 2,240 | 2,601 | - |
| Preliminary Design – Northern California | 213 | 213 | 213 | - |
| Bookend Investments | 798 | 798 | 798 | 707 |
| Total | 21,180 | 27,865 | 35,514 | 707 |

## 3.2 Southern California Capital Cost Estimates

**Table 6** shows the capital cost estimates for the Southern California sections remain unchanged compared to the 2023 PUR. The Bakersfield to Palmdale and Burbank to Los Angeles project sections have completed environmental clearance, and the cost estimates for those sections were updated in the 2023 PUR and 2022 Business Plan (respectively) consistent with the Records of Decision approving those final environmental documents. The cost ranges for those sections represent the accuracy of the estimate as a Class 4 estimate based on the Association for the Advancement of Cost Engineering (AACE) cost classification system as applied to projects that have advanced to about the 15 percent design level.

The remaining project segments are getting closer to completing the environmental phase, with the Palmdale to Burbank project section expected to be completed in summer 2024 and Los Angeles to Anaheim in 2025. The current cost estimates for those sections remain the same given that environmental analysis is ongoing. The Authority typically updates the cost estimates after the Record of Decision because during the environmental analysis, scope can change significantly as the route alignment is determined, conflicts and community concerns are identified, and scope is added to mitigate for environmental and community issues. While costs will be further updated after the scope is settled with the Record of Decision, the Authority has been transparent about cost considerations during the environmental process.

**Table 6:** Southern California Capital Cost Estimates (millions, YOE$)

| Scope Element | Low | Base | High | Expenditures |
|---|---|---|---|---|
| | **Southern California** | | | **12/31/2023** |
| Bakersfield to Palmdale | 13,712 | 17,140 | 20,740 | - |
| Palmdale to Burbank | 12,635 | 16,775 | 24,428 | - |
| Burbank to Los Angeles | 2,201 | 2,935 | 3,405 | - |
| Los Angeles to Anaheim | 2,478 | 2,918 | 3,352 | - |
| Preliminary Design – Southern California | 382 | 382 | 382 | - |
| Bookend Investments | 500 | 500 | 500 | 38 |
| Total | 31,908 | 40,650 | 52,807 | 38 |

## 3.3 Program-Wide Capital Cost Estimates

**Table 7** shows the other program wide costs required to implement the full 494-mile system beyond the Merced to Bakersfield project include acquiring the remaining trainsets (66 total), completing the heavy maintenance facility in the Central Valley, continuing project development in Northern and Southern California sections, and program management support. Specifically:

- The heavy maintenance facility balance cost estimate is lower than the 2022 Business Plan estimate, reflecting a scope shift in order to make a higher initial investment in this facility as part of the Merced to Bakersfield project.
- The cost of acquiring the balance of trainsets required for expanding operations beyond the Central Valley remain unchanged from the estimate presented in the 2023 Project Update Report.
- The Project Development and Program management costs outside of Merced to Bakersfield section have been updated and are now represented separately.

**Table 7:** Program Wide Capital Costs (millions, YOE$)

| Scope Element | Low | Base | High | Expenditures |
|---|---|---|---|---|
| | **Program Wide** | | | **12/31/2023** |
| Project Development & Support | 1,049 | 1,049 | 1,049 | 831 |
| Heavy Maintenance Facility Balance | 248 | 275 | 301 | - |
| Trainsets Balance | 4,161 | 4,643 | 5,084 | - |
| Solar Power Generation Balance | 166 | 184 | 202 | - |
| Total | 5,624 | 6,151 | 6,636 | 831 |

# 4 APPROACH AND METHODOLOGY

## 4.1 Overview

The 2024 Business Plan capital cost estimates for future work are predominantly considered Class 4 based on the level of design maturity in the sections that have been advanced to 15% design complete, as defined by the AACE.

After achieving environmental Records of Decision (RODs), the Authority is now advancing with project footprint definition designs (approximately 30% design level) that will allow for Class 3 estimates, which are typically prepared to form the basis for budget authorization, appropriation, and/or funding. As such, they provide the initial control estimate against which actual costs and resources are monitored. The level of engineering ranges from 10 percent to 40 percent complete and typically includes horizontal and vertical alignments; typical cross sections; preliminary roadway and structure design; preliminary assessment of utility impacts; preliminary identification of systems facilities; development of environmental footprints and right of way requirements; and initial constructability reviews.

**Table 8:** Estimate Classifications by AACE International[1]

| Estimate Class | Maturity Level of Project Definition Deliverables (Expressed as % of complete definition) | End Usage (Typical Purpose of estimate) | Methodology (Typical estimating method) | Expected Accuracy Range (Typical variation in low and high ranges) * |
|---|---|---|---|---|
| Class 5 | 0% to 2% | Concept screening | Capacity factored, parametric models, judgment, or analogy | L: -20% to -50%<br>H: +30% to +100% |
| Class 4 | 1% to 15% | Study of feasibility | Equipment factored or parametric models | L: -15% to -30%<br>H: +20% to +50% |
| Class 3 | 10% to 40% | Budget authorization or control | Semi-detailed unit costs with assembly level line items | L: -10% to -20%<br>H: +10% to +30% |
| Class 2 | 30% to 75% | Control or bid/tender | Detailed unit cost with forced detailed takeoff | L: -5% to -15%<br>H: +5% to +20% |
| Class 1 | 65% to 100% | Check estimate or bid/tender | Detailed unit cost with forced detailed takeoff | L: -3% to -10%<br>H: +3% to +15% |

The state of technology, availability of applicable reference cost data and many other risks affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency.

[1] AACE International – Association of the Advancement of Cost Engineers (https://web.aacei.org/).

Typical accuracy ranges for Class 3 estimates are -10 percent to -20 percent on the low side and +10 percent to +30 percent on the high side. The accuracy ranges that were applied to Phase 1 cost estimates vary depending on the complexity of the project scope elements, maturity of underlying technical baseline information and the inclusion of appropriate contingencies.

## 4.2 Estimating Approach & Methodology for Current Projects

The cost estimates methodology for the major current contracts of the ongoing construction package projects is based on arriving at an Estimate At Completion (EAC) value. EAC is calculated as the Total Forecast Value of each Contract plus a risk informed allocated contingency value calculated using a Monte Carlo model. Total Forecast value calculation involves taking the current contract value and subtracting the expenditures to date resulting in the value of remaining work. The value of the certain portion of all Pending Change Orders, Potential Change Orders, Trends and risks whose probability exceeds 90%, are added to this remaining work value to arrive at the Total Contract Forecast value. This methodology relies on the Program management team extensive experience and management of the current contracts changes as well as the negotiation history with the Design Build Contractors.

In addition to determining the Total Contract Forecast, allocated contingency is estimated by building a stochastic risk model based on the estimated value of risks and the value of the uncertain portion of all potential change orders, and trends. Monte Carlo simulations are run against the stochastic model to arrive at recommended contingency values across a range of confidence levels. The Authority has chosen the P65 confidence level to estimate contingency budget levels.

Total Forecast for smaller support contracts is based on an aggregate burn rate across the contracts for a given scope element within a project. This burn rate was extended to accommodate the period of performance of the project being supported. Contingency is calculated using a Top-Down risk model based on applicable Beta risk factors. (refer next section for explanation of the Top-Down approach to risk modelling)

## 4.3 Estimating Approach & Methodology for Future Projects

### *4.3.1 Basis of Quantities*

The development of an accurate and credible capital cost estimate starts with the estimation of quantities that adequately reflect the scope of a project or program. The quantities in each geographic section of the Phase 1 program were estimated by take-off calculation of construction elements as depicted on the preliminary engineering drawings (i.e., volumetric quantification) or as assumed by experienced engineering staff where required details were insufficient on the preliminary engineering drawings. When the preliminary designs have not advanced beyond the basic footprint definition, such as passenger stations or maintenance facilities, parametric or analogy estimating of quantities was undertaken to capture construction scope of these features. A detailed listing of engineering documents forming the technical baseline for the 2024 Business Plan capital cost estimate is included in Appendix A: Technical Baseline Documents

### *4.3.2 Basis of Cost*

The basis of any cost estimate is centered around the unit costs used to price different construction elements, such as embankments, viaducts, tunnels, earth retaining structures, track, grade separations, etc., that are referred to as Unit Price Elements.

The unit costs were developed using standard industry practices based on historical bid data validated by unit cost analysis. Bid prices were used for more common construction elements while the unit cost analysis method was applied for complex construction elements. The unit price elements were subsequently

updated using a current Caltrans cost database, as applicable, and applying recorded historic Los Angeles construction cost escalation indexes published by Engineering News Record (ENR).

Contractor margin is added on top of fully burdened direct construction cost to have a complete, in place cost estimate. This approach is based on the contractor's field staffing which includes indirect costs such as office space, field consumables, bonds, insurance, and the contractor's home office overhead and margin.

## 4.4 Allowances and Other Costs

In addition to estimating the contractor direct and indirect costs, allowances and other costs had to be included to allow for program costs as described below (these allowances change as the project progress through stages):

### *4.4.1 Environmental Mitigation*

Environmental mitigation costs have been established based on actual commitments on the Central Valley projects (CP 1, CP 2-3, CP 4, SR99) that had already received environmental clearance and are now in construction. These costs were used as the baseline in determining what environmental mitigation costs can be expected on the other projects of the Phase 1 program. This was accomplished by application of factors accounting for corridor type (i.e. new, existing, or shared use), relation to grade (at-grade, elevated, or in tunnel), and an area factor affecting land acquisition costs needed to implement off-site mitigation for impacted environmental resources. Environmental Mitigation covers that mitigation required to satisfy the ROD's, monitoring during construction and post construction reclamation and replacements (e.g. wetland replacement, wildlife husbandry etc.) and monitoring after construction substantial completion.

Site improvements such as passenger stations and maintenance facilities received a flat allowance of the respective construction costs to estimate the environmental mitigation costs associated with these program features.

### *4.4.2 Temporary Facilities*

An allowance was used to account for the cost of temporary facilities, indirect costs, and mobilizations in the capital cost estimate. This allowance was assumed as a percent of the total cost of track structures, station buildings, maintenance facilities, roadway modifications, and highway grade separations.

### *4.4.3 Right of Way*

Right-of-Way (ROW) requirements, including permanent acquisitions and temporary construction easements, are based on preliminary engineering design documents and available land valuations. ROW budgets for Merced and Bakersfield extensions were updated to reflect recent Authority experience with land acquisitions in Central Valley Segment including a more precise index for inflation (the Case Schiller U.S. National Home Price Index).

### *4.4.4 Professional Services*

Professional services are required to implement the program from initial planning, preliminary engineering, environmental evaluation, and program management to final design, construction management, and startup. Transit Cooperative Research Program Report 138 Estimating Soft Costs for Major Public Transportation Fixed Guideway Projects had been endorsed by Federal Transit Administration (FTA) as the guidance and estimating cost of professional services on major rail transit programs. This report offers a methodology of evaluating professional services costs based on the experience of major transportation programs, while recognizing key influencing factors characterized as mathematical relationships (i.e., project lengths, construction cost, mode, delivery method, and access conditions) and categorical relationships (development duration, political influence, and agency policies).

## 4.5 Risk Assessment and Contingency

The risk assessment was conducted in accordance with the Authority's Program Risk Management Plan. At the project level, project risks are tracked in risk registers managed by the Project Construction Manager and overseen by the Program Management Oversight (PMO) Branch. Risk registers are updated monthly with quarterly workshops.

Cost risk assessment for the 2024 Business Plan used the following two modeling methods:

- **Top-Down Model (Beta Factor)** – The Top-Down methodology for evaluating cost-risk uses broad parameters derived from historical project information adopting the FRA's Oversight Procedure 40 (OP40) Risk and Contingency Management. The FRA 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 10$^{th}$ 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 10$^{th}$ and 90$^{th}$ percentile confidence levels. The Beta factor is a composite number made up of individual assessed risk values, for each cost element, based on risk exposure at the different stages of the project. The Beta factors are applied at Standard Cost Category (SCC) level 2 (i.e. 10.01, 10.02 etc.). The FRA 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 FRA Top-Down model provides guidelines on assignment of 'normal Beta factors. Adjustments, where appropriate, are as described below. The five risk categories are:
    - Requirement's risk
    - Design Risk
    - Market Risk
    - Construction Risk
    - Post-Construction Risk

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

- **Bottom-Up Model (Monte Carlo)** – The Bottom-up methodology is the term used to describe the traditional Monte Carlo-based approach to risk quantification, requiring consideration of uncertainty around individual estimating components and specific project risks. This approach requires the establishment of source and range of variability around that source, such as historical data, supplier quotations, or bottom-up quantitative and pricing detail. The Monte Carlo approach uses both the project basis of estimate and the project's Risk Register as a basis for ascertaining current uncertainty supporting a clear traceability through to the risk model results.

### *4.5.1 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. number of lanes, vehicles, 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.

### 4.5.2 Design Risk

Design Risk is the component of the Beta factor that relates to the risk that occurs during the "design" phase after the preliminary engineering phase. The risks are still fairly high at this stage because not all the technical details are not known and there is still an opportunity to make numerous project scope changes. Some of the typical risks include scope changes required for political or technical reasons, geotechnical soil conditions, design complications, environmental mitigation and design errors and omissions.

### 4.5.3 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.

### 4.5.4 Construction

#### 4.5.4.1 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.

#### 4.5.4.2 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.

#### 4.5.4.3 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.

### 4.5.5 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. Also called the Beta Range Model, the top-down cost risk assessment method has been developed through implementation on many transportation projects and is the required approach to be used on all FTA and FRA Transit Grant funded projects nationally. The OP40 requires Grant Applications have sufficient funding to support a 65% confidence level (P65).

The selection on which modeling method is based on the stage of the project and is summarized below.

**Table 9:** Modeling Method Selection

| Project | Beta Model | Monte Carlo Model |
|---|---|---|
| CP1 | X (Other Costs) | X (DB Costs) |
| CP2-3 | X (Other Costs) | X (DB Costs) |
| CP4 | X (Other Costs) | X (DB Costs) |
| SR99 | N/A | N/A |
| SR46 | | X |
| Track and Systems | X | |
| Traction Power – Supplied by PGE | X | |
| Traction Power – Supplied via Solar | X | |
| Rail Facilities and Trainsets | X | |
| Merced Extension | X | |
| Bakersfield Extension | X | |
| Central Valley Stations | X | |
| Project Development | X | |
| Program Wide Support | X | |
| Program Wide Unallocated Contingency | | X |
| Bookend and Local Projects | X | |
| Program-wide model | X (Other Costs) | X (DB Costs) |

### *4.5.6 Allocated and Unallocated Contingencies (Outside of Central Valley Projects)*

Contingency is divided into two categories for this Program—allocated and unallocated.

Allocated contingency is added to each cost category based on an assessment of the level of design information, complexity of design element, means and methods and site accessibility available for individual items of work. The resulting allocated contingencies implemented in the estimate range between 10 and 50 percent reflecting professional judgment and experience related to the cost variability typically seen for items of work within each cost category. Contingencies vary based on the project stage gate. For projects that are non-environmentally cleared, the exact percentage selected for each cost category is included in Appendix B: Applied Contingencies (Outside of Central Valley Projects). Generally, the contingencies are higher for underground work reflecting the additional exposure for unknowns as well as the construction complexity. It is also higher for stations, terminals, storage yard facilities and utilities as their design progress is still in the conceptual level and identification of all the utilities are not yet determined.

Unallocated contingency is typically included to address uncertainties that are more global in nature, such as schedule delays, changes in contracting environment or other such issues that are not associated with individual construction activities. Unallocated contingencies have been estimated at five percent of the total construction costs including right-of-way and professional services for the segments that are in preliminary engineering stage of development. Unallocated contingencies have been adjusted to include approved project contingencies and third-party allowances for the segments issued for final design and construction.

### 4.5.7 Review and Optimization

For projects outside the Central Valley Segment, upon completion of the initial draft estimate following the steps outlined above, a series of workshops were held assessing major scope changes, cost trends, and other influencing factors in each geographic section. It was recognized that although preliminary engineering documents tend to capture the entire project footprint for complete environmental analysis and clearance aimed at minimizing the risk of supplemental evaluations in the future, it also results in a conservative design subject to optimization through subsequent design development stages. Optimization measures were applied on the baseline estimate as high-level adjustments including, but not limited to, the following:

- Structural design criteria optimization;
- Lower profile where possible;
- Minimize separation between bored tunnels;
- Assume no mechanical ventilation in short tunnels;
- Station modular design;
- Reflect participation of other parties in grade separation costs; and
- Reflect future application of formal Value Engineering.

### 4.5.8 Year of Expenditure

Merced to Bakersfield Year of Expenditure estimates are based on a Stripped and Adjusted Base Estimate (SABCE) which is a current (base) year number that is free of all latent and patent contingency. Future inflation is applied to the SABCE to account for escalation in costs through the delivery phases from the base year forwards to calculate the YOE. Risk is applied to this inflated (YOE) figure. For remaining project segments outside of Merced to Bakersfield, the cost ranges represent the accuracy of the estimate based on the estimating procedures and methods used by the Association for the Advancement of Cost Engineering classification system (18R-97 Cost Estimate Classification System). Since the segments outside the Central Valley are currently unfunded, there is no schedule estimate for when Phase I will be completed; however, for purposes of cost estimation, the schedule scenario is unchanged since the Business Plan 2020 with the Phase I system being ready for operations on December 30, 2033

For Merced to Bakersfield, the base year date for the PUR23 was July 1, 2022, and this remains same for the Business Plan 2024. All estimated costs for Central Valley works are brought up to a consistent starting base of July 2022 and inflation is applied forwards based on the program schedule. The year of expenditures model non-escalated values were profiled based on the schedule durations and assumed expenditure profiles for each project. To arrive at the year of expenditure (YOE) escalated values, the risk model values were then adjusted using forecasted escalation factors. This resulted in a SABCE (YOE) to which risk was then added. Inflation factor assumptions applied in the model are based on the sources and forecasts shown below:

**Table 10:** Inflation Factor Assumptions for Merced to Bakersfield

| Calendar Year | Jul-Dec 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|
| Inflation Factor | 1.31% | 5.31% | 3.61% | 3.24% | 3.14% | 2.00% | 2.00% | 2.00% | 2.00% |
| | | | | | | | | | |
| Data source | ENR | CA DOF | CA DOF | CA DOF | CA DOF | US Federal Reserve | US Federal Reserve | US Federal Reserve | US Federal Reserve |
| Data series | CCI-LA | CPI-U CA Index | CPI-U CA Index | CPI-U CA Index | CPI-U CA Index | FOMC – PCE Inflation | FOMC – PCE Inflation | FOMC – PCE Inflation | FOMC – PCE Inflation |
| Data date | Jan-23 | Jan-23 | Jan-23 | Jan-23 | Jan-23 | Dec-22 | Dec-22 | Dec-22 | Dec-22 |

*Estimates were updated using 2022 actual prices, and future inflation is based on the California Department of Finance (DOF) inflation forecast (through 2026) and the Federal Reserve Bank inflation forecast after that (2027 – 2030).

# 5 ASSUMPTIONS AND EXCLUSIONS

## 5.1 Design Development Stages

All Phase 1 geographical segments outside of the current Design-Build projects in the 119-mile Central Valley Segment (comprised of Construction Package 1, Construction Package 2-3, and Construction Package 4) have advanced to the Preliminary Engineering design development stage. Los Angeles to Anaheim geographic project sections are still undergoing design refinements in support of the environmental reviews, and once these environmental documents are approved, the capital cost estimates for these segments will be updated in the future releases of the Phase 1 cost estimates.

## 5.2 Estimate General Assumptions and Exclusions

### *5.2.1 General*

The capital costs presented in 2024 Business Plan are based on the 2023 PUR which included the latest information available from several different sources including the:

- Authority's Project Construction Management (PCM) firms overseeing the three design-build projects in Central Valley;
- Track and Systems Request for Proposal and subsequent issued addenda;
- Preliminary Engineering for Project Definition (PEPD);
- 2022 Business Plan Basis of Estimate Report;
- 2023 PUR Basis of Estimate Report;
- San Francisco to San Jose EIR/EIS Basis of Estimate Report;
- Merced Station Relocation Re-Examination In-Progress PEPD; and
- Prototypical Station Indicative Drawings (Central Valley Stations).

### *5.2.2 Central Valley Segment*

The 119-mile Central Valley Segment (Madera to Poplar Avenue) costs comparison to the 2022 Business Plan summarized below in **Table 11**.

**Table 11:** Central Valley Segment Cost Comparisons to Business Plan 2022

| Scope Element | BP2022 | Estimate YOE | P30 | P50 | P65 | Expenditures |
|---|---|---|---|---|---|---|
| | **Central Valley Segment** | | | | | **12/31/2023** |
| Central Valley Construction | 10,255 | 11,485 | 12,246 | 12,357 | 12,455 | 8,472 |
| Track & Systems 119 Single Track | 2,362 | 2,722 | 3,236 | 3,541 | 3,813 | 1 |
| Program Management & Support (Con) | 687 | 686 | 728 | 743 | 769 | 505 |
| Project Reserve | 46 | 46 | 46 | 46 | 46 | - |
| Interim Use | 162 | 162 | 162 | 162 | 162 | 54 |
| Program Wide Unallocated Contingency | 420 | 0 | 318 | 368 | 410 | - |
| **Subtotal CVS CON** | **13,932** | **15,101** | **16,736** | **17,217** | **17,655** | 9,032 |
| Project Development, Management, and Support | 574 | 544 | 575 | 589 | 607 | 546 |
| Total Central Valley Segment | 14,506 | 15,645 | 17,311 | 17,806 | 18,262 | 9,578 |

#### 5.2.2.1 Assumptions:

Central Valley Construction

- CP1:
  - DB estimate and risk based on October 2022 data date EAC model;
  - Other support costs and risk based on Top-Down model, includes PCM, Right-of-Way, Environmental, Resource Agency, Third Party, and DB Stipends;
  - CP1 Sweeper Lids scope and cost included in CP1 Other;
  - Third Party Traffic and Basin costs included in Stations budget; and
  - Rail Operations Third Party Costs during T&S Phase 1 included in T&S budget.
- CP2-3
  - DB estimate based on October 2022 data date EAC model;
  - Other support costs include PCM, Right-of-Way, Environmental, Resource Agency, Third Party, DB Stipends, and Hazardous Waste Provisional Sum;
  - Elimination of 5 bridges credit caried in CP2-3 EAC;
  - Hanford Station Platform viaduct carried in Stations budget; and
  - Rail Operations Third Party Costs during T&S phase moved to T&S budget.
- CP4
  - DB estimate based on October 2022 data date EAC model;
  - Other support costs include PCM, Right-of-Way, Environmental, Resource Agency, Third Party, DB Stipends; and
  - DB scope identified for descoping remained in CP4 DB costs since final approval for descope was not complete at time of PUR and Business Plan.

Track & System 119 Mile

- Estimate assumes single track for 119-mille;
- Includes percentage for attributable cost related to PG&E traction power, T&S support, and environmental cost; and
- Full construction and support costs for Fresno Historic Station and Train Certification Facility (TCF) are included.

Program Management & Support

- Includes percentage of attributable costs related to Program Management, Legal, Resource Agency, and Early Train Operator (ETO).

Project Reserve, Interim Use, and Program Wide Unallocated Contingency

- Includes full Project Reserve, Interim Use, and Program Wide Unallocated Contingency accounts as established by the FRA Grant Agreement.

Project Development, Management, and Support

- Includes portion of MF ROD, Full FB ROD, Portion of Program Management, Legal, and Resource Agency associated with those RODS And Preliminary ROW Expenditures for both MF and FB.

### *5.2.3 Merced – Bakersfield Segment*

#### 5.2.3.1 Merced Extension

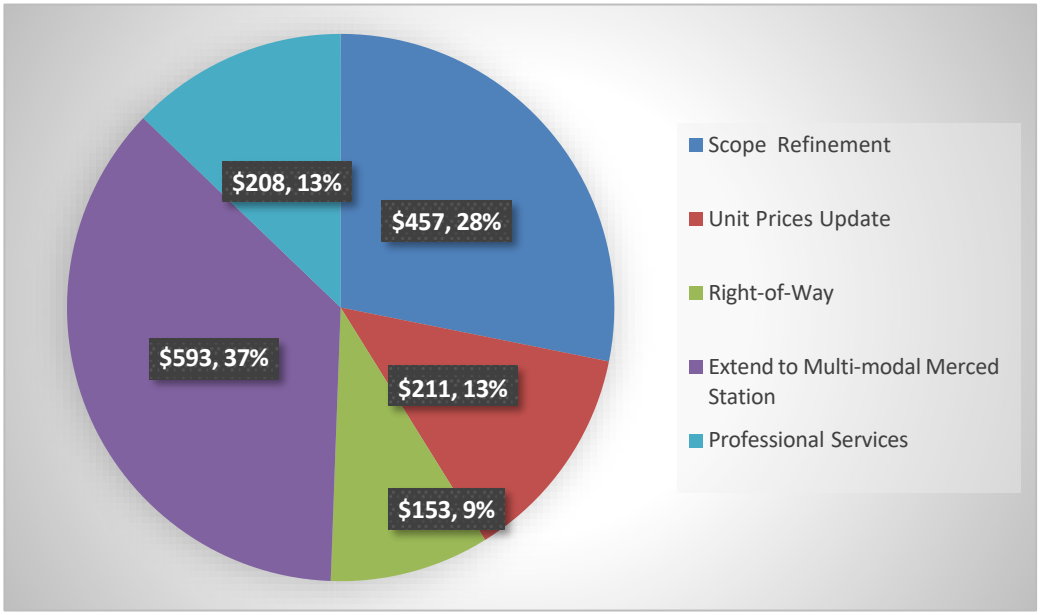
The estimated capital costs of extending the high-speed rail alignment from the CP-1 project terminus in Madera north to the Merced Station, including necessary ROW acquisitions, are presented in **Table 12**.

**Table 12:** Merced Extension, Civil and ROW (YOE$ in millions)

| Scope Element | P30 | P50 | P65 | Expenditures 12/31/2023 |
|---|---|---|---|---|
| **Merced Extension** | 3,780 | 4,140 | 4,462 | - |

The main cost trends contributing towards the total increase in the capital costs since the release of 2022 Business Plan are shown in **Figure 1**.

**Figure 1** - Merced Extension Cost Trends (Stripped, 2022 $ in millions)




The scope of this high-speed rail extension includes construction of a two-track alignment from Avenue 19 in Madera to R Street in Merced which includes a portion of the Central Valley Wye (CVY) required to make this connection to a multimodal station in downtown Merced allowing transfers to Altamont Corridor Express (ACE) and Amtrak San Joaquin passenger rail services.

The estimate is based on the approved environmental reexamination of the proposed changes to the Approved Merced to Fresno Section Final EIR/EIS. This reexamination is consistent with recent legislation defining the Merced to Bakersfield segment of the HSR system as including "a new combined station in downtown Merced, and connections to the Amtrak San Joaquins and the Altamont Corridor Express." Prior estimate was based on the Merced to Fresno Project Section Final EIR/EIS, which identified that the profile between Station (Sta.) 5970+00 and Sta. 6066+14.09 would be a combination of at-grade, open trench, and a cut and cover structure under State Route (SR) 99, ending at Martin Luther King Jr. Way in the City of Merced, with the Merced Station located at grade between G Street and Martin Luther King Jr. Way.

The current estimate includes the changes made by the approved reexamination which includes: Changing the vertical profile between Sta.5970+00 and Sta. 6066+14.09 from at-grade, retained-cut and at-grade profile to a profile that begins at grade, continues on retained cut to a cut and cover structure under East Childs Avenue followed by an open trench between E. Childs Avenue and SR 99, then a cut and cover structure under SR 99 followed by retained fill section and an elevated structure from approximately Sta. 6059+42 to Sta. 6104+32, and Relocating the Merced Station from its currently approved location (between G Street and Martin Luther King Jr. Way) approximately 0.7 mile to the north to a new location (between O Street and R Street).

The Merced Station (passenger platforms) would be changed from an at-grade station to an elevated intermodal station that would have the ability to connect to future Altamont Corridor Express (ACE) and Amtrak San Joaquins services. The station would also include a publicly accessible pedestrian overhead crosswalk over the existing UPRR right-of-way that would be constructed at the station to a surface parking lot along 16th Street between R Street and O Street. The station would also include surface parking underneath the elevated viaduct structure between Canal Street and R Street and surface parking between

R Street and V Street between the UPRR right-of-way and 15th Street.

Due to these revisions to the alignment and scope, the estimated quantities that were used for the cost estimate for this extension were derived from several documents and were pieced together to reflect the scope of the new alignment. the following baseline documents were used to estimate quantities:

- Ave. 19 to Ranch Rd. (Sta 5655+00) – Alignment Plans for the CVY (SR 152 North to Road 11 Alternative);
- Ranch Rd. (5655+00) to E. Childs Ave. (Sta 5970+00) – Alignment Plans for the Merced to Fresno (Hybrid Alternative); and
- E. Childs Ave (Sta 5970+00) to R St. – In-progress Alignment Plans for Merced Station Relocation Re-examination.

Detailed quantities that were estimated for the civil elements of work in this section are presented in 6 and 7. The major scope elements include the following:

- 3.6 miles of viaduct and bridge structures;
- 7 grade separations:
  - E. Le Grand Overhead
  - Road 4/ Lincoln Road
  - Robertson Blvd
  - Road 16
  - Road 17 1/2
  - Road 20
  - Road 22
  - Avenue 20 1/2
- 4 5 roadway modifications; and
- 12 roadway closures.

**Table 13:** Parametric quantities between Ave. 19 and E. Childs Ave.

| Description | Unit | QTY |
|---|---|---|
| Elevated Structure – 1 Track Abutment | EA | 9.000 |
| Elevated Structure – 1 Track (20’ Avg Pier Ht), with Pipe Piles | RM | 0.228 |
| Elevated Structure – 1 Track (30’ Avg Pier Ht), with CIDH Piles | RM | 0.050 |
| Elevated Structure – 1 Track (30’ Avg Pier Ht), with Pipe Piles | RM | 0.248 |
| Balanced Cantilever Structure (185’ MS) – 1 Track (30’ Avg. Pier Ht) | RM | 0.220 |
| Elevated Structure – 1 Track (40’ Avg Pier Ht), with Pipe Piles | RM | 0.497 |
| Elevated Structure – 1 Track (50’ Avg Pier Ht), with Pipe Piles | RM | 0.398 |
| Elevated Structure – 1 Track (60’ Avg Pier Ht), with CIDH Piles | RM | 0.610 |
| Elevated Structure – 2 Track Abutment | EA | 16.000 |
| Elevated Structure – 2 Track (20’ Avg Pier Ht), with CIDH Piles | RM | 0.382 |
| Elevated Structure – 2 Track (30’ Avg Pier Ht), with Pipe Piles | RM | 0.210 |
| Balanced Cantilever Structure (200’ MS) – 2 Track (30’ Avg. Pier Ht) | RM | 0.210 |
| Balanced Cantilever Structure (296’ MS) – 2 Track (40’ Avg. Pier Ht) | RM | 0.120 |
| Elevated Structure (LS) – 1 Track (40’ Avg. Pier Ht), with Pipe Piles | RM | 0.030 |

| Description | Unit | QTY |
|---|---|---|
| Elevated Structure (LS) – 2 Track (30' Avg. Pier Ht), with Pipe Piles | RM | 0.004 |
| Elevated Structure (LS) – 2 Track (40' Avg. Pier Ht), with Pipe Piles | RM | 0.002 |
| Elevated Structure – 2 Track (50' Avg Pier Ht), with Pipe Piles | RM | 0.003 |
| Elevated Steel Box Structure 100' Length – 1 Track (50' Ave Pier Ht) | RM | 0.377 |
| Bridge Structure – 3 span with 1 Track (30' Avg Pier Ht) w/ CIDH Piles | RM | 0.095 |
| Bridge Structure – 3 span with 1 Track (30' Avg Pier Ht) w/ Pipe Piles | RM | 0.042 |
| Bridge Structure – 1 span with 2 Tracks | RM | 0.018 |
| Bridge Structure – 3 span with 2 Track (20' Avg Pier Ht) w/ CIDH Piles | RM | 0.045 |
| Bridge Structure – 3 span 2 Track (30' Avg Pier Ht) w/ Pipe piles | RM | 0.030 |
| Bridge Structure – 1 span CIP w/ 4 Tracks | RM | 0.020 |
| At-Grade Track-bed in Fil – 1 Track (5' Avg. Exc Depth) – without Fence | RM | 1.000 |
| At-Grade Track-bed in Fil – 1 Track (10' Av. Exc Depth) – without Fence | RM | 0.563 |
| At-Grade Track-bed in Fil – 1 Track (15' Av. Exc Depth) – without Fence | RM | 0.390 |
| At-Grade Track-bed in Fil – 1 Track (20' Av. Exc Depth) – without Fence | RM | 0.725 |
| At-Grade Track-bed in Fil – 1 Track (40' Av. Exc Depth) – without Fence | RM | 2.580 |
| At-Grade Track-bed in Fill – 2 Track (5' Av. Exc Depth) – without Fence | RM | 4.319 |
| At-Grade Track-bed in Fil – 2 Track (10' Av. Exc Depth) | RM | 5.966 |
| At-Grade Track-bed in Fil – 2 Track (10' Av. Exc Depth) – without Fence | RM | 6.162 |
| At-Grade Track-bed in Fil – 2 Track (15' Av. Exc Depth) – without Fence | RM | 3.615 |
| At-Grade Track-bed in Fil – 2 Track (20' Av. Exc Depth) – without Fence | RM | 5.250 |
| At-Grade Track-bed in Fil – 2 Track (40' Av. Exc Depth) – without Fence | RM | 0.785 |
| At-Grade Track-bed in Fil – 4 Track (5' Av. Exc Depth) – without Fence | RM | 0.286 |
| At-Grade Track-bed in Fil – 4 Track (10' Av. Exc Depth) – without Fence | RM | 0.443 |
| At-Grade Track-bed in Fil – 4 Track (15' Av. Exc Depth) – without Fence | RM | 0.230 |
| At-Grade Track-bed in Fil – 4 Track (20' Av. Exc Depth) – without Fence | RM | 0.630 |
| Pumping Station | EA | 2.000 |
| Landscaping Allowance, Guideway | RM | 26.818 |
| Roadway Modification, New AC Paving (6"AC/18AB) | SF | 3,718,826 |
| Roadway Modification, New AC Paving (8"AC/30AB) | SF | 1,257,118 |
| Access Road Entrance Point | EA | 27.000 |
| Demolition Allowance, Bridge | SF | 12,518 |
| Demolition Allowance, Building (1 Story) | SF | 211,949 |

| Description | Unit | QTY |
|---|---|---|
| Demolition Allowance, Asphalt Pavement | SY | 327,210 |
| Demolition Allowance, Concrete Pavement | SY | 36,219 |
| Utility Relocation Allowance, Level 1 | RF | 141,500 |
| Relocate Fiber Optic Line | LF | 3,700 |
| Relocate Natural Gas Line (4-12" Diameter) – Standard Complexity | LF | 41,600 |
| Relocate Natural Gas Line (4-12" Diameter) – High Complexity | LF | 3,500 |
| Protect in Place Natural Gas Line (4-12" Diameter) | LF | 400.000 |
| Relocate Petroleum Products Pipeline (12" Diameter) | LF | 31,500 |
| Relocate Overhead Electric (70-115KV) – Standard Complexity | LF | 15,300 |
| Relocate Overhead Electric (115-230KV) – High Complexity | LF | 6,100 |
| Retaining Wall – 1 Wall (12' Avg. Height) | LF | 3,033 |
| Retaining Wall – 1 Wall (20' Avg. Height) | LF | 1,501 |
| Retaining Wall – 1 Wall (30' Avg. Height) | LF | 2,830 |
| Access Restriction Fencing | LF | 255,677 |
| ROW | LS | 1.000 |
| Roadway Excavation | CY | 632,019 |
| Roadway Embankment | CY | 341,760 |
| Roadway Structure: One Span, One Lane | EA | 1.000 |
| Roadway Structure: One Span, Two Lane | EA | 2.000 |
| Roadway Structure: Three Span, Main Span <160' | EA | 3.000 |
| Roadway Structure: Five-Span | EA | 1.000 |
| Roadway Structure: Multiple-Structure, Five-Span | EA | 1.000 |

**Table 14:** Parametric quantities between E. Childs Ave. and Merced Multimodal Station

| Description | Unit | QTY |
|---|---|---|
| At-Grade Track-bed in Fil – 2 Track (10' Av. Exc Depth) | RM | 0.753 |
| Pumping Station | EA | 3.000 |
| Retained Cut, Trench – 2 Track (10' Avg. Exc Depth) | RM | 1.069 |
| Parking – At Grade | STL | 1,233.000 |
| Roadway Modification, New AC Paving | SF | 1,058,610.000 |
| Roadway Modification, New AC Paving (6"AC/18AB) | SF | 77,693.000 |
| Access Road Entrance Point | EA | 16.000 |
| Demolition Allowance, Building (1 Story) | SF | 208,050.480 |
| Demolition Allowance, Building (2 Story) | SF | 7,027.920 |
| Demolition Allowance, Asphalt Pavement | SY | 13,444.320 |
| Demolition Allowance, Concrete Curb | LF | 504.000 |
| Demolition Allowance, Concrete Sidewalk | SY | 336.240 |
| Utility Relocation Allowance, Level 1 | RF | 9,656.064 |
| Relocate Natural Gas Line (4-12" Diameter) – Standard Complexity | LF | 11,729.000 |
| Relocate Petroleum Products Pipeline (12" Diameter) | LF | 10,082.000 |
| Relocate Overhead Electric (70-115KV) – Standard Complexity | LF | 2,618.000 |
| Containment (Crash) Wall – 1 Wall (12' Avg. Height Above Rail) | LF | 1,003.000 |
| Intrusion Protection Berm/Barrier | LF | 6,465.000 |
| Roadway Structure: One Span, Two Lane | EA | 3.000 |
| Roadway Overcrossing HSR – 6 lane retained fill roadway over 4 tracks | EA | 1.000 |

### 5.2.3.2 Bakersfield Extension

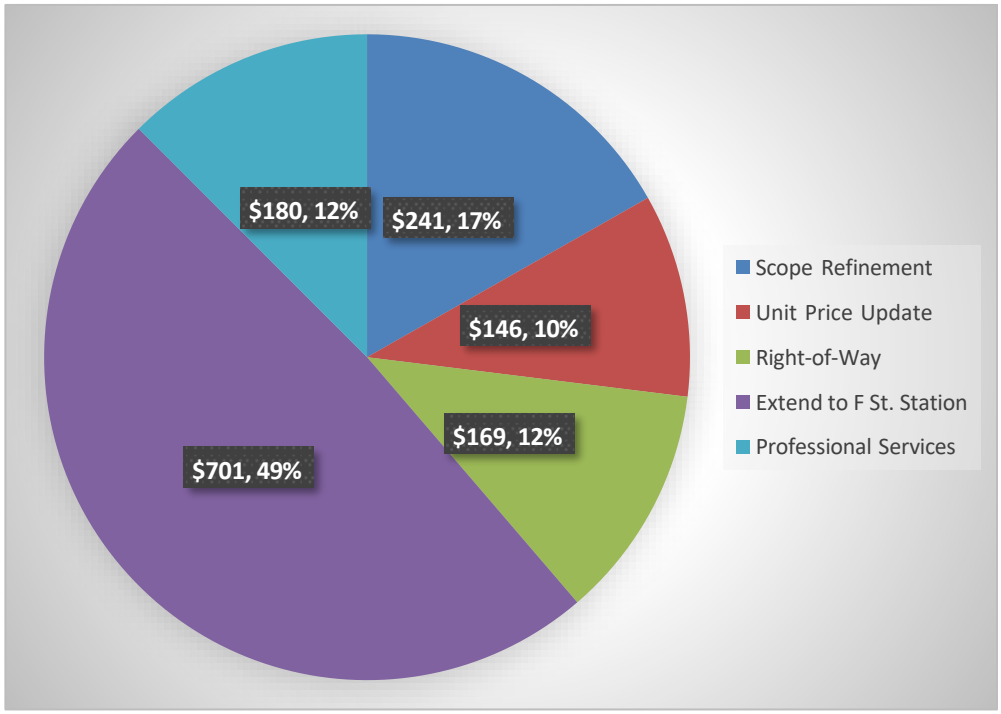
The estimated capital costs of extending the high-speed rail alignment from the CP-4 project terminus at Poplar Avenue south to F St. Station in downtown Bakersfield, including necessary ROW acquisitions, are presented in **Table 15**.

**Table 15:** Bakersfield Extension, Civil and ROW (YOE$ in millions)

| Scope Element | P30 | P50 | P65 | Expenditures 12/31/2023 |
|---|---|---|---|---|
| **Bakersfield Extension** | 2,752 | 3,020 | 3,258 | 14 |

The main cost trends contributing towards the total increase in the capital costs since the release of 2022 Business Plan are shown in **Figure 2**.

**Figure 2** - Bakersfield Extension Cost Trends (Stripped, 2022$ in millions)




The scope of this extension includes construction of a two-track alignment from Poplar Avenue in Shafter to F Street Station in Bakersfield as opposed to stopping at the Interim Terminal Station location north of the F Street Station location as was assumed in the 2022 Business Plan, effectively extending the high-speed rail alignment included in Bakersfield Extension costs by approximately 0.8 miles consisting of a wide viaduct structure. The entirety of the alignment is elevated on fill and Viaduct containing several required overcrossings to span existing UPRR/SJVRR Spurs, State Route highways, and local roadways. No guideway structure is underground for this alignment.

The quantities for this extension were derived from the following baseline documents:

- Fresno to Bakersfield Section Locally Generated Alternative (LGA) Basis of Quantities report dated November 2016 prepared by the Regional Consultant; and
- Alignment Plans for the LGA per the Final Supplemental EIR/EIS, Volume III, as adopted October 2019.

Detailed quantities that were estimated for the civil elements of work in this section are presented in **Table 16**. The major scope elements include the following:

- Several miles of viaduct and bridge structures; and
- Grade separations:
  - Poplar Avenue
  - Fresno Ave
  - Shafter Ave
  - E. Lerdo Hwy
  - Riverside St.
  - Cherry Ave
  - Driver Rd.
  - Zachary Ave
  - Zerker Rd.
  - Verdugo Ln
  - 7th Standard Road
  - Fruitvale Ave
  - Snow Rd
  - Knudsen Dr/SR99/State Rd (Roadways are directly adjacent to SR99)
  - State Rd/Olive Dr @ SR99 Interchange/State Rd (State Rd located at both the North and South of Olive Dr Interchange)
  - State Rd
  - Airport Dr
  - Airport Dr @ SR204 Interchange
  - Riverside Street
  - 34th Street
  - F Street

**Table 16:** Parametric quantities between Poplar Avenue (STA 5880+00) to the end of pocket track (STA 6885+00)

| Description | Unit | QTY |
|---|---|---|
| Elevated Structure – 2 Track (20’ Avg. Pier Ht) | RM | 1.076 |
| Elevated Structure – 2 Track (30’ Avg. Pier Ht) | RM | 1.368 |
| Elevated Structure – 2 Track (60’ Avg. Pier Ht) | RM | 1.149 |
| Elevated Structure – 3 Track at Station – 3 Columns (40’ Avg. Pier | RM | 0.066 |
| Elevated Structure – 4 Track at Station – 2 Columns (40’ Avg. Pier | RM | 0.321 |
| Elevated Structure – 4 Track at Station 4 Columns (40’ Avg. Pier | RM | 0.063 |
| Elevated Structure – 4 Track at Station – 4 Columns (50’ Avg. Pier | RM | 0.199 |
| Elevated Structure – 5 Track at Station – 3 Columns (40’ Avg. Pier | RM | 0.106 |
| Elevated Structure – 5 Track at Station – 3 Columns (50’ Avg. Pier | RM | 0.378 |
| Elevated Structure (LS) – 2 Track (40’ Avg. Pier Ht) | RM | 0.393 |
| Elevated Structure (LS) – 2 Track (50’ Avg. Pier Ht) | RM | 0.496 |
| Elevated Structure (LS) – 2 Track (60’ Avg. Pier Ht) | RM | 0.203 |
| HST Structure Box Culvert – 30’ x 16.5’ Opening – Verdugo Ln | EA | 1.000 |
| HST Structure Box Culvert – 10’ x 10’ Opening | EA | 3.000 |
| Bridge Structure – 3 span concrete structure with 2 Track | RM | 0.047 |
| Bridge Structure – 2 span concrete structure with 2 Track | RM | 0.132 |
| Bridge Structure – 4 span concrete structure with 2 Track | RM | 0.150 |
| Bridge Structure – 2 span precast girder structure with 2 Track | RM | 0.068 |
| Bridge Structure – 2 Track Steel Truss Bridges | RM | 0.313 |
| Concrete Bridge Structure – Single span Simply supported – 2 | RM | 0.091 |

| Description | Unit | QTY |
|---|---|---|
| Bridge Structure – Two Span Steel Plate Girder Structure with 2 Tracks + 1 Future Track for BNSF – Fresno Ave | RM | 0.047 |
| Bridge Structure – Three Span Steel Plate Girder Structure with 2 Tracks + 1 Future Track for BNSF – Shafter Ave | RM | 0.042 |
| Bridge Structure – Two Span Steel Plate Girder Structure with 2 Tracks + 1 Future Track for BNSF – Central Ave | RM | 0.022 |
| Bridge Structure – Two Span Steel Plate Girder Structure with 2 Tracks + 1 Future Track for BNSF – E Lerdo Hwy | RM | 0.047 |
| At-Grade Track-bed in Fill – 1 Track (10’ Avg. Fill Ht) | RM | 0.335 |
| At-Grade Track-bed in Fill – 1 Track (20’ Avg. Fill Ht) | RM | 0.677 |
| At-Grade Track-bed in Fill – 1 Track (30’ Avg. Fill Ht) | RM | 0.580 |
| At-Grade Track-bed in Fill – 2 Track (5’ Avg. Fill Ht-(0’-7’)) BNSF | RM | 0.919 |
| At-Grade Track-bed in Fill – 2 Track (10’ Avg. Fill Ht-(7’-12’)) | RM | 0.189 |
| At-Grade Track-bed in Fill – 2 Track (10’ Avg. Fill Ht-(7’-12’)) BNSF | RM | 0.237 |
| At-Grade Track-bed in Fill – 2 Track (15’ Avg. Fill Ht-(12’-17’)) | RM | 0.189 |
| At-Grade Track-bed in Fill – 2 Track (20’ Avg. Fill Ht-(17’-25’)) | RM | 1.928 |
| At-Grade Track-bed in Fill – 2 Track (30’ Avg. Fill Ht-(25’-35’)) | RM | 8.837 |
| At-Grade Track-bed in Fill – 2 Track (40’ Avg. Fill Ht-(30’-50’)) | RM | 0.518 |
| At-Grade Track-bed in Fill – 5 Track (5’ Avg. Fill Ht-(0’-7’)) BNSF | RM | 1.383 |
| Retained Fill, Walls One Side – 2 Tracks (20’ Avg. Wall Ht) BNSF | RM | 0.492 |
| Retained Fill, Walls One Side – 2 Tracks (30’ Avg. Wall Ht) | RM | 0.826 |
| Retained Fill, Walls One Side – 2 Tracks (30’ Avg. Wall Ht) BNSF | RM | 1.599 |
| Retained Fill, Walls Both Sides – 2 Tracks (30’ Avg. Wall Ht) | RM | 0.008 |
| Ballasted Freight Track – 2 Track | RM | 4.792 |
| Ballasted Freight Track – 3 Track | RM | 1.375 |
| Ballasted Track Relocation – 1 Track (Temporary) | RM | 3.096 |
| Ballasted Track Relocation – 1 Track (Permanent)- Spur | RM | 0.590 |
| Ballasted Turnout (25 MPH) | EA | 20.000 |
| Demolition Allowance, Asphalt Pavement | SY | 151,000.000 |
| Demolition Allowance, Concrete Curb | LF | 20,900.000 |
| Demolition Allowance, Concrete Sidewalk | SY | 10,000.000 |
| Demolition Allowance, Remove Railroad Track | RM | 4.792 |
| Utility Relocation Allowance, Level 4 | RM | 12.420 |
| Utility Relocation Allowance, Level 5 Urban | RM | 3.560 |
| Major Utility Relocation, Aerial Transmission Line | RM | 0.476 |
| Hazardous Material Removal Allowance, Medium | RF | 20.813 |
| Retaining Wall – 1 Wall (6’ Avg. Height) | LF | 190.000 |
| MSE Wall – 1 Wall (12’ Avg. Height) | LF | 1,203.000 |
| MSE Wall – 1 Wall (20’ Avg. Height) | LF | 2,987.000 |
| Retaining Wall – 1 Wall (30’ Avg. Height) | LF | 528.000 |
| MSE Wall – 1 Wall (30’ Avg. Height) | LF | 306.000 |
| Retaining Wall – 1 Wall (40’ Avg. Height) | LF | 414.000 |
| Canal Realignments (45’ x 10’ Trench) | LF | 4,830.000 |
| Canal Realignments (115’ x 10’ Trench) | LF | 6,550.000 |
| Hydraulic Crossing 5’ wide x 5’ deep x 150’ long RCBC | EA | 31.000 |
| Roadway Overcrossing – 7th Standard Interchange | EA | 1.000 |
| Roadway Overcrossing – Poplar Ave | EA | 1.000 |
| Roadway Overcrossing – Riverside St | EA | 1.000 |

| Description | Unit | QTY |
|---|---|---|
| Roadway Overcrossing HSR – Pedestrian Overcrossing – Carrier | EA | 1.000 |
| BNSF Signaling | LS | 1.000 |

### 5.2.4 Stations

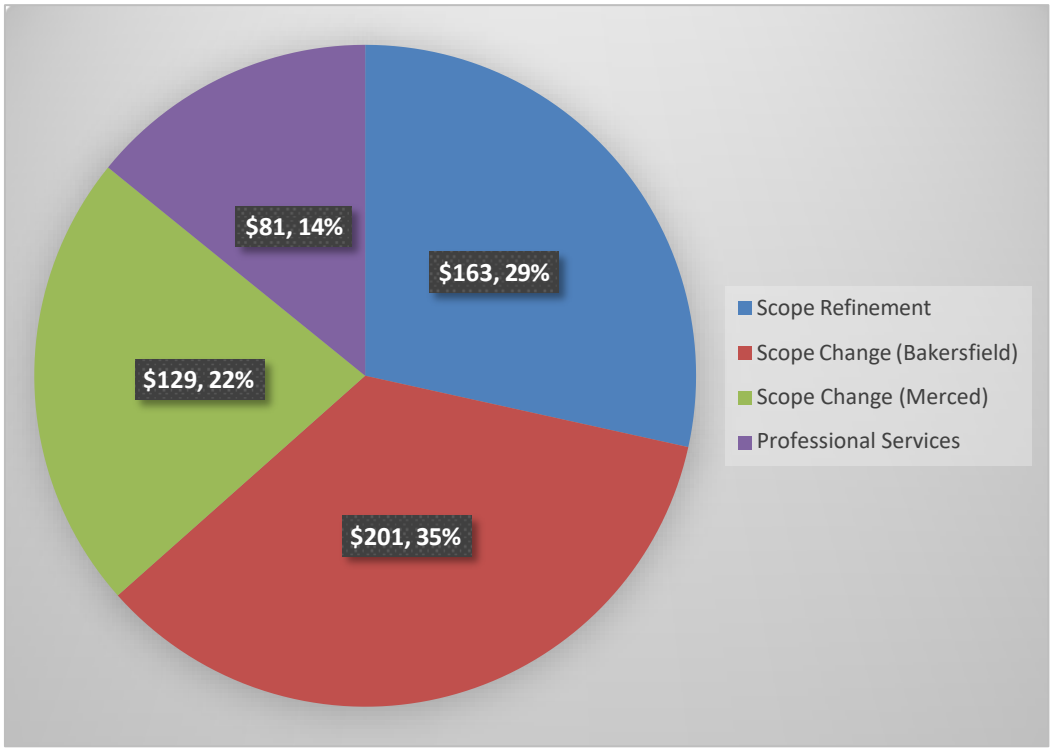
The estimated capital costs of the four high-speed rail stations in the Central Valley, including trackside and site elements, are presented in **Table 17**. The four stations reflected in this total estimate are Merced Station, Fresno Station, Kings Tulare Station, and Bakersfield Station.

**Table 17:** Central Valley Stations (YOE$ in millions)

| Scope Element | P30 | P50 | P65 | Expenditures 12/31/2023 |
|---|---|---|---|---|
| **Stations** | 1,044 | 1,147 | 1,237 | 11 |

The main cost trends contributing towards the total increase in the capital cost estimates since the release of 2022 Business Plan are shown in **Figure 3**. Scope refinements included in changes in the stations programming including the approved changes in the high-speed rail alignment that changed the Kings Tulare Station to an aerial station. Scope changes include actual revisions in both station locations and relations to grade. The prior Interim Terminal Station at Bakersfield has now been replaced with the ultimate F Street Station in downtown Bakersfield, and the at-grade station at Martin Luther King Way in Merced has been moved further north to R Street with the scope changed to an aerial multi-modal station.

**Figure 3** -Central Valley Stations Cost Trends (Stripped, 2022$ in millions)



The capital costs of the four stations in the Central Valley presented in the 2022 Business Plan were estimated based on minimal initial investment in support of Merced to Bakersfield early operating segment with the balance of the station improvements constructed with Phase 1 implementation. The updated Merced to Bakersfield station estimates now incorporate full buildout of the stations including platforms, canopies, canopy lighting, communications systems, photovoltaic arrays, OCS trusses, intrusion protection, vertical circulation, concourses, utilities, signage, site paving and landscaping, site civil infrastructure, and train crew spaces.

The following documents were utilized to create anticipated scope and quantities for each station:

- Merced-Fresno Final EIR EIS Volume III Station Plans;
- Fresno-Bakersfield Final EIR EIS April 2014 Volume III Section E Station Plans;
- Fresno-Bakersfield 23 0038 Kings Tulare Station (Kings Tulare Station Site Plan Variation Reexamination);
- Fresno to Bakersfield Locally Generated Alternative Final Supplemental Impact Report Volume III Station Plans;
- Prototypical Station Indicative Drawings;
- Station Prototypical Design Information; and
- Station Access Needs Calculation.

**Table 18:** Central Valley Stations Quantities Summary

| | Merced | Fresno | Kings Tulare | Bakersfield |
|---|---|---|---|---|
| **Pedestrian Overcrossing Elements** | | | | |
| Canopy (sf) | 28,278 | 33,300 | - | - |
| Pedestrian Overcrossing Structure (sf) | 4,900 | 8,820 | - | - |
| **Trackside Elements** | | | | |
| Platform Viaduct Structure (sf) | - | - | 86,220 | - |
| Parking Deck Structure (sf) | 216,558 | - | - | 392,000 |
| Canopy (sf) | 327,148 | 79,084 | 81,204 | 362,240 |
| Platform (sf) | 48,000 | 40,000 | 40,000 | 40,000 |
| Platform Access Concourse (sf) | 10,080 | 10,080 | 10,080 | 10,080 |
| **Site Elements (sf)** | 110,257 | 92,186 | 123,611 | 169,000 |

### *5.2.5 Track and Systems balance (including CVS second track)*

The estimated capital costs to install the high-speed rail mainline tracks, traction power and overhead contact system, and train control and communication systems for Merced and Bakersfield extensions and CVS second track are presented in **Table 19**.

**Table 19:** Track and Systems (YOE$ in millions)

| Scope Element | P30 | P50 | P65 | Expenditures 12/31/2023 |
|---|---|---|---|---|
| **Track and Systems** | 2,569 | 2,810 | 3,025 | - |

Track and system costs, including the costs in **Table 19** and the Track and Systems line item costs in **Table 11** were estimated from Merced Station to Madera (37 miles), Madera to Poplar Avenue (119 miles), and Poplar Avenue to Bakersfield Station (19 miles). The updated quantities for the track and systems were based on the Request for Proposal (RFP) including issued addenda during Authority's procurement of Track and Systems design-build contract which is now being restructured[2]. The Authority received valuable feedback from the industry during the active procurement period and reflected it in the updated quantities and pricing to represent the expected cost of the track and systems elements more accurately in Merced to Bakersfield segment. The updated individual track and systems quantities were assembled into a complete cost for a 1 Route Mile for each different track support structure type (at grade, trench, viaduct), and then parametrically applied to the overall length and quantities of each type in each segment following the format of bid forms included in the RFP as presented in **Table 20** below.

**Table 20:** Track and Systems Quantities Summary

| Sub-Element | Description | Segments 1AB Quantity (1AB Q) | Segments 2AB Quantity (2AB Q) | Segments 3AB Quantity (3AB Q) | Unit |
|---|---|---|---|---|---|
| 2.1.1 | At grade or on embankment | 177 | 20 | 53 | km |
| 2.1.2 | In trench >0.5 km | 3 | 0 | 2 | km |
| 2.1.3 | In tunnel >0.5 km | 0 | 0 | 0 | km |
| 2.1.4 | On aerial structure | 11 | 11 | 5 | km |
| 2.2.1 | Traction Power Substation (34.5 kV primary) | 5 | 0 | 1 | each |
| 2.2.2 | Paralleling Station | 17 | 3 | 6 | each |
| 2.2.3 | Switching Station | 4 | 1 | 1 | each |
| 2.2.4 | Communication Station | 19 | 2 | 5 | each |
| | Four-quadrant gates for at-grade crossings | 0 | 0 | 0 | each |
| 2.3.2 | Derailment containment | 45,060 | 5,182 | 0 | m |
| 2.3.3 | Segment 1A Insurance (GP 37.1) | 1 | 0 | 0 | each |
| 2.4.1 | Mainline interlocking | | | | |
| a. | Universal Interlocking with Double Crossover (not including c.) | 7 | 1 | 2 | each |
| b. | Single Crossover (not including c.) | 4 | 0 | 0 | each |

[2] California High-Speed Rail Authority to Restructure Track and Systems Procurement

| Sub-Element | Description | Segments 1AB Quantity (1AB Q) | Segments 2AB Quantity (2AB Q) | Segments 3AB Quantity (3AB Q) | Unit |
|---|---|---|---|---|---|
| c. | Very High-Speed Turnouts (142 MpH diversion speed) | 0 | 0 | 0 | each |
| 2.4.2 | Station tracks and refuge tracks | 13 | 4 | 2 | km |
| 2.4.3 | | | | | |
| a. | Turnout on mainline with Swing nose (not including c.) | 12 | 4 | 2 | each |
| b. | Turnout on station and refuge tracks with fixed nose (not including c.) | 6 | 2 | 0 | each |
| c. | Third Party track connection | 1 | 0 | 0 | each |
| 2.5.1 | Maintenance of Way Facility | 1 | 0 | 0 | each |
| 2.5.2 | Maintenance of Way Siding | 1 | 0 | 0 | each |
| 2.5.3 | Operations Control Center OCC/TCF | | | | |
| a. | Operations Control Center OCC/TCF initial (Schedule 17) | 1 | 0 | 0 | lot |
| b. | Operations Control Center OCC/TCF upgrade (Schedule 17) | 0 | 0 | 0 | lot |

Trainset costs were estimated using analogy method by assessing 16 similar high-speed trainset contracts procured globally from 2004 through 2016, adjusting for escalation and currency conversions. An allowance for conformance with US regulations and Buy America requirements was also added. The estimate assumed procurement of two prototype trainsets and four production trainsets to support Merced to Bakersfield initial operations. The estimated costs for the 6 trainsets are shown in **Table 21**.

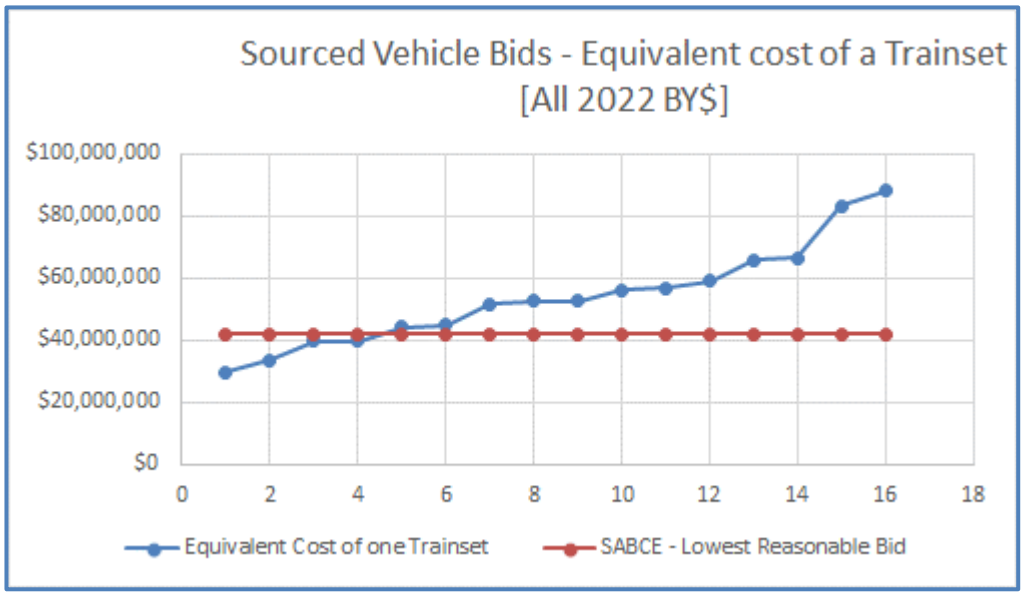
**Table 21:** Trainsets (YOE$ in millions)

| Scope Element | P30 | P50 | P65 | Expenditures 12/31/2023 |
|---|---|---|---|---|
| **Trainsets (6 total)** | 465 | 516 | 561 | - |

The trainsets scope includes design, manufacture, delivery, testing, and certification of the 6 trainsets. Any operating and maintenance costs during the service period and any associated facilities (e.g. rail operations center, admin offices, etc.) are not included in the scope.

The adopted risk methodology follows the FRA Top-Down risk modelling approach. Calculation of the SABCE for the Trainsets was arrived at by taking the mid-way value between the lowest bid and the average of all the bids considered to be a reasonable estimate for the Stripped and Adjusted Base Cost [SABCE]. The Top-Down model uses the SABCE inflated (YOE) values as the starting point for the addition of risk through the application of the BETA factors. **Figure 4** below shows the range of the normalized sourced bids and the SABCE.

**Figure 4** -Trainset SABCE




The SABCE includes an adjustment to remove transferred risk included in the sourced bids through the procurement process, given, at an early stage of design / Pre-Bid the Top-Down model BETA factors account for all risk (retained and transferred).The SABCE approach requires all latent and patent contingency be removed prior to the application of BETA accepting that as the projects move through procurement transferred risk is absorbed in bid prices.

The SABCE also includes further adjustments to account for FRA Tier III safety compliance and Buy America adherence. FRA Tier III compliance allows high speed trains to utilize existing infrastructure.

The Tier III compliant trainsets can operate over shared corridors in Northern California at conventional speeds and as fast as 220mph in areas of exclusive rights-of-way, provided with grade separation structures.

These adjustments resulted in a cost for a trainset before allowance for setting up supply chain and other non-recurrent costs to meet the Buy America compliance.

Non-recurring costs are only added to the prototype trainsets 1 and 2 and will not impact the estimated cost of the remaining 4 trainsets needed for the initial revenue service. It is also estimated that this non-recurring cost will not impact further revenue service vehicles' costs for Phase 1 as it is assumed the manufacturing supply chain, once established, will continue to be utilized. Therefore, Trainsets 1 and 2 cost estimate includes 100% of these non-recurring setup costs which allows for a Buy America compliance with an estimated 60% content compliance waiver. The risk on this SABCE trainset 1 and 2 accounts for a less Buy America waiver and accounts for market risk.

The sourced bids were all normalized to a common base date of July 1 2022 following which adjustments as outlined above were made to form the SABCE (BY$). Finally these stripped and adjusted trainset unit costs were subjected to escalation to the targeted award / NTP of 1Q 2024 and then escalated through manufacturing, delivery, and testing through the start of revenue service using the inflation factor assumptions in **Table 10** based on a front-loaded cash flow expenditure profile in-line with expected manufacturing norms as shown below in **Table 22**.

**Table 22:** Trainsets Cash Expenditures Profile

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 |
|---|---|---|---|---|---|---|---|---|---|
| Protype Assumed Cash Flow | 27% | 35% | 25% | 7% | 4% | 2% | | | 100% |
| Revenue Vehicle Assumed Cash Flow | | 27% | 35% | 25% | 7% | 4% | 2% | | 100% |

The estimate risk model results for procurement of the two prototype trainsets and four production trainsets to support Merced to Bakersfield initial operations are shown in **Table 23**.

**Table 23:** Trainsets (YOE$ in millions)

| Level 4 | SABCE | SABCE | P30 | P50 | P65 |
|---|---|---|---|---|---|
| | BY$2022 | YOE | YOE | YOE | YOE |
| Two initial trainsets | $ 172,249,906 | $ 195,599,961 | $ 239,802,283 | $ 266,001,552 | $ 289,386,754 |
| Each initial trainset | $ 86,124,953 | $ 97,799,980 | $ 119,901,141 | $ 133,000,776 | $ 144,693,377 |
| | | | | | |
| 4 Revenue service sets | $ 157,637,444 | $ 183,871,459 | $ 225,423,336 | $ 250,051,654 | $ 272,034,640 |
| Each Revenue service set | $ 39,409,361 | $ 45,967,865 | $ 56,355,834 | $ 62,512,913 | $ 68,008,660 |
| | | | | | |
| Trainsets (6#) | $ 329,887,351 | $ 379,471,420 | $ 465,225,619 | $ 516,053,206 | $ 561,421,393 |
| | | | | | |

### 5.2.6 Maintenance Facility

The initial Heavy Maintenance Facility in the Central Valley was assumed to be a minimal investment included under the Interim Program Baseline budget presented in the 2022 Business Plan. The scope of maintenance activities that would be required during the initial high-speed rail operations between Merced and Bakersfield has been expanded to a facility similar in scope to a Light Maintenance Facility essentially transferring these costs from the Heavy Maintenance Facility balance costs included in the Phase 1 budget. The updated initial maintenance facility cost in the Central Valley was based on making an analogy to the scope and cost of the Light Maintenance Facility proposed in Lancaster as part of the Bakersfield to Palmdale section and presented in the Bakersfield to Palmdale Draft Capital Cost Estimate Report[3]. In addition, the estimated budget for the initial maintenance facility in the Central Valley was increased to account for the cost of a trainset certification facility (TCF) that will need to be implemented during the testing and commissioning period as well as an allowance for a Driver Simulator equipment, as shown in **Table 24**.

**Table 24:** Maintenance Facility in Central Valley (YOE$ in millions)

| Scope Element | P30 | P50 | P65 | Expenditures 12/31/2023 |
|---|---|---|---|---|
| **Heavy Maintenance Facility*** | 326 | 364 | 399 | - |
| **Driver Simulator** | 16 | 18 | 19 | - |
| **Sub-total** | 342 | 382 | 418 | - |
| **Trainset Certification Facility**** | 63 | 71 | 78 | - |

*The Heavy Maintenance facility is budgeted as the Light Maintenance Facility (also referred to as the Initial Maintenance Facility), for support during the initial proof of service phase and then ultimately enhanced into the HMF.

**Trainset Certification Facility costs are included in the Track and Systems estimate **Table 11**

### 5.2.7 PG&E and Solar Power Generation

Traction Power will be supplied via a combination of grid supplies provided by PGE and Battery Storage/Solar Power Facilities at each of the Traction Power feeder sites. Estimates were obtained from PGE and specialist renewable energy companies for the scope requirements and feeder sites for the CHSR project. All TPSS have been identified and have received environmental clearance. Right-of-Way to host the solar PV arrays, Battery Electric Storage (BESS) and TPSS has already been acquired at 3 of the 4 TPSS (12, 10, 9). The fourth TPSS location (TPSS 7) is north of the project limits for the 119 and has yet to be acquired,

**Figure 5** below shows the location of the proposed TPSS sites, and **Figure 6** below shows the proposed Traction Power and Battery Storage/Solar Power generation configuration outline.

PG&E scope includes:

- The scope of the PG&E work is for the 171-miles between Merced and Bakersfield and includes Traction Power Supply Substations 7, 9, 10 and 12; and
- PG&E will provide through a separate contract direct with the Authority 115/230 kV system to provide electrical connections to CHSRA traction power substations (TPSS).

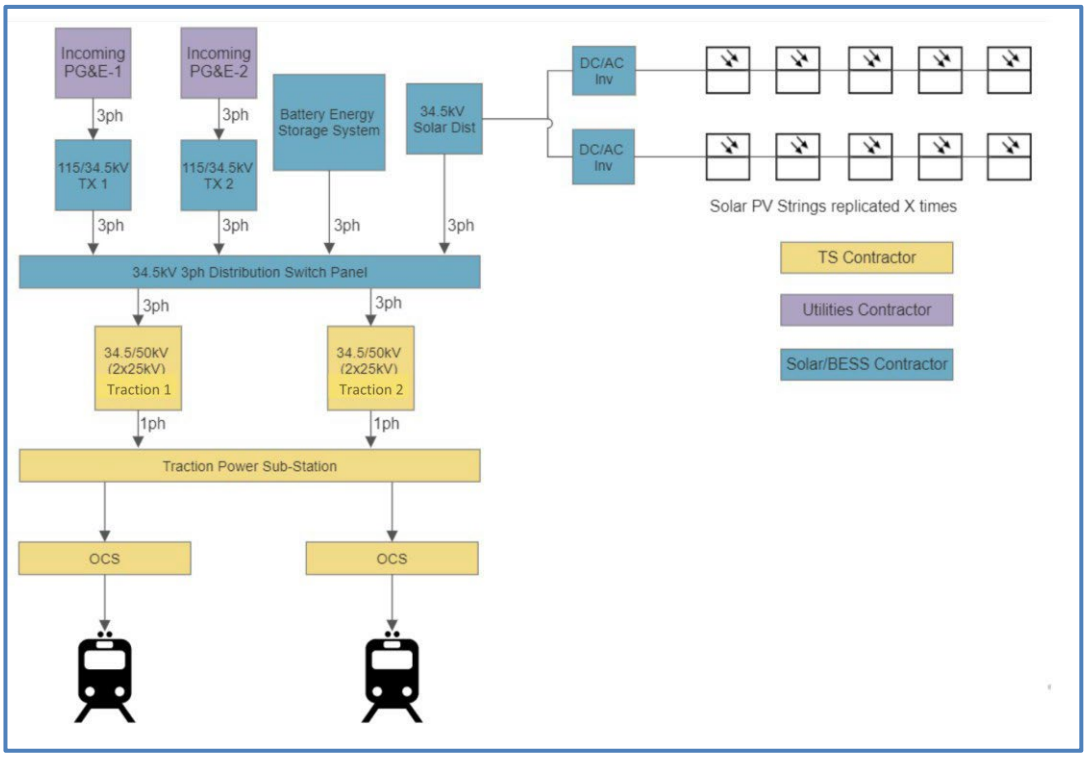
[3] https://hsr.ca.gov/wp-ontent/uploads/docs/programs/bakersfield-palmdale/BP_Draft_EIRS_Vol_2_App_6-B_PEPD_Draft_Capital_Cost_Estimate_Report.pdf

Battery Storage/Solar Power scope includes:

- Delivery of Solar photovoltaic arrays (Solar PV), Battery electric storage units (BESS), and Transmission interconnection equipment to supply renewable energy for the 171-mile Merced to Bakersfield operating segment;
- 4 traction power substations (TPSS) required to supply traction power, each of which is connected to PG&E assets;
- Solar PV, BESS, and transmission interconnection equipment are required for each of the 4 TPSS locations. This project also includes approximately 20 miles of cable to connect the solar PV arrays to the BESS which will be sited at each TPSS.

**Figure 5** - TPSS Traction Power location site plan

**Figure 6** - PGE Traction Power and Solar Power Generation Configuration




Traction Power has adopted the Top-Down approach to risk for PGE and Battery Storage/Solar Generation scope. The PGE and Battery Storage/Solar Generation estimates were adjusted to reflect the minimum required to support testing and the start of initial Revenue Service. The balance has been further inflated and included as a post start of revenue service Year 5 build-out and is not included in the PUR 23 overall estimate. **Table 25** provides minimum and complete scope costing at 2022 $.

**Table 25:** PG&E and Battery Storage/Solar Generation Minimum Product Costs [2022$ in millions] Excl Risk

| | Minimum Product | | | Complete Scope | | |
|---|---|---|---|---|---|---|
| | **Test Track 2028** | **Revenue Operations 2030 incremental cost** | **Minimum Product Total 2030 Revenue Operations** | **Test Track 2028** | **Revenue Operations 2030 incremental cost** | **Complete scope Total 2030 Revenue Operations** |
| PG&E Connections | 99 | 67 | 168 | 133 | 90 | 224 |
| Solar & Battery | 29 | 29 | 59 | 92 | 80 | 171 |
| **Totals (rounded)** | **128** | **96** | **227** | **225** | **170** | **395** |

Scope is for the Merced to Bakersfield 171mile estimate (TPSS 7, 9, 10 & 12). The construction costs are based on PG&E estimating methodology, but PG&E will only undertake the physical Substation work for TPSS 7, with the remainder (TPSS7 transmission line, all of TPSS 9, 10 & 12) undertaken by a Contractor engaged by the Authority separately.

The PG&E oversight costs are included in the estimated figures, with the Authority responsible for all Contract Management. Costs supplied by PGE are in 2020 dollars which have been inflated to 2Q 2022 BY$.

For the total construction estimates the PGE price has risk items added, either at 25% or a fixed dollar value if there are risks that PG&E understand well. This subtotal then has a 20% contingency added resulting in the total values provided by PGE as below. This effectively means that the risk/contingency pot is approximately 50% of the unburdened cost. The oversight cost is fixed at 15% of the construction cost. Material costs are estimated at 30% of total construction cost. This base estimate has been stripped of the PGE added (50%) contingency described above to form a SABCE.

Battery Storage are located at each of the TPSS sub-station sites; TPSS Sites 7, 9, 10, and 12. Estimates for the Battery Storage/Solar Generation scope described above are at BY$ 2022 and originate from specialist renewable energy suppliers.

The PGE estimate has been updated to 2022 BY$, and then the PGE and Battery Storage/Solar Generation estimates have had inflation applied through targeted NTP and construction using the expenditure profile in **Table 26** below to form the SABCE YOE.

**Table 26:** Expenditure profile assumed for PGE traction power inflation

| 2024 | 2025 | 2026 | 2027 | 2028 | 2029 |
|---|---|---|---|---|---|
| 0% | 0% | 15% | 40% | 40% | 5% |

Standard recommended BETA risk profiles have been applied to the SABCE YOE based on a 15% design development status. PGE stated their estimate [before contingency] was the minimum [i.e. there was no range around the estimate suggesting a lower potential starting point before contingency]. The PGE estimate had been created from past project data and made allowances for specific CHSR site conditions.

There will also be a separate contract placed with PGE for project and construction management support of the design and construction to be awarded separately to PGE approved contractors. Estimates have been sourced through PGE and are on the same basis as the hard construction cost estimates.

**Table 27:** Summary of Traction Power costs and corresponding risk assessment

| Rail Scope Component | Estimate | Estimate YOE | P30 | P50 | P65 |
|---|---|---|---|---|---|
| PGE Traction Power (4 sites) | 186 | 225 | 267 | 292 | 314 |
| PGE PCM Contract to manage Traction Power design and installations | 29 | 35 | 41 | 45 | 48 |
| SOLAR facilities | 60 | 72 | 86 | 93 | 101 |
| Traction Power | 275 | 332 | 394 | 430 | 463 |

### 5.2.8 Program Wide Support

Program Wide Support is a level of effort element that extends to the period of performance finish date of the work being supported. Program Wide Support includes Program Management, Legal, and Non-CP related Resource Agency, Risk Management, and Financial Advisor. The program wide support for the existing Baseline previously ended in 2026, which was not adequate to support the remaining systems work in the PUR2023. This estimate extends program wide support to the updated completion date of 12/31/2030 for the 171-mile initial operating segment from Merced to Bakersfield.

### 5.2.9 Northern California

The capital cost of the San Francisco to San José section was updated to reflect the Authority's Board of Directors approval of the final EIR/EIS for this section and record PEPD design. The capital costs for this section presented in the approved Final EIR/EIS document were adjusted to remove overlap with the San José to Merced section costs and included a $550 million contribution towards Downtown Rail Extension (DTX) Phase 1I Project. Refer to San Francisco to San José Section PEPD Record Set Capital Cost Estimate Report[4] for more detail. **Table 28** presents major scope elements in Northern California by each section:

**Table 28:** Northern California Summary of Major Scope Elements

| Section | Approx. Length (miles) | Viaducts & Bridges (miles) | Tunnels & Trenches (miles) | HSR Stations (each) | Grade Separations* (each) | Maintenance Facilities** (each) |
|---|---|---|---|---|---|---|
| **San Francisco to San Jose** | 43 | - | - | 2 | 41* | 1 LMF |
| **San Jose to Gilroy** | 39 | 3.3 | - | 2 | 32* | 1 MOWF |
| **Gilroy to Carlucci Road** | 49 | 16.5 | 15.2 | - | 7 | - |
| **Central Valley Wye Balance** | 25 | 3.2 | - | - | 8 | - |

** Includes alterations of existing grade separations and at grade crossings*
***Includes trainset maintenance and maintenance of way facilities*

Other than the changes described above, the capital cost estimates for San José to Merced, Central Valley Balance, and Preliminary Design budget for Northern California remained unchanged from the costs presented in the 2022 Business Plan Basis of Estimate Report[5], as shown in **Table 29**.

4 https://hsr.ca.gov/wp-content/uploads/2022/05/Final_EIRS_FJ_V2-49_APP_6-A_Capital_Cost_Estimate_Report.pdf

5 https://hsr.ca.gov/wp-content/uploads/2022/05/2022-Business-Plan-Basis-of-Estimate-Final-with-Signoff-A11Y.pdf

**Table 29:** Northern California Capital Costs (YOE$ in millions)

| Scope Element | Low | Base | High | Expenditures 12/31/2023 |
|---|---|---|---|---|
| **San Francisco to San Jose** | 3,936 | 4,967 | 6,407 | - |
| **San Jose to Gilroy** | 4,075 | 6,020 | 8,733 | - |
| **Gilroy to Carlucci Road** | 10,316 | 13,627 | 16,762 | - |
| **Central Valley Wye Balance** | 1,842 | 2,240 | 2,601 | - |
| **Preliminary Design** | 213 | 213 | 213 | - |
| **Bookend Investments** | 798 | 798 | 798 | 707 |
| Total: | 21,180 | 27,865 | 35,514 | 707 |

The $798 million bookend investment in Northern California was previously included in the Authority's Baseline Budget and has now been presented separately in the 2023 Project Update Report as part of the Northern California capital cost. Refer to Appendixes M through P for the detailed cost breakdowns by SCC minor categories.

### *5.2.10 Southern California*

The capital costs in Southern California sections remained unchanged from the costs presented in the 2022 Business Plan Basis of Estimate Report[5], as shown in **Table 30**, except for the Bakersfield to Palmdale section. The capital costs in the Bakersfield to Palmdale section were reduced by $1.2 billion to reflect the transfer of high-speed rail guideway scope between the previously assumed Interim Terminal Station and F Street Station in Bakersfield. This scope is now being accounted for in the updated Bakersfield Extension cost estimate.

**Table 30:** Southern California Capital Costs (YOE$ in millions)

| Scope Element | Low | Base | High | Expenditures 12/31/2023 |
|---|---|---|---|---|
| **Bakersfield to Palmdale** | 13,712 | 17,140 | 20,740 | - |
| **Palmdale to Burbank** | 12,635 | 16,775 | 24,428 | - |
| **Burbank to Los Angeles** | 2,201 | 2,935 | 3,405 | - |
| **Los Angeles to Anaheim** | 2,478 | 2,918 | 3,352 | - |
| **Preliminary Design** | 382 | 382 | 382 | - |
| **Bookend Investments** | 500 | 500 | 500 | 38 |
| Total: | 31,908 | 40,650 | 52,807 | 38 |

The $500 million bookend investments in Southern California were previously included in the Authority's Baseline budget and has been presented separately in the 2023 Project Update Report as part of the Southern California capital cost. Refer to Appendixes Q through T for the detailed cost breakdowns by SCC minor categories. **Table 31** presents major scope elements in the Southern California by each section:

**Table 31:** Southern California Summary of Major Scope Elements

| Section | Approx. Length (miles) | Viaducts & Bridges (miles) | Tunnels & Trenches (miles) | HSR Stations (each) | Grade Crossings* (each) | Maintenance Facilities** (each) |
|---|---|---|---|---|---|---|
| **Bakersfield to Palmdale** | 78 | 16 | 10.8 | - | 12 | 2 |
| **Palmdale to Burbank** | 41 | 1.2 | 27.2 | 2 | 8 | - |
| **Burbank to Los Angeles** | 14 | - | 2.6 | - | 14 | - |
| **Los Angeles to Anaheim** | 31 | 2.9 | 0.7 | 2 | 10 | - |

** May include changes to existing grade separations, the addition of new grade separations or other improvements of at-grade crossings.*
***Includes trainset (heavy and light) maintenance and maintenance of way facilities*

**N.B.** Environmental clearance for two Southern California project sections is in progress. The 2023 PUR carried forward assumptions from 2017 and continues to provide the basis for assumptions and estimates, even though some changes may have subsequently been proposed. When environmental certification is complete, those decisions and

### *5.2.11 Trainsets Balance*

The capital cost estimates to acquire the balance of the high-speed trainsets (66 trainsets) required to operate the full Phase 1 service are presented in **Table 32** and are based on the cost estimates presented in the 2022 Business Plan Basis of Estimate Report[6].

**Table 32:** Trainsets Balance (YOE$ in millions)

| Scope Element | Low | Base | High | Expenditures 12/31/2023 |
|---|---|---|---|---|
| **Trainsets Balance** | 4,161 | 4,643 | 5,084 | - |

### *5.2.12 Heavy Maintenance Facility Balance*

The initial Maintenance Facility constructed in Central Valley in support of Merced to Bakersfield service will need to be expanded into the ultimate Heavy Maintenance Facility after the first 5 years of operations. The capital costs to implement the balance of the Heavy Maintenance Facility in Central Valley are presented in **Table 33** and are based on the Heavy Maintenance estimate included in the 2022 Business Plan Capital Cost Basis of Estimate Report reduced by the cost that has been transferred to the initial maintenance facility in support of Merced to Bakersfield initial operations.

**Table 33:** Maintenance Facility Balance (YOE$ in millions)

| Scope Element | Low | Base | High | Expenditures 12/31/2023 |
|---|---|---|---|---|
| **Heavy Maintenance Facility Balance** | 248 | 275 | 301 | - |

### 5.2.13 Solar Traction Power Generation Balance

As described above, PGE Power and Solar Power Generation is included in the PUR 23 sufficient only to supporting testing and start of initial revenue service operations through to Year 5 revenue service. The PUR 23 includes an estimate of cost to complete the PGE Power and Solar Power Generation balance to support full-service operations from Year 5 onwards. The full build out assumes a design and construction period starting in 2032 to be complete by 2035.

**Table 34** below show the estimated build out costs for PGE Traction Power and Solar Generation.

**Table 34:** Traction Power Build Out Year 5 costs

| Traction Power Build Out Year 5 Operations | Estimate | YOE Estimate | Low | Base | High |
|---|---|---|---|---|---|
| Traction Power Build-Out | 143 | 194 | 231 | 252 | 272 |
| PG&E | 33 | 45 | 53 | 58 | 63 |
| Solar Generation | 109 | 149 | 166 | 184 | 202 |
| | | | | | |

6 https://hsr.ca.gov/wp-content/uploads/2022/05/2022-Business-Plan-Basis-of-Estimate-Final-with-Signoff-A11Y.pdf

# APPENDIX A: TECHNICAL BASELINE DOCUMENTS

| Geographic Segment | Baseline Document |
|---|---|
| San Francisco to San Jose | Record PEPD, November 2021 |
| San Jose to Gilroy | Record PEPD, March 2019 |
| Gilroy to Carlucci Rd. | Record PEPD, March 2019 |
| Merced to Central Valley Wye | 15% Design Submittal, Record Set, July 2011<br>Merced Station Relocation Re-examination, In-progress 15% Design Submittal |
| Central Valley Wye - Legs 1 (Ranch Rd. to Leg 2) | 15% Design Submittal, Record Set, August 2016 |
| Central Valley Wye - Leg 2 (Carlucci Rd. to Madera) | 15% Design Submittal, Record Set, August 2016 |
| Madera to Poplar Rd. (Civil) | CP1, CP2-3, CP4, SR99 - Project Estimates at Completion |
| Madera to Poplar Ave. (Balance) | Merced – Fresno 15% Design Submittal, Record Set, July 2011<br>Fresno – Bakersfield 15% Design Submittal, Record Set, January 2014 |
| Poplar Rd. to Bakersfield | Fresno – Bakersfield Locally Generated Alternative, Record Set PEPD Submission, November 2016 |
| Central Valley Stations | In-Progress 30% Design (canopies)<br>Merced – Fresno Final EIR/EIS Volume III Station Plans<br>Fresno – Bakersfield Final EIR/EIS April 2014 Volume III Section E Station Plans<br>Fresno – Bakersfield 23 0038 Kings Tulare Station (Kings Tulare Station Site Plan Variation Re-examination)<br>Fresno – Bakersfield Locally Generated Alternative FSEIR Volume III Station Plans |
| Bakersfield to Palmdale | Revised Record PEPD Submittal (CCNM Design Option), October 2020; Record of Decision Approved |
| Palmdale to Burbank | Draft PEDP, February 2019 |
| Burbank to Los Angeles | PEPD Record Set, April 2021; Record of Decision Approved |
| Los Angeles to Anaheim | PEPD Record Set, March 2018 |
| Heavy Maintenance Facility | Conceptual design reflected in 2018 Business Plan estimate. |

# APPENDIX B: APPLIED CONTINGENCIES (OUTSIDE OF CENTRAL VALLEY PROJECTS)

| Categories for Detailed Capital Cost Budget | | Applied Contingency |
|---|---|---|
| **10 Track Structures and Track** | | |
| 10.01 | Track structure: Viaduct | 20.0% |
| 10.02 | Track structure: Major/Movable bridge | 20.0% |
| 10.03 | Track structure: Undergrade Bridges | — |
| 10.04 | Track structure: Culverts and drainage structures | 19.0% |
| 10.05 | Track structure: Cut and Fill (> 4' height/depth) | 25.0% |
| 10.06 | Track structure: At-grade (grading and subgrade stabilization) | 19.0% |
| 10.07 | Track structure: Tunnel | 31.0% |
| 10.08 | Track structure: Retaining walls and systems | 20.0% |
| 10.09 | Track new construction: Conventional ballasted | 11.0% |
| 10.10 | Track new construction: Non-ballasted | 11.0% |
| 10.11 | Track rehabilitation: Ballast and surfacing | 11.0% |
| 10.12 | Track rehabilitation: Ditching and drainage | — |
| 10.13 | Track rehabilitation: Component replacement (rail, ties, etc.) | — |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 11.0% |
| 10.15 | Track: Major interlockings | — |
| 10.16 | Track: Switch heaters (with power and control) | — |
| 10.17 | Track: Vibration and noise dampening | — |
| 10.18 | Other linear structures including fencing, sound walls | 15.0% |
| **20 Stations, Terminals, Intermodal** | | |
| 20.01 | Station buildings: Intercity passenger rail only | 21.0% |
| 20.02 | Station buildings: Joint use (commuter rail, intercity bus) | 21.0% |
| 20.03 | Platforms | — |
| 20.04 | Elevators, escalators | — |
| 20.05 | Joint commercial development | — |
| 20.06 | Pedestrian / bike access and accommodation, landscaping, parking lots | 21.0% |
| 20.07 | Automobile, bus, van access ways, including roads | 21.0% |
| 20.08 | Fare collection systems and equipment | — |
| 20.09 | Station security | — |

| Categories for Detailed Capital Cost Budget | | Applied Contingency |
|---|---|---|
| **30 Support Facilities: Yards, Shops, Admin. Buildings** | | |
| 30.01 | Administration building: Office, sales, storage, revenue counting | — |
| 30.02 | Light maintenance facility | 21.0% |
| 30.03 | Heavy maintenance facility | 21.0% |
| 30.04 | Storage or maintenance-of-way building/bases | 21.0% |
| 30.05 | Yard and yard track | 20.0% |
| **40 Sitework, Right of Way, Land, Existing Improvements** | | |
| 40.01 | Demolition, clearing, site preparation | 21.0% |
| 40.02 | Site utilities, utility relocation | 29.0% |
| 40.03 | Hazardous material, contaminated soil removal/mitigation | 45.0% |
| 40.04 | Environmental mitigation: wetlands, historic/archeology, parks | 48.0% |
| 40.05 | Site structures including retaining walls, sound walls | 21.0% |
| 40.06 | Temporary facilities and other indirect costs during construction | 19.0% |
| 40.07 | Purchase or lease of real estate | 26.0% |
| 40.08 | Highway/pedestrian overpass/grade separations | 25.0% |
| 40.09 | Relocation of existing households and businesses | — |
| **50 Communications & Signaling** | | |
| 50.01 | Wayside signaling equipment | 11.0% |
| 50.02 | Signal power access and distribution | 11.0% |
| 50.03 | On-board signaling equipment | 11.0% |
| 50.04 | Traffic control and dispatching systems | 11.0% |
| 50.05 | Communications | 11.0% |
| 50.06 | Grade crossing protection | 11.0% |
| 50.07 | Hazard detectors: dragging equipment high water, slide, etc. | 11.0% |
| 50.08 | Station train approach warning system | 11.0% |
| **60 Electric Traction** | | |
| 60.01 | Traction power transmission: High voltage | 11.0% |
| 60.02 | Traction power supply: Substations | 11.0% |
| 60.03 | Traction power distribution: Catenary and third rail | 11.0% |
| 60.04 | Traction power control | 11.0% |
| **70 Vehicles** | | |
| 70.02 | Vehicle acquisition: Electric Multiple Unit | 20.0% |

| Categories for Detailed Capital Cost Budget | | Applied Contingency |
|---|---|---|
| **80 Professional Services (applies to Cats. 10-60)** | | |
| 80.01 | Service Development Plan/Service Environmental | 13.0% |
| 80.02 | Preliminary Engineering/Project Environmental | 13.0% |
| 80.03 | Final design | 13.0% |
| 80.04 | Project management for design and construction | 13.0% |
| 80.05 | Construction administration & management | 13.0% |
| 80.06 | Professional liability and other non-construction insurance | 13.0% |
| 80.07 | Legal; Permits; Review Fees by other agencies, cities, etc. | 13.0% |
| 80.08 | Surveys, testing, investigation | 13.0% |
| 80.09 | Engineering inspection | 13.0% |
| 80.10 | Start up | 13.0% |

# APPENDIX C: MERCED EXTENSION COSTS BY SCCS (P65 $)

| SCC No. | Description | Cost |
|---|---|---|
| 10.01 | Track Structure: Viaduct | 638,501,420 |
| 10.02 | Track Structure: Major/Movable Bridge | 27,764,533 |
| 10.05 | Track Structure: Cut and Fill | 373,845,841 |
| 10.07 | Track Structure: Tunnels | 88,316,378 |
| 10.08 | Track Structure: Retaining Walls and systems | 273,426,624 |
| 40.01 | Demolition, clearing, site preparation | 21,114,231 |
| 40.02 | Site Utilities, utility relocation | 238,408,270 |
| 40.03 | Hazardous Material | 58,349,140 |
| 40.04 | Environmental Mitigation | 70,944,343 |
| 40.05 | Site Structures: Including Retaining Walls/Soundwalls | 135,840,643 |
| 40.07 | Right of Way | 354,277,038 |
| 40.08 | Highway/pedestrian overpass/Grade Separations | 509,245,016 |
| 80.02 | Preliminary Engineering/Project Environmental | 55,825,142 |
| 80.03 | Final Design | 134,947,833 |
| 80.04 | Project Management for Design and Construction | 95,466,402 |
| 80.05 | Construction Administration and Management | 71,600,117 |
| 80.07 | Legal, Permits; Review Fees by Other Agencies, Cities, etc. | 11,611,571 |
| 80.10 | Startup | 12,095,614 |
| 90.02 | Allocated/Unallocated Contingency | 1,290,221,490 |
| | **Total** | **4,461,801,645** |

# APPENDIX D: BAKERSFIELD EXTENSION COSTS BY SCCS (P65 $)

| SCC No. | Description | Cost |
|---|---|---|
| 10.01 | Track Structure: Viaduct | 791,801,886 |
| 10.02 | Track Structure: Major/Movable Bridge | 245,485,640 |
| 10.05 | Track Structure: Cut and Fill | 118,590,627 |
| 10.08 | Track Structure: Retaining Walls and systems | 101,854,591 |
| 10.09 | Track: Ballasted | 41,107,683 |
| 10.14 | Track: Special Trackwork | 8,374,072 |
| 40.01 | Demolition, clearing, site preparation | 6,897,634 |
| 40.02 | Site Utilities, utility relocation | 106,774,447 |
| 40.03 | Hazardous Material | 5,919,779 |
| 40.04 | Environmental Mitigation | 49,903,666 |
| 40.05 | Site Structures: Including Retaining Walls/Soundwalls | 104,852,908 |
| 40.07 | Right of Way | 308,059,638 |
| 40.08 | Highway/pedestrian overpass/Grade Separations | 131,798,108 |
| 50.01 | Wayside signaling equipment | 11,851,932 |
| 80.02 | Preliminary Engineering/Project Environmental | 40,679,110 |
| 80.03 | Final Design | 96,969,568 |
| 80.04 | Project Management for Design and Construction | 65,086,576 |
| 80.05 | Construction Administration and Management | 48,814,932 |
| 80.07 | Legal, Permits; Review Fees by Other Agencies, Cities, etc. | 8,135,822 |
| 80.10 | Startup | 8,135,822 |
| 90.02 | Allocated/Unallocated Contingency | 957,321,246 |
| | **Total** | **3,258,415,686** |

# APPENDIX E: 171-MILE MERCED TO BAKERSFIELD (AND OTHER PHASE 1) CAPITAL COSTS BY SCCS (P65 $)

| SCC No. | Description | Cost |
|---|---|---|
| 10.00 | Track Structures & Track | 7,684,312,339 |
| 10.01 | Track Structure: Viaduct | 1,430,303,306 |
| 10.02 | Track Structure: Major/Movable Bridge | 273,250,172 |
| 10.05 | Track Structure: Cut and Fill | 492,436,471 |
| 10.07 | Track Structure - Tunnel | 88,316,378 |
| 10.08 | Track Structure: Retainage Walls and Systems | 375,281,216 |
| 10.09 | Track new construction: Conventional ballasted | 1,242,547,007 |
| 10.10 | Track new construction: non-ballasted | 164,908,209 |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 119,219,862 |
| 10.18 | Other Linear Structures | 279,153,433 |
| 20.01 | Station Buildings: Intercity passenger rail only | 423,335,000 |
| 20.02 | Station Buildings: Joint use (commuter rail, intercity bus) | 771,326,174 |
| 30.01 | Administration building: Office, sales, storage, revenue counting | 50,750,151 |
| 30.02 | Light Maintenance Facility | 236,948,100 |
| 30.04 | Storage or maintenance of way building/bases | 96,835,921 |
| 40.01 | Demolition, clearing, site preparation | 28,011,866 |
| 40.02 | Site Utilities, utility relocation | 345,182,717 |
| 40.03 | Hazardous Material | 64,268,918 |
| 40.04 | Environmental Mitigation | 443,545,345 |
| 40.05 | Site Structures: Including Retaining Walls/Soundwalls | 240,693,551 |
| 40.07 | Right of Way | 2,558,921,625 |
| 40.08 | Highway/pedestrian overpass/Grade Separations | 1,515,651,525 |
| 50.01 | Wayside signaling equipment | 463,593,877 |
| 50.04 | Traffic control and dispatching systems | 42,534,186 |
| 50.05 | Communications | 578,071,481 |
| 50.07 | Hazard detectors: dragging equipment, high water, slide etc. | 147,607,491 |
| 60.02 | Traction power supply: substations | 921,350,345 |
| 60.03 | Traction power supply: substations | 313,164,117 |
| 60.04 | Traction power control | 2,511,243 |
| 70.02 | Vehicle Acquisition: Electric multiple unit | 438,294,543 |
| 80.02 | Preliminary Engineering/Project Environmental | 1,312,319,280 |
| 80.03 | Final Design | 332,298,332 |
| 80.04 | Project Management for Design and Construction | 3,362,657,127 |
| 80.05 | Construction Administration and Management | 853,037,979 |
| 80.07 | Legal, Permits; Review Fees by Other Agencies, Cities, etc. | 709,453,535 |
| 80.10 | Startup | 21,647,641 |
| 90.02 | Allocated/Unallocated Contingency | 6,899,382,591 |
| | **Total** | **35,323,123,054** |

# APPENDIX F: 171-MILE STATIONS COSTS BY SCCS (P65 $)

| SCC No. | Description | Cost |
|---|---|---|
| 20.02 | Station Buildings: Joint use (commuter rail, intercity bus) | 750,882,400 |
| 40.04 | Environmental Mitigation | 16,751,646 |
| 80.03 | Design | 83,386,479 |
| 80.04 | Project Construction Management (PCM) | 30,617,930 |
| 80.07 | Third Party | 5,102,965 |
| 90.02 | Unallocated/Allocated Contingency | 350,088,840 |
| | **Total** | **1,236,830,260** |

# APPENDIX G: TRACK AND SYSTEMS BALANCE (INCLUDING CVS SECOND TRACK) COSTS BY SCCS (P65 $)

| SCC No. | Description | Cost |
|---|---|---|
| 10.09 | Track new construction: Conventional ballasted | 559,260,504 |
| 10.10 | Track new construction: non-ballasted | 76,763,467 |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 51,597,839 |
| 10.18 | Other Linear Structures | 129,943,716 |
| 30.01 | Administration building: Office, sales, storage, revenue counting | 23,623,794 |
| 30.04 | Storage or maintenance of way building/bases | 45,076,355 |
| 40.04 | Environmental mitigation: wetlands, historic/archeology, parks | 61,788,406 |
| 50.01 | Wayside signaling equipment | 210,282,303 |
| 50.04 | Traffic control and dispatching systems | 19,799,327 |
| 50.05 | Communications | 269,087,703 |
| 50.07 | Hazard detectors: dragging equipment, high water, slide etc. | 68,710,120 |
| 60.02 | Traction power supply: substations | 274,459,172 |
| 60.03 | Traction power distribution: Catenary and third rail | 146,944,384 |
| 80.04 | Project management for design and construction | 224,945,278 |
| 90.02 | Unallocated/Allocated Contingency | 862,315,458 |
| | **Total** | 3,024,597,826 |

# APPENDIX H: 171-MILE BOOKENDS COSTS BY SCCS

| SCC No. | Description | Cost |
|---|---|---|
| 20.01 | Station Buildings: Joint use (commuter rail, intercity bus) | 423,335,000 |
| 40.08 | Highway/pedestrian overpass/grade separations | 874,608,400 |
| | **Total** | **1,297,943,400** |

# APPENDIX I: 171-MILE TRAINSETS (6 total) BY SCCS (P65 $)

| SCC No. | Description | Cost |
|---|---|---|
| 70.02 | Vehicle Acquisition: Electric multiple unit | 379,471,420 |
| 90.02 | Unallocated/Allocated Contingency | 181,949,973 |
| | **Total** | **561,421,393** |

# APPENDIX J: SOLAR AND UTILITY INTERCONNOCTION BY SCCS (P65 $)

| SCC No. | Description | Cost |
|---|---|---|
| 60.02 | Traction power supply: substations | 164,917,065 |
| 90.02 | Unallocated/Allocated Contingency | 65,201,924 |
| | **Total** | 230,118,989 |

# APPENDIX K: 171-MILE MAINTENANCE FACILITY AND DRIVING SIMULATOR BY SCCS (P65 $)

| SCC No. | Description | Cost |
|---|---|---|
| 30.02 | Light Maintenance Facility | 236,948,100 |
| 70.02 | Vehicle Acquisition:  Electric multiple unit | 12,530,360 |
| 80.03 | Final Design | 14,216,886 |
| 80.04 | Project management for design and construction | 7,108,443 |
| 80.07 | Legal; Permits; Review Fees by other agencies, cities, etc. | 1,184,741 |
| 80.10 | Start up | 1,184,741 |
| 90.02 | Unallocated/Allocated  Contingency | 144,974,782 |
| | **Total** | **418,148,053** |

# APPENDIX L: SAN FRANCISCO TO SAN JOSE COSTS BY SCCS (BASE, YOE$)

| SCC No. | Description | Cost |
|---|---|---|
| 10.02 | Track Structure: Major/Movable Bridge | 78,179,496 |
| 10.06 | Track structure: At-grade (grading and subgrade stabilization) | 297,210,039 |
| 10.08 | Track structure: Retaining walls and systems | 29,559,720 |
| 10.09 | Track new construction: Conventional ballasted | 48,916,218 |
| 10.10 | Track new construction: Non-ballasted | 20,380,621 |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 19,443,672 |
| 10.16 | Other Linear Structures | 465,489 |
| 20.01 | Station buildings: Intercity passenger rail only | 706,896,174 |
| 20.06 | Pedestrian / bike access and accommodation, landscaping, parking lots | 2,805,462 |
| 20.07 | Automobile, bus, van accessways including roads | 25,795,808 |
| 30.02 | Light maintenance facility | 990,288,683 |
| 40.01 | Demolition, clearing, site preparation | 135,877 |
| 40.02 | Site utilities, utility relocation | 30,869,821 |
| 40.04 | Environmental mitigation: wetlands, historic/archeology, parks | 56,564,556 |
| 40.06 | Temporary facilities and other indirect costs during construction | 69,134,457 |
| 40.07 | Purchase or lease of real estate | 1,795,327,225 |
| 40.08 | Highway/pedestrian overpass/grade separations | 220,129,986 |
| 50.05 | Communications | 89,400,808 |
| 60.03 | Traction power distribution: Catenary and third rail | 115,854,805 |
| 80.03 | Final Design | 72,414,400 |
| 80.04 | Project Management for design and construction | 67,644,790 |
| 80.05 | Construction Administration and Management | 54,115,832 |
| 80.07 | Legal; Permits; Review Fees by other agencies, etc, start up | 6,764,479 |
| 80.10 | Startup | 8,759,347 |
| 90 | Unallocated Contingency | 159,633,533 |
| | **Total** | **4,966,691,300** |

# APPENDIX M: SAN JOSE TO GILROY COSTS BY SCCS (BASE, YOE$)

| SCC No. | Description | Cost |
|---|---|---|
| 10.01 | Track structure: Viaduct | 293,464,604 |
| 10.02 | Track structure: Major/Movable bridge | 114,378,373 |
| 10.05 | Track structure: Cut and Fill (> 4' height/depth) | 18,310,099 |
| 10.06 | Track structure: At-grade (grading and subgrade stabilization) | 453,040,105 |
| 10.09 | Track new construction: Conventional ballasted | 289,495,724 |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 51,645,277 |
| 10.16 | Other Linear Structures | 1,734,366 |
| 10.15 | Track: Major interlockings | 5,849,578 |
| 20.02 | Station buildings: Joint use (commuter rail, intercity bus) | 134,250,752 |
| 20.06 | Pedestrian / bike access and accommodation, landscaping, parking lots | 25,660,621 |
| 20.07 | Automobile, bus, van accessways including roads | 283,503,164 |
| 30.04 | Storage or maintenance-of-way building/bases | 309,321,021 |
| 40.02 | Site utilities, utility relocation | 398,258,593 |
| 40.04 | Environmental mitigation: wetlands, historic/archeology, parks | 78,657,102 |
| 40.05 | Site structures including retaining walls, sound walls | 164,282,904 |
| 40.06 | Temporary facilities and other indirect costs during construction | 96,136,458 |
| 40.07 | Purchase or lease of real estate | 2,090,050,574 |
| 40.08 | Highway/pedestrian overpass/grade separations | 79,489,507 |
| 50.01 | Wayside signaling equipment | 100,157,559 |
| 50.05 | Communications | 39,265,669 |
| 50.07 | Hazard Detectors | 26,833,213 |
| 60.01 | Traction power transmission: High voltage | 115,543,209 |
| 60.02 | Traction power supply: Substations | 82,357,434 |
| 60.03 | Traction power distribution: Catenary and third rail | 118,456,391 |
| 60.04 | Traction power control | 279,414 |
| 80.03 | Final design | 168,326,198 |
| 80.04 | Project management for design and construction | 76,627,832 |
| 80.05 | Construction administration & management | 134,791,658 |
| 80.07 | Legal; Permits; Review Fees by other agencies, cities, etc. | 16,848,958 |
| 80.10 | Start up | 33,861,289 |
| 90 | Unallocated Contingency | 219,573,931 |
| | **Total** | **6,020,451,576** |

# APPENDIX N: GILROY TO CARLUCCI RD. COSTS BY SCCS (BASE, YOE$)

| SCC No. | Description | Cost |
|---|---|---|
| 10.01 | Track structure: Viaduct | 3,516,669,440 |
| 10.02 | Track structure: Major/Movable bridge | 178,450,911 |
| 10.05 | Track structure: Cut and Fill (> 4' height/depth) | 128,149,282 |
| 10.07 | Track structure: Tunnel | 4,977,716,474 |
| 10.09 | Track new construction: Conventional ballasted | 163,690,236 |
| 10.10 | Track new construction: Non-ballasted | 116,921,370 |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 9,561,248 |
| 10.15 | Track: Major interlockings | 6,171,007 |
| 10.16 | Other Linear Structures | 22,329,962 |
| 20.07 | Automobile, bus, van accessways including roads | 327,523,006 |
| 30.04 | Storage or maintenance-of-way building/bases | 4,059,834 |
| 40.02 | Site utilities, utility relocation | 63,593,029 |
| 40.04 | Environmental mitigation: wetlands, historic/archeology, parks | 305,922,080 |
| 40.05 | Site structures including retaining walls, sound walls | 138,106,500 |
| 40.06 | Temporary facilities and other indirect costs during construction | 373,904,764 |
| 40.07 | Purchase or lease of real estate | 438,212,644 |
| 40.08 | Highway/pedestrian overpass/grade separations | 275,392,615 |
| 50.01 | Wayside signaling equipment | 127,954,929 |
| 50.05 | Communications | 50,163,322 |
| 50.07 | Hazard Detectors | 34,280,406 |
| 60.01 | Traction power transmission: High voltage | 147,653,166 |
| 60.02 | Traction power supply: Substations | 105,244,921 |
| 60.03 | Traction power distribution: Catenary and third rail | 151,332,352 |
| 60.04 | Traction power control | 357,066 |
| 80.03 | Final design | 654,673,250 |
| 80.04 | Project management for design and construction | 265,130,432 |
| 80.05 | Construction administration & management | 465,291,595 |
| 80.07 | Legal; Permits; Review Fees by other agencies, cities, etc. | 58,161,450 |
| 80.1 | Start up | 43,264,143 |
| 90 | Unallocated Contingency | 476,903,421 |
| | **Total** | **13,626,784,855** |

# APPENDIX O: CENTRAL VALLEY WYE BALANCE COSTS BY SCCS (BASE, YOE$)

| SCC No. | Description | Cost |
|---|---|---|
| 10.01 | Track structure: Viaduct | 293,260,172 |
| 10.02 | Track structure: Major/Movable bridge | 22,916,946 |
| 10.05 | Track structure: Cut and Fill (> 4' height/depth) | 381,673,966 |
| 10.07 | Track structure: Tunnel | 1,284,875 |
| 10.09 | Track new construction: Conventional ballasted | 84,961,132 |
| 10.10 | Track new construction: Non-ballasted | 8,318,302 |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 15,057,004 |
| 20.06 | Pedestrian / bike access and accommodation, landscaping, parking lots | 5,236,594 |
| 20.07 | Automobile, bus, van accessways including roads | 120,136,291 |
| 40.01 | Demolition, clearing, site preparation | 16,370,231 |
| 40.02 | Site utilities, utility relocation | 128,769,602 |
| 40.04 | Environmental mitigation: wetlands, historic/archeology, parks | 85,667,907 |
| 40.05 | Site structures including retaining walls, sound walls | 99,993,261 |
| 40.06 | Temporary facilities and other indirect costs during construction | 46,016,807 |
| 40.07 | Purchase or lease of real estate | 109,291,674 |
| 40.08 | Highway/pedestrian overpass/grade separations | 269,280,364 |
| 50.01 | Wayside signaling equipment | 51,684,767 |
| 50.04 | Traffic control and dispatching systems | 499,968 |
| 50.05 | Communications | 23,642,470 |
| 50.07 | Hazard Detectors | 18,909,617 |
| 60.01 | Traction power transmission: High voltage | 37,478,286 |
| 60.02 | Traction power supply: Substations | 79,436,643 |
| 60.03 | Traction power distribution: Catenary and third rail | 78,761,617 |
| 60.04 | Traction power control | 371,056 |
| 80.03 | Final design | 86,689,043 |
| 80.04 | Project management for design and construction | 10,508,025 |
| 80.05 | Construction administration & management | 52,139,390 |
| 80.07 | Legal; Permits; Review Fees by other agencies, cities, etc. | 8,689,894 |
| 80.10 | Start up | 8,689,895 |
| 90 | Unallocated Contingency | 94,655,456 |
| | **Total** | **2,240,391,255** |

# APPENDIX P: BAKERSFIELD TO PALMDALE COSTS BY SCCS (BASE, YOE$)

| SCC No. | Description | Cost |
|---|---|---|
| 10.01 | Track structure: Viaduct | 1,020,134,048 |
| 10.05 | Track structure: Cut and Fill (> 4' height/depth) | 2,172,589,463 |
| 10.07 | Track structure: Tunnel | 6,068,238,845 |
| 10.09 | Track new construction: Conventional ballasted | 423,112,987 |
| 10.10 | Track new construction: Non-ballasted | 113,740,038 |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 39,242,388 |
| 20.02 | Station buildings: Joint use (commuter rail, intercity bus) | 300,141,660 |
| 20.07 | Automobile, bus, van accessways including roads | 315,728,720 |
| 30.04 | Storage or maintenance-of-way building/bases | 159,977,947 |
| 40.01 | Demolition, clearing, site preparation | 80,831,444 |
| 40.02 | Site utilities, utility relocation | 522,552,175 |
| 40.03 | Hazardous material, contaminated soil removal/mitigation, ground water | 44,936,363 |
| 40.04 | Environmental mitigation: wetlands, historic/archeology, parks | 393,500,090 |
| 40.05 | Site structures including retaining walls, sound walls | 693,558,530 |
| 40.06 | Temporary facilities and other indirect costs during construction | 495,429,485 |
| 40.07 | Purchase or lease of real estate | 733,341,658 |
| 40.08 | Highway/pedestrian overpass/grade separations | 228,640,953 |
| 50.01 | Wayside signaling equipment | 142,448,660 |
| 50.04 | Traffic control and dispatching systems | 141,561 |
| 50.05 | Communications | 120,114,056 |
| 50.07 | Hazard Detectors | 3,014,214 |
| 60.01 | Traction power transmission: High voltage | 12,358,204 |
| 60.02 | Traction power supply: Substations | 429,467,737 |
| 60.03 | Traction power distribution: Catenary and third rail | 217,256,575 |
| 60.04 | Traction power control | 37,571 |
| 80.03 | Final design | 865,351,650 |
| 80.04 | Project management for design and construction | 151,048,743 |
| 80.05 | Construction administration & management | 505,601,616 |
| 80.07 | Legal; Permits; Review Fees by other agencies, cities, etc. | 95,144,000 |
| 80.10 | Start up | 59,326,597 |
| 90 | Unallocated Contingency | 733,155,581 |
| | **Total** | **17,140,163,559** |

# APPENDIX Q: PALMDALE TO BURBANK COSTS BY SCCS (BASE, YOE$)

| SCC No. | Description | Cost |
|---|---|---|
| 10.01 | Track structure: Viaduct | 882,323,817 |
| 10.02 | Track structure: Major/Movable bridge | 25,256,627 |
| 10.05 | Track structure: Cut and Fill (> 4' height/depth) | 584,453,920 |
| 10.07 | Track structure: Tunnel | 7,902,708,440 |
| 10.08 | Track structure: Retaining walls and systems | 1,712,932,364 |
| 10.09 | Track new construction: Conventional ballasted | 97,112,102 |
| 10.10 | Track new construction: Non-ballasted | 162,179,227 |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 17,883,971 |
| 20.01 | Station buildings: Intercity passenger rail only | 142,594,952 |
| 20.02 | Station buildings: Joint use (commuter rail, intercity bus) | 57,119,489 |
| 30.04 | Storage or maintenance-of-way building/bases | 27,134,900 |
| 40.01 | Demolition, clearing, site preparation | 14,883,734 |
| 40.02 | Site utilities, utility relocation | 116,631,476 |
| 40.03 | Hazardous material, contaminated soil removal/mitigation, ground water | 3,789,854 |
| 40.04 | Environmental mitigation: wetlands, historic/archeology, parks | 210,771,572 |
| 40.05 | Site structures including retaining walls, sound walls | 50,800,458 |
| 40.06 | Temporary facilities and other indirect costs during construction | 503,032,915 |
| 40.07 | Purchase or lease of real estate | 1,352,499,919 |
| 40.08 | Highway/pedestrian overpass/grade separations | 312,804,551 |
| 50.01 | Wayside signaling equipment | 115,065,187 |
| 50.05 | Communications | 186,967,975 |
| 60.02 | Traction power supply: Substations | 278,195,907 |
| 60.03 | Traction power distribution: Catenary and third rail | 358,497,544 |
| 80.03 | Final design | 455,787,568 |
| 80.04 | Project management for design and construction | 201,345,379 |
| 80.05 | Construction administration & management | 201,345,379 |
| 80.07 | Legal; Permits; Review Fees by other agencies, cities, etc. | 61,751,646 |
| 80.10 | Start up | 61,751,657 |
| 90 | Unallocated Contingency | 677,692,848 |
| | **Total** | **16,775,315,378** |

# APPENDIX R: BURBANK TO LOS ANGELES COSTS BY SCCS (BASE, YOE$)

| SCC No. | Description | Cost |
|---|---|---|
| 10.02 | Track Structure: Major/Movable Bridge | 70,547,571 |
| 10.04 | Track Structure: Culverts and Drainage Structures | 87,213,397 |
| 10.06 | Track structure: At-grade (grading and subgrade stabilization) | 98,947,169 |
| 10.07 | Track structure: Tunnel | 169,119,960 |
| 10.08 | Track structure: Retaining walls and systems | 53,804,333 |
| 10.09 | Track new construction: Conventional ballasted | 278,351,312 |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 8,424,236 |
| 20.01 | Station buildings: Intercity passenger rail only | 831,087 |
| 20.02 | Station buildings: Joint use (commuter rail, intercity bus) | 37,129,784 |
| 20.06 | Pedestrian / bike access and accommodation, landscaping, parking lots | 9,419,829 |
| 30.02 | Light maintenance facility | 61,933,472 |
| 30.05 | Yard and yard track | 54,875,097 |
| 40.01 | Demolition, clearing, site preparation | 24,555,285 |
| 40.02 | Site utilities, utility relocation | 168,381,693 |
| 40.03 | Hazardous material, contaminated soil removal/mitigation, ground water | 105,651,624 |
| 40.04 | Environmental mitigation: wetlands, historic/archeology, parks | 45,641,969 |
| 40.05 | Site structures including retaining walls, sound walls | 145,931,516 |
| 40.06 | Temporary facilities and other indirect costs during construction | 55,784,629 |
| 40.07 | Purchase or lease of real estate | 967,957,886 |
| 40.08 | Highway/pedestrian overpass/grade separations | 67,975,276 |
| 50.01 | Wayside signaling equipment | 35,326,356 |
| 50.03 | On-board signaling equipment | 1,242,978 |
| 50.04 | Traffic Control and Dispatching Systems | 539,417 |
| 50.05 | Communications | 13,341,992 |
| 50.07 | Hazard Detectors | 13,642,351 |
| 60.02 | Traction power supply: Substations | 37,610,142 |
| 60.03 | Traction power distribution: Catenary and third rail | 38,931,191 |
| 60.04 | Traction Power Control | 706,153 |
| 80.03 | Final Design | 67,931,866 |
| 80.04 | Project Management for design and construction | 24,036,272 |
| 80.05 | Construction Administration and Management | 71,704,293 |
| 80.07 | Legal; Permits; Review Fees by other agencies, etc, start up | 15,377,350 |
| 80.10 | Startup | 9,645,806 |
| 90 | Unallocated Contingency | 92,602,928 |
| | **Total** | **2,935,116,221** |

# APPENDIX S: LOS ANGELES TO ANAHEIM COSTS BY SCCS (BASE, YOE$)

| SCC No. | Description | Cost |
|---|---|---|
| 10.01 | Track structure: Viaduct | 148,786,916 |
| 10.02 | Track structure: Major/Movable bridge | 28,853,909 |
| 10.04 | Track structure: Culverts and drainage structures | 13,775,278 |
| 10.05 | Track structure: Cut and Fill (> 4' height/depth) | 1,182,729 |
| 10.09 | Track new construction: Conventional ballasted | 224,112,385 |
| 10.10 | Track new construction: Non-ballasted | 17,733,065 |
| 10.14 | Track: Special track work (switches, turnouts, insulated joints) | 15,097,162 |
| 20.01 | Station buildings: Intercity passenger rail only | 52,054,576 |
| 20.07 | Automobile, bus, van accessways including roads | 578,783 |
| 40.01 | Demolition, clearing, site preparation | 3,918,397 |
| 40.02 | Site utilities, utility relocation | 261,182,247 |
| 40.04 | Environmental mitigation: wetlands, historic/archeology, parks | 57,638,756 |
| 40.05 | Site structures including retaining walls, sound walls | 44,130,186 |
| 40.06 | Temporary facilities and other indirect costs during construction | 19,748,505 |
| 40.07 | Purchase or lease of real estate | 1,188,626,972 |
| 40.08 | Highway/pedestrian overpass/grade separations | 308,025,646 |
| 50.01 | Wayside signaling equipment | 48,273,123 |
| 50.04 | Traffic control and dispatching systems | 1,962,557 |
| 50.05 | Communications | 23,800,642 |
| 50.07 | Hazard Detectors | 2,041,055 |
| 60.01 | Traction power transmission: High voltage | 100,231,942 |
| 60.02 | Traction power supply: Substations | 93,903,116 |
| 60.03 | Traction power distribution: Catenary and third rail | 80,281,314 |
| 60.04 | Traction power control | 565,199 |
| 80.03 | Final design | 16,367,312 |
| 80.04 | Project management for design and construction | 16,367,311 |
| 80.05 | Construction administration & management | 16,367,312 |
| 80.07 | Legal; Permits; Review Fees by other agencies, cities, etc. | 6,876,655 |
| 80.10 | Start up | 6,876,654 |
| 90 | Unallocated Contingency | 118,304,081 |
| | **Total** | **2,917,663,785** |

# Final 2024_Business_Plan_Basis_of_Estimate_Draft_03282024_Clean

Final Audit Report 2024-04-09

| | |
|---|---|
| Created: | 2024-03-28 |
| By: | Alicia Barrios (Alicia.Barrios@hsr.ca.gov) |
| Status: | Signed |
| Transaction ID: | CBJCHBCAABAAsp7SmjoYx2UsIYBltkIR-GwmKiOpuZfW |

## "Final 2024_Business_Plan_Basis_of_Estimate_Draft_03282024_Clean" History

Document created by Alicia Barrios (Alicia.Barrios@hsr.ca.gov)
2024-03-28 - 8:38:00 PM GMT- IP address: 165.225.242.102

Document emailed to Jamey Matalka (Jamey.Matalka@hsr.ca.gov) for signature
2024-03-28 - 8:41:56 PM GMT

Document emailed to Bill Casey (Bill.Casey@hsr.ca.gov) for signature
2024-03-28 - 8:41:56 PM GMT

Document emailed to Brian Annis (Brian.Annis@hsr.ca.gov) for signature
2024-03-28 - 8:41:57 PM GMT

Document emailed to lewis.rand@hsr.ca.gov for signature
2024-03-28 - 8:41:57 PM GMT

Document emailed to mohamed.hassan@hsr.ca.gov for signature
2024-03-28 - 8:41:57 PM GMT

Document emailed to waleed.aboukhadra@hsr.ca.gov for signature
2024-03-28 - 8:41:57 PM GMT

Document emailed to Jon Carter (jon.carter@hsr.ca.gov) for signature
2024-03-28 - 8:41:57 PM GMT

Email viewed by Jamey Matalka (Jamey.Matalka@hsr.ca.gov)
2024-03-28 - 8:42:56 PM GMT- IP address: 104.47.64.254

Document e-signed by Jamey Matalka (Jamey.Matalka@hsr.ca.gov)
Signature Date: 2024-03-28 - 8:43:01 PM GMT - Time Source: server- IP address: 165.235.53.254

Email viewed by waleed.aboukhadra@hsr.ca.gov
2024-03-28 - 8:45:18 PM GMT- IP address: 104.47.64.254

Signer waleed.aboukhadra@hsr.ca.gov entered name at signing as Waleed Aboukhadra
2024-03-28 - 9:21:40 PM GMT- IP address: 208.127.82.223

Document e-signed by Waleed Aboukhadra (waleed.aboukhadra@hsr.ca.gov)
Signature Date: 2024-03-28 - 9:21:42 PM GMT - Time Source: server- IP address: 208.127.82.223

Email viewed by lewis.rand@hsr.ca.gov
2024-03-28 - 10:06:24 PM GMT- IP address: 104.47.65.254

Signer lewis.rand@hsr.ca.gov entered name at signing as Lewis
2024-03-28 - 10:06:53 PM GMT- IP address: 208.87.235.180

Document e-signed by Lewis (lewis.rand@hsr.ca.gov)
Signature Date: 2024-03-28 - 10:06:55 PM GMT - Time Source: server- IP address: 208.87.235.180

Email viewed by Jon Carter (jon.carter@hsr.ca.gov)
2024-03-28 - 11:39:37 PM GMT- IP address: 104.47.64.254

Document e-signed by Jon Carter (jon.carter@hsr.ca.gov)
Signature Date: 2024-03-28 - 11:39:56 PM GMT - Time Source: server- IP address: 165.225.242.110

Email viewed by mohamed.hassan@hsr.ca.gov
2024-03-29 - 6:14:58 PM GMT- IP address: 104.47.65.254

Signer mohamed.hassan@hsr.ca.gov entered name at signing as Mohamed Hassan
2024-03-29 - 6:15:24 PM GMT- IP address: 165.235.53.254

Document e-signed by Mohamed Hassan (mohamed.hassan@hsr.ca.gov)
Signature Date: 2024-03-29 - 6:15:26 PM GMT - Time Source: server- IP address: 165.235.53.254

Email viewed by Brian Annis (Brian.Annis@hsr.ca.gov)
2024-03-30 - 1:11:54 AM GMT- IP address: 104.47.65.254

Document e-signed by Brian Annis (Brian.Annis@hsr.ca.gov)
Signature Date: 2024-03-30 - 1:12:03 AM GMT - Time Source: server- IP address: 165.235.53.254

New document URL requested by Alicia Barrios (Alicia.Barrios@hsr.ca.gov)
2024-04-08 - 4:01:54 PM GMT- IP address: 165.235.53.254

New document URL requested by Alicia Barrios (Alicia.Barrios@hsr.ca.gov)
2024-04-09 - 4:59:59 PM GMT- IP address: 165.235.53.254

Document e-signed by Bill Casey (Bill.Casey@hsr.ca.gov)
Signature Date: 2024-04-09 - 10:14:06 PM GMT - Time Source: server- IP address: 165.235.53.254

Agreement completed.

2024-04-09 - 10:14:06 PM GMT