

## 5.0 Project Costs and Operations

### 5.1 Introduction

This chapter discusses the estimated costs for building, operating, and maintaining the Merced to Fresno Section of the California HST System, based on a 15% level of design used in preparing this EIR/EIS. The approach and the details used to prepare the construction cost estimate are provided in the *Merced to Fresno Section Cost Estimate Report*, which is available upon request from the Authority. Appendix 5-A to this EIR/EIS is the Operations and Service Plan Summary and Appendix 5-B is a memorandum regarding HST operations and maintenance cost.

### 5.2 Capital Costs

Capital costs represent the total cost associated with the design, management, land acquisition and construction of the HST system. The estimate of long-term operations and maintenance (O&M) costs include both train operations and infrastructure maintenance. Operations consists of labor costs, electrical power, and other factors required to keep the HST 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.

To help evaluate and compare project construction costs, FRA has 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, track (ballasted and non-ballasted) and special trackwork.
- **20 Stations, Terminals, Intermodal** – Includes rough grading, excavation, station structures, enclosures, finishes, equipment; mechanical and electrical components including HVAC, station power, lighting, public address/customer information systems; safety systems such as fire detection and prevention, security surveillance, access control, life safety systems, etc.
- **30 Support Facilities: Yards, Shops, and Administration Buildings** – Includes rolling stock service, inspection, storage, heavy maintenance and overhaul facilities and equipment as 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 Improvements** – Includes cost of demolition, hazardous materials removals, 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** – Covers all costs of implementing Automatic Train Control (ATC) systems, inclusive of Positive Train Control (PTC) and intrusion detection where is applicable.
- **60 Electric Traction** – Covers costs of traction power supply system including supply, paralleling and switching substations as well as connections to the power utilities; traction power distribution system in the form of Overhead Contact System (OCS).
- **70 Vehicles** – Includes costs for acquisition of the trainsets (design, prototype unit, and production and delivery of trainsets to the project site on annual basis). The cost of acquiring trainsets was not included in the capital cost estimate prepared for this document.
- **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 project 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. Financial charges are not included in the capital cost estimate prepared for this document.

### 5.2.1 High-Speed Train Alternatives

The conceptual HST cost estimates prepared for each of the study alternatives was developed by utilizing 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 Central Valley labor and material costs. All material quantities are estimated based on a 15% level of design for the Merced to Fresno Section. This level of design has generally defined at-grade or elevated profiles, structure types, placement of retaining walls, and earth fill. HST stations are still conceptual, but roadway and utility relocations have been designed, and power substations have been sized and located.

The costs include the total effort and materials to construct the Merced to Fresno Section, including modifications to roadways required to accommodate HST grade-separated guideways. It should be noted that the capital cost estimate reflects only HST-related infrastructure improvements and does not include costs associated with the No Project Alternative.

Detailed right-of-way needs are included in the 15% design drawings (see Volume III 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 rural, and by density level) 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 HST right-of-way but do not include costs associated with temporary easements for construction that are assumed to be part of allocated contingencies added to right-of-way acquisition costs.

These costs do not include acquiring HST vehicles because they are part of the statewide HST System and are not associated with constructing individual sections. Consistent with the *2009 Report to the Legislature* (Authority 2009), the cost of vehicles was determined by using publically available data regarding recent sales of comparable equipment to other HST projects around the world and by informally consulting with manufacturers. The systemwide cost of vehicle procurement is divided into two parts: Opening Day demand (assumes 60 trainsets in 2020) and Optional Orders, which accommodate the demand for increases in ridership (assumes 40 trainsets between 2025 and 2035). Total vehicle costs, including vehicles needed for Opening Day service and Optional Orders is estimated at \$3.3 billion in year-of-expenditure dollars.

Professional services are estimated at 13.5% of the construction costs and include final design (6%), construction management (4%), program management (3%), and agency costs (0.5%). Environmental mitigation costs are based on similar estimates, with approximately 3% of the capital cost required to mitigate environmental impacts, considering potential project impacts and typical mitigation costs in the region.

At this stage of design, many project features have not been fully developed; therefore, early 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 between 10% and 25% of the estimated construction and right-of-way acquisition costs, while unallocated contingency (project reserve intended to cover unknown risks is estimated at 5% of the construction and right-of-way acquisition costs.

Table 5-1 shows estimates for each study alternative. The estimates are detailed by project cost item to help identify where the alternatives differ and why.

**Table 5-1**  
 Capital Cost of the HST Alternatives (2010 \$Thousands)

<b>FRA Standard Cost Categories</b>	<b>UPRR/ SR 99 Alternative with Ave 24 Wye</b>	<b>UPRR/ SR 99 Alternative with Ave 21 Wye</b>	<b>UPRR/ SR 99 Alternative West Chowchilla Design Option with Ave 24 Wye</b>	<b>BNSF Alternative with Ave 24 Wye</b>	<b>BNSF Alternative with Ave 21 Wye</b>	<b>Hybrid Alternative with Ave24 Wye</b>	<b>Hybrid Alternative with Ave 21 Wye</b>
10 Track Structures & Track	\$3,485,000	\$3,008,000	\$2,629,000	\$1,961,000	\$1,844,000	\$1,383,000	\$2,059,000
20 Stations, Terminals, Intermodal	\$170,000	\$170,000	\$170,000	\$170,000	\$170,000	\$170,000	\$170,000
30 Support Facilities: Yards, Shops, Admin. Bldgs	\$12,000	\$12,000	\$27,000	\$12,000	\$12,000	\$27,000	\$27,000
40 Sitework, Right Of Way, Land, Existing Improvements	\$1,416,000	\$1,348,000	\$1,205,000	\$1,325,000	\$1,138,000	\$1,218,000	\$1,318,000
50 Communications & Signaling	\$151,000	\$129,000	\$116,000	\$156,000	\$140,000	\$117,000	\$135,000
60 Electric Traction	\$486,000	\$417,000	\$374,000	\$504,000	\$452,000	\$378,000	\$440,000
70 Vehicles	Considered a systemwide cost and not included as part of individual HST study alternatives						
80 Professional Services (applies to Cats. 10-60)	\$723,000	\$637,000	\$561,000	\$511,000	\$461,000	\$393,000	\$509,000
90 Unallocated Contingency	\$251,000	\$222,000	\$197,000	\$178,000	\$162,000	\$141,000	\$180,000
100 Finance Charges	Estimate to be developed prior to project construction						
<b>Total</b>	\$6,694,000	\$5,943,000	\$5,279,000	\$4,817,000	\$4,379,000	\$3,827,000	\$4,838,000

All HST alternatives in the Merced to Fresno Section reflect costs of Fresno Kern Street Station Alternative. Another station being considered is the Fresno Mariposa Street Station Alternative which is estimated to cost \$27 million less.

The BNSF Alternative design options would allow the HST to connect from the UPRR in Merced to the BNSF corridor near the community of Le Grand. These design options were developed to parallel Mission Avenue or Mariposa Way and to travel through Le Grand or east of Le Grand. The design options that travel east of Le Grand are substantially more expensive. The least costly design option is the Mission Ave design option. The primary difference in the cost is attributed to the longer length of the guideway and the additional elevated guideway required for the design options that travel east of Le Grand compared with those that go through Le Grand.

### 5.2.2 Heavy Maintenance Facilities

Another project component of the Central Valley portion of the HST System is the construction and operation of an HMF. Five sites are under consideration for the HMF between the cities of Merced and Fresno. Table 5-2 lists the projected costs for these design options, including connecting tracks and infrastructures. The costs for the HMF alternatives are estimated based on conceptual site and functional layouts and the unit costs for comparable rail equipment, maintenance, and storage facilities.

**Table 5-2**  
 Cost for Heavy Maintenance Facilities Alternatives (2010 \$Thousands)

<b>FRA Standard Cost Categories</b>	<b>Heavy Maintenance Facility (Adjacent Site Alternatives)</b>	<b>Heavy Maintenance Facility (Castle Commerce Center)</b>
10 Track Structures & Track	\$32,000	\$348,000
20 Stations, Terminals, Intermodal	\$—	\$—
30 Support Facilities: Yards, Shops, Admin. Bldgs	\$383,000	\$383,000
40 Sitework, Right Of Way, Land, Existing Improvements	\$77,000	\$108,000
50 Communications & Signaling	\$3,000	\$11,000
60 Electric Traction	\$37,000	\$63,000
70 Vehicles	\$—	\$—
80 Professional Services (applies to Cats. 10-60)	\$66,000	\$116,000
90 Unallocated Contingency	\$22,000	\$39,000
100 Finance Charges	\$—	\$—
<b>Total</b>	<b>\$620,000</b>	<b>\$1,068,000</b>

Except for the Castle Commerce Center HMF site, all of the HMF sites would be adjacent to one or more of the HST alternative alignments, and their costs include relatively similar components. For instance, each potential HMF site (except the Castle Commerce Center site) would require approximately the same length of lead guideway. The site plan is standard; therefore, there is no major difference at this level of design. The sites were screened to eliminate major resource conflicts and difficult site constraints. The proposed HMF sites would generally require relatively low land costs; therefore, there are no noticeable cost differences between the sites (except the Castle Commerce Center site). The Castle Commerce Center site would require a longer lead guideway from the Downtown Merced Station, which would not follow the future HST guideway extension toward Sacramento for two reasons:

- The Authority has not decided whether the UPRR or the BNSF route would be the route between Merced and Sacramento.
- A guideway designed for operation at 220 mph in accordance with the design criteria for the future northbound extension would bypass the Castle Commerce Center, which would require a lead guideway traveling in reverse from the north to enter the proposed HMF site; therefore, the lead guideway would be a separate and unique guideway from the Merced HST station to the Castle Commerce Center HMF.

### 5.3 Operation and Maintenance Costs

Chapter 2, Alternatives, describes O&M activities in greater detail. HST service during Phase 1 would connect San Francisco with Los Angeles via the Central Valley by 2020. HST service during Phase 2 would extend to Sacramento and San Diego beginning in 2027. The plan is to offer express, limited-stop, and all-stop services, depending on the time of the day and projected needs. There would be 24 HST stations; 2 HST stations would be located within the Merced to Fresno Section. Operation costs are projected to maintain 212 trainsets, each 656 feet long by 2035, one HMF for the entire HST system, and one maintenance-of-way facility approximately every 100 miles.

O&M costs account for staff and supplies required to run the HST system and keep it properly maintained. O&M costs are estimated based on daily train miles, operation speeds, travel times, HST station configurations, maintenance and storage facilities, and assumed operating frequencies (Parsons Brinckerhoff 2011). The allocations of systemwide O&M cost estimates to the Merced to Fresno Section are proportional to the number of miles and train frequency, where the mileage ranges between 78 and 98 miles of guideway for the three alternatives, and the projected employment at maintenance facilities and stations in the Section.

#### 5.3.1 Operating Speeds

The HSTs would operate at high speeds (150 to 220 miles per hour) within most of the Merced to Fresno Section. There are some curves, such as from the Bay Area toward Merced, where speeds may be limited to 150 mph. A few other curves would slow the trains to 180 mph; otherwise, the Merced to Fresno Section is designed to reach maximum speeds. Figure 5-1 illustrates general speeds for the HST alternatives.

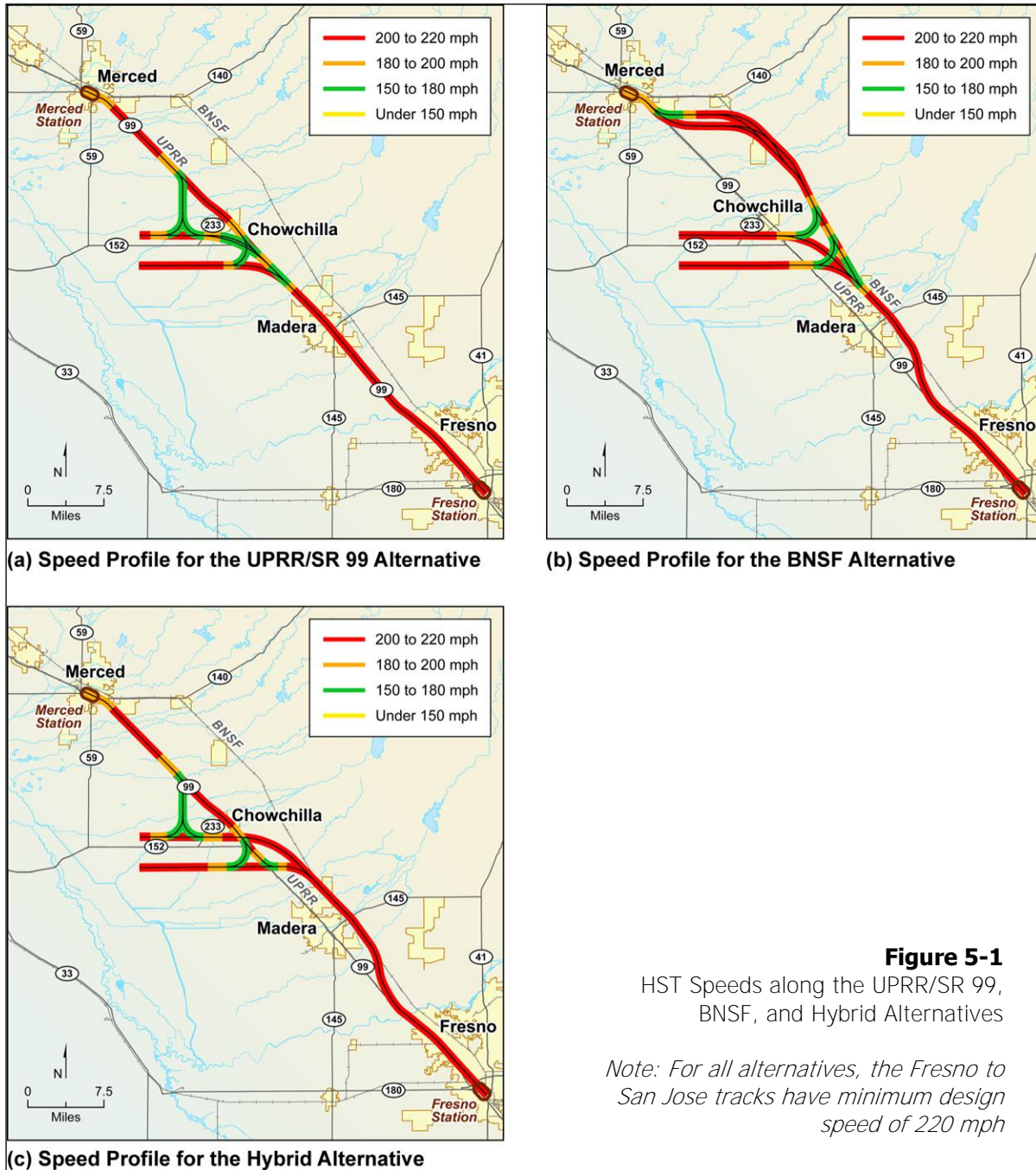
#### 5.3.2 Travel Times

Table 5-3 shows the optimal express train times between Merced, Fresno, and other destinations in the proposed statewide HST System. Merced and Fresno would connect to the Bay Area and Los Angeles in Phase 1. In Phase 2, the HST System would extend to Sacramento and San Diego by 2027.

**Table 5-3**

Optimal Express Travel Times from Merced to Fresno and Other Cities (hours:minutes)

	San Francisco	San Jose	Bakersfield	Los Angeles	Anaheim	Sacramento (Phase 2)	San Diego (Phase 2)	Fresno/Merced
Merced	1:14	0:45	0:52	1:40	1:58	0:43	2:57	0:21
Fresno	1:20	0:51	0:37	1:24	1:43	0:59	2:42	0:21



**Figure 5-1**  
 HST Speeds along the UPRR/SR 99,  
 BNSF, and Hybrid Alternatives

*Note: For all alternatives, the Fresno to San Jose tracks have minimum design speed of 220 mph*

### 5.3.3 Development of Operation and Maintenance Costs

Maintenance costs are generated in part by using the routine maintenance-of-way and infrastructure staffing estimates prepared by operations analysis based on the train miles for the section and the operating schedule provided in Chapter 2, Alternatives. As described in Chapter 2, the HST System would include several types of maintenance facilities.

The maintenance-of-way (i.e., infrastructure, guideways, and systems), and vehicle maintenance costs were developed primarily from information about other HST systems (specifically the Train de Grand Vitesse HST system in France). Information from non-US national railway and transport ministries verifies that the costs developed for the California HST System are consistent with their experience. Maintenance-

of-way labor is based on ratios per mile of guideway or rights-of-way, assuming more labor- and maintenance-intensive ballast guideway throughout, which would result in approximately 680 personnel in multiple specialized, mechanized teams over two shifts for the entire California HST System. The cost of maintenance-of-way materials were established as percentages of the capital cost per year, varying in accordance with the expected life of the investment and allowances for tools and equipment.

Maintenance of trainsets and other vehicle costs are based on a materials cost of per trainset mile per year for routine maintenance, and labor in two shifts spread throughout the facilities along the Phase 1 system. Heavy overhauls were estimated at \$1.02 per trainset mile per year (2009 dollars), including materials and additional staff in two shifts. In total, 2,120 persons would be working on vehicle maintenance and cleaning, including administrative personnel.

The overall calculation for the HST operating costs is based on an average hourly wage per employee of \$34 per hour (2009 dollars) with an additional 32% increase to cover fringe benefits and employer paid taxes. In addition, a contingency of 15% was added to all labor costs for drivers and onboard HST crew, and 10% for all other labor. The number of train operators and other staff required for Phase 1 operations is estimated at 1,347 individuals, which includes positions in central control, station services, sales, marketing, general administration, and security. Calculated O&M costs were then escalated by 3% to 2010 dollars.

Table 5-4 lists the total O&M costs estimated for Phase 1 of the California HST Project.

**Table 5-4**  
 Annual Phase 1 System O&M Cost (2010 \$Millions)

O&M Activity	Phase 1
Operations	\$633.0
Maintenance	531.8
Contingency	60.8
Insurance	51.5
<b>Total</b>	<b>\$1,277.1</b>

O&M costs are apportioned to the Merced to Fresno Section based on staffing and labor expenditures associated with the proposed O&M and other facilities and the trainset miles operated within this Section. Table 5-5 presents the estimated annual O&M costs allocated to the Merced to Fresno Section in 2010 dollars.

**Table 5-5**  
 Annual O&M Costs of the Merced to Fresno Section  
 (2010 \$Millions)

Annual O&M Cost	Without HMF	With HMF
Operations	\$68.2	\$68.2
Maintenance	20.9	121.7
Contingency	7.2	12.2
Insurance	6.1	6.1
<b>Total</b>	<b>\$102.5</b>	<b>\$208.3</b>