Draft Bay Area to Central Valley High-Speed Train (HST) Program Environmental Impact Report/ Environmental Impact Statement (EIR/EIS)

Summary

July 2007

U.S. Department of Transportation
Federal Railroad Administration

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Draft

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Summary

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July 2007

California High-Speed Rail Authority and Federal Railroad Administration. 2007. *Bay Area to Central Valley High-Speed Train (HST) Program Environmental Impact Report/ Environmental Impact Statement (EIR/EIS)*. Draft.   Summary. July. Sacramento, CA and Washington, D.C.

S-1 SUMMARY

S-1.1 Introduction and Background

The California High-Speed Rail Authority (Authority) proposes a high-speed train (HST) system for intercity travel in California between the major metropolitan centers of Sacramento and the San Francisco Bay Area in the north, through the Central Valley, to Los Angeles and San Diego in the south. The HST system is projected to carry as many as 117 million passengers annually by the year 2030. The Authority adopted a final business plan (Business Plan) in June 2000, which examined the economic viability of a train system capable of speeds in excess of 200 miles per hour (mph) (322 kilometers per hour [kph]) on a fully grade-separated track, with state-of-the-art safety, signaling, and automated control systems. The Authority and Federal Railroad Administration (FRA) completed a statewide program environmental impact report/ environmental impact statement (EIR/EIS) in November 2005 as the first phase of a tiered environmental review process for the proposed HST system. The HST Alternative was selected by the Authority and FRA. As part of this selection, the Authority and FRA defined a broad corridor between the Bay Area and Central Valley for additional review at the program level (Figure S.1-1).

Following the certification of the statewide program EIR/EIS, the Authority initiated this Bay Area to Central Valley environmental review process for compliance with state and federal laws, in particular the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). This Bay Area to Central Valley HST Program EIR/EIS (Program EIR/EIS) further examines this region as the next phase of the tiered environmental review process. The Authority is the project sponsor and the lead agency for purposes of the state CEQA requirements. The FRA is the federal lead agency for compliance under NEPA.

This Bay Area to Central Valley study region is generally bounded by (and includes) the Pacheco Pass (State Route 152 [SR 152]) to the south, the Altamont Pass (Interstate 580 [I-580]) to the north, the BNSF corridor to the east, and the Caltrain corridor to the west[1] (Figure S.1-1). The Authority directed staff to "prepare a separate program-level EIR to identify a preferred alignment within the broad corridor between and including the Altamont Pass and Pacheco Pass for the HST segment connecting the San Francisco Bay Area to the Central Valley." This Program EIR/EIS evaluates the potential impacts of proposed alignment alternatives and station location options in the study region and defines general mitigation strategies to address potentially significant adverse impacts. Future tiered, site-specific project-level environmental documents will assess the impacts of constructing and implementing individual HST projects (i.e., portions of the HST system).

The Authority envisions seeking possible future federal financial support for the system, which may be provided through the FRA. The FRA and the U.S. Department of Transportation (DOT) have several loan and loan guarantee programs that might be potential sources of future financial assistance. Although no grant or federal bond financing programs currently provide such support, several proposals to create such programs are pending before Congress. In addition to possible funding, a Rule of Particular Applicability is likely to be required from the FRA to establish safety standards for the proposed HST system for operating at speeds over 200 mph (322 kph) and for operations in shared-use rail corridors.

The Notice of Preparation (NOP) for this Program EIR/EIS was released November 14, 2005. The Notice of Intent (NOI) was published in the Federal Register on November 28, 2005. The scoping process included 12 officially noticed agency and public scoping meetings in late November and early December

1 Highway route numbers are provided only as a convenient reference for the reader, not as a limitation on the corridor to be considered.

2005. Recognizing the important relationship of HST alignments and stations to a regional rail system in the northern California area, the HST scoping meetings were held in conjunction with public meetings on the San Francisco Bay Area Regional Rail Plan initiation meetings. More than 500 people participated in the scoping meetings. During the scoping process, the Authority gathered information from agencies and interested members of the public regarding their questions and concerns related to the scope of this Program EIR/EIS.

Following the issuance of the NOI and NOP and the scoping meetings, the Authority and the FRA formed a working group made up of representatives from 27 federal and state agencies to consult during the environmental review process. The interagency group met during the development of this Draft Program EIR/EIS to discuss major issues from the perspective of these agencies and to provide input to the lead agencies to help focus the analysis and streamline the review process.

The federal and state agency representatives included in this process were asked to provide input for the following specific areas.

- Scope of the Program EIR/EIS.
- Purpose and need statement/program objectives.
- Technical methods of analysis and study area definition.
- Substantive issues of particular concern.
- Sources of information and data relevant to their agencies.
- Impact avoidance, minimization, and mitigation strategies.
- Identification of possible alternatives to be analyzed in the Program EIR/EIS.
- Procedural requirements and permits or approvals necessary for subsequent phases of environmental review.

The Authority also held numerous meetings with and invited input from regional and local agencies in the region potentially affected by the proposed HST system. Meetings of the Authority governing board were also a forum for providing information about the environmental process. These meetings were held in major cities in the project area to provide a convenient opportunity for regional and local participation and input.

Comments received during this scoping process assisted the Authority and FRA in their review and evaluation of possible HST Alignment Alternatives and station location options and identification of those to be carried forward for environmental evaluation in this Program EIR/EIS (described in Section S-4).

S-1.2 Purpose of and Need for a High-Speed Train System in California

S-1.2.1 Purpose

This Program EIR/EIS identifies and evaluates HST Alignment Alternatives and station location options within and related to the Bay Area to Central Valley study region as part of a statewide HST system. The purpose of the Bay Area HST is *to provide a reliable high-speed electrified train system that links the major Bay Area cities to the Central Valley, Sacramento, and southern California and that delivers predictable and consistent travel times. Further objectives are to provide interfaces between the HST system and major commercial airports, mass transit, and the highway network and to relieve capacity constraints of the existing transportation system in a manner sensitive to and protective of the Bay Area's and California's unique natural resources.*

S-1.2.2 Statewide Need[2]

The capacity of California's intercity transportation system is insufficient to meet existing and future demand, and the current and projected future congestion of the system will continue to result in deteriorating air quality, reduced reliability, and increased travel times. The system has not kept pace with the tremendous increase in population, economic activity, and tourism in the state. The interstate highway system, commercial airports, and conventional passenger rail system serving the intercity travel market are operating at or near capacity and will require large public investments for maintenance and expansion to meet existing demand and future growth over the next 20 years and beyond. Moreover, the ability to expand many major highways and key airports is uncertain; some needed expansions may be impractical or may be constrained by physical, political, or other factors. Simply stated, the need for improvements serving intercity travel in California relates to the following issues.

- Future growth in demand for intercity travel.
- Capacity constraints that will result in increasing congestion and travel delays.
- Unreliability of travel stemming from congestion and delays, weather conditions, accidents, and other factors that affect the quality of life and economic well-being of residents, businesses, and tourism in California.
- Reduced mobility as a result of increasing demand on limited modal connections between major airports, transit systems, and passenger rail in the state.
- Poor and deteriorating air quality and pressure on natural resources as a result of expanded highways and airports.

S-1.2.3 Regional Need

The needs of the Bay Area to Central Valley region are similar to those identified for the statewide HST system.

A. REGIONAL GROWTH

Today, the nine-county Bay Area is home to nearly 7 million people and more than 3 million jobs. By 2050, the region's population is anticipated to grow by more than 40%, for a total of 10 million people. This population growth will put tremendous pressure on the existing transportation network, and the peak travel periods are expected to encompass many more hours of the day. For example, MTC's 2000 San Francisco Bay Crossing Study projected the Bay Bridge peak period to more than double from 1.5 hours in 2000 to 3.5 hours by 2020.

Additionally, growth in the region is taking place in the form of dispersed land uses that rely on individual vehicles for most trips. Without improved and more extensive transit systems leading to the main Central Valley cities and connecting them to each other, there will be little chance for these cities to move toward compact transit-oriented development.

B. REGIONAL CONGESTION

The Bay Area already experiences the second-worst traffic congestion in the country, after Los Angeles. Congestion is expected to worsen over the next 25 years, especially in existing hotspots. The combination of significant population growth, dispersed development patterns (requiring a car for most trips), highway facilities that cannot keep pace with traffic demands, and large increases in interregional commuting, has worsened and will continue to worsen congestion levels and the associated environmental and economic impacts.

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[2] Also presented in the statewide program EIR/EIS (California High-Speed Rail Authority and Federal Railroad Administration 2005).

C. ECONOMIC IMPLICATIONS

The adverse economic impacts of congestion and inadequate transportation/transit access are already apparent. The 150,000 daily hours of Bay Area commute congestion had an estimated cost of $2.6 billion in 2003 alone. When transportation access to urban and suburban centers becomes too difficult, employers are likely to move jobs to areas where land prices are lower and workers' commutes might be shorter. Without better passenger rail access, major job growth will continue to decentralize and move to places like the Central Valley.

D. ENVIRONMENTAL IMPLICATIONS

Without an expanded rail and transit network and more compact development, there may be greater adverse effects on the natural environment. More than 400,000 acres (ac) (161,874 hectares [ha]) of land in the Bay Area are at risk from development. Promoting development in walkable communities near HST, intermodal, and other transit stations offers the best opportunity for taking development pressure off open space and farms. Demand for an additional 550,000 homes near transit in the Bay Area by 2030 is anticipated, but transit-oriented development functions well only when transit service is sufficiently frequent and reliable that residents can reduce the length and the number of car trips they take.

An additional growing environmental concern is global climate change, and the transportation sector is responsible for about 40% of greenhouse gas emissions in California, and up to 50% in the Bay Area. Because these emissions are directly proportional to the amount of fuel burned, offering effective and efficient transportation choices can result in reduced driving and reduced emissions.

S-1.3 Alternatives

The Program EIR/EIS evaluates the No Project, and HST Alternative Alignments and station locations options, and representative HST Network Alternatives within the Bay Area to Central Valley region.

S-1.3.1 No Project Alternative

This Program EIR/EIS compares the No Project and HST Alternative Alignments (Figure S.4-1). For the No Project Alternative, both existing and future conditions (2030) are considered. The No Project Alternative represents the region’s transportation system (highway, air, and conventional rail) as it existed in 1999–2000 and as it would be in 2030 with the addition of transportation projects currently programmed for implementation (already in funded programs/financially constrained plans) according to the State Transportation Improvement Program (STIP), regional transportation plans (RTPs) for all modes of travel, airport improvement plans, and intercity passenger rail plans.

The No Project Alternative addresses the geographic area serving the same intercity travel market as the proposed HST Alignment Alternatives in the region, as described below. The No Project Alternative is assessed for how it would satisfy the purpose and need and program objectives for the HST system regarding congestion, safety, reliability, and travel times.

S-1.3.2 High-Speed Train Alignment Alternatives and Station Location Options

The HST Alignment Alternatives and station location options in the region represent the proposed action. A statewide HST system was selected by the Authority and FRA as the preferred system alternative in the statewide Program Final EIR/EIS. It has been identified on a statewide basis as the environmentally preferred alternative under NEPA, as well as the environmentally superior alternative under CEQA.

The HST system would consist of steel train tracks on a trackbed placed at grade level, on an aerial structure, in a tunnel, or in a trench. Trainsets would travel on the trackbed between stations and would be powered by electrical power supplied to the train from an overhead catenary system that would receive its power from the power distribution system. Train maintenance and layover facilities would be located at select locations along the HST line. This Program EIR/EIS analyzes the impacts from portions of the system that would be located within the broadly defined Bay Area to Central Valley region—referred to as the *study region* in this Program EIR/EIS.

Technology

Informed by previous studies and the statewide program EIR/EIS, the Authority and FRA selected state-of-the-art, electrically powered, high-speed, steel-wheel-on-steel-rail technology for the proposed statewide system, which would serve the major metropolitan centers in California, including the study region.

State-of-the-art safety, signaling, and automated train-control systems would be used. The steel-wheel-on-steel-rail electrified train is proposed to be primarily on exclusive track, with small portions of the route on shared track with other passenger rail operations. The train track would be at grade, in an open trench or tunnel, or on an elevated guideway, depending on terrain and physical constraints. To reduce potential environmental impacts, extensive portions of many of the alignment alternatives are within or adjacent to existing rail or highway right-of-way, rather than on new alignment. Tunnel segments of the alignment are proposed through the mountain passes (e.g., Diablo Range/Pacheco Pass between south San Jose and the Merced).

Service Levels

Most passenger service is assumed to run between 6:00 a.m. and 8:00 p.m. By 2030, the proposed service would include approximately 124–139 weekday trains in each direction to serve the study region and the statewide intercity travel market, with 91–96 of the trains running between northern and southern California and the remaining 33–43 trains serving shorter distance markets. The proposed system would be capable of speeds in excess of 200 mph (322 kph), and the projected travel times would be designed to compete with air and auto travel. For example, the projected travel time by HST between San Francisco in the Bay Area and Los Angeles would be just over 2 and a half hours.

A representative statewide system evaluated in this Program EIR/EIS was forecast to carry between 88 and 117 million passengers in 2030, with the potential to accommodate higher ridership by adding trains. For a conservative assessment of potential environmental impacts, the higher ridership forecast has been used in describing the proposed HST system and its impacts, and is referred to as *representative demand* ridership. However, for resource topics where the high-end ridership forecasts would result in potential benefits (e.g., energy, air quality, and travel conditions), additional analysis is included to address the impacts associated with the low-end forecasts.

Determination of Range of Alternative Alignments and Station Location Options

The Authority and the FRA started developing the HST Alignment Alternatives by seeking to identify the most reasonable and practicable HST corridors, alignments, and station location options for analysis in this Program EIR/EIS. As part of this process, HST technologies and corridors previously considered were reevaluated, and a screening of potential alignment alternatives and station location options was conducted. This screening analyzed all reasonable and practical alignment alternatives and station location options within the selected HST corridors in the study region.

The evaluation of potential HST corridors, alignment alternatives, and station location options used the following factors: extent of construction difficulty, environmental impacts, land use compatibility, right-of-way needs, potential connectivity/accessibility to other transportation facilities and services, and ridership/revenue generation potential. The screening of alignment alternatives and station location options comprised the following key activities.

- Review of past alignment alternatives and station location options identified within selected corridors defined in previous studies.
- Identification through the environmental scoping process of alignment alternatives and station location options not previously evaluated.
- Evaluation of alignment alternatives and station location options using standardized engineering, environmental, and financial criteria (described above) and evaluation methodologies at a consistent level of analysis.
- Identification of the ability of alignment alternatives and station location options to meet defined objectives.

The results of this analysis are documented in the *Draft Alignment Alternatives and Potential Station Locations Options Report* (California High-Speed Rail Authority and Federal Railroad Administration 2006), presented at the Authority's March 22, 2006, board meeting and in the *Additional Potential HST Alignment and Stations Considered but Rejected Report* (California High-Speed Rail Authority and Federal Railroad Administration 2006) presented at the Authority's August 9, 2006, *Board Meeting*. Technical data, combined with public and agency input, provided the Authority and the FRA with the necessary information to focus further studies for the Program EIR/EIS on those alignment alternatives, station location options, and HST systems that represent a reasonable range of practicable alternatives to meet the project purpose and attain several objectives established by the Authority. Those objectives include:

- Maximize ridership and revenue potential.
- Maximize connectivity and accessibility.
- Maximize compatibility with existing and planned development.
- Maximize avoidance of areas with geologic and soils constraints.
- Maximize avoidance of areas with potential hazardous materials.
- Minimize operating and capital costs.
- Minimize impacts on natural resources.
- Minimize impacts on social and economic resources.
- Minimize impacts on cultural resources.

Complex issues associated with the tunneling were addressed as part of the statewide program EIR/EIS process. This work focused on the feasibility, construction methods, and cost assumptions associated with proposed tunneling for the HST system and resulted in the Authority's objective of minimizing the amount of tunneling required, particularly the use of long tunnels (more than 6 mi [10 km] long), due to cost, time of construction, and potential for delay. Tunnels more than 12 mi (19 km) long are generally considered infeasible for this project, and it is the Authority's objective to cross major fault zones at grade. The technical information produced as part of the statewide program EIR/EIS is documented in the *Tunneling Issues Report* (California High-Speed Rail Authority January 2004).

Alternative Alignments and Station Location Options

To facilitate analysis and presentation of the HST Alignment Alternatives in this Program EIR/EIS, the study region was divided into six corridors: (1) San Francisco to San Jose, (2) Oakland to San Jose, (3) San Jose to Central Valley, (4) East Bay to Central Valley, (5) San Francisco Bay Crossings, and (6) Central Valley. These corridors encompass considerable variations in terms of land use, terrain, and construction configuration (mix of at-grade, aerial structure, and tunnel sections). The alignment alternatives and station location options considered in each corridor are defined in Table S.4-1.

Table S.4-1

Alignment Alternatives and Potential Station Location Options

Corridor	Possible Alignments	Alignment Alternative	Alignment Alternative Description
San Francisco to San Jose: Caltrain	1 of 1	San Francisco to Dumbarton	From San Francisco, this alignment alternative would follow south the Caltrain rail alignment and assumes that the HST system would share tracks with Caltrain commuter trains. The entire alignment would be grade separated.
	1 of 1	Dumbarton to San Jose	
Station Location Options One of two: Transbay Transit Center or 4th and King Millbrae/SFO One of two: Redwood City or Palo Alto			
Oakland to San Jose: Niles/ I-880	1 of 2	West Oakland to Niles Junction	From Oakland, this alignment alternative would travel south following the Union Pacific Railroad's (UPRR's) Niles Subdivision Line (i.e., Hayward Line) and then transition to I-880. The alignment would be at-grade along the Niles Subdivision Line.
		12th Street/City Center to Niles Junction	
	1 of 2	Niles Junction to San Jose via Trimble	The alignment alternative would be at-grade along the Niles Subdivision Line and on an aerial structure in the median of I-880. The I-880 HST portion would mostly be on an aerial configuration from San Jose to Fremont. The Trimble Road segment would be on an aerial structure and in a tunnel (where adjacent to San Jose International Airport).
		Niles Junction to San Jose via I-880	This alignment alternative would travel south following the UPRR's Niles Subdivision Line (i.e., Hayward Line), then transition to I-880. The alignment would be at-grade along the Niles Subdivision Line and on an aerial structure in the median of I-880. The I-880 HST portion would mostly be on an aerial configuration from San Jose to Fremont.
Station Location Options One of two: West Oakland/7th Street or 12th Street/City Center Coliseum/Airport One of two: Union City (BART) or Fremont (Warm Springs)			
San Jose to Central Valley: Pacheco Pass	1 of 1	Pacheco	This alignment alternative would extend south along the Caltrain/UPRR rail corridor through the Pacheco Pass and then the San Joaquin Valley along either Henry Miller Road (connecting to either the UPRR or BNSF) or north of the Grassland Ecological Area (GEA) connection to the BNSF.
	1 of 3	Henry Miller (UPRR Connection)	
		Henry Miller (BNSF Connection)	
		GEA North	

Corridor	Possible Alignments	Alignment Alternative	Alignment Alternative Description
Station Location Options o San Jose (Diridon) o One of two stations: Morgan Hill (Caltrain) or Gilroy (Caltrain)			
East Bay to Central Valley: Altamont Pass	1 of 4	I-680/ 580/UPRR	This alignment alternative would extend east via a relatively direct routing (mostly in tunnel) between Niles Junction and I-680, then use the I-680 alignment before transitioning to the I-580 corridor (at the I-580/I-680 junction).
		I-580/ UPRR	This alignment alternative would extend east via a relatively direct routing (mostly in tunnel) between Niles Junction and I-680, then use the UPRR alignment through Pleasanton before transitioning to the I-580 corridor through Livermore and the Altamont Pass to Tracy.
		Patterson Pass/UPRR	This alignment alternative would extend east via a relatively direct routing (mostly in tunnel) between Niles Junction and I-680 then use the UPRR alignment through Pleasanton and Livermore before transitioning to the I-580 corridor through the Patterson Pass between Livermore and Tracy.
		UPRR	This alignment alternative would extend east via a relatively direct routing (mostly in tunnel) between Niles Junction and I-680, then use the UPRR alignment through Pleasanton and Livermore before transitioning to the I-580 corridor through the Altamont Pass to Tracy.
	1 of 4	Tracy Downtown (BNSF Connection)	From Livermore, these alignments would pass through either downtown Tracy or to the current Tracy ACE station connection with either the BNSF or UPRR.
		Tracy ACE Station (BNSF Connection)	
		Tracy ACE Station (UPRR Connection)	
		Tracy Downtown (UPRR Connection)	
Station Location Options One of six stations, depending on the alignment alternative: Pleasanton (I-680/Bernal Rd), Pleasanton (BART), Livermore (Downtown) , Livermore (I-580), Livermore (Greenville Road/UPRR), Livermore (Greenville Road/I-580) One of two stations, depending on the alignment alternative: Tracy (Downtown) or Tracy (ACE)			
San Francisco Bay Crossings	1 of 2	Trans Bay Crossing – Transbay Transit Center	This alignment alternative would connect the Oakland (West Oakland or 12th Street City Center) and San Francisco (Transbay Transit Center or 4th and King) HST stations via a new transbay tube. This alignment could serve either Altamont Pass or Pacheco Pass alignment alternatives.
		Trans Bay Crossing – 4th & King	
	1 of 6	Dumbarton (High Bridge)	This alignment alternative would serve the Altamont Pass alignment alternatives and link the East Bay to the San Francisco Peninsula in the vicinity of the existing Dumbarton Rail Bridge. Between Niles Junction and the Dumbarton
		Dumbarton (Low Bridge)	

Corridor	Possible Alignments	Alignment Alternative	Alignment Alternative Description
		Dumbarton (Tube)	Bridge, this option would use the Centerville rail alignment. Design options for this alignment include use of an improved Dumbarton Rail Bridge (low level), a new high-level bridge, and a new transbay tube.
		Fremont Central Park (High Bridge)	This alignment alternative would serve the Altamont Pass alignment alternatives and link the East Bay to the San Francisco Peninsula in the vicinity of the existing Dumbarton Rail Bridge. Between Niles Junction and the Dumbarton Bridge, this alignment alternative would use an existing utility alignment and a new alignment through the Don Edwards Natural Wildlife Refuge. Design options for this alignment include use of an improved Dumbarton Rail Bridge (low level), a new high-level bridge, and a new transbay tube.
		Fremont Central Park (Low Bridge)	
		Fremont Central Park (Tube)	
Station Location Options Union City (Shinn)			
Central Valley	1 of 6	BNSF – UPRR	This alignment alternative would use various connectors between the BNSF and UPRR alignments.
		BNSF	This alignment alternative would connect with either the Altamont or Pacheco Pass alignment alternatives, using principally the BNSF rail line in the Central Valley.
		UPRR N/S	This alignment alternative would connect with either the Altamont or Pacheco Pass alignment alternatives, using principally the UPRR rail line in the Central Valley.
		BNSF Castle	This alignment alternative would diverge from the BNSF alignment to serve the Castle Air Force Base (AFB).
		UPRR – BNSF Castle	This alignment alternative would diverge from the UPRR - BNSF alignment to serve the Castle AFB.
		UPRR – BNSF	This alignment alternative would use various connectors between the UPRR and BNSF alignments.
Station Location Options One of two stations for Modesto, depending on the alignment alternative: Downtown Modesto or Briggsmore (Amtrak). One of two stations for Merced, depending on the alignment alternative: Downtown Merced or Castle AFB.			

The alignment alternatives and stations location options analyzed in this Program EIR/EIS are shown in Figure S.4-1. For purposes of this analysis, conceptual designs were developed for all of the alignment alternatives and station location options carried forward that include plan and profile sheets, cross sections, and station descriptions (Appendices 2-D through 2-F). Conceptual designs are based on *Engineering Criteria* (California High-Speed Rail Authority and Federal Railroad Administration 2004).

As part of the development of the *Bay Area Regional Rail Plan*, some HST Alignment Alternatives were considered for regional rail "overlay" services that would be implemented by other transportation agencies in cooperation with the Authority. Overlay services would involve operating regional commuter trains on the HST infrastructure and serving additional non-HST regional rail stations. Regional rail overlay services are not integral to the HST system and are not considered alternatives in this Program EIR/EIS; however, the development of the regional rail plan is considered in the cumulative analysis of HST Alignment Alternatives as a related but separate potential project.

Network Alternatives

Information for a range of HST Network Alternatives is also reported to better understand the implications of selection of certain alignment alternatives and station location options. A network alternative consists of a combination of alignment alternatives and station location options (i.e., combining the corridors described on page S-6 and listed in Table S.4-1, to provide an HST network in the study region as part of a statewide HST system). To provide a broad range of information about network alternatives, several operating scenarios for combinations of terminus stations were investigated, with one exception (a network alternative that terminates in Union City), the network alternatives range from one to three of the major city centers in the Bay Area (San Francisco, Oakland, and San Jose) having direct HST service. Representative network alternatives are defined in Chapter 2 and evaluated in Chapter 7 of the Draft Program EIR/EIS.

S-1.4 High-Speed Train Network Alternatives Comparisons

The HST Network Alternatives vary in their ability to meet the purpose, need, and objectives of the HST system, and they provide additional data to inform the future identification of preferred alignment alternatives and station location options. Although HST Alignment Alternatives and station location options were screened and evaluated to identify those that are likely to be reasonable and practicable and meet the project's purpose, need, and objectives, the representative network alternatives have not yet been so evaluated. The network alternatives were developed to enable an evaluation and comparison of how various combinations of alignment alternatives would meet the project's purpose and need and how each would perform as an HST network that is part of a statewide HST system (e.g., travel times between various station locations, anticipated ridership, operating and maintenance costs, energy consumption, auto trip diversions). The different system characteristics, as well as environmental impacts and factors of the network alternatives, present complex choices that will be better supported and informed following public review and comment on this Program EIR/EIS.

A summary comparison and important differences among network alternatives are described below. Table S.5-1 presents a summary of characteristics and potential impacts for the 21 representative network alternatives. These representative network alternatives present a range of reasonable alternatives among the three basic approaches for linking the Bay Area and Central Valley: Altamont Pass (11 network alternatives); Pacheco Pass (6 network alternatives); and Pacheco Pass with Altamont Pass (local service) (4 network alternatives). The impact quantities provided are prior to any mitigation. A more extensive presentation of characteristics and potential impacts is provided in Chapter 7 of the Draft Program EIR/EIS.

S-1.4.1 Travel Conditions/Service to Urban Centers/International Airports

The HST Network Alternatives vary in the degree they serve urban areas/centers and international airports. All but one[3] of the network alternatives provide direct HST services to (i.e., includes a HST station within) one and up to three of the major urban centers in the Bay Area—San Francisco, San Jose, and Oakland. Some of the network alternatives provide direct service to the international airports at San Francisco and/or Oakland. Each network alternative provides service to particular travel corridors and

[3] One network alternative would not directly serve San Francisco, Oakland, or San Jose but would rather pass over the Altamont Pass and terminate at Union City.

Table S.5-1: Summary of Characteristics and Impacts for the Network Alternatives

Characteristic / Impacts	Altamont Pass											Pacheco Pass						Pacheco Pass with Altamont Pass (local service)			
	San Francisco & San Jose Termini	Oakland & San Jose Termini	San Francisco, Oakland & San Jose Termini	San Jose Terminus	San Francisco Terminus	Oakland Terminus	Union City Terminus	San Francisco & San Jose — via SF Peninsula	San Francisco, San Jose, Oakland – no Bay Crossing	Oakland & San Francisco – via Transbay tube	San Jose, Oakland, & San Francisco via Transbay tube	San Francisco & San Jose Termini	Oakland & San Jose Termini	San Francisco, Oakland, & San Jose Termini	San Jose Terminus	San Jose, San Francisco & Oakland- via Transbay Tube	San Jose, Oakland & San Francisco- via Transbay Tube	San Francisco & San Jose Termini	Oakland & San Jose Termini	SF, Oak, & SJ Termini (without Dumbarton Bridge)	San Jose Terminus
Figure # (see Chapter 7 of the Draft Program EIR/EIS)	*7.2-1*	*7.2-2*	*7.2-3*	*7.2-4*	*7.2-5*	*7.2-6*	*7.2-7*	*7.2-8*	*7.2-9*	*7.2-10*	*7.2-11*	*7.2-12*	*7.2-13*	*7.2-14*	*7.2-15*	*7.2-16*	*7.2-17*	*7.2-18*	*7.2-19*	*7.2-20*	*7.2-21*
Length (miles)	203.34	182.16	241.16	160.18	191.56	170.86	157.93	213.30	244.70	179.64	199.11	267.53	256.87	309.60	213.15	276.31	265.66	339.16	318.45	360.90	286.04
Number of stations	9	8	11	6	8	7	5	9	11	8	9	7	7	10	4	8	8	10	9	12	7
Capital costs (billions $)	$12.7	$10.0	$15.1	$7.7	$11.0	$8.2	$6.0	$12.6	$14.5	$12.9	$14.8	$12.4	$11.6	$16.0	$8.0	$17.0	$16.3	$18.3	$16.0	$20.4	$13.5
Capital costs/mile of alignment (millions)	$62.5	$54.9	$62.6	$48.1	$57.4	$48.0	$38.0	$59.1	$59.3	$71.8	$74.3	$46.3	$45.2	$51.7	$37.5	$61.5	$61.4	$54.0	$50.2	$56.5	$47.2
Ridership (millions annual)	87.91	88.01	81.13	94.65	93.88	94.39	83.49	90.75	85.22	95.94	89.62	93.33	91.37	85.52	79.69	95.2	92.07	96.15	92.88	87.81	89.79
Revenue (millions annual)	$2,844	$2,881	$2,625	$3,176	$3,127	$3,153	$2,701	$2,743	$2,733	$3,164	$2,884	$3,090	$3,071	$2,782	$2,666	$3,152	$3,038	$2,992	$3,065	$2,897	$2,963
Annual operating costs (millions)	$1,099	$1,085	$1,098	$1,076	$1,124	$1,093	$1,073	$1,115	$1,123	$1,106	$1,093	$1,182	$1,166	$1,174	$1,099	$1,196	$1,179	$1,171	$1,140	$1,179	$1,130
Bridge over bay=B Transbay tube=T	B	—	B	—	B	—	—	B	—	T	T	—	—	—	—	T	T	B	—	—	—
SF, Oakland, San Jose - # served	2	2	3	1	1	1	0	2	3	1	3	2	2	3	1	3	3	2	2	3	1
International airports	SFO	OAK	SFO/OAK	—	SFO	OAK	—	SFO	SFO/OAK	OAK	OAK	SFO	OAK	SFO/OAK	—	SFO	OAK	SFO	OAK	SFO/OAK	—
Express Train Travel Times (Hours.Min)																					
San Francisco - Los Angeles	2.36	—	2.36	—	2.36	—	—	2.36	3.17	2.31	2.31	2.38	—	2.38	—	2.38	2.38	2.45	—	3.26	—
Oakland - Los Angeles	—	2.23	2.23	—	—	2.23	—	—	2.23	2.23	2.23	—	2.30	2.30	—	2.46	2.30	—	2.30	2.30	—
San Jose - Los Angeles	2.19	2.19	2.19	2.19	—	—	—	2.37	2.19	—	2.19	2.09	2.09	2.09	2.09	2.09	2.09	2.26	2.26	2.26	2.26
San Francisco - Sacramento	1.06	—	1.06	—	1.06	—	—	1.06	1.39	0.57	0.57	1.47	—	1.47	—	1.47	1.44	1.15	—	1.48	—
Oakland - Sacramento	—	0.53	0.53	—	—	0.53	—	—	0.53	0.53	0.53	—	1.38	1.38	—	1.43	1.38	—	1.00	1.00	—
San Jose - Sacramento	0.49	0.49	0.49	0.49	—	—	—	1.03	0.49	—	0.49	1.18	1.18	1.18	1.18	1.18	1.18	0.56	0.56	0.56	0.56
Union City - Los Angeles	—	—	—	—	—	—	2.13	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Characteristic / Impacts	Altamont Pass											Pacheco Pass						Pacheco Pass with Altamont Pass (local service)			
	San Francisco & San Jose Termini	Oakland & San Jose Termini	San Francisco, Oakland & San Jose Termini	San Jose Terminus	San Francisco Terminus	Oakland Terminus	Union City Terminus	San Francisco & San Jose — via SF Peninsula	San Francisco, San Jose, Oakland – no Bay Crossing	Oakland & San Francisco – via Transbay tube	San Jose, Oakland, & San Francisco via Transbay tube	San Francisco & San Jose Termini	Oakland & San Jose Termini	San Francisco, Oakland, & San Jose Termini	San Jose Terminus	San Jose, San Francisco & Oakland- via Transbay Tube	San Jose, Oakland & San Francisco- via Transbay Tube	San Francisco & San Jose Termini	Oakland & San Jose Termini	SF, Oak, & SJ Termini (without Dumbarton Bridge)	San Jose Terminus
Union City - Sacramento	—	—	—	—	—	—	0.43	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Farmland (acres)	764.2	761.9	764.2	761.9	757.8	755.5	755.5	757.8	761.9	755.5	761.9	1,372.3	1,378.7	1,378.7	1,372.3	1,372.3	1,378.7	1,380.0	1,384.1	1,384.1	1,384.1
Prime farmland (acres)	429.1	426.8	429.1	426.8	422.7	420.3	420.3	422.7	426.8	420.3	426.8	663.3	669.7	669.7	663.3	663.3	669.7	760.4	764.5	764.5	764.5
Floodplains (acres) direct impacts	308.3	218.6	315.3	211.6	270.7	181.1	177.6	317.7	314.5	181.1	218.6	520.8	477.5	573.4	424.9	520.8	477.5	547.1	456.4	552.2	432.2
Floodplains/linear mile of alignment	1.52	1.20	1.31	1.32	1.41	1.06	1.12	1.49	1.29	1.01	1.10	1.95	1.86	1.85	1.99	1.88	1.80	1.61	1.43	1.53	1.51
Streams (linear feet)	16,824	17,660	19,814	14,670	15,995	16,831	14,432	17,481	20,273	16,831	17,660	20,276	21,788	24,401	17,663	20,276	30,278	27,130	27,666	30,278	24,197
Waterbodies (lakes + SF bay) (acres)	39.6	2.3	39.6	2.3	39.6	2.3	2.3	39.6	2.3	38.8	38.8	3.8	4.5	4.5	3.8	40.3	41	41.9	5.3	5.3	4.6
Wetlands (acres)	45.9	12.3	46.3	12.0	44.4	10.8	10.7	44.4	12.4	33.6	35.1	15.6	17.4	17.5	15.5	38.4	40.2	56.1	25.3	25.4	23.7
Nonwetland waters (linear feet)	16,773	14,032	16,932	13,577	15,947	13,502	13,113	15,947	14,662	13,502	14,032	14,395	14,533	15,123	14,395	14,395	14,553	19,891	17,977	18,556	17,521
Species (special status plants)	56	40	57	39	56	39	38	56	56	40	42	58	49	63	46	59	50	70	67	71	54
Species (special status wildlife)	50	44	50	43	49	44	36	49	50	43	43	53	49	53	38	53	49	57	51	58	50
Cultural resources (number)	149	128	173	93	144	112	88	180	203	112	117	165	106	193	78	106	109	196	133	220	109
4(f)/6(f) Resources (0-150 feet)	22	20	28	14	14	12	9	20	30	13	21	16	17	28	6	17	19	23	25	35	17
Station Location Options																					
Transbay Transit Center	■		■		■			■	■	■	■	■		■		■	■	■		■	
Millbrae/SFO	■		■		■			■	■			■		■		■		■		■	
Redwood City (Caltrain)	■		■		■				■							■					
Palo Alto (Caltrain)								■				■		■				■		■	
West Oakland/7th Street		■	■			■			■	■	■		■	■		■	■		■	■	
Coliseum/Airport		■	■			■			■	■	■		■	■			■		■	■	

Characteristic/Impacts	Altamont Pass											Pacheco Pass						Pacheco Pass with Altamont Pass (local service)			
	San Francisco & San Jose Termini	Oakland & San Jose Termini	San Francisco, Oakland & San Jose Termini	San Jose Terminus	San Francisco Terminus	Oakland Terminus	Union City Terminus	San Francisco & San Jose — via SF Peninsula	San Francisco, San Jose, Oakland – no Bay Crossing	Oakland & San Francisco – via Transbay tube	San Jose, Oakland, & San Francisco via Transbay tube	San Francisco & San Jose Termini	Oakland & San Jose Termini	San Francisco, Oakland, & San Jose Termini	San Jose Terminus	San Jose, San Francisco & Oakland- via Transbay Tube	San Jose, Oakland & San Francisco- via Transbay Tube	San Francisco & San Jose Termini	Oakland & San Jose Termini	SF, Oak, & SJ Termini (without Dumbarton Bridge)	San Jose Terminus
Union City (BART)		■	■			■	■		■	■	■		■	■			■		■	■	
Union City (Shinn)					■			■													
Fremont (Warm Springs)	■			■														■			■
San Jose (Diridon)	■	■	■	■				■	■		■	■	■	■	■	■	■	■	■	■	■
Gilroy (Caltrain)												■	■	■	■	■	■	■	■	■	■
Pleasanton (I-680/Bernal Rd)	■	■	■	■	■	■	■	■	■	■	■							■	■	■	■
Tracy (Downtown)	■	■	■	■	■	■	■	■	■	■	■							■	■	■	■
Modesto (Downtown)	■	■	■	■	■	■	■	■	■	■	■							■	■	■	■
Briggsmore (Amtrak)												■	■	■	■	■	■				
Merced (Downtown)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Notes

■ indicates stations served

urban areas, ranging from direct service along the Caltrain corridor to downtown San Francisco to direct service to San Jose Station (Diridon) and/or to downtown Oakland. Some would provide direct service to southern Santa Clara County, southern Alameda County, and/or the Tri-Valley area.

Connectivity with and enhancement of other transit systems (e.g., ACE, Caltrain, Capital Corridor, BART, Valley Transportation Authority) also varies among the network alternatives. The network alternatives would greatly increase the capacity for intercity and commuter travel and reduce existing automobile traffic in specific travel corridors. Full grade-separation along rail corridors included in the network alternative would improve local traffic flow and reduce air pollution at existing rail crossings.

Direct service to more of the study region would result in greater benefits for travel conditions, including increased connectivity to other transit systems, increased convenience, increased reliability, and improved travel times. In particular, a direct connection to the San Francisco International Airport, the region's hub airport, and/or to the Oakland International Airport provides increased connectivity for air transportation system riders.

The combinations and variations of HST station location options and associated direct service areas for each network alternative are described in detail in the travel conditions sections shown in Chapter 7 of the Draft Program EIR/EIS.

S-1.4.2 Capital and Operating Costs

Capital Costs

Capital costs for the HST Network Alternatives range from $6.0 billion for Altamont Pass Union City terminus—the shortest network alternative—to $20.4 billion for a combination of the Altamont and Pacheco Network options with service to all three urban centers—the longest network alternative. The average cost per mile ranges from $37.5 million for a Pacheco Pass alternative terminating at San Jose to $74.3 million for a Pacheco Pass alignment serving San Francisco and Oakland with a new transbay tube.

The highest costs per mile are for the network alternatives that include a new San Francisco Bay crossing in a tube or a bridge. Network alternatives that include a new transbay tube between Oakland and San Francisco exhibit costs per mile of between $61.4 and $74.3 million. Network alternatives that include a new bridge crossing of the Bay near Dumbarton exhibit costs between $54.0 and $62.6 million per mile.

Inclusion of a new transbay tube is estimated to cost from $3.8 to $4.0 billion. A new Dumbarton Bridge is estimated to cost $1.3 to $1.7 billion. Crossing the Bay in a tube in the Dumbarton Corridor would cost an additional $362 million compared to the high bridge option[4].

The remaining network alternatives range in cost per mile between $37.5 for a Pacheco alignment ending in San Jose and $59.3 for an Altamont alignment that would circle the bay and serve San Jose, Oakland, and San Francisco with no bay crossing.

Operating Issues and Costs

The cost to operate and maintain an HST system varies proportionately with the length of the network and the frequency of the service to be provided. For the comparison presented in this document, the frequency of trains serving the Bay Area was kept consistent between the network alternatives considered. The systemwide operating and maintenance (O&M) costs are the lowest for the Altamont Pass network alternatives, ranging from $1.07 to $1.12 billion per year, because of the substantially

[4] Unit costs for the Oakland to San Francisco transbay tube, Dumbarton railbridge (high-bridge and low-bridge options), and Dumbarton tube were obtained from MTC as part of the *Regional Rail* planning studies.

shorter length for Sacramento to Bay Area services. The systemwide O&M costs for the Pacheco Pass network alternatives are approximately $80 million per year more than the Altamont Pass network alternatives serving the same markets.

The Altamont Pass network alternatives would require the system to split in two separate directions to serve both San Jose and San Francisco given a constant number of trains. This decreases the frequency of service from other markets in the state to these stations by a factor of two, as compared to network alternatives using the Pacheco Pass alignment alternatives. Based on forecasted travel demand, two-thirds of the trains would be directed to San Francisco and one-third of the trains would be directed to San Jose. Serving San Jose and both sides of the Bay Area (San Francisco Peninsula and East Bay) would require a three-direction split for the Altamont Pass network alternatives and a two-direction split for the Pacheco Pass network alternatives.

HST operations would need to be coordinated and integrated with existing and planned commuter rail services, including Caltrain service on the San Francisco Peninsula and ACE service in the I-580 corridor.

S-1.4.3 Travel Times

Express train travel times from San Francisco to Los Angeles vary by 2 minutes between the Pacheco Pass and Altamont Pass network alternatives, assuming a new Bay Crossing at Dumbarton for the Altamont Pass. On the Altamont Pass network alternatives, this trip would take 2 hours and 36 minutes and 2 additional minutes for the Pacheco Pass network alternatives. For Oakland, the express trip to Los Angeles would take 7 minutes longer for the Pacheco Pass network alternatives compared to the Altamont Pass network alternatives, which would take 2 hours and 23 minutes. A San Jose to Los Angeles express trip over the Pacheco Pass (via Henry Miller Road) would take 2 hours and 19 minutes and would be 10 minutes faster than the Altamont Pass network alternatives.

Larger differences are apparent for the express trips between San Francisco and Sacramento. For the Altamont Pass network alternatives[5], this trip would take 1 hour and 6 minutes. The Pacheco Pass network alternatives would take an additional 41 minutes. An express trip between Oakland and Sacramento would take 53 minutes over the Altamont Pass and an additional 45 minutes over the Pacheco Pass. From San Jose to Sacramento, the express travel time over the Pacheco Pass would be 49 minutes, with an additional 29 minutes over the Pacheco Pass.

S-1.4.4 Ridership

The base (low-end) ridership forecasts for the network alternatives range from 79.7 million passengers a year by 2030 for the Pacheco Pass San Jose (only) terminus—the shortest Pacheco Pass network alternative—to 96.2 million passengers a year by 2030 for the Pacheco Pass plus Altamont Pass (local service) to San Francisco and San Jose network alternative. The base (low-end) revenue for the network alternatives ranges from $2.63 to $3.18 billion per year by 2030. Table S.5-1 summarizes the total base ridership and revenue forecast for each network alternative.

The results indicate that frequency of service is a major factor toward high ridership and revenue for the network alternatives. For example, the Altamont Pass option with service to San Francisco (no direct links to San Jose or Oakland) has higher ridership and revenue forecast than for the base Altamont Pass network alternative (with direct service to San Francisco and Oakland), where total frequency of service is split between the line to San Francisco and the line to San Jose. The ridership and revenue is less for network alternatives where there is a reduced frequency of service to the major markets. Additional frequency of service (along with higher operational costs) would be needed to increase ridership for these network alternatives.

[5] For Altamont Pass options with a new Bay Crossing at Dumbarton

S-1.4.5 Farmland Impacts

Impacts to farmland range from 755.5 (306 ha) to 764.2 ac (309 ha) for the Altamont Pass network alternatives and from 1,372.3 (555 ha) to 1,378.7 ac (558 ha) for the Pacheco Pass network alternatives. The higher Pacheco Pass numbers are in part due to the use of the BNSF-UPRR, rather than the UPRR N/S alignment, in the Central Valley for the representative Pacheco network alternatives. Use of the BNSF-UPRR alignment adds 240 additional ac (97 ha) of impacts to farmlands for the Pacheco Pass network alternatives. The Pacheco Pass network alternatives would have higher farmland impacts than the Altamont Pass network alternatives, even if the 240 additional ac (97 ha) for the Central Valley BNSF-UPRR alignment were removed. Acreages for the combined Altamont Pass and Pacheco Pass network alternatives range from 1,380 (558.5 ha) to 1384.1 ac (560.13 ha) and include the lower impact UPRR alignment in the Central Valley.

A similar pattern is apparent for the prime farmland, with Altamont Pass network alternatives impacts ranging from 420.3 (170 ha) to 429.1 ac (174 ha) and Pacheco Pass network alternatives ranging from 663.3 (268 ha) to 669.7 ac (271 ha). Use of the BNSF-UPRR alignment adds 57 additional ac (23 ha) of impacts to prime farmlands for the Pacheco Pass network alternatives. The Pacheco Pass network alternatives would have higher prime farmland impacts than the Altamont Pass network alternatives, even if the 57 additional ac (23 ha) for the Central Valley BNSF-UPRR alignment were removed. The combined Altamont Pass and Pacheco Pass network alternatives show a range between 760.4 (308 ha) and 764.5 ac (309 ha).

S-1.4.6 Floodplain Impacts

Impacts to floodplain for the network alternatives range from 177.6 (72 ha) to 315.3 ac (127.6 ha) for the Altamont Pass network alternatives. The Pacheco Pass network alternatives show a floodplain impact range of 424.9 (171.95 ha) to 573.4 ac (232 ha). Use of the BNSF-UPRR alignment adds 60.1 additional (24 ha) ac of floodplain impacts to the Pacheco Pass network alternatives. The Pacheco Pass network alternatives would have higher floodplain impacts than the Altamont Pass network alternatives, even if the 60.1 (24 ha) additional ac for the Central Valley BNSF-UPRR Alignment were removed. Acreage impacts per linear mile range from a low of 1.01 ac (0 ha) for the Altamont Oakland and San Francisco via a transbay tube alignment to a high of 1.99 ac (1 ha) for the Pacheco Pass network alternative terminating in San Jose.

S-1.4.7 Biological Impacts

Streams and Lakes/San Francisco Bay

On a per mile basis, the linear feet of stream crossings range from 75.79 (31 ha) to 133.97 (54 ha). The network alternatives that cross the San Francisco Bay affect 38.8 (17 ha) to 40.3 (16 ha) additional ac of water.

Wetlands/Waters of the United States

Direct wetland impacts of between 44.4 (18 ha) and 56.1 ac (23 ha) occur when the network alternatives cross the San Francisco Bay on a new bridge in the Dumbarton area. The new Dumbarton alignment and bridge account for 33.9 ac (14 ha) of direct wetland impacts. Direct wetland impacts of between 33.6 (14 ha) and 40.2 ac (16 ha) occur when the network alternatives have a transbay crossing of San Francisco Bay. The transbay crossing alignment accounts for 22.83 ac (9 ha) of direct wetland impacts. Absent Bay crossings, the direct wetland impacts range between 10.7 (4 ha) and 17.5 ac (7 ha) for Altamont Pass and Pacheco Pass network alternatives and up to 25.4 ac (10 ha) for the combined Altamont and Pacheco alternatives. The shortest network alternative—Altamont Pass with a Union City Terminus—would affect the least amount of wetlands area. The shortest Pacheco Pass network alternative, with a terminus in San Jose, would directly affect 15.5 ac (6 ha). The Pacheco Pass network alternatives would directly affect wetlands in the Central Valley along Henry Miller Road.

Impacts to waters of the United States vary among the network alternatives, with a range from 13,113 ft (3,997 m) to 19,891 ft (6,063 m) Higher impacts (more than 15,947 ft [4,861 m]) occur for network alternatives that cross the San Francisco Bay on a bridge structure in the Dumbarton area.

Endangered Species

The number of plant and wildlife species affected generally increases as the network alternative lengths increase and vice-versa. The lowest number of special-status plant species present is 38 for the Altamont Pass with a Union City terminus—the shortest network alternative. This alternative would not extend up either side of the Bay, where there are a number of additional species associated with the ecology of the Bay. For the Pacheco Pass network alternatives, the San Jose terminus is shortest and would affect the fewest number of plant species—46. The highest number of plant species present is 71 for the combined Pacheco Pass and Altamont Pass network alternatives serving San Francisco, Oakland, and San Jose without a bay crossing.

The 36 wildlife species present for the Altamont with Union City terminus network alternative is the lowest number, again for the shortest network alternative. It would not extend up either side of the Bay, where there are a number of additional species associated with the ecology of the Bay. For the Pacheco Pass network alternatives, the San Jose terminus is shortest and would affect the fewest number of wildlife species—38. The largest number of species present—58—would be for the combined Pacheco Pass and Altamont Pass network alternatives serving San Francisco, San Jose, and Oakland without a bay crossing.

S-1.4.8 Cultural/4(f)/6(f) Resources

The number of cultural resources affected for the HST Network Alternatives varies from 78 for the Pacheco Pass network alternative terminating at San Jose to 220 for the combined Pacheco Pass and Altamont Pass network alternative serving San Francisco, Oakland, and San Jose without a Bay Bridge.

Among the Altamont Pass network alternatives, the Union City terminus is the shortest and has the lowest number of cultural resources at 88. It does not extend up either side of the Bay, where there are more known cultural resources. Both the peninsula and East Bay contain older, more developed areas, and the potential to find cultural resources is high. The Altamont Pass network alternative serving San Francisco, San Jose, and Oakland with no Bay crossing extends up both sides of the Bay and has the highest potential to affect cultural resources in the urban areas. This network alternative shows 203 potentially affected cultural resources.

Among the Pacheco Pass network alternatives, the San Jose terminus is shortest and has the lowest number of cultural resources at 78. It also does not extend up either side of the Bay, where there are more known cultural resources. The Altamont Pass network alternative serving San Jose, San Francisco, and Oakland extends up both sides of the Bay and has the highest potential for effects on cultural resources. This network alternative shows 193 potentially affected cultural resources. Use of the BNSF-UPRR alignment for the Pacheco Pass network alternatives reduces the number of cultural resources by 39.

The highest number of potentially affected resources—220—would be for the combined Pacheco Pass and Altamont Pass network alternative serving San Jose, Oakland, and San Francisco without a Bay crossing.

The number of parklands and wildlife refuges within 150 ft (46 m) of the network alternatives varies from six for the shorter Pacheco Pass with a San Jose terminus to 35 for the combined Pacheco Pass and Altamont Pass network alternative with San Francisco, Oakland, and San Jose service without a Bay crossing.

S-1.4.9 Visual/Aesthetic Impacts

Each of the network alternatives would have visual impacts on the various landscape typologies along the alignments. Particular impacts would occur at specific locations. Visual simulations of various locations are shown in Section 3.9, Aesthetics and Visual Resources. Overall, the network alternatives are rated as low to medium impacts, with no major overall differences among the network alternatives.

S-1.4.10 Noise/Vibration Impacts

Overall noise impacts for the network alternatives are rated as medium for all alternatives. Vibration impacts are typically rated as medium, although for some network alternatives, vibration impacts are rated as medium to high.

S-1.4.11 Traffic/Air Impacts/Energy

The network alternatives have the potential to reduce overall air pollution, total energy consumption, and traffic congestion as compared to the No Project Alternative. Comparing the energy required by each mode to carry a passenger 1 mile (1.6 km), an HST needs only about one-third that required by an airplane and one-fifth that required by a commuter automobile trip. Comparing the pollutant burden generated by each mode to carry a passenger 1 mile (1.6 km), an HST generates approximately less than one-tenth of the pollutants (excluding CO_2) that would be generated by an airplane or by a commuter automobile trip. The representative base HST forecast would result in a reduction of 22 million barrels of oil and 17.6 billion pounds of CO_2 emissions annually by 2030, as compared to the No Project Alternative. Diversions from the automobile to HST could lead to a projected 5% statewide reduction in vehicle miles traveled (VMT) on the highway system, with VMT reductions of between 7% and 12% in Bay Area and Central Valley counties.

The network alternatives with the highest ridership levels show the greatest reductions in VMT on the roadways in the region. The reduction in VMTs results in a corresponding reduction in vehicular emissions, energy consumption, and traffic. Therefore, the network alternatives with the highest ridership would have the greatest traffic, energy and air quality benefits.

S-1.4.12 Growth Impacts

Compared to the No Project condition, the study area population in 2030 is expected to increase from about 1.6% with the Pacheco Pass network alternatives to about 2.2% with the Altamont Pass network alternatives (149,000 to 199,800), employment is expected to increase from by 1.7% with the Pacheco Pass network alternatives to 1.8% with the Altamont Pass network alternatives (96,000 to 102,100 jobs), and urbanized areas are expected to increase from by 0.1% with Pacheco Pass network alternatives to 0.6% with Altamont Pass network alternatives (9,650 ac [3,905 ha] to 14,500 ac [5,868 ha]).

Highest growth rates are expected in Madera and Merced Counties, plus Stanislaus County for the Altamont Pass network alternatives. Highest urbanization rates are expected in Madera, Merced, and Fresno Counties, plus San Joaquin and Stanislaus Counties for the Altamont Pass network alternatives. HST would have similar growth inducement potential regardless of network alternative. Oakland and San Francisco termini options have similar overall growth potential, but there is a spatial shift between East Bay and Peninsula. Service termination in San Jose would lower areawide growth inducement. HST station options have similar systemwide growth inducement potential. Downtown HST station location options have lower urbanization rates for their home county.

S-1.5 Areas of Controversy

In considering a choice of alignment alternatives and station location options to form an HST network in the study region, the Authority will take into account potential impacts on natural resources, cost, travel conditions, effects on travel time and ridership, and public and agency input. Other considerations might be possible modifications to alignment alternatives by using more costly designs and construction techniques (e.g., tunnels and elevated guideways), or moving the location of alignments for functional or cost reasons or to avoid or minimize impacts on sensitive resources. The following are the known principal areas of controversy:

- Selection of an HST network with appropriate service to the Bay Area, including choice of mountain crossing, choice of alignments, location of stations, and number of stations directly served.
- Impacts to biological resources and wildlife areas, particularly related to the San Francisco Bay Crossings.
- Impacts to urban areas, mostly to the result of noise and visual effects.

S-1.6 Avoidance and Minimization

As currently planned, the HST system would avoid and minimize many potential negative environmental consequences. Conceptual designs for the HST Alignment Alternatives meet the project objectives and design criteria, which set specific goals to avoid and minimize negative environmental consequences. Chapter 3 of the Draft Program EIR/EIS includes in each topic area a discussion of mitigation strategies. In addition, design and construction practices have been identified that would be employed as the HST system is developed further in the project-level environmental review, final design, and construction stages. Key aspects of the design practices include (i.e., are not limited to) the following.

- Minimize impact footprint and associated direct impacts to farmlands, parklands, biological, and water resources through maximum use of existing transportation corridors.
- Minimize impact to farmlands and associated growth through the selection of multimodal transportation hubs for potential HST station locations that would maximize access and connectivity as well as provide for efficient (transit-oriented) growth centered on these station locations.
- Increase safety and circulation and potentially reduce air pollution and noise impacts, through use of grade separation at road crossings, of considerable portions of adjacent existing services with construction of the planned HST system.
- Pursue agreements with owners/rail operators to place the HST alignment within existing rail rights-of-way, to reduce the need for additional right-of-way and minimize potential impacts to agricultural resources and other natural resources.
- Cooperate with regulatory agencies to develop acceptable specific design and construction standards for stream crossings, including (i.e., not limited to) maintaining open surface (bridged versus closed culvert) crossings, infrastructure setbacks, erosion control measures, sediment-controlling excavation/fill practices, and other best management practices.
- Fully line tunnels with impermeable material to prevent infiltration of groundwater or surface waters to the extent possible based on available geologic information and previous tunneling projects in proximity to proposed tunnels.
- Where there is potential for significant barrier effects that could divide wildlife populations or habitat areas or impede wildlife migration corridors, underpasses or overpasses or appropriate passageways will be designed during project-level environmental review for implementation at reasonable intervals during construction to avoid, minimize, or mitigate potential impacts to wildlife movement.
- The potential impacts associated with construction access roads would be greatly limited, and avoided altogether through sensitive areas, by using in-line construction (i.e., by using the new rail infrastructure as it is built to transport equipment to and from the construction site and transporting excavated materials away from the construction area to appropriate reuse [e.g., as fill material,

aggregate for new concrete] or disposal sites). To avoid creating access roads in sensitive areas, necessary geologic exploration would be conducted using helicopter transport for drilling equipment to minimize surface disruption, followed by site restoration on the completion of work.

S-1.7 Least Environmentally Damaging Preferred Alternative (LEDPA)

The U.S. Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers (USACE) have participated in the development of this Draft Program EIR/EIS and, in accordance with the memorandum of understanding between FRA and EPA for this environmental review, will be consulted concerning the selection of the preferred alignment alternative and the route most likely to yield the least environmentally damaging practicable alternative (LEDPA), which will be identified in the Final Program EIR/EIS.

S-1.8 Public and Agency Involvement

Public and agency involvement was conducted as part of this program environmental process. Involvement was accomplished through a variety of means, including the scoping process, which included a series of public and agency scoping meetings, consultation meetings with federal and state resource agency staff representatives throughout the environmental process, informational meetings with interested groups and agencies, presentations and briefings to a broad spectrum of interest groups, information materials (such as a series of fact sheets), the Authority's Web site presenting information about the proposed project and study evaluations, noticed public meetings of the Authority's governing board at which key policy issues and decisions were raised and discussed and opportunities for public comment were provided, and public circulation and posting on the Authority's website of this Draft Program EIR/EIS.

S-1.9 Next Steps in the Environmental Process

This Program EIR/EIS considers the HST Alignment Alternatives and station location options and the HST Network Alternatives for the study region at a program level of environmental analysis. After considering public and agency comment, the Authority and the FRA will identify preferred alignment alternatives, station location options, and a preferred network alternative. The Authority and FRA will prepare a final Program EIR/EIS, which will include responses to comments and a description of the preferred alignment and station location options for the Bay Area to Central Valley.

At the completion of this program environmental process, the Authority expects to be able to certify the Program EIR/EIS and make findings for compliance with CEQA, the FRA expects to be able to issue a Record of Decision for compliance with NEPA, and both agencies expect to be able to make various determinations.

After completing the program environmental process, preliminary engineering and project-level environmental review would commence in the study region to the extent needed to assess site-specific issues and potential environmental impacts not already addressed in this Program EIR/EIS. Project-level environmental review would focus on a portion or portions of the proposed HST system and would provide further analysis of potential impacts and mitigation at an appropriate site-specific level of detail to obtain needed permits and to implement HST projects. Also, after completing this program environmental process, the Authority would begin working with local governments, transportation agencies, and private parties to identify right-of-way preservation needs and protective advance acquisition opportunities consistent with state and federal authority requirements.

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