

## 6 PROJECT COSTS AND OPERATIONS

### 6.1 Introduction

This chapter discusses the estimated costs for building, operating, and maintaining the Burbank to Los Angeles Project Section of the California High-Speed Rail (HSR) System, based on a preliminary level of design used in preparing this Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS). Information about the approach and additional details in preparing the construction cost estimates are provided in Volume 2 of this document and include:

- Appendix 2-C, *Operations and Service Plan Summary*, provides background information on the intended service and operations of the HSR system to provide sufficient detail for the environmental evaluation of proposed HSR operations.
- Appendix 6-A, *High-Speed Rail Operating and Maintenance Cost for use in EIR/EIS Project-Level Analysis*, summarizes the assumptions used to estimate full-system HSR operations and maintenance (O&M) costs.
- Appendix 6-B, *Burbank to Los Angeles Project Section Preliminary Engineering for Project Definition (PEPD) Record Set Capital Cost Estimate Report* (Authority and FRA, 2018), presents the capital cost estimating methodology and summary of capital cost estimates. As stated in the report, the construction cost estimates were developed for each alternative based on the preliminary engineering for project definition design plans, which are the same plans used in the environmental impact analysis in this EIR/EIS.

The sections below discuss capital and O&M cost estimating methodology, assumptions, and costs. Additionally, vehicle and O&M costs are based on the Authority's 2016 Business Plan for consistency with the environmental impact analysis.<sup>1</sup>

### 6.2 Capital Costs

Capital costs represent the total cost associated with the design, management, land acquisition, and construction of the HSR system. The estimated long-term costs include both train operations and infrastructure maintenance. Operations consist of labor costs, electrical power, and other factors required to keep the HSR system in service, whereas maintenance includes routine servicing of vehicles, maintenance of the tracks, signals, communications, and other systems needed to keep the system safe and reliable.

#### 6.2.1 Standardized Capital Cost Categories

To help evaluate and compare project construction costs, the California High-Speed Rail Authority (Authority) and Federal Railroad Administration (FRA) developed 10 main standardized capital cost categories. Each standard cost category is briefly described below:

- **10 Track Structures and Track**—Includes elevated structures (bridges and viaducts), embankments and open cuts, retaining wall systems, tunnels, culverts and drainage structures, track (ballasted and nonballasted), and special trackwork.
- **20 Stations, Terminals, Intermodal**—Includes rough grading; excavation; station structures; enclosures; finishes; equipment; mechanical and electrical components, including heating, ventilation, and air conditioning; station power; lighting; public address/customer service information systems; and safety systems, such as fire detection and prevention, security surveillance, access control, and life safety systems.
- **30 Support Facilities: Yards, Shops, Administrative Buildings**—Includes rolling stock service, inspection, storage, heavy maintenance and overhaul facilities and equipment, as

<sup>1</sup> The analysis presented in this EIR/EIS was initiated using the 2016 Business Plan. Given that there are minimal differences between the Authority's 2016 Business Plan and the Authority's 2018 and 2020 Business Plans, the costs included in this document rely on the 2016 Business Plan.

well as associated yard tracks and electrification. In addition, maintenance-of-way facilities are also included in this cost category.

- **40 Sitework, Right-of-Way, Land, Existing Conditions**—Includes cost of demolition, hazardous materials removal, environmental mitigation, utility relocations, noise mitigation, intrusion protection, grade separations, roadway improvements, acquisition of real estate, and temporary facilities and other indirect costs.
- **50 Communications and Signaling**—Includes all costs associated with implementing automatic train control systems, inclusive of positive train control and intrusion detection where it is applicable.
- **60 Electric Traction**—Includes costs of the traction power supply system, including supply, paralleling, and switching substations as well as connections to the power utilities and the traction power distribution system in the form of the overhead contact system.
- **70 Vehicles**—Includes costs for acquisition of the trainsets (design, prototype unit, and production and delivery of trainsets to the project site[s] on an annual basis). Acquisition of trainsets is considered a systemwide cost and is not included as part of the cost of individual HSR study alternatives.
- **80 Professional Services**—Includes all professional, technical, and management services related to the design and construction of infrastructure (Categories 10 through 60) during the preliminary engineering, final design, and construction phases of the project/program (as applicable).
- **90 Unallocated Contingency**—Includes program reserves.
- **100 Finance Charges**—Includes finance charges expected to be paid by the project/program sponsor/grantee prior to either the completion of the project or the fulfillment of the FRA funding commitment, whichever occurs later in time (not included in the estimate).

### 6.2.2 Assumptions and Exclusions

The Authority used the *Burbank to Los Angeles Project Section PEPD Record Set Capital Cost Estimate Report* (Appendix 6B in Volume 2 of this EIR/EIS) as the basis of the capital costs forecasts for this project section. Assumptions and exclusions used in the analysis provided in this Draft EIR/EIS include the following:

- The alignment section length will be 14 route miles.
- The HSR Build Alternative includes an allowance for curve realignment and additional right-of-way through the area that enters Los Angeles Union Station (LAUS). All tracks are assumed to have a minimum 650-foot radius in the area that enters LAUS as validated by the Authority.
- The HSR system will share track on the existing bridge located over the Los Angeles River at Figueroa Street.
- The HSR Build Alternative will include four HSR grade separations at Sonora Avenue, Grandview Avenue, Flower Street, and Goodwin Avenue. Goodwin Avenue is currently not a crossing, but the HSR Build Alternative will grade-separate Goodwin Avenue as an undercrossing, and the existing at-grade crossing at Chevy Chase Drive will be closed. Necessary right-of-way will be obtained, and out-of-sequence work will not occur. There may be additional costs due to operational restrictions and constraints related to working in an active rail corridor.
- Utility company relocation agreements will be obtained and there will be no out-of-sequence work.
- Only costs associated with raising the station platforms and electrifying the tracks are included for improvements at LAUS. Project improvements at LAUS that are included in the

Metro Link US Project, including new lead tracks and run-through tracks for HSR service, are not included in the capital cost estimate for this project section.

- The Burbank Airport Station is included in the capital cost estimate for this project section as a retained-cut design, which will be constructed by open-cut excavation methods with vertical retaining walls embedded in the terrain. The cost estimate includes: trench and tunnel guideway costs between the north end of the platform and the track transition to the south, station elements, utility relocations, land acquisitions, professional services, and unallocated contingency.
- The HSR Build Alternative will not include allowances for agreements with the Los Angeles County Metropolitan Transportation Authority/Union Pacific Railroad that will be needed for operating in this corridor.
- Intrusion barriers, which are structures around HSR operational features to protect an HSR train from the derailment of an adjacent train, are only required for rail operating speeds of more than 125 miles per hour. HSR train in the Burbank to Los Angeles Project Section will operate below 125 miles per hour; therefore, intrusion barriers will not be required.

### 6.2.3 Burbank to Los Angeles High-Speed Rail Build Alternative

The cost estimate prepared for the HSR Build Alternative was developed by using recent bid data from large transportation projects in the western United States and by developing specific, bottom-up unit pricing to reflect common HSR elements and construction methods with an adjustment for Los Angeles area labor and material costs. All material quantities for the Burbank to Los Angeles Project Section are estimated based on a preliminary level of design. This level of design has generally been defined as encompassing at-grade, retained fill, or below-grade profiles; structure types; placement of retaining walls; and earth fill. Stations are still conceptual, but roadway and utility relocations have been identified and power substations have been sized and located.

The capital costs include the total labor effort and materials to construct the Burbank to Los Angeles Project Section Build Alternative, including utility relocations and modifications to roadways required to accommodate HSR grade-separated guideways. It should be noted that the capital cost estimate reflects only related infrastructure improvements and does not include costs associated with the No Project Alternative.

Estimates are prepared in base-year dollars, with the base year defined as the 2018 calendar year. Unit costs are updated annually or as required. For cost estimates with a base year that is older than the current calendar by one or more years, actual historical construction cost index values are used to calculate the escalation rate to be applied to bring a cost from the period in question to the present.

Right-of-way costs were estimated based on the preliminary design and are provided in the *Burbank to Los Angeles Project Section PEPD Record Set Capital Cost Estimate Report* (Appendix 6B in Volume 2 of this EIR/EIS). However, as the design of the project evolves, the right-of-way limits will be reassessed to reflect refined property acquisition needs. As a result, property acquisition costs are estimated in broad categories (i.e., urban, suburban, and by population-density level), based on local land values rather than relying on a parcel-by-parcel assessment at this phase of project development. Right-of-way costs include the estimated cost to acquire properties needed for the future right-of-way and include costs associated with temporary easements for construction that are assumed to be part of the design-build contractor's responsibilities to negotiate use.

The capital cost estimates do not include the cost of acquiring HSR vehicles because they are part of the statewide system and are not associated with construction of individual sections. It should be noted, however, that, consistent with the *2016 Business Plan: Connecting and*

*Transforming California* (2016 Business Plan) (Authority 2016),<sup>2</sup> the cost of vehicles was determined using publicly available data regarding recent sales of comparable equipment to other projects around the world. Additional costs are included for adaptation of existing trainset designs to meet U.S. safety regulations and to comply with “Buy America”<sup>3</sup> requirements. The systemwide costs of vehicle procurement is divided into two milestones: Silicon Valley to the Central Valley and Phase 1, which extends from San Francisco to Anaheim. Total vehicle procurement cost is estimated at \$3.39 billion in 2015 dollars.

Again, using cost information collected from large transportation projects and adjusting for Los Angeles region labor and material costs, professional services are estimated at 15.5 percent of the construction costs. These costs are divided among preliminary engineering (2 percent), program management (3 percent), final design (6 percent), construction management (4 percent), and agency costs (0.5 percent). Environmental mitigation costs are estimated at approximately 3 percent of the capital cost, given potential project impacts and typical mitigation costs in the region.

At this early stage of design, the capital cost estimates include contingencies to account for changes in material costs and changes during project design. Currently, allocated contingencies (money reserves assigned to each cost category to cover risks associated with design uncertainty) are assumed to be between 10 percent and 25 percent of the estimated construction and right-of-way acquisition costs, and unallocated contingency (project reserves intended to cover unknown risks) is estimated at 5 percent of the construction costs.

Table 6-1 shows the estimate for the Burbank to Los Angeles Alternative.

**Table 6-1 Capital Cost of the Burbank to Los Angeles Alternative (2018\$ in millions)**

FRA Standard Cost Categories	HSR Build Alternative
10 Track Structures and Track	\$1,286
20 Stations, Terminals, Intermodal	\$134
30 Support Facilities: Yards, Shops, Administrative Buildings	\$57
40 Sitework, Right-of-Way, Land, Existing Conditions	\$1,516
50 Communications and Signaling	\$51
60 Electric Traction	\$65
70 Vehicles	Considered a systemwide cost and not included as part of the HSR Build Alternative
80 Professional Services	\$318
90 Unallocated Contingency	\$127
100 Finance Charges	Estimate to be developed prior to construction
<b>Total</b>	<b>\$3,554</b>

Source: Appendix 6B: *PEPD Record Set Capital Cost Estimate Report*

All costs are in first-quarter 2018 dollars (rounded to the nearest \$million). Allocated contingency is included in the unit costs.

HSR = high-speed rail

The cost associated with construction of the Burbank Airport Station and the track transition, estimated at \$1,059 million, is included in this total cost estimate of \$3,554 million. The breakdown of the Burbank Airport Station construction cost is: \$662 million for Category 10: Track

<sup>2</sup> The Authority publishes an update to its Business Plan every 2 years to inform the public on the status of project implementation. Preparation of this Draft EIR/EIS relies on the 2016 Business Plan (Authority 2016).

<sup>3</sup> “Buy America” requirements apply to mass transit projects and give preference to the use of domestically produced materials on any procurements funded at least in part by federal funds. Administered by the Federal Transit Administration, the requirements are described at 49 Code of Federal Regulations 661.

Structures and Track; \$91 million for Category 20: Stations, Terminals, Intermodal; \$141 million for Category 40: Site Work, Right-of-Way, Land, Existing Improvements; \$128 million for Category 80: Professional Services; and \$37 million for Category 90: Unallocated Contingency.

#### 6.2.4 Maintenance Facilities

O&M of the HSR system would require the placement of maintenance facilities along the alignment. For systemwide operations, the HSR System would include four types of maintenance facilities: maintenance of infrastructure facilities (MOIF), maintenance of infrastructure siding (MOIS) facilities, a heavy maintenance facility (HMF), and light maintenance facilities (LMF). These four types of facilities are described in Chapter 2, Section 2.3.9, of this Draft EIR/EIS. The California HSR System would require one HMF, located in the Central Valley. However, the design and spacing of MOIF and MOIS facilities along the HSR system do not require the Burbank to Los Angeles Project Section to include any of these maintenance facilities within the geographic limits of the project section. A nearby LMF would be used for all activities associated with fleet storage, cleaning, repair, overnight layover accommodations, and servicing facilities. The LMF closest to the Burbank to Los Angeles Project Section would be located near LAUS, within the Los Angeles to Anaheim Project Section.

### 6.3 Operating and Maintenance Costs

Chapter 2, Alternatives, describes O&M activities in detail. This analysis assumes that HSR service during Phase 1 would connect San Francisco with Los Angeles via the Central Valley by 2029. The plan is to offer express, limited-stop, and all-stop services, depending on time of day and projected needs. For Phase 1, there would be 13 HSR stations; up to 2 stations would be within the Burbank to Los Angeles Project Section (the Burbank Airport Station and LAUS). By 2040, multiple facilities would be required for overnight storage, inspection, and routine maintenance of over 78 trainsets, each 656 feet long. The HMF serving the entire HSR system would be located between Merced and Bakersfield. The HMF would store and maintain a portion of the trainsets. An MOIF would be located approximately every 150 miles, while an MOIS facility would be needed approximately every 75 miles.

O&M costs account for staff, labor, and material supplies required to run the HSR system and to perform required maintenance. O&M costs are estimated based on daily rail miles, operating speeds, HSR station configurations, maintenance and storage facilities, and assumed operating frequencies in accordance with the 2016 Business Plan (Authority 2016).

#### 6.3.1 Assumptions

The O&M cost forecasts for the Burbank to Los Angeles Project Alternative are based on assumptions included in the *High-Speed Rail Operating and Maintenance Cost for Use in EIR/EIS Project Level Analysis Memorandum* (Authority and FRA 2017). The Authority developed other assumptions based on refinements to the HSR plan over time and aspects specific to the Burbank to Los Angeles Project Section. Assumptions used in this analysis include the following:

- The apportionment of systemwide O&M cost estimates to the Burbank to Los Angeles Project Section is proportional to the cost per route mile in the project section.
- The Phase 1 system will open in 2029 and will cover approximately 520 miles.
- The Phase 1 system will serve 13 stations: San Francisco, Millbrae, San Jose, Gilroy, Merced, Fresno, Kings/Tulare, Bakersfield, Palmdale, Burbank, LAUS, Norwalk/Santa Fe Springs or Fullerton, and Anaheim Regional Transportation Intermodal Center.
- The Phase 1 system will include 196 revenue service train runs per day with varying stopping patterns between San Francisco and Anaheim, San Francisco and Los Angeles, San Jose and Los Angeles, Merced and Los Angeles, and Merced and Anaheim.
- The Phase 1 system assumes 6 hours of peak service and 10 hours of off-peak service daily. Phase 1 will include eight round-trip revenue service trains per hour during peak service and



five round-trip trains per hour during off-peak service. Not all of the revenue service train trips will occur within the Burbank to Los Angeles Project Section.

- The HSR system will include connecting bus service between Sacramento and Merced during Phase 1 operations.
- After full operational ramp-up, HSR operations will include 78 trainsets including spares, 34.5 million total trainset miles, and 2.2 million bus miles per year.

To support the Phase 1 HSR service outlined above, total O&M costs include additional assumptions related to maintenance and train operations. The system will include one operations control center and three terminal control facilities to manage dispatching. An HMF will be located in the Central Valley, with three LMFs dispersed across the rest of the system, including one near Gilroy, one in Northern California along the Peninsula Corridor at Brisbane, and one in Southern California near Los Angeles. O&M support activities will also be provided at five MOIFs.

### 6.3.2 Operating Speeds

The HSR trains would operate at high speeds (up to 220 miles per hour) over fully grade-separated, dedicated track, and at lower speeds in some areas with blended operations. Operating speeds in the Burbank to Los Angeles Project Section Build Alternative would not exceed 125 miles per hour due to blended operations.

### 6.3.3 Development of Operations and Maintenance Costs

An important goal of the Authority's business plan is to achieve a balance between O&M costs and projected farebox revenue as proof of the requirements mandated by Proposition 1A, the *Safe, Reliable, High-Speed Passenger Train Bond Act*, adopted by California voters in November 2008. The Authority has continued to refine its O&M cost model to reflect a more accurate cost basis for the program's current level of design.

O&M cost estimates include operations activities needed to serve and carry the forecast train service for Phase 1 in 2040 for the medium and high ridership forecasts as described in Chapter 2, the maintenance costs necessary to keep the system in a state of good repair, and administrative costs (Appendix 6-A). For consistency with the environmental impacts analysis, the estimated O&M costs in this chapter are based on the Authority's 2016 Business Plan.<sup>4</sup> The current HSR O&M model, where applicable, is based on cost categories defined in the U.S. Department of Transportation Inspector General's *High-Speed Intercity Passenger Rail Best Practices: Operating Costs Estimation* report (Office of the Inspector General 2011), where applicable. The report defines the general parameters for estimating the preliminary, intermediate, final, and commercial closeout stages of a program. No program falls neatly into all these parameters, and there is usually some overlap between the stages. In this context, large parts of the Authority's O&M cost model fall into the intermediate stage, while others might be classified as preliminary or have advanced to the final stage.

Unit prices were developed and applied to calculate the cost for each activity included in the operating plan. Although many of the O&M unit costs for the HSR system would be similar to the costs of U.S. conventional rail operations and can be reliably estimated from U.S. practices and costs, the unit cost to maintain high-speed trainsets and dedicated high-speed rail infrastructure has no close analogy in the U.S. Therefore, international O&M unit cost projections from comparable HSR operations were applied to planned California operations, HSR technology, and local cost levels and labor practices.

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<sup>4</sup> The Authority's 2018 Business Plan, adopted in June 2018, includes updated O&M costs. It states that "operations and maintenance costs in all scenarios are minimally impacted by the changes made since the 2016 Business Plan" (2018 Business Plan, chapter 7, p. 96). The Authority released a Draft 2020 Business Plan in February 2020 for public review and comment. The plan's final adoption is expected at the April 2020 Board meeting for submittal to the Legislature by May 1, 2020. The 2020 Business Plan forecasts were developed using the same travel forecasting model as the 2016 and 2018 Business Plans, updated for population and employment forecasts. The Phase 1 medium ridership forecast for 2040 is 38.6 million, and the high is 50.0 million.

The O&M costs of HSR equipment include the cost of (1) crew, administration, and supplies to operate and dispatch the HSR services; (2) electric power for traction, onboard systems, stations, and maintenance/other facilities; and (3) cleaning, inspection, maintenance, and overhaul of the trainsets.

Maintenance of infrastructure covers the costs of patrolling, inspecting, and maintaining the right-of-way, fencing, structures, bridges, tunnels, roadbed, track, signaling, overhead electric traction power system, substations and similar electrical facilities, communications, intrusion detection, and other facilities.

Station O&M costs include day-to-day operations of the station, ticket sales and machine maintenance, public safety, passenger handling, and cleaning. Station staffing is based on the number of train turns at each terminal station and station size. Station staffing assumes the following job categories.

Phase 1 HSR system operations would require approximately 25 individuals at the Burbank station and 120 individuals at Los Angeles Union Station.

The O&M cost model includes the following categories of O&M costs:

- Train operations
- Dispatching
- Maintenance of equipment
- Maintenance of infrastructure
- Station and train cleaning
- Commercial
- General and administrative activities
- Insurance
- Unallocated contingencies

The upgrades made to the 2016 O&M model have improved the detail and flexibility of the model to allow for more precise estimating and easier validation of source material.

Table 6-2 outlines the medium and high ridership forecast O&M costs by cost category estimated for Phase 1 of the California HSR Project for the year 2040. For more information on O&M cost forecasting, please refer to Appendix 6-A of this EIR/EIS.

**Table 6-2 Annual Operations and Maintenance Costs for Phase 1 (2015\$ in millions)**

O&M Activity	2040 Medium Ridership Forecast	2040 High Ridership Forecast
Train Operations	\$285	\$311
Dispatching	\$30	\$33
Maintenance of Equipment	\$134	\$146
Maintenance of Infrastructure	\$122	\$133
Station and Train Cleaning	\$71	\$77
Commercial	\$94	\$103
General and Administrative	\$53	\$58
Insurance	\$52	\$57
Unallocated Contingency	\$35	\$38
<b>Total</b>	<b>\$874</b>	<b>\$956</b>

Source: Appendix 6-A, High-Speed Rail Operating and Maintenance Cost for use in EIR/EIS Project-Level Analysis  
 O&M = operations and maintenance

O&M costs in 2015 dollars as apportioned to the Burbank to Los Angeles Project Section are shown in Table 6-3 and are based on the Phase 1 HSR System, total cost per route mile. The costs associated with O&M are apportioned on the basis of trainset miles operated in the Burbank to Los Angeles Project Section. The costs associated with the maintenance of infrastructure are apportioned as a ratio of 14 miles to the 520 Phase 1 total route miles.

**Table 6-3 Annual Operations and Maintenance Costs, Apportioned to the High-Speed Rail Burbank to Los Angeles Project Section (2015\$ in millions)**

O&M Activity	2040 Medium Ridership Forecast	2040 High Ridership Cost
Train Operations	\$7.98	\$8.71
Dispatching	\$0.84	\$0.92
Maintenance of Equipment	\$3.75	\$4.10
Maintenance of Infrastructure	\$3.42	\$3.72
Station and Train Cleaning	\$1.99	\$2.16
Commercial	\$2.44	\$2.88
General and Administrative	\$1.48	\$1.62
Insurance	\$1.46	\$1.60
Unallocated Contingency	\$0.98	\$1.06
<b>Total</b>	<b>\$24.34</b>	<b>\$26.77</b>

Source: Appendix 6-A, High-Speed Rail Operating and Maintenance Cost for use in EIR/EIS Project-Level Analysis  
The 2040 medium cost is based on a rate of \$1.75 million/mile; the 2040 high cost is based on a rate of \$1.91 million/mile.