

## 5.0 Project Costs and Operations

### 5.1 Introduction

This chapter discusses the estimated costs for building, operating, and maintaining the Fresno to Bakersfield Section of the California HST System, based on a 15% level of design used in preparing this EIR/EIS. The approach and details used to prepare the construction cost estimate are provided in the *Fresno to Bakersfield Section Cost Estimate Report* (Authority and FRA 2013), which is available upon request from the Authority. Table 5.2-1 that provides the capital cost estimate for each alternative has been updated. Changes in this table primarily reflect changes in quantity estimates in the areas of track, track structures, site work, and right of way as a result of refinement in the project design.

### 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 and the Authority have developed 10 main Standardized Capital Cost Categories (SCCC). Each standard cost category is briefly further described below:

- **10 Track Structures & 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; and safety systems such as fire detection and prevention, security surveillance, access control, life safety systems, etc.
- **30 Support Facilities: Yards, Shops, 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 & Signaling** – includes all costs of implementing Automatic Train Control (ATC) systems, inclusive of Positive Train Control (PTC) and intrusion detection where it is applicable.
- **60 Electric Traction** – includes 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). Acquisition of trainsets is considered a system wide cost and is not included as part of the cost of individual HST 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).

### 5.2.1 High-Speed Train Alternatives

The conceptual HST cost estimates prepared for each of the study alternatives were 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 high-speed rail 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 Fresno to Bakersfield 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 identified, and power substations have been sized and located.

The costs include the total effort and materials to construct the Fresno to Bakersfield 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.

Right-of-way costs were estimated based on the 15% design and are provided in the *Fresno to Bakersfield Section Preliminary Right-of-Way Requirements Report* (Authority 2013). 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 2012 Business Plan (Authority 2012), 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. Additional costs are included for adaptation of existing trainset designs to meet U.S. safety regulations and to comply with 'Buy America' requirements. The systemwide cost of vehicle procurement is divided into three parts: Initial Operating Section (Merced to the San Fernando Valley), Bay to Basin (from San Jose and Merced to the San Fernando Valley) and the Phase 1 Blended System (San Francisco to Los Angeles and Anaheim). Total vehicle procurement cost is estimated at \$3.2 billion in 2011 dollars.

Professional services are estimated at 13.5% of the construction costs; these costs are divided between final design (6%), construction management (4%), program management (3%), and agency costs (0.5%). Environmental mitigation costs are estimated at approximately 3% of the capital cost, given 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 to be between 10% and 25% of the estimated construction and right-of-way acquisition costs, and unallocated contingency (project reserves intended to cover unknown risks) is estimated at 5% of the construction and right-of-way acquisition costs.

Table 5.2-1 shows estimates for each alternative from the Fresno Station to the Bakersfield Station.

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**Table 5.2-1**  
 Capital Cost of the HST Alternatives

FRA Standard Cost Categories Base Year FY 2010 Dollars (millions)	Alternatives																							
	(See note at end of table for the alternative combinations denoted by the numbers.)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
10 Track Structures & Track	\$2,945	\$2,498	\$2,584	\$2,822	\$2,917	\$2,573	\$2,668	\$3,131	\$2,882	\$2,925	\$2,867	\$3,020	\$3,017	\$2,478	\$2,564	\$2,420	\$2,506	\$2,573	\$2,659	\$2,570	\$2,656	\$2,329	\$2,415	\$2,553
20 Stations, Terminals, Intermodal	\$283	\$297	\$307	\$297	\$307	\$297	\$307	\$283	\$283	\$283	\$283	\$283	\$300	\$297	\$307	\$297	\$307	\$297	\$307	\$314	\$324	\$297	\$307	\$297
30 Support Facilities: Yards, Shops, Admin. Bldgs.	Only item in this category for the Fresno to Bakersfield Section is the heavy maintenance facility (HMF) if an alternative site in this section is selected. The cost estimate for the HMF is provided in Section 5.2.2.																							
40 Sitework, Right-of-Way, Land, Existing Improvements	\$2,660	\$2,797	\$2,764	\$2,721	\$2,715	\$2,630	\$2,624	\$2,606	\$2,515	\$2,647	\$2,517	\$2,765	\$2,754	\$2,784	\$2,751	\$2,654	\$2,621	\$2,902	\$2,869	\$2,891	\$2,858	\$2,638	\$2,605	\$2,889
50 Communications & Signaling	\$186	\$184	\$180	\$184	\$180	\$184	\$180	\$186	\$186	\$187	\$185	\$185	\$185	\$185	\$181	\$183	\$179	\$183	\$179	\$183	\$179	\$183	\$179	\$184
60 Electric Traction	\$605	\$601	\$587	\$601	\$587	\$602	\$588	\$605	\$606	\$604	\$600	\$602	\$602	\$600	\$586	\$596	\$582	\$598	\$584	\$598	\$584	\$595	\$581	\$597
70 Vehicles	Considered a systemwide cost and not included as part of individual HST study alternatives.																							
80 Professional Services (applies to Cats. 10-60)	\$777	\$740	\$746	\$774	\$785	\$730	\$741	\$795	\$751	\$773	\$756	\$788	\$788	\$736	\$742	\$719	\$725	\$751	\$757	\$751	\$757	\$706	\$712	\$747
90 Unallocated Contingency	\$290	\$275	\$277	\$287	\$290	\$272	\$275	\$297	\$282	\$289	\$281	\$299	\$298	\$274	\$276	\$266	\$268	\$284	\$286	\$283	\$285	\$261	\$263	\$283
100 Finance Charges	Estimate to be developed before project construction.																							
<b>Total</b>	<b>\$7,746</b>	<b>\$7,392</b>	<b>\$7,445</b>	<b>\$7,686</b>	<b>\$7,781</b>	<b>\$7,288</b>	<b>\$7,383</b>	<b>\$7,903</b>	<b>\$7,505</b>	<b>\$7,708</b>	<b>\$7,489</b>	<b>\$7,942</b>	<b>\$7,944</b>	<b>\$7,354</b>	<b>\$7,407</b>	<b>\$7,135</b>	<b>\$7,188</b>	<b>\$7,588</b>	<b>\$7,641</b>	<b>\$7,590</b>	<b>\$7,643</b>	<b>\$7,009</b>	<b>\$7,062</b>	<b>\$7,550</b>
Notes:	<p>All costs are based on the Fresno Station-Mariposa Alternative.                      All costs assume the use of the below-grade options for the Hanford West Bypass 1 and 2 alternatives. For use of the at-grade options for the Hanford West Bypass 1 and 2 alternatives, add \$157 million to the total.                      A combination of ballasted and non-ballasted track forms may be implemented and could result in a cost increase of less than 5%.</p> <p>Acronyms and Abbreviations:                      Admin Bldgs = Administration Buildings                      Cats. = Categories                      FRA = Federal Railroad Administration                      FY = Fiscal Year                      HST = high-speed train</p> <p>Alternative Numbering: Each alternative combination was given a different number. Below is a list of every single possible combination of the proposed alignment and alternatives. If an alternative alignment is not mentioned, the BNSF Alternative is the alignment being used.</p> <p>1. BNSF                      2. BNSF – Hanford West Bypass 1                      3. BNSF – Hanford West Bypass 2 – Corcoran Elevated                      4. BNSF – Hanford West Bypass 2 – Corcoran Bypass                      5. BNSF – Corcoran Elevated                      6. BNSF – Corcoran Bypass</p> <p>7. BNSF – Allensworth Bypass                      8. BNSF – Wasco-Shafter Bypass                      9. BNSF – Bakersfield South                      10. BNSF – Bakersfield Hybrid                      11. BNSF – Hanford West Bypass 1 – Allensworth Bypass                      12. BNSF – Hanford West Bypass 1 – Wasco-Shafter Bypass                      13. BNSF – Hanford West Bypass 1 – Bakersfield South                      14. BNSF – Hanford West Bypass 1 – Bakersfield Hybrid                      15. BNSF – Hanford West Bypass 1 – Allensworth Bypass – Wasco-Shafter Bypass                      16. BNSF – Hanford West Bypass 1 – Allensworth Bypass – Bakersfield South                      17. BNSF – Hanford West Bypass 1 – Allensworth Bypass – Bakersfield Hybrid                      18. BNSF – Hanford West Bypass 1 – Wasco-Shafter Bypass – Bakersfield South                      19. BNSF – Hanford West Bypass 1 – Wasco-Shafter Bypass – Bakersfield Hybrid                      20. BNSF – Hanford West Bypass 1 – Allensworth Bypass – Wasco-Shafter Bypass – Bakersfield South                      21. BNSF – Hanford West Bypass 1 – Allensworth Bypass – Wasco-Shafter Bypass – Bakersfield Hybrid                      22. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Allensworth Bypass                      23. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Wasco-Shafter Bypass                      24. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Bakersfield South</p>																							

**Table 5.2-1 Continued**  
 Capital Cost of the HST Alternatives

FRA Standard Cost Categories Base Year FY 2010 Dollars (millions)	Alternatives (See note at end of table for the alternative combinations denoted by the numbers.)																							
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
10 Track Structures & Track	\$2,639	\$2,550	\$2,636	\$2,495	\$2,581	\$2,492	\$2,578	\$2,404	\$2,490	\$2,401	\$2,487	\$2,802	\$2,897	\$2,744	\$2,839	\$2,897	\$2,992	\$2,894	\$2,989	\$2,653	\$2,748	\$2,877	\$2,972	\$2,874
20 Stations, Terminals, Intermodal	\$307	\$314	\$324	\$297	\$307	\$314	\$324	\$297	\$307	\$314	\$324	\$297	\$307	\$297	\$307	\$297	\$307	\$314	\$324	\$297	\$307	\$297	\$307	\$314
30 Support Facilities: Yards, Shops, Admin. Bldgs.	Only item in this category for the Fresno to Bakersfield Section is the heavy maintenance facility (HMF) if an alternative site in this section is selected. The cost estimate for the HMF is provided in Section 5.2.2.																							
40 Sitework, Right-of-Way, Land, Existing Improvements	\$2,856	\$2,878	\$2,845	\$2,759	\$2,726	\$2,748	\$2,715	\$2,743	\$2,710	\$2,732	\$2,699	\$2,708	\$2,702	\$2,578	\$2,572	\$2,826	\$2,820	\$2,815	\$2,809	\$2,562	\$2,556	\$2,813	\$2,807	\$2,802
50 Communications & Signaling	\$180	\$184	\$180	\$182	\$178	\$182	\$178	\$182	\$178	\$182	\$178	\$185	\$181	\$183	\$179	\$183	\$179	\$183	\$179	\$183	\$179	\$184	\$180	\$184
60 Electric Traction	\$583	\$597	\$583	\$593	\$579	\$593	\$579	\$592	\$578	\$592	\$578	\$600	\$586	\$596	\$582	\$598	\$584	\$598	\$584	\$595	\$581	\$597	\$583	\$597
70 Vehicles	Considered a systemwide cost and not included as part of individual HST study alternatives.																							
80 Professional Services (applies to Cats. 10-60)	\$753	\$747	\$753	\$730	\$736	\$730	\$736	\$717	\$723	\$717	\$723	\$770	\$781	\$753	\$764	\$785	\$796	\$785	\$796	\$740	\$751	\$781	\$792	\$781
90 Unallocated Contingency	\$285	\$282	\$284	\$275	\$277	\$274	\$276	\$270	\$272	\$269	\$271	\$286	\$289	\$278	\$281	\$296	\$299	\$295	\$298	\$273	\$276	\$295	\$298	\$294
100 Finance Charges	Estimate to be developed before project construction.																							
<b>Total</b>	<b>\$7,603</b>	<b>\$7,552</b>	<b>\$7,605</b>	<b>\$7,331</b>	<b>\$7,384</b>	<b>\$7,333</b>	<b>\$7,386</b>	<b>\$7,205</b>	<b>\$7,258</b>	<b>\$7,207</b>	<b>\$7,260</b>	<b>\$7,648</b>	<b>\$7,743</b>	<b>\$7,429</b>	<b>\$7,524</b>	<b>\$7,882</b>	<b>\$7,977</b>	<b>\$7,884</b>	<b>\$7,979</b>	<b>\$7,303</b>	<b>\$7,398</b>	<b>\$7,844</b>	<b>\$7,939</b>	<b>\$7,846</b>
Notes:	<p>All costs are based on the Fresno Station–Mariposa Alternative.                      All costs assume the use of the below-grade options for the Hanford West Bypass 1 and 2 alternatives. For use of the at-grade options for the Hanford West Bypass 1 and 2 alternatives, add \$157 million to the total.                      A combination of ballasted and non-ballasted track forms may be implemented and could result in a cost increase of less than 5%.</p> <p>Acronyms and Abbreviations:                      Admin Bldgs = Administration Buildings                      Cats. = Categories                      FRA = Federal Railroad Administration                      FY = Fiscal Year                      HST = high-speed train</p> <p>Alternative Numbering: Each alternative combination was given a different number. Below is a list of every single possible combination of the proposed alignment and alternatives. If an alternative alignment is not mentioned, the BNSF Alternative is the alignment being used.</p> <p>25. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Bakersfield Hybrid                      26. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Allensworth Bypass – Wasco-Shafter Bypass                      27. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Allensworth Bypass – Bakersfield South                      28. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Allensworth Bypass – Bakersfield Hybrid                      29. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Wasco-Shafter Bypass – Bakersfield South                      30. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Wasco-Shafter Bypass – Bakersfield Hybrid                      31. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Allensworth Bypass - Wasco-Shafter Bypass – Bakersfield South</p> <p>32. BNSF – Hanford West Bypass 2 – Corcoran Elevated – Allensworth Bypass - Wasco-Shafter Bypass – Bakersfield Hybrid                      33. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Allensworth Bypass                      34. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Wasco-Shafter Bypass                      35. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Bakersfield South                      36. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Bakersfield Hybrid                      37. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Allensworth Bypass – Wasco-Shafter Bypass                      38. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Allensworth Bypass – Bakersfield South                      39. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Allensworth Bypass – Bakersfield Hybrid                      40. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Wasco-Shafter Bypass – Bakersfield South                      41. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Wasco-Shafter Bypass – Bakersfield Hybrid                      42. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Allensworth Bypass - Wasco-Shafter Bypass – Bakersfield South                      43. BNSF – Hanford West Bypass 2 – Corcoran Bypass – Allensworth Bypass - Wasco-Shafter Bypass – Bakersfield Hybrid                      44. BNSF – Corcoran Elevated – Allensworth Bypass                      45. BNSF – Corcoran Elevated – Wasco-Shafter Bypass                      46. BNSF – Corcoran Elevated – Bakersfield South                      47. BNSF – Corcoran Elevated – Bakersfield Hybrid                      48. BNSF – Corcoran Elevated – Allensworth Bypass – Wasco-Shafter Bypass</p>																							

**Table 5.2-1 Continued**  
 Capital Cost of the HST Alternatives

FRA Standard Cost Categories Base Year FY 2010 Dollars (millions)	Alternatives (See note at end of table for the alternative combinations denoted by the numbers.)																							
	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
10 Track Structures & Track	\$2,969	\$2,819	\$2,914	\$2,816	\$2,911	\$2,728	\$2,823	\$2,725	\$2,820	\$2,553	\$2,648	\$2,495	\$2,590	\$2,648	\$2,743	\$2,645	\$2,740	\$2,404	\$2,499	\$2,628	\$2,723	\$2,625	\$2,720	\$2,570
20 Stations, Terminals, Intermodal	\$324	\$297	\$307	\$314	\$324	\$297	\$307	\$314	\$324	\$297	\$307	\$297	\$307	\$297	\$307	\$314	\$324	\$297	\$307	\$297	\$307	\$314	\$324	\$297
30 Support Facilities: Yards, Shops, Admin. Bldgs.	Only item in this category for the Fresno to Bakersfield Section is the heavy maintenance facility (HMF) if an alternative site in this section is selected. The cost estimate for the HMF is provided in Section 5.2.2.																							
40 Sitework, Right-of-Way, Land, Existing Improvements	\$2,796	\$2,683	\$2,677	\$2,672	\$2,666	\$2,667	\$2,661	\$2,656	\$2,650	\$2,617	\$2,611	\$2,487	\$2,481	\$2,735	\$2,729	\$2,724	\$2,718	\$2,471	\$2,465	\$2,722	\$2,716	\$2,711	\$2,705	\$2,592
50 Communications & Signaling	\$180	\$182	\$178	\$182	\$178	\$182	\$178	\$182	\$178	\$185	\$181	\$183	\$179	\$183	\$179	\$183	\$179	\$183	\$179	\$184	\$180	\$184	\$180	\$182
60 Electric Traction	\$583	\$593	\$579	\$593	\$579	\$592	\$578	\$592	\$578	\$601	\$587	\$597	\$583	\$599	\$585	\$599	\$585	\$596	\$582	\$598	\$584	\$598	\$584	\$594
70 Vehicles	Considered a systemwide cost and not included as part of individual HST study alternatives.																							
80 Professional Services (applies to Cats. 10-60)	\$792	\$764	\$775	\$764	\$775	\$751	\$762	\$751	\$762	\$726	\$737	\$709	\$720	\$741	\$752	\$741	\$752	\$696	\$707	\$737	\$748	\$737	\$748	\$720
90 Unallocated Contingency	\$297	\$287	\$290	\$286	\$289	\$282	\$285	\$281	\$284	\$271	\$274	\$263	\$266	\$281	\$284	\$280	\$283	\$258	\$261	\$280	\$283	\$279	\$282	\$272
100 Finance Charges	Estimate to be developed before project construction.																							
<b>Total</b>	<b>\$7,941</b>	<b>\$7,625</b>	<b>\$7,720</b>	<b>\$7,627</b>	<b>\$7,722</b>	<b>\$7,499</b>	<b>\$7,594</b>	<b>\$7,501</b>	<b>\$7,596</b>	<b>\$7,250</b>	<b>\$7,345</b>	<b>\$7,031</b>	<b>\$7,126</b>	<b>\$7,484</b>	<b>\$7,579</b>	<b>\$7,486</b>	<b>\$7,581</b>	<b>\$6,905</b>	<b>\$7,000</b>	<b>\$7,446</b>	<b>\$7,541</b>	<b>\$7,448</b>	<b>\$7,543</b>	<b>\$7,227</b>
<p>Notes:                      All costs are based on the Fresno Station–Mariposa Alternative.                      All costs assume the use of the below-grade options for the Hanford West Bypass 1 and 2 alternatives. For use of the at-grade options for the Hanford West Bypass 1 and 2 alternatives, add \$157 million to the total.                      A combination of ballasted and non-ballasted track forms may be implemented and could result in a cost increase of less than 5%.</p> <p>Acronyms and Abbreviations:                      Admin Bldgs = Administration Buildings                      Cats. = Categories                      FRA = Federal Railroad Administration                      FY = Fiscal Year                      HST = high-speed train                      Alternative Numbering: Each alternative combination was given a different number. Below is a list of every single possible combination of the proposed alignment and alternatives. If an alternative alignment is not mentioned, the BNSF Alternative is the alignment being used.</p> <p>49. BNSF – Corcoran Elevated – Allensworth Bypass – Bakersfield South                      50. BNSF – Corcoran Elevated – Allensworth Bypass – Bakersfield Hybrid                      51. BNSF – Corcoran Elevated – Wasco Shafter Bypass – Bakersfield South                      52. BNSF – Corcoran Elevated – Wasco Shafter Bypass – Bakersfield Hybrid                      53. BNSF – Corcoran Elevated – Allensworth Bypass – Wasco-Shafter Bypass – Bakersfield South                      54. BNSF – Corcoran Elevated – Allensworth Bypass – Wasco-Shafter Bypass – Bakersfield Hybrid                      55. BNSF – Corcoran Bypass – Allensworth Bypass                      56. BNSF – Corcoran Bypass – Wasco-Shafter Bypass                      57. BNSF – Corcoran Bypass – Bakersfield South                      58. BNSF – Corcoran Bypass – Bakersfield Hybrid                      59. BNSF – Corcoran Bypass – Allensworth Bypass – Wasco-Shafter Bypass                      60. BNSF – Corcoran Bypass – Allensworth Bypass – Bakersfield South                      61. BNSF – Corcoran Bypass – Allensworth Bypass – Bakersfield Hybrid                      62. BNSF – Corcoran Bypass – Wasco-Shafter Bypass – Bakersfield South                      63. BNSF – Corcoran Bypass – Wasco-Shafter Bypass – Bakersfield Hybrid                      64. BNSF – Corcoran Bypass – Allensworth Bypass – Wasco-Shafter Bypass – Bakersfield South                      65. BNSF – Corcoran Bypass – Allensworth Bypass – Wasco-Shafter Bypass – Bakersfield Hybrid                      66. BNSF – Allensworth Bypass – Wasco-Shafter Bypass                      67. BNSF – Allensworth Bypass – Bakersfield South                      68. BNSF – Allensworth Bypass – Bakersfield Hybrid                      69. BNSF – Allensworth Bypass – Wasco-Shafter Bypass – Bakersfield South                      70. BNSF – Allensworth Bypass – Wasco-Shafter Bypass – Bakersfield Hybrid                      71. BNSF – Wasco-Shafter Bypass – Bakersfield South                      72. BNSF – Wasco-Shafter Bypass – Bakersfield Hybrid</p>																								

**Table 5.2-1 Continued**  
 Capital Cost of the HST Alternatives

FRA Standard Cost Categories Base Year FY 2010 Dollars (millions)	Alternatives (See note at end of table for the alternative combinations denoted by the numbers.)																							
	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
10 Track Structures & Track	\$2,665	\$2,567	\$2,662	\$2,479	\$2,574	\$2,476	\$2,571	\$3,111	\$3,053	\$3,206	\$3,203	\$2,962	\$3,186	\$3,183	\$3,128	\$3,125	\$3,037	\$3,034	\$2,862	\$2,804	\$2,957	\$2,954	\$2,713	\$2,937
20 Stations, Terminals, Intermodal	\$307	\$314	\$324	\$297	\$307	\$314	\$324	\$283	\$283	\$283	\$300	\$283	\$283	\$300	\$283	\$300	\$283	\$300	\$283	\$283	\$283	\$300	\$283	\$283
30 Support Facilities: Yards, Shops, Admin. Bldgs.	Only item in this category for the Fresno to Bakersfield Section is the heavy maintenance facility (HMF) if an alternative site in this section is selected. The cost estimate for the HMF is provided in Section 5.2.2.																							
40 Sitework, Right-of-Way, Land, Existing Improvements	\$2,586	\$2,581	\$2,575	\$2,576	\$2,570	\$2,565	\$2,559	\$2,593	\$2,463	\$2,711	\$2,700	\$2,447	\$2,698	\$2,687	\$2,568	\$2,557	\$2,552	\$2,541	\$2,502	\$2,372	\$2,620	\$2,609	\$2,356	\$2,607
50 Communications & Signaling	\$178	\$182	\$178	\$182	\$178	\$182	\$178	\$187	\$185	\$185	\$185	\$185	\$186	\$186	\$184	\$184	\$184	\$184	\$187	\$185	\$185	\$185	\$185	\$186
60 Electric Traction	\$580	\$594	\$580	\$593	\$579	\$593	\$579	\$604	\$600	\$602	\$602	\$599	\$601	\$601	\$597	\$597	\$596	\$596	\$605	\$601	\$603	\$603	\$600	\$602
70 Vehicles	Considered a systemwide cost and not included as part of individual HST study alternatives.																							
80 Professional Services (applies to Cats. 10-60)	\$731	\$720	\$731	\$707	\$718	\$707	\$718	\$791	\$774	\$806	\$806	\$761	\$802	\$802	\$785	\$785	\$772	\$772	\$747	\$730	\$762	\$762	\$717	\$758
90 Unallocated Contingency	\$275	\$271	\$274	\$267	\$270	\$266	\$269	\$296	\$288	\$306	\$305	\$283	\$305	\$304	\$297	\$296	\$292	\$291	\$281	\$273	\$291	\$290	\$268	\$290
100 Finance Charges	Estimate to be developed before project construction.																							
<b>Total</b>	<b>\$7,322</b>	<b>\$7,229</b>	<b>\$7,324</b>	<b>\$7,101</b>	<b>\$7,196</b>	<b>\$7,103</b>	<b>\$7,198</b>	<b>\$7,865</b>	<b>\$7,646</b>	<b>\$8,099</b>	<b>\$8,101</b>	<b>\$7,520</b>	<b>\$8,061</b>	<b>\$8,063</b>	<b>\$7,842</b>	<b>\$7,844</b>	<b>\$7,716</b>	<b>\$7,718</b>	<b>\$7,467</b>	<b>\$7,248</b>	<b>\$7,701</b>	<b>\$7,703</b>	<b>\$7,122</b>	<b>\$7,663</b>
Notes:	<p>All costs are based on the Fresno Station-Mariposa Alternative.                      All costs assume the use of the below-grade options for the Hanford West Bypass 1 and 2 alternatives. For use of the at-grade options for the Hanford West Bypass 1 and 2 alternatives, add \$157 million to the total.                      A combination of ballasted and non-ballasted track forms may be implemented and could result in a cost increase of less than 5%.</p> <p>Acronyms and Abbreviations:                      Admin Bldgs = Administration Buildings                      Cats. = Categories                      FRA = Federal Railroad Administration                      FY = Fiscal Year                      HST = high-speed train</p> <p>Alternative Numbering: Each alternative combination was given a different number. Below is a list of every single possible combination of the proposed alignment and alternatives. If an alternative alignment is not mentioned, the BNSF Alternative is the alignment being used.</p> <p>73. BNSF – HW Bypass 2 Modified – Corcoran Bypass – Wasco Shafter Bypass – Bakersfield South                      74. BNSF – HW Bypass 2 – Corcoran Bypass – Wasco Shafter Bypass – Bakersfield Hybrid                      75. BNSF – HW Bypass 2 Modified – Corcoran Bypass – Wasco Shafter Bypass – Bakersfield Hybrid                      76. BNSF – HW Bypass 2 – Corcoran Bypass – Allensworth Bypass - Wasco Shafter Bypass – Bakersfield South                      77. BNSF – HW Bypass 2 Modified – Corcoran Bypass – Allensworth Bypass - Wasco Shafter Bypass – Bakersfield South</p> <p>78. BNSF – HW Bypass 2 – Corcoran Bypass – Allensworth Bypass - Wasco Shafter Bypass – Bakersfield Hybrid                      79. BNSF – HW Bypass 2 Modified – Corcoran Bypass – Allensworth Bypass - Wasco Shafter Bypass – Bakersfield Hybrid                      80. BNSF – Corcoran Elevated – Allensworth Bypass                      81. BNSF – Corcoran Elevated – Wasco Shafter Bypass                      82. BNSF – Corcoran Elevated – Bakersfield South                      83. BNSF – Corcoran Elevated – Bakersfield Hybrid                      84. BNSF – Corcoran Elevated - Allensworth Bypass – Wasco Shafter Bypass                      85. BNSF – Corcoran Elevated - Allensworth Bypass – Bakersfield South                      86. BNSF – Corcoran Elevated - Allensworth Bypass – Bakersfield Hybrid                      87. BNSF – Corcoran Elevated – Wasco Shafter Bypass – Bakersfield South                      88. BNSF – Corcoran Elevated – Wasco Shafter Bypass – Bakersfield Hybrid                      89. BNSF – Corcoran Elevated - Allensworth Bypass - Wasco Shafter Bypass – Bakersfield South                      90. BNSF – Corcoran Elevated - Allensworth Bypass - Wasco Shafter Bypass – Bakersfield Hybrid                      91. BNSF – Corcoran Bypass – Allensworth Bypass                      92. BNSF – Corcoran Bypass – Wasco Shafter Bypass                      93. BNSF – Corcoran Bypass – Bakersfield South                      94. BNSF – Corcoran Bypass – Bakersfield Hybrid                      95. BNSF – Corcoran Bypass - Allensworth Bypass – Wasco Shafter Bypass                      96. BNSF – Corcoran Bypass - Allensworth Bypass – Bakersfield South</p>																							



**Table 5.2-1 Continued**  
 Capital Cost of the HST Alternatives

FRA Standard Cost Categories Base Year FY 2010 Dollars (millions)	Alternatives (See note at end of table for the alternative combinations denoted by the numbers.)											
	97	98	99	100	101	102	103	104	105	106	107	108
10 Track Structures & Track	\$2,934	\$2,879	\$2,876	\$2,788	\$2,785	\$2,776	\$3,000	\$2,997	\$2,851	\$2,848	\$2,942	\$2,939
20 Stations, Terminals, Intermodal	\$300	\$283	\$300	\$283	\$300	\$283	\$283	\$300	\$283	\$300	\$283	\$300
30 Support Facilities: Yards, Shops, Admin. Bldgs.	Only item in this category for the Fresno to Bakersfield Section is the heavy maintenance facility (HMF) if an alternative site in this section is selected. The cost estimate for the HMF is provided in Section 5.2.2.											
40 Sitework, Right-of-Way, Land, Existing Improvements	\$2,596	\$2,477	\$2,466	\$2,461	\$2,450	\$2,501	\$2,752	\$2,741	\$2,606	\$2,595	\$2,622	\$2,611
50 Communications & Signaling	\$186	\$184	\$184	\$184	\$184	\$185	\$186	\$186	\$184	\$184	\$184	\$184
60 Electric Traction	\$602	\$598	\$598	\$597	\$597	\$599	\$601	\$601	\$596	\$596	\$597	\$597
70 Vehicles	Considered a systemwide cost and not included as part of individual HST study alternatives.											
80 Professional Services (applies to Cats. 10-60)	\$758	\$741	\$741	\$728	\$728	\$743	\$784	\$784	\$754	\$754	\$767	\$767
90 Unallocated Contingency	\$289	\$282	\$281	\$277	\$276	\$276	\$298	\$297	\$285	\$284	\$290	\$289
100 Finance Charges	Estimate to be developed before project construction.											
<b>Total</b>	<b>\$7,665</b>	<b>\$7,444</b>	<b>\$7,446</b>	<b>\$7,318</b>	<b>\$7,320</b>	<b>\$7,363</b>	<b>\$7,904</b>	<b>\$7,906</b>	<b>\$7,559</b>	<b>\$7,561</b>	<b>\$7,685</b>	<b>\$7,687</b>
Notes: All costs are based on the Fresno Station-Mariposa Alternative. All costs assume the use of the below-grade options for the Hanford West Bypass 1 and 2 alternatives. For use of the at-grade options for the Hanford West Bypass 1 and 2 alternatives, add \$157 million to the total. A combination of ballasted and non-ballasted track forms may be implemented and could result in a cost increase of less than 5%.  Acronyms and Abbreviations: Admin Bldgs = Administration Buildings Cats. = Categories FRA = Federal Railroad Administration FY = Fiscal Year HST = high-speed train Alternative Numbering: Each alternative combination was given a different number. Below is a list of every single possible combination of the proposed alignment and alternatives. If an alternative alignment is not mentioned, the BNSF Alternative is the alignment being used.												
97. BNSF – Corcoran Bypass - Allensworth Bypass – Bakersfield Hybrid 98. BNSF – Corcoran Bypass – Wasco Shafter Bypass – Bakersfield South 99. BNSF – Corcoran Bypass – Wasco Shafter Bypass – Bakersfield Hybrid 100. BNSF – Corcoran Bypass – Allensworth Bypass - Wasco Shafter Bypass – Bakersfield South 101. BNSF – Corcoran Bypass – Allensworth Bypass - Wasco Shafter Bypass – Bakersfield Hybrid 102. BNSF – Allensworth Bypass – Wasco Shafter Bypass 103. BNSF - Allensworth Bypass – Bakersfield South 104. BNSF - Allensworth Bypass – Bakersfield Hybrid 105. BNSF – Allensworth Bypass – Wasco Shafter Bypass – Bakersfield South 106. BNSF – Allensworth Bypass – Wasco Shafter Bypass – Bakersfield Hybrid 107. BNSF – Wasco Shafter Bypass – Bakersfield South 108. BNSF – Wasco Shafter Bypass – Bakersfield Hybrid												

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### 5.2.2 Heavy Maintenance Facility

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 Fresno and Bakersfield. Table 5.2-2 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 5.2-2**  
 Cost for Heavy Maintenance Facility Site Alternatives

FRA Standard Cost Categories	Heavy Maintenance Facility Base Year FY 2010 Dollars (thousands)
10 Track Structures & Track	\$32,000
20 Stations, Terminals, Intermodal	0
30 Support Facilities: Yards, Shops, Admin. Bldgs.	383,000
40 Sitework, Right-of-Way, Land, Existing Improvements	77,000
50 Communications & Signaling	3,000
60 Electric Traction	37,000
70 Vehicles	0
80 Professional Services (applies to Cats. 10–60)	66,000
90 Unallocated Contingency	22,000
100 Finance Charges	0
<b>Total:</b>	<b>\$620,000</b>
FY = fiscal year	

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 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.

### 5.3 Operation and Maintenance (O&M) Costs

Chapter 2, Alternatives, describes Operation and Maintenance (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 starting in 2027. The plan is to offer express, limited-stop, and all-stop services, depending on the time of the day and projected needs. For Phases 1 and 2 there would be 24 HST stations; up to 3 HST stations would be located within the Fresno to Bakersfield Section. Multiple facilities would be required for overnight storage, inspection, and routine maintenance of over 200 trainsets, each 656 feet long, by 2035. An HMF serving the entire HST system would be needed and could be located in the Fresno to Bakersfield Section. If so, it would serve as a facility to store and maintain a portion of the trainsets. One maintenance-of-way facility would also be required 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 apportionment of systemwide O&M cost estimates to the Fresno to Bakersfield Section is proportional to the O&M activity and facilities within the section.

### 5.3.1 Operating Speeds

The HST would operate at high speeds (up to 220 miles per hour) throughout the Fresno to Bakersfield Section except for the Bakersfield Hybrid Alternative. With that alternative, the HST would operate at a speed of 120 miles per hour through Bakersfield.

### 5.3.2 Travel Times

Table 5.3-1 shows the optimal express train times between Fresno, Bakersfield, and other destinations in the proposed statewide HST System. Fresno and Bakersfield 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 5.3-1**  
 Optimal Express Travel Times from Fresno to Bakersfield and Other Cities (hours:minutes)

	San Francisco	San Jose	Los Angeles	Anaheim	Sacramento (Phase 2)	San Diego (Phase 2)	Bakersfield
Fresno	1:20	0:51	1:24	1:43	0:59	2:42	0:37
Bakersfield	1:51	1:21	0:54	1:13	1:29	2:12	n—

### 5.3.3 Development of Operation and Maintenance (O&M) Costs

O&M costs were estimated for the operations needed to serve and carry the forecast traffic for Phases 1 and 2, as described in Chapter 2, Alternatives; the maintenance necessary to keep the entire system in a state of good repair; and the administrative activities and costs. 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 California HST 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 United States. Therefore, international O&M unit cost projections from comparable HST operations were applied to planned California operations, HST technology, and local cost levels and labor practices.

The cost of operation and maintenance of HST equipment includes the cost of (1) crew, administration, and supplies to operate and dispatch the HST services; (2) electric power for traction, onboard systems, stations, and maintenance/other facilities; and (3) cleaning, inspection, maintenance, and overhaul of 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 facilities.

Station costs include the day-to-day operations of the station, ticket sales and machine maintenance, public safety, passenger handling, and cleaning.

Insurance, administration, and contingency costs round out the categories of costs presented.

At the higher level of activity associated with HST fares at 50% of airfares, maintenance of equipment activities around the state would employ 4,800 persons, transportation operations would employ 4,100 persons, maintenance of infrastructure activities would employ 800 persons, and all other activities would employ 1,600 persons. At the lower level of riders and operations associated with HST fares at 83% of airfares, employment would be roughly one-third lower in the three categories, except maintenance of infrastructure, which would be similar to the estimated employment with fares at 50% of airfares.

Table 5.3-2 lists the total O&M costs estimated for the full system, on completion of Phases 1 and 2, of the California HST System for the year 2035.

**Table 5.3-2**  
 Annual Phase Full System O&M Cost, Year 2035(2010 \$Millions)

O&M Activity	HST Fares at 50% of Airfare	HST Fares at 83% of Airfare
Operations & Maintenance of Equipment	\$1,967	\$1,312
Maintenance of Infrastructure	\$165	\$165
Stations	\$101	\$101
Insurance	\$25	\$25
Administration (10% of above)	\$226	\$161
Contingency (10% of above)	\$248	\$176
Total	\$2,732	\$1,940
HST = high-speed train O&M = operations and maintenance		

O&M costs in 2010 dollars as apportioned to the Fresno to Bakersfield Section are shown in Table 5.3-3, based on the levels of activity associated with the section as a proportion of full system costs. The costs associated with "Operations & Maintenance of Equipment" are apportioned on the basis of trainset miles operated within the Fresno to Bakersfield Section with and without the HMF. The costs associated with "Maintenance of Infrastructure" are apportioned as a ratio of 120 route miles to the 800 total route miles. The costs associated with "Stations" are apportioned as a ratio based on 3 of the 24 stations being situated in the Fresno to Bakersfield Section. The costs of "Administration" and "Contingency" are calculated as a percentage of the overall system costs.

**Table 5.3-3**  
 Annual 2035 O&M Costs Apportioned to the Fresno to Bakersfield Section  
 (2010 \$millions)

Annual O&M Cost	HST Fares at 50% of Airfare		HST Fares at 83% of Airfare	
	Without HMF	With HMF	Without HMF	With HMF
Operations & Maintenance of Equipment	\$236	\$628	\$158	\$419
Maintenance of Infrastructure	\$25	\$25	\$25	\$25
Stations	\$13	\$13	\$13	\$13
Insurance	\$3	\$3	\$3	\$3
Administration (10% of above)	\$28	\$67	\$20	\$46
Contingency (10% of above)	\$30	\$74	\$22	\$51
<b>Total</b>	<b>\$335</b>	<b>\$809</b>	<b>\$240</b>	<b>\$556</b>
HMF = heavy maintenance facility HST = high-speed train O&M = operations and maintenance				