4 hours. Likewise, as shown in Figure 3.2-3, increasing demand will lead to greater congestion, total travel time delay, and reduced reliability on the primary highway corridors in southern California.

According to the California Aviation System Plan, almost 173 million passengers enplaned and deplaned in California in 1999, a number that is expected to more than double by 2020 (California Department of Transportation 2001). Under the No Project Alternative, no additional runways or other major capacity expansion projects would be implemented by 2020. According to the Southern California Association of Governments, urbanized airports in southern California are already at 73% of total capacity and available capacity is rapidly diminishing (Southern California Association of Governments 2001). A similar trend can be expected across the state. As a result, many of the airports in the study area that are currently at or near capacity could become severely congested under the No Project Alternative. Capacity constraints are likely to result in significant future aircraft delays, particularly at California's three largest airports. SFO has "one of the worst flight delay records of major U.S. airports—only 64% of SFO flights were on time during 1998" (San Francisco International Airport 2003). According to SFO, within 10 years the three Bay Area airports will not have the sufficient capacity to meet regional air traffic demand even on a good weather day. LAX projects a demand of 19.2 million more annual passengers than their 78.7 million total passenger capacity by 2015, while San Diego International Airport expects to be at capacity prior to 2020 (San Diego Airport 2001). The projected delays at heavily used airports and forecasted highway congestion would continue to delay travel, negatively affecting the California economy and quality of life.

Given these travel trends, overall travel safety is also expected to worsen. As VMT continues to rise over the next 20 years under the No Project Alternative, the accident rate will not change appreciably, but the net number of accidents, injuries, and fatalities could increase, particularly for highway-based trips. As evidence of this trend, the National Highway Traffic Safety Administration reported that between 1998 and 2001 fatalities on California's roadways have increased by an average 4% annually (National Highway Traffic Safety Administration 2001).

Travel costs are also expected to rise because of capacity constraints. Regions could be faced with attempting to control demand through congestion pricing for both the auto and air modes. This approach could result in more congestion-priced toll roads like SR-91 in Orange and Riverside Counties, and peak-period landing fees for airports statewide. Both of these costs would be passed along to the consumer either directly in tolls or indirectly in ticketed fares.

As summarized in Table 3.2-4, the No Project Alternative could result in either a deteriorated LOS or no change compared to existing conditions.

Figure 3.2-3
Los Angeles Area Highway Congestion (2025 forecast)

Table 3.2-4
Existing Conditions Compared to No Project Alternative

	No Project Alternative (2020)	
Travel Factor	**Change from Existing Conditions**	**Comment**
Travel Time	Deteriorate	Increased congestion could result in further delays.
Reliability	Deteriorate	Increased congestion and no change in modal options or characteristics could result in greater unreliability.
Safety	Deteriorate	No change in modal options would maintain existing fatality and injury rates; however, increased demand could result in greater number of fatalities.
Connectivity	None	No additional intercity intermodal connections or options, or increased frequencies will be available.
Sustainable Capacity	Deteriorate	No significant mainline capacity improvements will be operational.
Passenger Cost	Deteriorate	Airfares are anticipated to increase beyond their current fare structures relative to other modal options.*

* Based on high-end forecasts from final business plan, California High Speed Rail Authority 2000.
Source: Parsons Brinckerhoff 2003.

B. NO PROJECT ALTERNATIVE VS. MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

This section presents expected travel conditions for the Modal and HST Alternatives and compares relative differences between No Project and the Modal and HST Alternatives. This section is organized by the six travel factors identified earlier. Only the HST Alternative would introduce a new mode to the California intercity transportation system. This new mode would result in some major differences in expected travel conditions. Each travel factor begins with a summary of the specific methods used to define and evaluate the Modal and HST Alternatives and the characteristics of each mode followed by an evaluation of impacts for the Modal and HST Alternatives.

Travel Time

Travel time is a key travel factor that determines the attractiveness of a particular mode of travel to passengers. Travel time is also an important economic factor that directly affects productivity (travel time for workers and products to get to their destination). For the purpose of this analysis, improved travel time is a benefit to the traveler because it can improve the intercity travel experience. Travel time for this analysis was measured as the total (door-to-door) travel time for the example city pairs presented in Chapter 1. Travel times representing the duration of the air or HST trips spent in the airplane or train (line-haul times) are included in Appendix 3.2-A.

Automobile Mode Characteristics: Travel time in an automobile largely depends on three factors: distance traveled, roadway design speed (and associated speed limit), and congestion levels. The design of a roadway dictates the time that will be required to travel between two destinations. The time of day and associated congestion also plays a role in how long a trip will take. For this analysis, it is assumed that the top speed of the automobile is 70 miles per hour (mph) (113 kilometers per hour [kph]).

Automobile travel times are based on driving times between the representative city pair origins and destinations, as summarized in Table 3.2-5. The travel time for existing conditions is the same as the times used in the California High Speed Rail Authority's (Authority's) final business plan (Business Plan) and is based on weighted averages of peak and off-peak travel times

(California High Speed Rail Authority 2000). To replicate the unique congested conditions in the San Francisco and Los Angeles areas, a delay penalty of 30 minutes (min) for trips originating in or destined for the San Francisco or Los Angeles regions was added to all year 2020 projections. This assumption was also incorporated in the higher-end HST ridership and revenue forecasts from the Business Plan. The travel time savings analysis developed for the economic growth analysis of this document (Chapter 5) shows that auto travel time for the Modal Alternative is estimated to be 8.5% shorter than for the No Project Alternative because of the reduction in congestion due to the increase in capacity on the highway system. In the same analysis, the auto travel times for the HST Alternative are estimated to be 4.1% shorter than the Modal Alternative because of the diversion of highway trips to the HST system (California High Speed Rail Authority 2000a).

Table 3.2-5
Total Door-to-Door Automobile Travel Times (Hours:Minutes)

City Pairs	Existing Conditions (1999)[a]	2020 (Alternatives) Automobile Total Door-to-Door Travel Times[b]		
		No Project	Modal	HST
Los Angeles downtown to San Francisco downtown	6:57	7:57	7:16	7:36
Fresno downtown to Los Angeles downtown	4:00	4:30	4:06	4:18
Los Angeles downtown to San Diego downtown	2:19	2:49	2:35	2:41
Burbank (airport) to San Jose downtown	5:50	6:50	6:15	6:32
Sacramento downtown to San Jose downtown	2:10	2:40	2:26	2:33

[a] California High Speed Rail Authority's final business plan, 2000, and Independent Ridership and Charles River Associates, Passenger Revenue Projections for High Speed Rail Alternatives in California, 2000.

[b] Sum of existing conditions plus representative delay penalty of 30 min for origin and destinations at San Francisco or Los Angeles, which is consistent with the high-end revenue and ridership forecasts for the Business Plan. Under the low-end revenue and ridership analysis the travel time under No Project would be the same as existing conditions.

Source: Parsons Brinckerhoff 2003.

Air Mode Characteristics: Air travel is the fastest line-haul mode at 530 mph (853 kph) maximum cruising speed. However, a significant portion of a passenger's trip is spent accessing the airport, passing through one or more security checkpoints, boarding and alighting the aircraft, and egressing the airport. The components of a door-to-door air trip include the components listed below. (See Appendix 3.2-B for more detailed explanation.)

- Access time: time spent driving to the airport.
- Terminal time: time spent getting through the airport terminal.
- Line-haul time: time spent on the aircraft.
- Arrival time: time spent getting to the final destination.

It is assumed that all air trips would require travel on the regional highway system with the exception of San Francisco, where some passengers could use the newly opened BART to SFO rail link. Also, passengers in the Los Angeles area could use a Metrolink connection to Burbank.

Total air travel times are summarized in Table 3.2-6. As shown, No Project travel times would increase between 15 and 30 minutes compared to existing conditions, depending on city pairs.[1] These changes are due to increases in line-haul travel time resulting from insufficient capacity at airports under No Project. It is estimated that air travel times would change under the Modal and HST Alternatives compared to No Project because the additional infrastructure under the Modal Alternative and the diversion of trips to HST would reduce airside congestion levels, while all other factors (arrival, terminal, and departure times) would remain constant (California High Speed Rail Authority 2003). Although there would be an improvement of intercity highway travel times, this improvement is not meaningful for access trips to and from the airports.

Table 3.2-6
Total Door-to-Door Air Travel Time (Hours:Minutes)

City Pairs	Airports	Existing Conditions (1999)	2020 Alternatives Air Mode Total Door-to-Door Travel Times		
			No Project Alternative[a]	Modal[b]	HST[c]
Los Angeles downtown to San Francisco downtown	LAX, LGB, BUR, SNA, ONT, SFO, OAK, SJC	3:02	3:32	3:27	3:26
Fresno downtown to Los Angeles downtown	FAT, SNA, ONT, LAX, LGB, BUR	2:47	3:02	3:01	3:00
Los Angeles downtown to San Diego downtown	LAX, LGB, BUR, SNA, ONT, SAN	2:30	3:00	2:45	2:46
Burbank (Airport) to San Jose downtown	BUR and SJC	2:44	3:14	3:09	3:08
Sacramento downtown to San Jose downtown	SMF and SJC	No Service	No Service	No Service	No Service

N/A = Not applicable.
[a] 15-min penalty for San Francisco, Los Angeles, and San Diego area airports based on high-end ridership and revenue forecasts from the Business Plan. Under the low-end forecasts, travel time in 2020 would be the same as under existing conditions.
[b] Total travel time reduced based on increase in capacity at airports.
[c] Total travel time reduced because of reduction in demand at airports from trips shifting from air to HST.
Source: Parsons Brinckerhoff 2003.

High-Speed Train Mode Characteristics: With a maximum operating speed of 220 mph (354 kph), the HST is slower in line-haul speed than an airplane but considerably faster than an automobile. However, for most intercity trips within California, the quick arrival, terminal, and departure times make the overall HST travel time competitive with that of air travel. The HST would also connect closer city pairs, those less than 150 mi (241 km) apart, and for those trips would compete strongly with the automobile. For example, HST travel between Los Angeles and Bakersfield or Sacramento and Modesto would likely be faster than automobile travel.

In Europe and the United States, rail travel time improvements have shifted travel demand from air to rail travel. Within a decade of its inauguration, France's Train à Grande Vitesse (TGV) Sud-Est succeeded in capturing more than 90% of the travel market between Paris and Lyon (Meunier 2002). Amtrak's Acela and Metroliner trains have 50% of the total air-rail market, which is split between New York and Washington. In Germany, recent passenger rail improvements between Frankfurt and Cologne were undertaken with the purpose of shifting air

[1] This assumption is consistent with the high-end revenue and ridership assumptions for the Business Plan.

trips from congested airports where capacity was constrained and could not be expanded to high-speed rail that could more quickly serve the same markets. This same principle could apply to the major airports in the study area, including San Francisco and Los Angeles. The air operation time-slots released by substituting HST for local air service at these two airports could provide more opportunities for international and interstate flights.

HST would also provide direct connections to several airports. This connectivity, combined with the line-haul speed of the HST, could result in faster total travel times for air travelers who use air travel and the HST to reach their final destination. For example, passengers arriving at San Francisco could transfer to the HST and travel to Merced, and this connection could be competitive with or possibly faster than connecting to another flight, driving, or taking a bus or shuttle.

The train in this instance may be quicker for two reasons. First, trains may be boarded swiftly, often in less than 2 minutes because of the number of doors and ability to accommodate extra passengers. In contrast, boarding an airplane must be controlled for security and typically takes place through one door (or at most two doors), a process that can take up to half an hour. Second, current airline boarding practice requires passengers to be present at the gate at least 20 minutes before the scheduled departure time.

Another key difference between HST and air travel is the percentage of total travel time spent during the line haul. On a train, this proportion of time is quite high, and can be used for work, pleasure, or relaxation. For example, passengers traveling by HST between any of the below city pairs would be able to use their laptop computers or any number of personal audio, video, or game devices for approximately 70% of the total travel time, while passengers traveling by air would be able to use these devices for just 30% of their trip.[2]

Total travel times are summarized in Table 3.2-7. Since no HST exists or would exist under the No Project or Modal Alternatives, only the travel times for the HST Alternative are shown. While these travel times are from downtown to downtown where HST has a distinct advantage over air travel because of terminal locations, the potential for many online stations could make the HST competitive for many other trips. Like air travel, the HST has the following door-to-door trip components. (See Appendix 3.2-B for more detailed explanation.)

- Access time: time spent driving to the train station.
- Terminal time: time spent getting through the train station.
- Line-haul time: time spent on the train.
- Arrival time: time spent getting to the final destination.

[2] Although the line-haul time of the flight is about 33% of the total trip, due to restrictions on use of electronics during take off and landing, the productive time is reduced by another 10%.

Table 3.2-7
Total Door-to-Door High-Speed Train Mode Travel Times (Hours:Minutes)

City Pairs	2020 HST Total Door-to-Door Travel Times
Los Angeles downtown to San Francisco downtown	3:20[3]
Fresno downtown to Los Angeles downtown	2:23
Los Angeles downtown to San Diego downtown	2:16
Burbank (airport) to San Jose downtown	2:52
Sacramento downtown to San Jose downtown	1:53
Source: California High Speed Rail Authority 2000.	

Existing conventional rail services are typically not competitive with other modes. For example, while the HST line-haul time (a component of total trip time) between downtown San Francisco and Los Angeles would be just under 2.5 hrs, the only existing direct rail service between the Bay Area (Oakland) and Los Angeles (Coast Starlight service) currently has a line-haul time of more than 12 hrs and operates one train daily in each direction. The San Joaquin service between Oakland and Los Angeles currently takes about 8 hrs and 40 min but requires transferring to a bus for the Bakersfield to Los Angeles segment of the trip. The HST line-haul time between downtown Los Angeles and downtown San Diego would be about 1 hr and 13 min as compared with current Surfliner line-haul time of 2 hrs and 45 min. Caltrans and Amtrak plan to reduce travel times by up to 30% on key intercity routes such as the Pacific Surfliner and Capitol Corridor services over the next 20 years; however the projects required to reach these goals are not yet funded.

Alternatives Comparison for Travel Time

No Project Alternative: There are no travel-time benefits associated with the No Project Alternative because there are no significant improvements to capacity or modal options. The No Project Alternative would likely result in longer travel times in all cases as compared to existing conditions, and these increases would range between 15 and 60 minutes for the representative city pairs.

Modal Alternative: The Modal Alternative could achieve up to a 16-min reduction in travel time for the representative city pairs compared to the No Project Alternative. The greatest savings would be achieved in the most congested corridors of Sacramento to San Francisco. These benefits would occur primarily due the additional highway capacity in the Bay Area and southern California regions with the Modal Alternative. It is estimated that with the additional capacity proposed for airports there would be some travel time benefits over the No Project Alternative.

High-Speed Train Alternative: The greatest time savings would be achieved using express service between Fresno and Los Angeles and between Los Angeles and San Diego. Because of its faster line-haul speed, HST would compete with the automobile for shorter distance intercity trips. Because of its shorter terminal processing times, HST would also compete with the airplane for longer distance intercity trips. In the Central Valley, HST would provide shorter travel times than both the highway and air modes for travelers headed to locations near HST stations.

[3] Time based on I-5 alignment option. Antelope Valley alignment option would be 3:30, an additional 10 minutes.

Reliability

In its simplest form, reliability can be defined as variation in travel time, hour-to-hour and day-to-day for the same trip. Reliability is important for almost any travel need and on any travel mode. Business travelers want to be able to predict how long it will take them to arrive at a meeting, either across town or across the state. Express shippers need to know where packages are at all times and when they will be available for delivery. Vacationers who want to spend as little of their time off as possible traveling to and from their destinations often find themselves making their trips during the most congested days of the year. Reliable travel means fewer late arrivals, improved efficiency, saved time, and reduced frustration.

Travel on most transportation modes is consistent and repetitive, yet at the same time highly variable and unpredictable. This apparent contradiction accrues because travel is consistent and repetitive since peak usage periods occur regularly and can be predicted. The relative size and timing of rush hour is well known in most communities. Simultaneously, travel is variable and unpredictable because on any given day unusual circumstances such as a rainstorm or an auto accident can cause serious delays at any time.

The traveling public's experience with variations in travel reliability affects their decisions of how and when to travel, so that they have a reasonable expectation that they will arrive at their destination at a particular time. For example, if a highway is known to have highly variable traffic conditions, a traveler using that route to catch a flight routinely leaves extra time reach the airport.

Travel time reliability is the direct result of the variable and often unpredictable events that can occur on different travel modes and at any time of day. The traditional way of measuring and reporting travel times experienced by highway users is to consider only average or typical conditions. However, the travel times experienced by users are seldom constant, even for travel on the same facility in the same peak or off-peak time period. Reliability is influenced by several underlying factors that vary over time and that influence the environment within which transportation operates. These factors are listed below.

Incidents: Incidents are events that disrupt normal travel flow, such as obstructions in the travel lanes of highways. Events such as vehicular crashes, mechanical breakdowns, and debris in travel lanes are the most common form of incidents for any mode. On highways, events that occur on the shoulder or roadside can also influence traffic flow by distracting drivers, leading to changes in driver behavior and ultimately to the quality of traffic flow.

Inclement Weather: Inclement weather and related environmental conditions (rain, fog, snow, ice, sun glare, etc.) can lead to changes in operator behavior, vehicle performance, and operational control requirements that affect traffic flow. Motorists respond to inclement weather by reducing their speeds and increasing their headways. Airport and civil aviation authorities respond by grounding flights or delaying takeoffs and landings. In cases of severe weather, authorities respond by closing roadways and creating vehicle caravans.

Construction: Construction can often reduce the number, width, or availability of travel lanes, rail tracks, and runways. Nearby construction activities can also reduce reliability if operating rules or conditions are changed (e.g., slow orders on rail tracks). Delays caused by work zones have been cited by highway travelers as one of the most frustrating conditions they encounter on trips.

Volume Variation: Volume variation is day-to-day variability in demand that leads to some days with higher travel volumes than others. Different demand volumes superimposed on a system with fixed capacity results in variable, less reliable travel times.

Special Events: Special events such as concerts, fairs, and sports events cause localized congestion and disruption in the vicinity of the event that is radically different from typical travel patterns in the area.

Traffic Control Devices and Procedures: These can lead to intermittent disruption of travel flow through means such as air traffic control, railroad signals and switches, railroad grade crossings, drawbridges, and poorly timed signals.

Base Capacity: Base capacity refers to the physical capacity of a transportation system, such as the number the highway lanes or runways. The interaction of base capacity with the other influences on reliability has an effect on transportation system performance. This is due to the nonlinear relationship between volume and capacity on any mode. When congested conditions are approached, small changes in volume lead to diminished throughput of the transportation system and consequent large changes in delay. Further, facilities with greater base capacity are less vulnerable to disruptions; for example, an incident that blocks a single lane has a greater impact on a highway with two travel lanes than a highway with three travel lanes.

Vehicle Availability and Routing: These can directly affect a traveler's ability to make an on-time trip, particularly on a common carrier such as airplane and train, or by rental car. End-to-end routing, hubbing,[4] and other strategies to maximize vehicle operation time can affect reliability when a vehicle that is needed in one location first has to complete a trip from a different location. Short layovers or "pads" that are scheduled between trips for a given vehicle also affect vehicle availability.

The extent to which these eight factors affect each of the major intercity travel modes, and by extension the Modal Alternative and HST Alternative, is analyzed and compared on a qualitative basis by describing and ranking the extent to which each travel mode is potentially susceptible to each of the eight factors. It is presented in Table 3.2-8 and further detailed below. Because the alternatives are composed of combinations of modal elements (including different modes for trip segments like station or terminal access), modal rankings have been combined, providing a qualitative understanding of the reliability of each alternative.

Table 3.2-8
Modal Reliability

	Relative Susceptibility to Reliability Factors*		
Factor	**Air**	**Automobile**	**High-Speed Train**
Incidents	**Low** Air travel has very few major incidents, and is generally not influenced by incidents on other modes.	**High** Automobile travel can be influenced by minor and major incidents at any location along the roadway and is frequently affected by incidents outside of the right-of-way.	**Low** HST has very few major incidents and is generally not influenced by incidents on other modes since the number of grade crossings is minimal or non-existent.
Weather	**High** A variety of weather conditions anywhere in the country can affect air travel.	**High** A variety of weather conditions can degrade operator ability, make roadways impassible, or damage roadways.	**Low** Trains can operate under virtually any conditions. Guideway is constructed to minimize weather impact.

[4] Hubbing is a reference to the "hub and spoke" operations practice where airlines coordinate a large number of their flights to arrive at a major terminal at the same time to allow passengers to transfer from one plane to the next to complete their trip to their final destination.

Factor	Air	Automobile	High-Speed Train
	Relative Susceptibility to Reliability Factors*		
Construction	**Low** Most activities scheduled for periods of low airport usage. High-quality construction minimizes routine maintenance needs.	**Moderate** Construction activities (major and minor) are common, but generally occur during warm weather months. Lane closures are often of long-term duration.	**Low** Most activities are scheduled for hours when system is closed. High-quality construction minimizes routine maintenance needs.
Special events	**Low** Special events (e.g., air space closure) are generally rare but can lead to rerouting or airport closure when they do occur.	**Moderate** Special events are common and can create volume fluctuations or short-term lane closures.	**Low** Most special events can be easily accommodated on HST without effect on travel time. Guideway closures are uncommon for this factor.
Traffic control devices or procedures	**Moderate** Reliability strongly influenced by air traffic control rules and capabilities.	**Moderate** Auto travel influenced by traffic signals, railroad crossings, and other devices. Influence depends on level to which devices are optimized.	**Low** HST operates in exclusive, grade-separated right-of-way, minimizing external influences. Double-tracked guideway minimizes switching needs. HST control systems are redundant and highly automated, allowing for a high level of precision in dispatching and control.
Inadequate base capacity	**Moderate** Capacity can be strong influence due to complex procedures for gate usage, taxiing, and takeoffs/ landings. This factor has strong interaction with weather at certain airports.	**High** This is one of the strongest influences on highway reliability, particularly for facilities with three or fewer lanes per direction. Travel time degrades quickly as capacity is approached.	**Low** HST system generally has large capacity reserve. Operations are not allowed to exceed design capacity. Exclusive guideway maintains high level of base capacity at all times.
Volume variation	**Moderate–High** Air travel demand and number of scheduled flights fluctuates broadly from day to day. Aircraft loading and unloading times directly affected by passenger volumes.	**High** Peak-period travel in medium to large urban areas highly influenced by day-to-day or seasonal volume variations. Strong interaction with inadequate base capacity.	**Low** Day-to-day variation in train volumes tends to be low. Passenger volume variation generally does not influence travel times.
Vehicle availability or routing	**High** Airplanes are used multiple times in a given day, and availability can be affected by factors anywhere in the world and with any type of routing system (point-to-point or hub-and-spoke). High capital cost discourages airlines from keeping large reserve fleet.	**Low** Private automobiles are ubiquitous and are widely available for rental in emergency situations. The road and highway network provides alternative routes for most trips.	**Moderate** HST vehicles complete multiple end-to-end trips in a day, potentially affecting availability at specific times and locations; simple routing schemes generally followed.

* High indicates that the factor can exert a strong negative influence on travel time reliability for the mode. Conversely, low indicates that the factor generally does not play a role in influencing travel time reliability for the mode.

Source: Cambridge Systematics, Inc. 2003.

Automobile Mode Characteristics: On a day-by-day basis, automobiles tend to be the least reliable of the three modes. Highway travel is highly or moderately susceptible to seven of the eight factors described above. It is only when considering the influence of vehicle availability and routing that automobiles potentially would have a lower susceptibility than other modes.

Recent research provides further evidence on the unreliability of highway travel (Texas Transportation Institute and Cambridge Systematics, Inc. 2003). This research, which used actual travel time data covering 579 mi (932 km) of freeways in the Los Angeles area, shows that reliability problems exist on highways at all times of the day, all days of the week, and all weeks of the year. This research expressed unreliability in terms of a buffer index, the amount of extra time motorists would need to budget to be certain of arriving on time at their destination 95% of the time. Results showed that a motorist in Los Angeles would need to allow an additional 45 min for a typical 1-hr highway trip—fully 75% of normal driving time. Even in midday periods, a traveler would need to budget an additional 30 min for the same 1-hr trip, or 50% of the normal time. It is important to note that a buffer does not represent certainty, and on any given day this buffer may or may not be needed.

Air Mode Characteristics: Despite its high average speed, air travel often suffers from reliability problems due to a number of factors. The data in Table 3.2-8 suggest that air travel is moderately or highly susceptible to weather, vehicle availability, volume variation, inadequate base capacity, and traffic control procedures. Air travel is more susceptible than the other two modes to reliability problems arising from weather and vehicle availability. Bad weather and a shortage of aircraft in other states can impact service in California. Air travel reliability is generally not, however, influenced by incidents, construction, and special events.

Airline on-time statistics compiled by the Federal Aviation Administration show air travel reliability problems are widespread in California. Airline on-time statistics are available through the Bureau of Transportation Statistics Web site (http://www.bts.gov/ntda/oai). These statistics were reviewed to compare actual versus scheduled flight times for flights departing from Sacramento (SMF), SFO, LAX, and San Diego (SAN) in June 2002.[5] The statistics were analyzed to determine the median scheduled flight time and the 95th percentile actual flight time for flights departing from these four airports.[6] These times and the resulting buffer are shown in Table 3.2-9.[7]

The data in Table 3.2-9 indicate that air travel is generally more reliable than highway travel, as suggested by the smaller buffers (10 to 15% for air travel versus 50 to 75% for highway travel). Nonetheless, the data also show that air travelers at these four airports still need to budget an additional 9 to 18 min of in-vehicle travel time to account for unforeseen reliability problems that often arise with air travel.

[5] Statistics were analyzed for all flights operated by Alaska, America West, American, American Eagle, Delta, Southwest, United, and United Express. These eight airlines account for more than 95% of domestic departures at these four airports. More than 29,000 individual flights were included in the sample.

[6] The 95th percentile was chosen to maintain consistency with the research results reported for the highway mode.

[7] As with the highway mode, the buffer indicates the additional time needed above the average (median) time air travelers would need to budget to arrive on time for their flight with 95% certainty. For air travel, the buffer is expressed as a percentage of the median flight time.

Table 3.2-9
Reliability Statistics for Air Travel in California

Airport	Delay (95th Percentile Travel Time)	Scheduled Flight Time (Median)	Buffer (Delay/Schedule d Flight Time)
Sacramento (SMF)	9 min.	85 min.	10.6%
San Diego (SAN)	12 min.	90 min.	13.3%
San Francisco (SFO)	18 min.	118 min.	15.3%
Los Angeles (LAX)	12 min.	110 min.	10.9%
Source: Bureau of Transportation Statistics, June 2002.			

<u>High-Speed Train Mode Characteristics</u>: HST has been shown to have a low susceptibility to nearly all of the major factors that affect reliability. It is only on the issue of vehicle availability that HST, like all common carrier modes, has a higher level of susceptibility than highways. Also, HST has the same or lower level of susceptibility on all eight factors compared with air travel or even conventional rail.

Statistics from HST operations in Europe and Asia further confirm the high level of reliability that is inherent with HST. In France, more than 98% of TGV train runs have been completed within 1 min of schedule. In Spain during 2002, 99.8% of AVE runs were completed within 5 min of schedule. In Japan, the JR Central Shinkansen line averaged a 16-second delay per train in 2002. Using the buffer concept that was described for highways and air, these data suggest that HST travelers would likely need to have a schedule buffer less than 1 min (less than 1% of scheduled travel time) to account for unforeseen delay and reliability. This in-vehicle travel time buffer is extremely small compared to all other modes.

HST systems have proven worldwide to be far more reliable than conventional U.S. intercity rail services. Several factors account for this reliability.

- Intercity rail service involves mixed operations between conventional intercity passenger services and heavy freight traffic, whereas the HST service would not share tracks with heavy freight services.
- Depending on location and number of operations, the quality of train signal/control/dispatch systems for freight rail systems vary, whereas the HST services would use state-of-the-art automated control systems.
- Most conventional intercity passenger rail routes operate on freight railroads that are dispatched by the host freight railroad. Therefore, dispatching decisions may be based first on the needs of the host railroad, and then on the needs of the passenger train. For example, if a freight train is too long to go into a siding, the dispatcher will have to put the passenger train in the siding to wait until the longer freight train passes. This is just one type of delay for passenger trains using freight railroads.
- Grade crossings are inherently dangerous, providing the opportunity for vehicle and pedestrian collisions and delay due to malfunction of grade-crossing protection equipment. The HST service would be completely double-tracked, fenced, and grade-separated.

Although detailed statistics were not available, reports on rail operations in California suggest that conventional rail reliability is low (California Department of Transportation 2002). While Amtrak strives to complete a minimum of 90% of its train runs on time, the most recent data shows that the Capitol Corridor is on time about 84% of the time, while intercity service within the LOSSAN corridor is on time about 78% of the time. Monthly statistics for the Capitol Corridor show that the 90% on-time goal has only been reached in 2 of the past 24 months.

Alternatives Comparison for Reliability
A qualitative comparison of the alternatives was conducted by considering the relative reliability of the modes that are present in each alternative, the relative modal usage in each alternative, and any major changes such as highway lane additions or modal diversion that are present in an alternative. As described more fully below, the HST Alternative is projected to have the highest reliability, while the No Project Alternative is projected to have the lowest reliability.

No Project Alternative: Reliability under the No Project Alternative is likely to be lower than under the other alternatives for the following reasons.

- The No Project Alternative depends heavily on the automobile, which has been shown to have the worst reliability of the three modes.
- Existing congestion and reliability problems continue, because the No Project Alternative provides no new highway and airport base capacity.
- Greater highway and aviation congestion and more reliability problems accrue, because the No Project Alternative absorbs an increasing demand for travel with little increase in base capacity.

Modal Alternative: The Modal Alternative is likely to have better reliability than the No Project Alternative, but poorer reliability than the HST Alternative for the following reasons.

- The Modal Alternative depends heavily on the automobile, which has been shown to have the worst reliability of the three modes.
- Lower congestion and less susceptibility to reliability problems would result because the Modal Alternative could provide more base capacity to carry the expected increase in travel demand on highways and at airports than the No Project Alternative.

The Modal Alternative is likely to result in lower highway and air congestion levels than the HST Alternative since there is a measurable increase in capacity for both modes. Since the capacity increases between the No Project Alternative and the Modal Alternative but the number of intercity trips does not, less delay is accredited under the Modal Alternative to capacity constraints on both roadways and at airports. Nonetheless, Chapter 1 and Section 3.1 of this Program EIR/EIS have shown that the Modal Alternative would still experience near-capacity conditions on many highways and airports, increasing the likelihood of reliability problems. These problems would be compounded by the lack of a reliable alternative travel mode, such as the HST.

High-Speed Train Alternative: The HST Alternative is likely to provide the greatest degree of travel reliability for the following reasons.

- HST would divert significant levels of intercity demand from less reliable modes, particularly highways.
- HST provides a completely separate transportation system that would have less susceptibility to many factors influencing reliability.
- Highway and air travel reliability would improve because HST reduces travel demand on highways and air.

The various HST alignment options are not likely to exhibit appreciable differences in system reliability since system capacity and demand would be roughly equivalent. Major design differences (e.g., extent of tunneling) would not make a meaningful difference in reliability, and differences in base travel times on HST would not influence reliability.

Sensitivity to Travel Demand Forecasts: As with travel time, reliability is also influenced by the level of travel demand. Other things being equal, reliability is expected to be better on facilities that have lower travel demand (or experience lower V/C ratios) due to the non-linear relationship between volume and capacity, as mentioned above. Therefore, lower levels of highway or air travel demand, such as those suggested by the base Business Plan forecasts, would be expected to improve reliability for the highway and air modes for the Modal and HST Alternatives. The reliability improvement would likely be greatest for the No Project Alternative since its base capacity is most constrained and would experience the largest relative improvement in V/C ratios and delay. For the same reasons, the Modal Alternative would likely experience the second-largest reliability improvement, and the HST Alternative would experience the smallest improvement. Nonetheless, given the large reliability advantage enjoyed by the HST mode, the HST Alternative would still be expected to provide the greatest degree of travel reliability across the range of travel demand scenarios suggested in the Business Plan.

Safety

In transportation, three basic characteristics interact to influence the safety of a mode.

- Operator: His or her training, regulation, and experience.
- Vehicle: Its condition, regulation, control systems, and crashworthiness.
- Environment: Weather, guideway type, guideway condition, and terrain.

Each of these characteristics plays a role in the overall safety of the modes, which for this analysis is quantified as the probability of passenger fatality. Injuries are more difficult to compare between modes because they are categorized differently by mode and different injury ratings are used. For instance, automobile injuries are generally related to automobile crashes, while for air, bus, and rail they can include injuries that occur as part of a crash, while boarding/alighting, or in the terminal. The severity of these injuries can vary from scrapes and bruises to life-threatening ones. For the purposes of this analysis, injuries by mode will be discussed but are not measured as a key indicator of safety. This analysis also only considers injuries and fatalities of passengers and does not include employees or other staff.

To compare the relative impact of safety between alternatives, fatalities are measured by rate of fatality per 100 million passenger miles traveled. For this analysis the high-end forecasts were assumed because this approach will present the worst case for potential fatalities for all modes and alternatives. The safest mode is the one that has the lowest number of fatalities per 100 million passenger miles traveled (PMT).

Automobile Mode Characteristics: The automobile is unquestionably the most used and the most dangerous mode of transportation being considered in this Program EIR/EIS. The National Highway Traffic Safety Administration estimates that the national motor vehicle fatality rate is 0.80 fatalities per 100 million passenger miles traveled. Nationally in 2000, there were about 6.4 million reported motor vehicle crashes that resulted in 42,000 fatalities and 3.2 million injuries. About 4.2 million crashes involved property damage only (National Highway Traffic Safety Administration 2001). The National Highway Traffic Safety Administration estimates that deaths and injuries resulting from motor vehicle crashes are the leading cause of death for persons between the ages of 4 and 33, while traffic-related fatalities account for more than 90% of all transportation-related fatalities. According to the California Highway Patrol, in 2000 there were 3,331 fatal crashes in California alone (California Highway Patrol 2000). The risk to an individual depends most strongly on the time spent behind the wheel or in the passenger's seat. The longer the journey or the more frequently the journey is made, the greater the risk of a crash. Some of the factors that influence auto and highway safety are listed below.

- Operator.
  - Drivers vary in age, experience, ability, and many other factors.
  - Non-professional drivers typically operate automobiles.
  - Limited regulatory requirements govern who can operate an automobile and the type of training that is needed, and these requirements vary between states.
- Vehicle.
  - Privately owned vehicles are mechanically not as reliable as the public transportation modes.
  - Maintenance and inspections are not regulated, and are performed by mechanics of varying skill levels.
  - Crashworthiness and roadworthiness varies depending on make and model.
  - Minimum requirements rather than optimum standards dictate safe operating conditions.
- Environment.
  - Highways provide no latitudinal or longitudinal control to individual automobiles.
  - Fixed objects (e.g., trees, light poles, sign posts) are frequently placed within the highway right-of-way.
  - Weather and lighting conditions (wind, rain, fog, snow, ice, darkness, and sun glare) can adversely impact vehicle and driver performance.
  - Traffic control systems that regulate the speed and safe operation of an automobile are limited in influence.
  - Roadway conditions and designs are varied and can include systems based on different design speeds, vehicles, and operating conditions.
  - Drivers are subject to a multitude of potential distractions and interferences.

<u>Air Mode Characteristics</u>: Air travel is a safe mode of travel and in recent years has become even safer with the introduction of improved aircraft and state-of-the-art air traffic control systems. According to the U.S. Department of Transportation, the likelihood of fatality due to commercial air travel is relatively small (0.02 fatalities per 100 million PMT). According to the University Of Michigan Transportation Research Institute, flying a typical nonstop flight is 65 times safer than driving the same distance. Takeoff and landing presents the greatest safety risk during a flight; between 1991 and 2000, 95% of all airline fatalities occurred either during takeoff or landing, and just 5% of fatalities occurred at cruising altitudes (Sivak and Flannagan 2002). Consequently, the risks of flying depend mostly on the number of segments flown and not on the distance flown. Injuries associated with air travel can occur during the process of boarding and alighting, and during flight. Most are relatively minor and include scrapes, bruises, broken bones, and a few serious falls. Some of the factors that influence air travel safety are listed below.

- Operator.
  - Commercial aircraft can only be operated by professional pilots, who are rigorously trained and must update their proficiency regularly.
  - Other airline personnel such as flight attendants are trained to provide immediate assistance in emergency situations.
  - Pilots are subject to drug tests and are regulated by the Federal Aviation Administration.
  - Automation of fight operations is well developed and commonly installed.
- Vehicle.
  - Aircraft are regularly maintained to high standards and the Federal Aviation Administration regularly inspects these maintenance records.
  - Aircraft themselves are constructed of high-grade metals and, provided they are maintained regularly, can be in active service for decades.
  - All aircraft occupants are required to wear seatbelts during takeoffs and landings, the two procedures that present the greatest safety risk.
  - Air traffic control systems in the United States are standardized and are some of the safest, most reliable systems in the world for controlling commercial aircraft and warning them of potential dangers.
- Environment.
  - One of air travel's greatest weaknesses is its vulnerability to weather. Although most commercial aircraft can fly above or below most storm systems, they often have no choice during takeoffs and landings but to fly through thunderstorms, snow, ice, and fog. Particularly severe weather conditions can ground all aircraft and prevent those in flight from landing.
  - Unexpected turbulence during flight can injure passengers. For this reason, passengers are often required to wear seat restraints and are discouraged from walking or standing during flight.
  - Aircraft have no guideway to provide latitudinal or longitudinal control, and therefore run the risk of striking fixed or other flying objects while on the ground or during flight.

<u>High-Speed Train Mode Characteristics</u>: Based on statistics from Europe and Japan, HST is the safest mode of travel.[8] Since 1988, there have been 85 injuries and 14 fatalities[9] reported on all dedicated HST systems in Europe. In Japan's 34 years of HST operations, no passenger fatalities have been reported. For the purposes of this analysis and for comparison purposes only, it is assumed that the fatality rate for HST is less than air travel but greater than 0.0, or 0.001 per 100 million PMT. Similar to air travel, the likelihood of injury is associated with boarding and alighting, and during operation, with injuries ranging from minor to severe. The distinguishing reasons for the safety of HST travel relative to air and highway travel are summarized below. The HST mode would be much safer than conventional intercity rail services in California, which operate on freight railroads that have a mix of rail traffic and grade crossings.

[8] There are no statistics for HST safety in the United States.

[9] The worst accident on a dedicated high-speed right-of-way was a derailment in Piacenza, Italy in 1997, which resulted in eight fatalities.

- Operator.
  - HST operators would be rigorously trained and tested and are required to update their qualifications regularly.
  - HST operators would be required to submit to drug tests and are subject to regulation by the FRA and operating railroads.
  - The train would be completely automated and the train operator would be a failsafe redundant system component that could act in the unlikely case that a system malfunction or other problem occurs.
- Vehicle.
  - The FRA passenger equipment safety standards (49 C.F.R. Part 238) dictate the buff strength or amount of force a train can withstand in a collision, for all passenger equipment. The buff strength is adjusted to the operating and rail traffic conditions and is designed to minimize injuries of fatalities due to rail crashes.
  - The trains would be completely automated, allowing for centralized command and control of the train system, effectively eliminating the chance of operator error. Much like the BART system in the San Francisco Bay Area, a centralized system would control the operation of the train while the operator would be the physical eyes and ears of the train ensuring passenger safety.
  - Like airplanes, trains and the infrastructure they operate on (tracks, control systems, and electrification systems) would be maintained on a regular schedule. Maintenance records are subject to inspection by the FRA.
  - Like aircraft, passenger train equipment is built for a long service life. If maintained properly, a modern train car can have a useful life of at least 30 years.
  - HST traffic control and communications systems are state-of-the-art, regulated and managed during all hours of operation. These systems control the train's speed, schedule, routing, and headway (following distance behind another train). These systems combined with the operator have integral redundancy and ensure safety.
- Environment.
  - The HST system would be fully access controlled and grade-separated (including grade crossings), virtually eliminating pedestrian and motor vehicle conflicts.
  - The HST system would be closed to all other rail traffic, greatly reducing the possibility of collision with other trains. An exception is the Caltrain corridor between Gilroy and San Francisco, where the HST would travel at reduced speeds and share the track with express commuter passenger trains.
  - Inclement weather has only a minimal impact on HST operations. Because it is nearly impossible to read line side signals flashing by at 200 mph (322 kph), HSTs use a cab signaling system that transmits commands directly to the driver. This technology makes high-speed operation possible in darkness, rain, and fog. In Japan, even moderate snowfall does not slow the Shinkansen because of special ice-melting equipment built into the rail bed.
  - Unlike aircraft, HST systems are not subject to turbulence. Passengers may sit without seat restraints and may stand and walk comfortably even at maximum speeds and around curves.
  - Although HST systems do operate in highly seismic areas such as Japan, no fatalities have ever occurred as a result of a seismic event. Failsafe technology would stop the

trains when an earthquake is detected, and at-grade construction in fault zones would further improve safety.

- The HST system, like other public intercity modes, is inspected on a regular schedule as required in federal regulations. This regular inspection of both rolling stock and track would ensure the safety of the HST.

The safety characteristics of each mode are summarized in Table 3.2-10. This table shows that for all three safety characteristics, the HST mode has the best safety performance. While air and HST are similar in regard to operator and vehicle characteristics, HST performs better with regard to the environment because the HST is capable of operating safely and comfortably in a variety of climatic conditions compared to aircraft, without the need for passenger restraints. The automobile mode fares poorest in terms of safety.

Table 3.2-10
Safety Performance by Mode

	Safety Performance Characteristics		
Mode	**Operator** Training Regulation Experience	**Vehicle** Condition Regulation Control systems Crashworthiness	**Environment** Weather Guideway condition Terrain
Automobile	Poor	Good	Poor
Air	Excellent	Excellent	Poor
HST	Excellent	Excellent	Excellent

Alternatives Comparison for Safety

The safety performance for each alternative is shown in Table 3.2-11. The HST Alternative has the best overall safety performance primarily because it diverts 34 million annual passengers from the least safe automobile mode to HST[10], the safest mode. This demand shift combined with the rigorous requirements of HST operators, regular vehicle inspection, maintenance, control systems, crashworthiness, and ability to operate in virtually all weather conditions, make the HST Alternative superior to No Project and Modal Alternatives.

Table 3.2-11
Safety Performance by Alternatives

	Safety Performance Characteristics		
Alternative	**Operator** Training Regulation Experience	**Vehicle** Condition Regulation Control systems Crashworthiness	**Environment** Weather Guideway condition Terrain
No Project	Good	Good	Poor
Modal	Good	Good	Poor
HST	Excellent	Excellent	Excellent

[10] This number is based on the high-end ridership forecast for the HST based on the Business Plan. If the HST ridership were less (42 million instead of 68 million, including 10 million long-distance commuters for both the low and high forecasts), then fewer trips would be diverted from auto, effectively increasing the overall number of potential fatalities per year.

No Project Alternative: While the rate of injury or fatality is not expected to increase under the No Project Alternative, the increase in highway travel would be expected to cause the number of injuries and fatalities to increase as compared to existing conditions.

Modal Alternative: No significant safety benefits are associated with the Modal Alternative compared to the No Project Alternative, with about the same number of highway-related fatalities projected to occur under either scenario. However, because the Modal Alternative would provide some excess capacity not used by intercity highway or air trips, the additional capacity would likely be absorbed by commuting or other local trips. These induced trips could add to the amount of travel (PMT) on certain segments and could increase the number of fatalities. Furthermore, while the Modal Alternative also includes an improvement to air travel capacity and may ultimately increase the demand for air travel, these trips are more likely to use local and regional roadway systems to access the airports than under the HST Alternative, and this outcome could also pose a potential safety risk.

High-Speed Train Alternative: The HST Alternative would produce the greatest safety benefit compared to the No Project and Modal Alternatives. HST would divert about 34 million annual intercity highway trips from the Modal or No Project Alternatives, resulting in fewer injuries and fatalities annually.

Connectivity

Connectivity in the study area can be measured qualitatively and quantitatively using the number of modal options that offer competitive transportation services, the availability of intermodal connections, and the frequency of service (number of departures). A greater number of competitive modal options is considered a benefit because it increases the diversity, redundancy, and flexibility of the overall transportation system and provides travelers with greater choices.

- Modal options are a measure of the intercity modal diversity of each of the alternatives.
- An intermodal connection or facility allows passengers to transfer from one mode to another to complete a trip. A connection can be as simple as a timed connection between a train and a bus or as elaborate as the BART connection to SFO where air, rail, and bus all converge to give multiple transportation options.
- Frequency is measured as the number of departures available to travelers in the study area. High service frequency benefits travelers because it increases the number of possible connections to different modes and the number of options available for travel to a destination.

Modal Options: The No Project Alternative provides four modal options: automobile, air, intercity rail, and intercity bus. However, intercity travel in California is dominated by automobile and air transportation. The automobile accounts for over 88% of all intercity trips, with air transportation representing more than 10% and conventional rail carrying most of the remaining trips. Although the automobile and air modes compete against one another for the longer-distance intercity trips, such as San Francisco to Los Angeles, the automobile is without rival for many intermediate intercity trips. Table 3.2-12 shows intercity trips by mode between the major metropolitan regions in the study area. Between the San Francisco Bay Area and the Los Angeles Metropolitan Area, air transportation serves almost 52.5% of the travel market, with the automobile accounts for 47.3%, and conventional rail 0.2%. Only air transportation offers fast enough travel times to compete for the long-distance business travel market. Trips between the Central Valley and either the San Francisco Bay Area or the Los Angeles Metropolitan Area are good examples of intermediate intercity trips. For these markets, the automobile serves 97.3% of the travel market, while air transportation has 1.5% and conventional rail about 1.2%.

Table 3.2-12
1997 Intercity Trip Table Summary[a]

	1997 Base Trip Tables		
Market	**Air**	**Auto**	**Amtrak Rail**
Los Angeles to Sacramento	2,179,140	2,861,527	9,129
Los Angeles to San Diego	407,185	34,870,032	934,322
Los Angeles to San Francisco	9,376,455	8,442,469	36,525
Sacramento to San Francisco	40,797	20,475,524	502,956
Sacramento to San Diego	613,341	736,732	[b]
San Diego to San Francisco	2,417,203	2,387,001	[b]
Los Angeles/San Francisco to Valley Cities	368,805	23,747,021	290,896
Other	250,059	43,157,606	225,434
Total	15,652,986	136,677,910	2,000,351

[a] Air trips in this table are "local" (or true origin/destination) air trips between metropolitan areas. Connect air trips (which are not destined to a city within the corridor), and their potential for diversion to HST were forecast in the previous study using a separate procedure and subcontractor. The diversion to HST of connect trips is small in absolute numbers, and limited to a few shorter distance intercity markets. The previous connect air forecasts of HST ridership are used in this study as appropriate for the applicable Modal or HST Alternative.

[b] Amtrak trips for these markets are essentially zero and are therefore excluded from the table for clarity.

Source: U.S. Department of Transportation, Caltrans, and Charles River Associates, January 2000.

The Modal Alternative would provide additional capacity but no additional modal options beyond those existing or in the No Project Alternative.

The HST Alternative would provide a new intercity, interregional, and regional passenger mode that would improve connectivity to other existing transit modes and airports. HST would bring competitive travel times and frequent and reliable service to the traditional urban centers of the San Francisco Bay Area, Los Angeles Metropolitan Area, Sacramento, and San Diego. It would significantly improve the modal options available in the Central Valley and other areas of the state currently not well served by public transport (bus, rail, air) for intercity trips.

Tables 3.2-13 (low end) and 3.2-14 (high end) show intercity trips by mode between the major metropolitan regions in the study area projected for 2020 with a statewide HST system. Under the low-end or Business Plan assumptions, between the San Francisco Bay Area and the Los Angeles Metropolitan Area, HST is projected to capture at least 43% of the travel market. Air transportation would serve up to 24% of the travel market, the automobile up to 33%, and conventional rail virtually none of the market. For the high-end ridership assumptions, between the San Francisco Bay Area and the Los Angeles Metropolitan Area, HST is projected to capture up to 71% of the travel market, with the automobile as low as 28%, air transportation serving as little as 1%, and conventional rail virtually none of the market. For trips between the Central Valley and either the San Francisco Bay Area or the Los Angeles Metropolitan Area, the automobile would serve nearly 79% of the intercity travel market, while HST would capture nearly all the remaining 21% for the low-end forecasts (nearly 76% automobile trips and 24% HST trips for the high-end forecasts). The HST Alternative would provide similar benefits to other intermediate intercity markets served by the HST system. For longer-distance intercity trips, HST would provide a competitive alternative to driving and flying. For intermediate intercity trips, HST would also be an attractive alternative to driving.

Table 3.2-13
2020 Intercity Trip Table Summary Business Plan Scenario (Low End)

	2020 Business Plan Trip Tables			
Market	**Air**	**Auto**	**Amtrak Rail**	**HST[a]**
Los Angeles to Sacramento	1,132,827	2,720,332	97	3,384,964
Los Angeles to San Diego	20,805	42,023,218	298,843	5,304,220
Los Angeles to San Francisco	6,487,057	8,549,065	162	11,269,050
Sacramento to San Francisco	2,696	26,448,373	351,485	1,690,169
Sacramento to San Diego	745,079	644,200	61	702,630
San Diego to San Francisco	2,820,117	2,191,051	75	2,228,436
Los Angeles/San Francisco to Valley Cities	32,624	54,950,291	50,583	5,153,090
Other	5,286,399[b]	30,179,854	73,545	2,269,543
Total	16,527,605	167,706,384	774,851	32,002,103

a Low-end Business Plan ridership forecast.
b Other trips—connecting air trips from outside of the state.

Table 3.2-14
2020 Intercity Trip Table Summary Sensitivity Analysis Scenario (High End)[a]

	2020 Business Plan Trip Tables			
Market	**Air**	**Auto**	**Amtrak Rail**	**HST[b]**
Los Angeles to Sacramento	29,070	3,176,209	97	6,141,554
Los Angeles to San Diego	1,393	50,373,405	298,843	7,444,541
Los Angeles to San Francisco	287,089	9,503,243	162	24,338,901
Sacramento to San Francisco	2,546	30,853,989	351,485	2,246,588
Sacramento to San Diego	60,065	707,496	61	1,749,001
San Diego to San Francisco	177,361	2,315,668	75	6,609,892
Los Angeles/San Francisco to Valley Cities	7,636	64,680,617	50,583	7,228,074
Other	5,277,019[c]	34,315,568	73,545	2,638,702
Total	5,842,178	195,926,194	774,851	58,397,253

a Air trips in Tables 3.2 13 and 3.2 14 are "local" (or true origin/destination) air trips between metropolitan areas. Connect air trips (which are not destined to a city within the corridor), and their potential for diversion to HST were forecast in the previous study using a separate procedure and subcontractor. The diversion to HST of connect trips is small in absolute numbers, and limited to a few shorter-distance intercity markets. The previous connect air forecasts of HST ridership are used in this study as appropriate for the applicable Modal or HST Alternative.
b High-end Business Plan ridership forecast.
c Connecting air trips from outside of the state.
Source: Charles River Associates, January 2000.

Intermodal Connections: The automobile can be used to go virtually anywhere in California. Unlike common carrier transportation modes (air, bus, or rail), the automobile does not require or depend upon intermodal connections to get from the trip origin to the trip destination. The automobile mode would have the same flexibility in the Modal Alternative and the HST Alternative.

Scheduled airline service allows a traveler to reach any destination served by commercial airlines in a relatively short travel time. Unlike the automobile, commercial air travel requires intermodal connections to get to the airport and to a final destination. Moreover, airports are predominately located outside major city centers, a considerable distance from the major transit hubs, which are typically downtown. With the exception of the San Francisco and Burbank airports, which are served directly by rail, all airports in California require transfers to automobiles or road-based public transportation.

It is assumed that there would be limited new intermodal connections under the No Project and Modal Alternatives because a limited number of these improvements are currently planned and programmed.

HST stations would be generally located at existing transportation centers that can serve a wider area through public transit and would enhance intermodal connections in each region. HST stations in the traditional urban cores of the Sacramento, San Francisco Bay, and Los Angeles areas would connect to the heart of the established public transit networks. For example, Los Angeles Union Station (LAUS) is projected to be the most heavily used HST station. LAUS is the transit hub of Los Angeles County and is the primary destination for the Metrolink Commuter rail services, the Los Angeles Metro Red Line, the Pasadena Gold Line, the Amtrak Surfliner service, and the regional bus transit services. The potential station at the Transbay Terminal in San Francisco would be located in the heart of San Francisco's financial district and within walking distance of all major downtown hotels, the convention center, and Union Square retail. The Transbay Terminal would also serve Caltrain commuter rail, all the major bus services to downtown San Francisco, BART, and the extensive San Francisco Municipal Railway (Muni) light-rail system.

HST could have a profound effect on the Central Valley and on outlying areas that are not currently well served by other forms of public transportation. HST would provide convenient and reliable connections to the airports and downtowns of San Francisco and Los Angeles, and to Central Valley cities. All of the potential HST station sites in the Central Valley would either be in city centers or at transportation hubs (airports and Amtrak stations).

<u>Frequency</u>: The automobile, by offering unlimited potential frequency and because it can be driven at virtually any time and to virtually any destination, has the highest connectivity of any mode.

Although 17 commercial airports are included in this study, the range of city pairs served is considerably narrower because little to no commercial service exists between some of the city pairs. Air travel is market-driven and consequently airlines concentrate their operations on markets that are profitable. The San Francisco Bay Area to Los Angeles Metropolitan Area corridor is the most heavily traveled air corridor in the world. This intercity travel market and the long distance markets to/from Sacramento and to/from San Diego have many daily departures and arrivals. In other regions such as the Central Valley, where demand is lower and the distances shorter, the number of daily flights serving California intercity markets is far more limited. Table 3.2-15 shows the daily 1997 average air frequencies by airport pair (Charles River Associates, Inc. 2000). While LAX had service to eight airports within the study area with over ten flights daily in each direction, Fresno had only two (Los Angeles and San Francisco) and Bakersfield only one (Los Angles). Merced, Modesto, Stockton, and Visalia had virtually no air service within the study area.

The additional air transportation capacity provided by the Modal Alternative would likely result in frequency increases between the airports where improvements were made. In particular, based on the assumptions for the Modal Alternative, air service between Fresno and the major metropolitan areas (Sacramento, the San Francisco Bay Area, Los Angeles, and San Diego) could be significantly improved.

The HST system adds a new intercity service to the statewide intercity transportation network that would offer a variety of services with different stopping patterns (express, skip-stop, and local services) to serve long-distance, intermediate, and shorter-distance intercity trips. Consequently, HST would increase frequencies for some city pairs that are not well served by air transportation. In addition to the major city pairs, smaller cities in the Central Valley and suburban cities surrounding the major markets would be directly connected with frequent intercity service.

Table 3.2-15
Daily 1997 Average Air Frequencies by Airport Pair (Each Direction)[a,b]

	BFL	BUR	CLD	FAT	LAX	MCE	MOD	MRY	OAK	ONT	SAN	SCK	SFO	SJC	SMF	SNA
Bakersfield																
Burbank	0															
Carlsbad	0	0														
Fresno	0	4	0													
Los Angeles	19	0	13	30												
Merced	0	0	0	1	0											
Modesto	0	0	0	0	0	0										
Monterey	0	0	0	0	20	0	0									
Oakland	0	15	0	0	35	0	0	0								
Ontario	0	0	0	4	15	0	0	0	12							
San Diego	0	6	0	3	76	0	0	0	11	0						
Stockton	0	0	0	0	0	0	0	0	0	0	0					
San Francisco	5	13	0	17	49	2	5	15	0	8	25	0				
San Jose	0	8	0	0	27	0	0	0	1	7	14	0	0			
Sacramento	3	10	0	2	13	0	0	0	0	10	11	0	20	0		
Orange County	0	0	0	4	17	0	0	3	13	0	1	0	10	14	5	
Visalia	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0

[a] Three-digit codes for airports used as the column headings correspond to the airport names in the row headings.

[b] Data for this table has changed considerably since 1997. For example, there are currently 18 non-stop flights between Los Angeles and Fresno, and seven between San Francisco and Fresno.

Source: Official Airline Guide online database, with calculations by Charles River Associates.

The proposed HST system would serve about 20 to 30 stations (depending on alignment option selected). Table 3.2-16 shows the number of daily trains (for each direction) served for each station pair as assumed for the Business Plan. This table shows that, compared to air transportation, the addition of HST service would greatly increase the number of trains serving major and intermediate destinations. For example, Fresno is expected to have service to 20 stations/cities with frequencies of at least 10 trains daily in each direction, while Bakersfield would have service to 19 stations/cities with frequencies of at least 10 trains daily in each direction. Central Valley cities such as Merced, Modesto, Stockton, and Visalia as well as additional urban markets in the San Francisco Bay Area and southern California such as East San Gabriel Valley, Palo Alto/Redwood City, Riverside, Sylmar, and Escondido, would all receive frequent service to all HST stations.

Table 3.2-16
2020 High-Speed Train Frequencies by Station Pair (Each Direction)

	S.D.	M.M	ESC	TEM	RIV	ONT	E.S.G.	L.A.	BUR	SYL	BAK	TUL	FSN	L.B.	GIL	S.J.	R.C.	SFO	S.F.	MER	MOD	STK	SAC
San Diego																							
Mira Mesa	39																						
Escondido	39	39																					
Temecula	39	39	39																				
Riverside	39	39	39	39																			
Ontario	39	39	39	39	39																		
East San Gabriel	39	39	39	39	39	39																	
Los Angeles	52	39	39	39	39	39	39																
Burbank	31	31	31	31	31	31	31	34															
Sylmar	31	31	31	31	31	31	31	34	34														
Bakersfield	30	22	22	22	22	22	22	33	21	21													
Tulare Co	11	11	11	11	11	11	11	11	12	12	12												
Fresno	25	17	17	17	17	17	17	28	14	14	28	12											
Los Banos	7	8	8	8	8	8	8	8	8	8	8	8	10										
Gilroy	20	20	20	20	20	20	20	23	23	23	12	8	11	10									
San Jose	28	22	22	22	22	22	22	33	23	23	20	8	19	10	25								
Redwood City/Palo Alto	20	20	20	20	20	20	20	23	23	23	12	8	11	10	25	25							
SFO	20	20	20	20	20	20	20	23	23	23	12	8	11	10	25	25	25						
San Francisco	36	26	26	26	26	26	26	46	23	23	21	8	19	10	25	35	25	25					
Merced	4	4	4	4	4	4	4	4	4	4	4	4	4	4	9	9	9	9	9				
Modesto	8	5	5	5	5	5	5	8	4	4	8	4	8	9	9	9	9	9	9	13			
Stockton	13	10	10	10	10	10	10	13	9	9	10	4	11	9	9	9	9	9	9	13	17		
Sacramento	16	13	13	13	13	13	13	9	9	10	11	4	11	9	9	18	9	9	18	13	17	22	

Source: High Speed Rail Authority's final business plan 2000.

Alternatives Comparison for Connectivity

No Project Alternative: Under the No Project Alternative, there would be no net improvement to the connectivity options in the state over the existing conditions. There would no new modes introduced, no new intermodal terminals or connections, and no improvements in air transportation frequencies.

Modal Alternative: Under the Modal Alternative, there would be significant capacity improvements to the air and highway system, but no new modes introduced into the system or intermodal facilities. The additional air capacity would likely result in additional frequencies between the airports where improvements were made. In particular, based on the assumptions for the Modal Alternative, air service between Fresno and the major metropolitan areas (Sacramento, the San Francisco Bay Area, Los Angeles, and San Diego) could be substantially improved where capacity exists.

High-Speed Train Alternative: The HST Alternative would add a new mode to the state's intercity transportation system. The HST would create a variety of new intermodal connections to local, regional, and intercity modes. The HST would add frequencies to the state's intercity travel network, allowing greater flexibility in travel time and location; however, this alternative could result in some decreases in air frequencies in some markets. Of all the alternatives, the HST Alternative provides the highest level of connectivity in the study area, particularly between the Central Valley cities and the city centers of the major metropolitan areas.

Sustainable Capacity

Sustainable capacity is a measure of the transportation capacity of an alternative to meet not only the projected demand but to provide a sustainable capacity over time without the need to develop additional infrastructure. Sustainable capacity is quantitatively measured by the amount of additional transportation infrastructure required to accommodate potential future demand beyond the demand forecast for this system.

For this analysis the design demand is assumed to be the 283 million annual intercity trips by 2020,[11] and both the Modal and HST Alternatives have been developed to accommodate this demand. To test the sustainable capacity of the Modal and HST Alternatives, a theoretical system capacity to accommodate potential additional demand was identified. For the purposes of this analysis, the system capacity is assumed to be approximately 31,500 passengers per hour, which represents a reasonable capacity for a 2-track HST system.[12] The ability of any of the alternatives to accommodate the hypothetical capacity is evaluated by region in terms of capacity on intercity transportation facilities (i.e., 31,500 passengers per hour on the intercity highway segments, airports, or HST for the Bay Area to Merced region) and used as a benchmark to compare the sustainable capacity of No Project, Modal, and HST Alternatives. A description follows of how the theoretical sustainable capacity was developed for each mode and for each alternative.

Highway Mode Characteristics: The sustainable capacity of a highway facility depends largely on the availability of travel lanes and the speed that autos are able to travel. This relationship is expressed as LOS, which is defined in Section 3.1, Traffic and Circulation. While all modes are subject to capacity constraints that affect the vehicle's speed, given the small capacity of most

[11] This demand includes the baseline demand of 215 million annual intercity trips and the 58 million high-end representative intercity demand trips. Not included in this analysis are 10 million commute trips.

12 The figure 31,500 represents 75% of 42,000 passengers per hour. The 42,000 passengers per hour is based on a train separation of 3 minutes between trains and a train capacity of about 1,050 passengers per train for both directions on a double-track system. Trains could be designed with more seating and can accommodate standing passengers if needed and therefore could exceed 42,000 passengers per hour.

automobiles (five passengers), more vehicles are required to accommodate a large passenger demand. To meet a higher travel demand, automobiles have two basic options for increasing capacity.

- Vehicle size may be increased (buses): the higher the capacity of the vehicle, the more passengers can be carried at a high rate of speed, and this assumes or requires a change in typical driver behavior.
- Capacity of the roadway may be increased (highway expansion): the addition of lanes allows more autos to travel safely with sufficient stopping distance.

The capacity of an intercity highway lane has been assumed to be 2,300 vehicles per hour with an average auto occupancy rate of 2.4 passengers per intercity vehicle trip, or about 5,520 intercity passengers per hour per lane per direction. Under the No Project and Modal Alternatives, where travel demand is split primarily between the auto and air modes, the highway demand would be 86%[13] of the total 31,500 passengers per hour, or approximately 27,100 passengers per hour in two directions (or 13,500 passengers per direction). Based on an average intercity vehicle occupancy rate of 2.4 passengers per vehicle, 13,500 passengers per direction is equivalent to an additional 5,600 vehicles per direction in addition to the future 2020 peak hour traffic demand. To accommodate the theoretical system capacity, on average[14] every highway link in the study area in all regions would require three additional highway lanes in each direction above and beyond what is proposed under the No Project Alternative. For the Modal Alternative, two additional highway lanes in each direction above and beyond what is proposed would be needed to accommodate the theoretical system capacity. No additional lanes would be required for the HST Alternative because the additional travel demand could be shifted from the highway system to the HST system.

<u>Air Mode Characteristics</u>: The sustainable capacity of an air travel system depends on both the airport and the aircraft. The capacity of an airport includes both airside (e.g., terminals, gates, runways, taxiways, and airspace) and landside (e.g., curbsides, roadways, and parking spaces) systems and facilities. Typical commercial aircraft can range between small jets such as regional jets and Boeing 737s with passenger capacities of 20 to 135, and large jets such as Boeing 777s and 747s with passenger capacities of 200 to 350. As presented in Chapter 2, Alternatives, this analysis assumes the Boeing 737 with a seating capacity of 135 will be the typical aircraft used for the intercity market within California.

It is possible to increase the capacity of the air travel system either by increasing the capacity of individual aircraft or by using more small aircraft and by expanding airports. However, for the air travel system to function properly, all systems must be in balance to avoid bottlenecks and unnecessary congestion. For instance, while it is possible to use larger aircraft at all of the airports considered in this analysis, it is necessary that the airside and landside systems be sized to adequately accommodate the additional demand.

Average runway and gate capacity was used to estimate the sustainable capacity of airports. Determining peak-period runway capacity typically requires sophisticated computer simulation techniques and considers the number of runways and their physical relationship to each other for each airport (crossing runways have less capacity then parallel runways, and capacity is further reduced during inclement weather), and the aircraft types that operate during the peak period.

[13] Based on mode splits forecast for 2020 conditions by Charles River Associates 2000.

[14] Some areas, such as along I-5 between Bakersfield and Los Angeles, did not require additional lanes, as two lanes per direction would be added under the Modal Alternative; others, such as SR-58 and SR-14, required two additional lanes.

Consistent with the approach used for the Modal Alternative, the same ratios (i.e., 525,000 passengers per gate per year and 30 gates per runway) were used to calculate the additional gates and runways required to accommodate the theoretical demand. Similar to estimating the number of highway trips, the total number of air trips are estimated at 4,100 air trips per hour per region, based on the forecasted mode split of 13% of air trips[15] (see Chapter 2).

The addition of 4,100 peak hour trips to each of the regions would require, on average, 51 gates and one runway in each region in addition to the improvements proposed under the Modal Alternative.[16] However, since major urban areas such as the Los Angeles region and the Bay Area have several airports with multiple gates and runways, it is reasonable to expect that those regions could accommodate some of the peak demand with operational improvements. Since interstate and international flights are also competing for the additional slots, any growth in intrastate flights would require additional gate and runway capacity improvements. In the regions with fewer airport options such as the Northern and Southern Central Valley and San Diego, where the gate and runway capacity simply does not exist, additional gates and runways would be needed above and beyond the Modal Alternative's additions. No additional gates or runways would be required for the HST Alternative because the shift of demand from the air system to the HST system would allow airports to handle the peak demand without additional capacity.

<u>High-Speed Train Mode Characteristics</u>: Sustainable capacity of an HST system is determined by the attributes listed below.

- Capacity of rail line (e.g., single track or double track).
- Capacity of the train (number of trainsets, or locomotives and coaches).
- Capacity of stations and passenger facilities, and the lengths of platforms.
- Speed at which the train can travel.
- Train control system.
- Degree that shared-use track is used by other services, thereby reducing available capacity of the HST.

The HST Alternative is a double-track system that allows trains to travel in each direction without having to stop to meet and pass each other. The HST Alternative also incorporates off-line stopping tracks at stations, allowing through trains to pass local trains. The double-track system could sustain a theoretical line capacity of 31,500 passengers per hour without any additional guideway; however, the size and number of trains operating per hour would increase, and the support facilities (e.g., maintenance and storage yards and stations) may have to be sized accordingly. The HST line capacity of 31,500 passengers per hour is based on the design characteristics of the proposed HST system and the following assumptions.

- Trains will be separated by 3 minutes.

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15 Based on mode splits forecast for 2020 conditions by Charles River Associates 2000.

16 Based on 4,100 passengers per hour, multiplied by an 18-hour operating day, multiplied by 365, which equals 26,937,000 annual trips.

- The capacity of a train will be about 1,050 passengers with a load factor of 75%.
- Traffic will reach 40 trains per hour (both directions on a double track system).

Train capacity can vary depending on the number of cars and how the seats are configured in those cars. The trains can even accommodate standees if the demand exceeds seating capacity. Station platforms need to be the same length as the total length of the train. In this case the train and platforms are designed for a maximum length of more than 1,300 ft (400 m). The train control system is one of the ultimate determinants for speed on the train system, and is assumed to be adequate for the additional capacity (Nash 2003). The train control system is responsible for safely spacing the trains so that there is adequate stopping distance between the trains. While the train control system requirements will determine the ultimate safe traveling speed for the train, the design speed of the train also affects the capacity of the system as a whole. All of these factors play a role in determining the sustainable capacity of an HST system.

In California, conventional rail largely depends on the capacity of the host railroads, which are primarily freight railroads and commuter rail authorities. Amtrak, the current intercity operator, does not own any tracks or have dispatch control in the state. Since conventional rail, especially intercity passenger rail, is a tenant on the host railroads, the ultimate capacity of the line is not in their direct control. Infrastructure conditions, freight demand, and commuter rail demand all play a role in determining the capacity of the railroad. Currently there are considerable capacity constraints in southern California in the Los Angeles area and between Sacramento and San Jose in the Bay Area. Because of these severe capacity constraints in the state, conventional intercity passenger rail has very limited sustainable capacity.

Alternatives Comparison for Sustainable Capacity

No Project Alternative: There is little to no sustainable capacity in the No Project Alternative. The future transportation infrastructure is severely constrained by the limited number of capacity improvements funded or programmed for 2020. Improvements associated with the No Project Alternative are generally to existing interchanges versus line capacity expansion or improvement projects. The highway system's sustainable capacity would require additional infrastructure to accommodate any growth in demand. To accommodate the theoretical system capacity of 31,500 passengers per hour, the highway system would require at least three additional lanes in each direction. The capacity of airports would have to be expanded somewhat more than improvements contemplated under the Modal Alternative. Therefore, the No Project Alternative would not accommodate the theoretical demand and would require extensive infrastructure expansion to have sustainable capacity.

Modal Alternative: There is insufficient capacity in the Modal Alternative to accommodate the additional theoretical demand in all regions. Additional highway and airport infrastructure beyond the Modal Alternative improvements would be required to accommodate the 31,500 peak passenger demand theoretical system capacity. While the Modal Alternative would include some excess highway and airport capacity in the potentially modified highway and airport system, it would not be sufficient in all areas to meet the additional demand and overall service levels would be degraded with use beyond the representative demand. Where the Modal Alternative would provide excess capacity (e.g., capacity gained through addition of a full lane), the capacity would probably be absorbed by other travelers (e.g., commuter or other trips). Additional capacity for highways and airports might be further increased with either higher auto occupancy rates or larger aircraft, respectively. However, auto occupancy rates are not likely to change on a statewide level.

Likewise, the prevailing trend in the aviation industry and projections for future aircraft operations are toward a greater reliance on small and regional jet aircraft (up to 135 passengers) compared to large aircraft for the short-haul intercity travel market under evaluation for this study. Additionally, if larger aircraft were used, landside improvements would still be required to accommodate demand. In both cases, it is important to note that without capacity increases through either lane widenings or additional runways and gates, service levels would worsen for both modes because in both cases performance is contingent on available capacity.

High-Speed Train Alternative: The HST Alternative would provide a train system with sufficient infrastructure to meet the projected demand and to allow for capacity expansion beyond the design year requirements. It would provide an additional mode for the state's intercity transportation system, effectively creating a capacity release valve for the existing intercity modes. The ultimate capacity of the HST could exceed the forecasted 20- to 40-year demand by increasing frequency of service, adding cars to trainsets, using double-deck passenger cars or linking multiple trainsets together on the proposed dual-track system. In addition, the HST Alternative presents a reasonable alternative to expanding highway and aviation infrastructure. Compared to the No Project and Modal Alternatives, the HST Alternative would require no additional infrastructure (with the exception of rolling stock, stations, and maintenance facilities) to provide substantially additional capacity; therefore, the HST Alternative would have the highest sustainable capacity.

Passenger Cost

Passenger cost is a measure of the relative differences in travel costs between the No Project, Modal, and HST Alternatives. Passenger cost for this analysis means the total cost of the trip, including the cost of traveling to the airport or station, the airplane or train fare, and other associated expenses. Cost is one of the key factors that can influence passenger choice of modes.

There is a range of existing intercity travel options, from relatively inexpensive intercity bus to premium air. For example, the cost of traveling round-trip between Los Angeles and San Francisco (one of the busiest travel corridors in the world) can be as little as $25 for an intercity bus ticket to as much as $350 for a walk-up fare for airline travel. The air travel market particularly features large variations in fares. Sources of these variations include the following factors.

- Time of travel: Peak-period travel tends to be more expensive, and Saturday night stays tend to be less expensive.
- Time of booking: Early bookings tend to be less expensive, while last-minute bookings are more expensive.
- Airport choice: Travel between major destinations such as Los Angeles and San Francisco boasts a variety of options and fares, while travel to or from smaller airports with limited service such as Fresno and Bakersfield have greatly limited fare and travel choices.

Passenger cost is quantitatively measured by actual costs to the passenger associated with a typical door-to-door trip. The representative city pairs presented in the travel time discussion earlier in the section are used as a basis to compare the relative differences in cost

Automobile Mode Characteristics: For highway travel, it is assumed that the entire door-to-door trip is made with a private automobile and that there are no ancillary access costs. Automobile travel costs are shown as the total costs per passenger and per auto. The total costs of owning and operating a vehicle include depreciation, maintenance, repairs, taxes, insurance, etc. and are shown on a per-auto basis in Table 3.2-17. The ridership and revenue estimates for the Business Plan are based on the perceived costs of making an automobile trip (e.g., fuel) and do not include all of the true costs associated with owning and operating a vehicle.

Table 3.2-18 summarizes the costs for making a one-way trip for the representative city pairs. Parking is not included even though this could be an additional significant expense. (All-day parking in downtown San Francisco or Los Angeles can be as high as $25.) As shown in the table, the door–to-door average perceived one-way cost per person for traveling between representative city pairs by highway range from $15 to $48 per passenger, and $25 to $81 for total costs.

Table 3.2-17
Auto Ownership and Operating Costs by Category (2003$)[a]

Cost Category	Percent of Cost	Cents
Financing	15	7.7
Depreciation	35	18.0
Fuel Tax	4	2.0
Fuel	9	4.6
Repairs	2	1.0
Maintenance	5	2.6
State Fees	3	1.5
Insurance	27	13.8
Total	100	51.2

[a] All costs escalated by 3% for 3 years to calculate 2003 dollars.
Source: Federal Highway Administration, Our Nation's Highways, 2000.

Table 3.2-18
One-Way Door-to-Door Trip Automobile Costs (2003$)[a,b]

City Pair	Average Total Cost per Passenger[c]	Total Costs per Auto[d]
Los Angeles downtown to San Francisco downtown	$81	$194
Fresno downtown to Los Angeles downtown	$47	$112
Los Angeles downtown to San Diego downtown	$25	$61
Burbank (airport) to San Jose downtown	$70	$169
Sacramento downtown to San Jose downtown	$25	$60

[a] California High Speed Rail Authority Business Plan cost numbers. HST ridership forecasts assumed only perceived auto costs. Average cost does not include parking.
[b] All costs escalated by 3% for 3 years to calculate 2003 dollars.
[c] Total cost based on average cost of owning and operating a vehicle of 51 cents per mile divided by the assumed average auto occupancy rate of 2.4 persons. Source: Federal Highway Administration, Our Nation's Highways, 2000.
[d] Full cost of driving a single-occupant auto based on average cost of owning and operating a vehicle of 51 cents per mile.
Source: Federal Highway Administration, Our Nation's Highways, 2000; Parsons Brinckerhoff 2003.

Air Mode Characteristics: The passenger cost of air travel is primarily determined by the available fare. Depending on the airport, airline, time of year, day of the week, and even certain hours of the day, the price of an air ticket can vary greatly. Regions with competing airports or alternative sub-markets (i.e., Ontario and Oakland) have more fare, schedule, and airline options compared to airports with limited service (e.g., Fresno and Bakersfield). In California, since most air operations are scheduled to serve longer distance markets, some major airports such as San Francisco and Los Angeles have a more limited choice of airlines and fare options for intra-California travel. Airports that provide more limited service, such as Fresno and Bakersfield, typically have only a few flights available per day and typically one or two airlines that serve that market. However, airports like Ontario and Oakland have frequent intra-California flights from a range of airlines at highly competitive fares.

Average total air costs were calculated as including access, egress, and airfare costs. The access and egress sum cost ranges from $10 to $24 per trip. Air trips require at least one other mode to travel from a different location (e.g., home/office) to the airport, which may include public transit (bus or rail), taxi/shuttle, or private auto (may require parking or drop-off).

A range of airfares are available that depend on time of purchase (e.g., 21-day advance purchase versus same-day fare), duration of visit (e.g., same-day or Saturday night stay), and departure time (e.g., peak versus off-peak). Table 3.2-19 summarizes the average total cost for air travel between city pair destinations based on the Business Plan estimates (escalated to 2003 dollars) for business and non-business travel.. As shown, airfares vary widely and can range from $94 between Burbank and San Jose to $224 between Sacramento and San Jose for business travel.[17]

Table 3.2-19
Average Business and Non-Business Fares One-Way Door-to-Door Air Trip Passenger Costs (2003$)[a]

City Pair	Average Total Costs[b] Business/Non-Busiiness
Los Angeles downtown to San Francisco downtown	$148/$89
Fresno downtown to Los Angeles downtown	$193/$112
Los Angeles downtown to San Diego downtown	$148/$89
Burbank (airport) to San Jose downtown	$94/$54
Sacramento downtown to San Jose downtown	N/A

[a] Based on low-end revenue and ridership forecasts from the Business Plan. Costs are escalated by 3% for 3 years.
[b] Sample costs include fares as well as parking, taxi fares, and other costs involved with traveling to and from the airport.
Source: Parsons Brinckerhoff 2003.

High-Speed Train Mode Characteristics: Similar to air travel, the primary cost associated with HST travel is the cost of the train ticket. For this analysis, the fare schedule identified in the Business Plan (escalated to 2003 dollars) was used to compare the representative city pairs (Table 3.2-20). However, based on experience in Asia and Europe, HST fares may vary the way airfares do with the time of year, day of week and duration of stay. New competition may also develop between the different modes that may affect HST fares. The HST could also offer premium and economy services with corresponding fares depending on the markets that develop.

As with air travel, both an access and egress fee of about $5 or $6 ($10 to $12 total) are part of the HST average total costs. HST travel requires at least one mode change to access the nearest HST station. Because the HST stations are generally located in the city centers they are assumed

[17] There is no direct air service between Sacramento and San Jose; therefore it is assumed that this trip would be between SMF and SFO with a shuttle connection to San Jose.

to be located in closer proximity to larger population and work centers than airports. The HST line-haul travel fare was estimated by using the fare schedule presented in the Business Plan (escalated to 2003 dollars).

Table 3.2-20
High-Speed Train One-Way Door-to-Door Trip Passenger Costs (2003$)[a]

City Pairs	Average Total Cost[b] Business/Non-Busiiness
Los Angeles downtown to San Francisco downtown	$59/$35
Fresno downtown to Los Angeles downtown	$50/$31
Los Angeles downtown to San Diego downtown	$47/$29
Burbank (airport) to San Jose downtown	$52/$31
Sacramento downtown to San Jose downtown	$48/$29

[a] Based on business fare costs provided in Business Plan.
[b] Sample costs include fares as well as parking, taxi fares, and other costs involved with traveling to and from the airport.
Source: Parsons Brinckerhoff (2003).

Depending on city pair, level of state support for fare subsidies, and competition, intercity passenger rail would be cost-competitive with the HST. On average, given current fares for Amtrak service and the proposed fares for HST, conventional intercity service would cost approximately 10% less than the HST for the representative city pairs listed above (assuming the same access and egress fees as the HST). Conventional rail would also be considerably less expensive than air based on the representative city pairs.

Alternatives Comparison for Passenger Costs
No Project Alternative: Overall, auto passenger costs are considerably lower for short- and mid-range trips than airfares for short haul routes, such as Los Angeles to San Diego, Los Angeles to Fresno or Sacramento to San Jose. For long-range trips, such as Los Angeles to San Francisco or Burbank to San Jose, the automobile remains competitive due to the access and egress costs associated with air travel.

Modal Alternative: Because no additional mode options are included in the Modal Alternative, passenger costs would be, on average, equal to those of the No Project Alternative. The same passenger cost analysis of short-, mid-, and long-range trips of the No Project Alternative pertains to the Modal Alternative.

High-Speed Train Alternative: The HST Alternative would provide an overall passenger cost savings for all city pairs analyzed. On average, the HST Alternative could save from 8% to 44%, depending on city pair, of the passenger costs associated with the No Project and Modal Alternatives. The HST mode is cost-competitive with the highway mode for all trips and is less expensive than the air mode. For all city pairs, the HST Alternative provides a price-competitive alternative to existing airline service and the automobile.

3.2.4 High-Speed Train Alignment Options Comparison

Travel time, connectivity and passenger cost for the HST can all be affected by which alignment option the HST travels on. This section discusses the relative differences by region of the alignment options for the HST Alternative.

A. BAY AREA TO MERCED

The selection of the Diablo Range direct options between the San Francisco Bay Area and the Central Valley would have significant implications for HST service. The Diablo Range direct alignments are a shorter and faster option between the San Francisco Bay Area and Sacramento/Northern San Joaquin Valley, providing for much shorter travel times between these markets. For example, for express trains between Sacramento and San Jose, the Diablo Range direct alignments travel times would be about 25 min less than for the Pacheco Pass (50 min for the Diablo alignments verses 1 hr and 15 min for the Pacheco Pass options). The Diablo Range direct options would permit express travel times between Sacramento and San Francisco in 1 hr and 20 min, compared to 1 hr and 45 min via the Pacheco Pass options.

The Diablo Range direct alignments would place Merced on the San Francisco to Los Angeles segment of the HST network, which would result in a higher frequency of service to/from Merced. However, the Pacheco Pass alignment options include potential stations at Gilroy (or Morgan Hill) and Los Banos, whereas the Diablo Range alignments do not have any stations between Merced and San Jose. The populations that would be served by the Gilroy and Los Banos stations would therefore have much shorter access times and access costs to the nearest HST station with the Pacheco Pass alignments. The potential Gilroy/Morgan Hill Station would have a particularly high impact on connectivity, travel times, and access costs, since in addition to serving Southern Santa Clara County, it would also be the most accessible station location for serving the Santa Cruz, Monterey/Carmel, and Salinas populations.

The decision on how best to serve the Bay Area cities would also have a major impact on the HST system. This Program EIR/EIS evaluates both potential service to the Bay Area along the San Francisco Peninsula and potential service along the East Bay to Oakland. If service to both sides of the Bay were pursued, service to each Bay Area station (north of San Jose) would be less frequent. However, if only one side of the Bay were directly served by the proposed HST system, the number of intermodal connections would be greatly reduced. The access times and access costs would increase significantly, and the competitiveness of the new mode on the side of the Bay not served would also be reduced. For example, if the East Bay is not directly served, all trains bound for the Bay Area would terminate in downtown San Francisco. However, there would be no HST link to directly serve Oakland, the Oakland Airport, or Southern Alameda County. Potential HST passengers from the East Bay would have to either use the Capitol Corridor, mass transit, or drive to San Francisco, San Jose, or the Peninsula to use the HST service.

The I-880 alignment would provide superior travel times to connect the HST system to the East Bay as compared to the Hayward/Niles/Mulford Line. The Mulford Line is a longer route and has tight curves that would severely restrict speeds between Fremont and Union City. For all potential markets to Oakland, the I-880 corridor would offer express and local travel times of about 6 min less than the Mulford Line. Using the I-880 corridor, travel times between Oakland and Los Angeles could be achieved in 2 hrs and 18 min, whereas using the Mulford Line the same trip would take a minimum of 2 hrs and 24 min.

Potential Station Locations

- For service to downtown San Francisco, the Transbay Terminal and the 4th and King Station were selected for further evaluation. The 4th and King Station is the existing terminus for the Caltrain commuter rail service. This station site (adjacent to Pacific Bell Stadium) is well connected to the San Francisco Muni system but stops more than a mile short of the financial district of downtown San Francisco and does not connect to BART. The Transbay Terminal would offer significantly greater connectivity to San Francisco and the greater Bay Area than the existing 4th and King site due to its location in the heart of the downtown San Francisco financial district, where many potential HST passengers could walk to the station. In addition, the Transbay Terminal would serve as the transit hub for all of the major services to downtown San Francisco, with the advantage of direct connections to BART and Muni. The 4th and King Station would have about a 2.5-min shorter line-haul travel time to San Francisco than the Transbay Terminal, since the trains would travel at relatively slow speeds between 4th and King and the Transbay Terminal, a distance of 1.2 mi (1.9 km). However, since the Transbay Terminal would offer much greater connectivity to San Francisco and the greater Bay Area than the existing 4th and King site, total travel times to downtown destinations via the Transbay Terminal are expected to be superior.

- West Oakland Station and 12th Street City Center Station were selected for further consideration for the Oakland terminus station. Both of these potential stations would directly connect with BART, and both would have good freeway access. The 12th Street City Center Station would have superior connectivity, as it is located in the heart of downtown Oakland where many potential HST passengers could walk to the station. The 12th Street City Center BART Station is also a transfer station providing greater connectivity to the regional rail transit system.
- A potential station to serve San Mateo County would be located either at Redwood City or Palo Alto. Both would be multi-modal stations at existing Caltrain station locations. The Palo Alto Station would be a stop for the Caltrain express services, and therefore would have better connectivity to the regional commuter service and to the Peninsula.
- A potential station to serve Southern Alameda County would be located at either Union City or Fremont (Auto Mall Parkway). Both station locations would offer a high level of connectivity. The Union City Station would connect to BART, the Capitol Corridor, and AC Transit; whereas the Auto Mall Parkway Station would have good access to the I-880 freeway and connect to the Capitol Corridor, ACE Commuter Rail, and AC Transit. The Union City Station site serves both alignment options for East Bay service, while the Auto Mall Parkway site is only served by the Mulford Line alignment.
- South Santa Clara County potentially would be served by a station at either Gilroy or Morgan Hill. Both of these two potential stations would be at Caltrain commuter rail station locations. The Gilroy Station is about 10 mi (16 km) south of Morgan Hill and therefore provides better connectivity, travel times, and lower access costs to the Santa Cruz, Monterey/Carmel, and Salinas markets. The Gilroy Station is only served by the Pacheco Pass/Gilroy/Caltrain alignment, and neither the Gilroy nor the Morgan Hill station sites would be served by the Diablo Range Northern alignment options.
- Four other potential stations are being considered for service to the Bay Area: Diridon Station in downtown San Jose, and stations to serve the three regional international airports, SFO, Oakland (Coliseum BART), and San Jose (Santa Clara). In addition, a potential station in the Central Valley to serve Los Banos is being considered for the Pacheco Pass alignment options. Diridon Station would be a multi-modal hub maximizing connectivity to downtown San Jose and the Southern Bay Area. Diridon Station would serve Caltrain, ACE Commuter Rail, the Capitol Corridor, Amtrak, VTA buses and light rail, and a possible link to BART. None of the three airport stations would be in the airport terminals, but each would permit easy access by people movers, or shuttles (at SFO, BART currently provides a direct connection from the Millbrae Caltrain Station to the SFO international terminal). All three potential airport stations would have direct connections to local and regional commuter rail

services and would minimize potential travel times and costs for HST passengers who would use the trains for access to the airports. The potential Los Banos Station would be north of the city of Los Banos with good accessibility to I-5 and would greatly reduce travel times and access costs to that population.

B. SACRAMENTO TO BAKERSFIELD

Between northern and southern California, the UPRR rail alignment is slightly more direct than the BNSF rail alignment, about 4 mi (6 km) less distance when measured from the BNSF and UPRR merge point, which is 2.3 mi (3.7 km) south of the Truxton Station on the BNSF and 3.6 mi (5.8 km) south of Bakersfield Golden State Station on the UPRR. However, since maximum speeds would be achieved throughout the Central Valley, the differences in travel times between northern and southern California would be marginal, with the UPRR providing potential travel times about 2 min less than the BNSF. The UPRR and BNSF rail alignments would serve the same populations and same number of potential stations. Therefore, the selection of the Central Valley alignment would not have an overall impact on Central Valley connectivity. Most of the potential stations locations throughout the Central Valley can be served by either the BNSF or the UPRR, and the preferred Central Valley alignment could even be a combination of these two existing freight rail corridors. The potential Modesto stations and potential station at either Hanford or Visalia are the exceptions, where the selection of the alignment (between Stockton and Merced for the Modesto Station and between Fresno and Bakersfield for Hanford/Visalia) would determine the potential station location since there are no practical connections between the UPRR and BNSF at these locations.

Potential Station Locations

- The Downtown Sacramento Valley Station would have better connectivity in Sacramento than the Power Inn Road Station location. The Valley Station is located in downtown Sacramento and is within walking distance of the state capitol. This multimodal station location serves the existing Amtrak services to Sacramento, including the Capitol Corridor, and will serve the Sacramento Light Rail Train (LRT) that is being extended to this station site. This site also has good access to I-5. Although the Power Inn site has good intermodal access to the Sacramento LRT and to US-50, it is located outside of downtown Sacramento, more than 5 mi (8 km) away from the state capitol. The Power Inn Station would have about a 3-minute shorter line-haul travel time to Sacramento then the Downtown Sacramento Valley Station, since the trains would travel at relatively slow speeds between Power Inn and the Valley Station, a distance of about 7.5 mi (12.1 km). However, the Sacramento Valley Station would offer greater connectivity to downtown Sacramento and the Sacramento region, and shorter total travel times to downtown destinations.
- Two potential station sites are evaluated to serve Modesto: a potential downtown station on the UPRR rail alignment, and the existing Amtrak Briggsmore Station on the BNSF alignment. The downtown station maximizes connectivity to downtown Modesto and provides convenient access to SR-99, whereas the Amtrak Briggsmore Station is about 5 mi (8 km) east of downtown Modesto. As noted above, the selection of the alignment between Stockton and Merced would determine the station site for Modesto.
- To serve Merced, potential station locations are evaluated at downtown Merced along the UPRR alignment, at Castle Air Force Base, and at the Merced Municipal Airport. The downtown station is located near the city center and transit hub of Merced, has good access to SR-99, and would have the highest level of connectivity of the three locations. The Castle Air Force Base site is about 7 mi (11 km) from downtown Merced, but would provide easy access to the developing University of California, Merced campus via a new highway alignment along Bellevue Avenue. The Merced Municipal Airport site would be less than 2 mi (3 km) from downtown Merced.

- Potential station sites in Tulare and Kings Counties are evaluated at Hanford and Visalia. The ultimate selection of an alignment between Bakersfield and Fresno would include the determination of station location. The Hanford site would connect to the Amtrak station in Hanford, whereas the Visalia Airport Station would best serve the more populated Tulare County cities of Visalia and Tulare. The BNSF serves Hanford and would result in faster travel times and lower access costs for Hanford residents and Kings County; the UPRR serves Visalia and would result in faster travel times and lower access costs for the Visalia population and Tulare County.
- The Truxton Station would have the highest connectivity of the three locations being evaluated to serve Bakersfield. The Truxton Station would connect to the new Bakersfield Amtrak Station and is in the city center of Bakersfield, within walking distance to the convention center and city hall. The Truxton station location also has good access to SR-99. The Golden State Station site is less than 2 mi (3 km) northeast of the city center next to SR-204. The Bakersfield Airport Station would be located outside of Bakersfield about 6 mi (10 km) northeast of the city center. The airport station would provide a high level of connectivity to the airport and has good access to SR-99.
- Two other potential stations are considered for Central Valley service, the ACE Stockton Downtown Station and Downtown Fresno Station. Both of these stations would maximize connectivity to downtown Stockton and to downtown Fresno. The ACE Stockton Station is the current terminus for the ACE Commuter Rail to San Jose and is located in the central part of Stockton. The Downtown Fresno Station is close to the city center and has convenient access to SR-99, SR-41, and SR-180 freeways.

C. BAKERSFIELD TO LOS ANGELES

The selection of the southern mountain crossing alignment option between Bakersfield and Los Angeles would have implications for the HST system and have an effect on the travel times between northern and southern California. The I-5 alignment would have express times about 10 min less than the SR-58/Soledad Canyon alignment, and local times about 12 min less. For example, the San Francisco to Los Angeles express travel time would be less than 2 hrs and 25 min for the I-5 alignment and just over 2 hrs and 35 min for the SR-58/Soledad Canyon alignment. The SR-58/Soledad Canyon alignment option includes a potential station at Palmdale, whereas the I-5 alignment does not have any stations between Bakersfield and Sylmar. The potential Palmdale Station would have a particularly high impact on connectivity since it would serve the growing communities of the Antelope Valley. The SR-58/Soledad Canyon alignment would also improve travel times and reduce access costs to and from the Antelope Valley population.

Between Sylmar and Los Angeles, the combined I-5/UPRR alignment would be shorter and have fewer speed-restricting curves than the UPRR/Metrolink alignment, resulting in travel time saved of about 1 min.

<u>Potential Station Locations</u>

- There are three station sites within the vicinity LAUS: LAUS, Union Station South, and Los Angeles River East. Of the three potential sites, the existing LAUS station has the best connectivity and therefore would also provide the fastest overall travel times to many destinations. LAUS is the transit/rail transportation hub of southern California. LAUS is the primary destination for the Metrolink commuter rail services, the Los Angeles Metro Red Line, the Pasadena Gold Line, the Amtrak Surfliner service, and the regional bus transit services. HST would serve LAUS on an elevated structure where transfers to other modes would be made directly under the HST platforms. The Los Angeles River East Station and Union Station South sites would require the construction of a pedestrian bridge/plaza across the US-101 freeway to connect with LAUS.

- The Palmdale Transportation Center is being considered as a potential station site for serving the Antelope Valley population. The Palmdale Transportation Center maximizes opportunities for intermodal connectivity. It is close to Palmdale Airport, with the opportunity for convenient shuttle or people-mover connections. The transportation center is the Metrolink Station for Palmdale and is a hub for local bus services. The Palmdale Transportation Center would provide short travel times and low access costs for the Antelope Valley population.
- The Sylmar Metrolink Station would provide a direct connection to the Metrolink regional commuter rail service and would have convenient access to the freeway network.
- The Burbank Metrolink Station would provide the highest connectivity to the Burbank area. This station site is in downtown Burbank, has a direct connection to the Metrolink regional commuter rail service, is a hub for bus transit in the Burbank area, has adjacent access to I-5, and is only 2.4 mi (3.9 km) from Burbank Airport. The Burbank Airport Station would be nearer to Burbank Airport at 1.6 mi (2.6 km) away, but would be outside the city center and does not connect with a Metrolink station or regional transit.

D. LOS ANGELES TO SAN DIEGO VIA INLAND EMPIRE

Between Los Angeles and Riverside, the UPRR Riverside and UPRR Colton rail alignments would serve the same populations and same number of potential stations, whereas the alignment options for either the UPRR Riverside or UPRR Colton that would directly serve the city center of San Bernardino and would offer greater connectivity with freeway, commuter rail, and local transit. Using the San Bernardino alignment would add between 4 min and 8 min to the travel time between Los Angeles and March ARB.

Decisions concerning how a proposed HST system would best serve San Diego would have implications for the HST system and its operations. The Miramar Road and Caroll Canyon alignment options would have considerable connectivity advantages over the Qualcomm alignment option. The Miramar Road alignment and the Carroll Canyon alignment options would directly serve downtown San Diego, while the Qualcomm Stadium Station would be about an 8-mi (13-km) drive or 10-mi (16-km) light rail ride to the city center. In addition, the Miramar Road and Carroll Canyon alignment options would provide an alternative to the potential Mira Mesa Station at University City.

The I-15 alignment to Qualcomm Station would have the shortest line-haul times (about 7 min less than the two options to downtown San Diego), but would not directly serve downtown San Diego. The line-haul time for the LRT between Qualcomm and the downtown San Diego Santa Fe Depot is more than 20 min long. The Miramar Road and Carroll Canyon alignment options would therefore be expected to provide considerably superior total travel times to downtown San Diego than the I-15 alignment to Qualcomm Stadium. Decisions on how best to serve San Diego with a proposed HST system could also impact total HST passenger costs for service to or from San Diego. The Miramar Road and Carroll Canyon alignment options that would serve downtown San Diego would be expected to have lower access costs to downtown San Diego than the I-15 alignment to Qualcomm Stadium.

Potential Station Locations

- Of the four potential stations sites serving East San Gabriel Valley, the Metrolink station sites at Pomona and City of Industry would have the widest range of multimodal connections to local and regional bus services, and to Metrolink commuter rail service. The City of Industry site would provide a more central location between the potential stations at LAUS and Ontario Airport. All of the potential station sites would have good access to the freeway network. The Pomona station area would be served by both the UPRR Colton and UPRR Riverside/Colton alignment options, whereas the El Monte station and City of Industry sites are on the UPRR Colton alignment and the South El Monte station on the UPRR Riverside alignment. The City of Industry site would provide a more central location between the potential stations at LAUS and Ontario Airport and therefore the lowest overall travel times.

- Of the four potential stations sites serving the Riverside/San Bernardino area, the San Bernardino Metrolink Station site would have the widest range of multimodal connections to local and regional bus services and to Metrolink commuter rail service. The UPRR Colton Station site would have the least connectivity to existing transit services, but would have the most central location for serving both the San Bernardino and Riverside populations and have good accessibility to I-10. The University of California, Riverside (UCR) site is furthest away from the freeway network but provides for the most convenient access to Riverside. Service to the San Bernardino Metrolink Station would provide the most convenient access to San Bernardino. The March ARB site would be adjacent to the airport, but would have the least connectivity, longest travel times, and highest access costs since the airport does not serve commercial air passengers and this site is furthest away from the Riverside/San Bernardino populations.
- For service to San Diego, the Downtown San Diego Santa Fe Depot site would have the highest connectivity. This station is located in the city center where many potential HST passengers could walk to their destination. The Santa Fe Depot is the terminus for the Coaster commuter rail service, the Amtrak Surfliner intercity service, provides direct connections to the San Diego LRT network, and is a bus transit hub for San Diego. San Diego International Airport is a unique airport in that is located adjacent to downtown San Diego and is only about 2 mi (3 km) from the city center. The San Diego Airport Station location would provide a convenient connection to the international airport and directly connect with the regional bus network and a San Diego LRT station. Although the San Diego airport location would not have as good connectivity to the city center as the Santa Fe Depot site, it would have a better connection to I-5. Qualcomm Stadium would provide a direct connection to the San Diego LRT network and good freeway access, but it would not have the same level of connectivity to the San Diego city center.
- The Escondido Downtown Transit Center would have somewhat higher connectivity than the Escondido I-15 Station Site. The Downtown Transit Center Station would be closer to the Escondido Transit Center, within 0.13 mi (0.20 km), and provide better connectivity with the proposed Escondido to Oceanside commuter rail service, but the Escondido I-15 site would provide more convenient freeway access.
- The University City station site in San Diego is located near a densely developed portion of San Diego, which could be served by the Coaster commuter rail service, would be served by San Diego LRT, and would provide a higher level of connectivity than the Mira Mesa station location. However, the University City site is not served by the I-15 alignment option that serves the Qualcomm Station.
- Potential stations are also being considered at the Ontario airport and Murietta. The Ontario Airport Station would provide a multi-modal connection to Ontario International Airport and link to region bus transit services. The Ontario Airport Station would provide the fastest HST travel times and reduce access costs for passengers looking to make an air connection at Ontario International Airport. A potential station at Murietta would serve the fast-growing Temecula/Murietta area. The Murietta at I-15/I-215 Interchange Station site would have convenient freeway access to both I-15 and I-215.

E. LOS ANGELES TO SAN DIEGO VIA ORANGE COUNTY

Decisions on how proposed rail improvements may best serve this region would have major implications for the HST system and operations. The Authority is considering optional service to LAX and Orange County. If service to LAX and/or Orange County were selected, frequencies to each station along the Los Angeles to San Diego via Inland Empire corridor could be less than if a single line south of Los Angeles were selected. However, if HST directly serves LAX and/or Orange County, the number of intermodal connections could be greatly increased. The travel times and access costs to these markets would be greatly decreased with the HST, and the competitiveness of the HST would be greatly increased for the southwest portions of Los Angeles County and/or Orange County intercity transportation markets. If the airport is not directly served, local transportation (shuttle, regional transit, or the automobile) would be needed between LAUS and the airport or to western Los Angeles County. For the link to Orange County, potential stations are being considered at Norwalk (southern Los Angeles County, serving the gateway cities), Anaheim, and Irvine. If Orange County is not directly served, passengers to southern Los Angeles County and Orange County would need to transfer to non-electric, conventional intercity rail Amtrak Surfliner service at LAUS.

The LOSSAN alignment between LAUS and Anaheim would provide a high level of connectivity with Metrolink, Amtrak Surfliner, and regional and local bus transit. However, because this alignment would require sharing tracks with existing services, it is severely constrained in terms of sustainable capacity and the potential frequency for HST service to Orange County. Operations models suggest that the HST operations may be limited to 18 to 45 trains per day (in each direction) to Orange County if the LOSSAN alignment is selected. In contrast, the UPRR Santa Ana alignment would be dedicated to HST service and would have the capacity to serve up to 20 trains per hour, but it does not provide direct connectivity to Metrolink or Amtrak.

Potential Station Locations

- South Los Angeles County could have a potential HST station at Norwalk either along the LOSSAN rail alignment or the UPRR Santa Ana alignment. The selection of the alignment between Los Angeles and Orange County would determine the preferred station location for serving the gateway cities of south Los Angeles County. The Norwalk LOSSAN site would be at Norwalk Metrolink Station with direct connectivity to the regional commuter rail service. This site is a bus transit hub for the area and is well served by I-5 and the Imperial Highway. The Norwalk UPRR site has no existing passenger rail connection, as it is located about 1 mi (1.6 km) east of the Green Line LRT terminus, but it has existing bus connections and good freeway access.
- Three other potential HST stations are being considered for this region: a potential station at LAX, and potential stations at Anaheim and Irvine to serve Orange County. The LAX station would be adjacent to the airport terminals and would permit easy access by a potential people mover, shuttle, or by walking. It would have direct connections to regional bus transit services and be the only HST station directly serving western Los Angeles County. The Anaheim Edison Field Amtrak Station and the Irvine Transportation Center are transit hubs with high connectivity for central and south Orange County respectively. These stations are OCTA bus transit hubs and serve existing Amtrak and Metrolink commuter rail services.

3.3 AIR QUALITY

This section provides an overview of the six air basins studied for this Program EIR/EIS and describes the composition of air pollutants in and the status of these air basins. In addition, this section describes the potential impacts that may directly and indirectly affect state and regional air quality under the No Project, Modal, and proposed High-Speed Train (HST) Alternatives, using the existing and No Project conditions for comparison.

Air pollution is a general term that refers to one or more chemical substances that degrade the quality of the atmosphere. Eight air pollutants have been identified by the U.S. Environmental Protection Agency (EPA) as being of concern nationwide: carbon monoxide (CO), sulfur oxides (SO_x), hydrocarbons (HC), oxides of nitrogen (NO_x), ozone (O_3), particulate matter 10 microns in diameter or less (PM10), particulate matter 2.5 microns in diameter or less (PM2.5) and lead (Pb). Except for HC (also referred to as total organic gases (TOG), all of these pollutants (NO_x in the form of NO_2 and SO_x in the form of SO_2) are collectively referred to as criteria pollutants. Pollutants that are considered greenhouse gases also affect air quality. Greenhouse gases include, NO_x, TOG, and carbon dioxide (CO_2). The sources of these pollutants, their effects on human health and general welfare, and their final deposition in the atmosphere vary considerably.

3.3.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY REQUIREMENTS

Federal Regulations

Air quality is regulated at the federal level under the Clean Air Act of 1970 (CAA) and the Final Conformity Rule (40 C.F.R. Parts 51 and 93). The Clean Air Act Amendments of 1990 (Public Law [P.L.] 101-549, November 15, 1990) direct the U.S. EPA to implement strong environmental policies and regulations that will ensure cleaner air quality. According to Title I, Section 101, Paragraph F of the Clean Air Act Amendments (42 U.S.C. § 7401 et seq.): "No federal agency may approve, accept, or fund any transportation plan, program, or project unless such plan, program or project has been found to conform to any applicable state implementation plan (SIP) in effect under this act." Title 1, Section 101, Paragraph F of the amendments, amends Section 176(c) of the CAA to define conformity as follows: conformity to an implementation plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards (NAAQS) and achieving expeditious attainment of such standards; and that such activities will not cause any of the following occurrences.

- Cause or contribute to any new violation of any NAAQS in any area.
- Increase the frequency or severity of any existing violation of any NAAQS in any area.
- Delay timely attainment of any NAAQS or any required interim emissions reductions or other milestones in any area. (42 U.S.C. § 7506[c][1].)

State Regulations

Air quality is regulated at the state level by the California Air Resources Board (CARB), the agency designated to prepare the SIP required by the federal CAA, under the California Clean Air Act of 1988 (Assembly Bill [AB] 2595) and other provisions of the California Health and Safety Code (Health and Safety Code § 39000 et seq.). California's Clean Air Act (CCAA) requires all districts designated as nonattainment for any pollutant to "adopt and enforce rules and regulations to achieve and maintain the state and federal ambient air quality standards in all areas affected by emission sources under their jurisdiction."

The responsibility for controlling air pollution in California is shared by 35 local or regional air pollution control and air quality management districts, CARB, and EPA. The districts issue permits for industrial pollutant sources and adopt air quality management plans and rules. CARB establishes the state ambient air quality standards, adopts and enforces emission standards for mobile sources, adopts standards and suggested control measures for toxic air contaminants, provides technical support to the districts, oversees district compliance, approves local air quality plans, and prepares and submits the SIP to EPA. EPA establishes NAAQS, sets emission standards for certain mobile sources (airplanes and locomotives), oversees the state air programs, and reviews and approves the SIP. CARB inventories sources of air pollution in California's air basins and is required to update the inventory triennially, starting in 1998 (Health and Safety Code §§ 39607 and 30607.3). CARB also identifies air basins that are affected by transported air pollution (Health and Safety Code § 39610; 17 C.C.R. Part 70500).

National and State Ambient Air Quality Standards

As required by the CAA Amendments of 1970 (P.L. 91-064, December 31, 1970) and the CAA Amendment of 1977 (P.L. 95-95, August 7, 1977), EPA has established NAAQS for the following air pollutants: CO, O_3, NO_2, PM10, SO_x, and Pb. CARB has also established standards for these pollutants. Recent legislation requires CARB to develop and adopt regulations to reduce greenhouse gases (AB 1493, 2002). The federal and state governments have both adopted health-based standards for pollutants. For some pollutants, the national and state standards are very similar; for other pollutants, the state standards are more stringent. The differences in the standards are generally due to the different health effect studies considered during the standard-setting process and how these studies were interpreted.

Table 3.3-1 lists the federal and state standards. The federal primary standards are intended to protect the public health with an adequate margin of safety. The federal secondary standards are intended to protect the nation's welfare and account for air-pollutant impacts on soil, water, visibility, vegetation, and other aspects of the general welfare. Areas that violate these standards are designated nonattainment areas. Areas that once violated the standards but now meet the standards are classified as maintenance areas. Classification of each area under the federal standards is done by EPA based on state recommendations and after an extensive review of monitored data. Classification under the state standards is done by CARB.

Table 3.3-1
State and National Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards[a] Concentration[c]	California Standards[a] Method[d]	Federal Standards[b] Primary[c,e]	Federal Standards[b] Secondary[c,f,g]	Federal Standards[b] Method[g]
O_3	1 hour	0.09 ppm (180 $\mu g/m^3$)	Ultraviolet photometry	0.12 ppm (235 $\mu g/m^3$)[h]	Same as primary standard	Ultraviolet photometry
	8 hour	N/A		0.08 ppm (157 $\mu g/m^3$)[h]		
PM10	24 hour	50 $\mu g/m^3$	Gravimetric or beta attenuation	150 $\mu g/m^3$	Same as primary standard	Inertial separation and gravimetric analysis
	Annual arithmetic mean	20 $\mu g/m^3$		50 $\mu g/m^3$		
PM2.5	24 hour	No separate state standard	Gravimetric or beta attenuation	65 $\mu g/m^3$	Same as primary standard	Inertial separation and gravimetric analysis
	Annual arithmetic mean	12 $\mu g/m^3$		15 $\mu g/m^3$		
CO	8 hour	9.0 ppm (10 mg/m^3)	NDIR	9 ppm (10 mg/m^3)	None	NDIR
	1 hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
	8 hour (Lake Tahoe)	6 ppm (7 mg/m^3)		N/A		
NO_2	Annual arithmetic mean	N/A	Gas phase chemilum-incescence	0.053 ppm (100 $\mu g/m^3$)	Same as primary standard	Gas phase chemilum-incescence
	1 hour	0.25 ppm (470 $\mu g/m^3$)		N/A		
Pb[i]	30 days average	1.5 $\mu g/m^3$	Atomic absorption	N/A	N/A	High volume sampler and atomic absorption
	Calendar quarter	N/A		1.5 $\mu g/m^3$	Same as primary standard	
SO_2	Annual arithmetic mean	N/A	Ultraviolet Fluorescence	0.030 ppm (80 $\mu g/m^3$)	N/A	Spectro-photometry (Pararosoani-line method)
	24 hour	0.04 ppm (105 $\mu g/m^3$)		0.14 ppm (365 $\mu g/m^3$)	N/A	
	3 hour	N/A		N/A	0.5 ppm (1300 $\mu g/m^3$)	
	1 hour	0.25 ppm (655 $\mu g/m^3$)		N/A	N/A	
Visibility reducing particles	8 hour (10 a.m. to 6 p.m., Pacific Standard Time)	In sufficient amount to produce an extinction coefficient of 0.23 per km-visibility of 10 mi (16 km) or more (0.07–30 mi [.011–48 km] or more for Lake Tahoe) due to particles when the relative humidity is less than 70%. Method: Beta attenuation and transmittance through filter tape.		No federal standards		

Pollutant	Averaging Time	California Standards[a] Concentration[c]	Method[d]	Federal Standards[b] Primary[c,e]	Secondary[c,f,g]	Method[g]
Sulfates	24 hour	25 µg/m^3				
Hydrogen sulfide	1 hour	0.03 ppm (42 µg/m^3)	Ultraviolet fluorescence			
Vinyl Chloride[h]	24 hour	0.01 ppm (26 µg/m^3)	Gas chroma-tography			

µg/m^3 = micrograms per cubic meter.
mg/m^3 = milligrams per cubic meter.
N/A = not available.
NDIR = Non-dispersive infrared photometry.
ppm = parts per million.

[a] California standards for O_3, CO (except Lake Tahoe), SO_2 (1 and 24 hour), NO_2, suspended particulate matter-PM10, PM2.5, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 C.C.R.

[b] National standards (other than O_3, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. For PM10, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m3 is equal to or less than one. For PM2.5, the 24-hour standard is attained when 98% of the daily concentrations, averaged over 3 years, are equal to or less than the standards.

[c] Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25 °C (77 °F) and a reference pressure of 760 mm (30 in) of mercury. Most measurements of air quality are to be corrected to a reference temperature of 25 °C (77 °F) and reference pressure measurements of air quality are to be corrected to a reference temperature of 25 °C (77 °F) and a reference pressure of 760 mm (30 in) of mercury (1,013.2 millibar [1 atmosphere]); ppm in this table refers to ppm volume, or micromoles of pollutant per mole of gas.

[d] Any equivalent procedure that can be shown to the satisfaction of CARB to give equivalent results at or near the level of the air quality standard may be used.

[e] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[f] Reference method as described by EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by EPA.

[g] New federal 8-hour O_3 and PM2.5 standards were promulgated by EPA on July 18, 1997.

[h] ARB has identified lead and vinyl chloride as "toxic air contaminants" with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

Source: California Air Resources Board 2003.

B. METHOD OF EVALUATION OF IMPACTS

Pollutants

Pollutants that can be traced principally to transportation sources and are thus relevant to the evaluation of the project alternatives include CO, O_3 precursors (NO_x and ROG), PM10, and CO_2. Since high CO levels are mostly the result of congested traffic conditions combined with adverse meteorological conditions, high CO concentrations are generally occur within 300 ft (91 m) to 600 ft (183 m) of heavily traveled roadways. Concentrations of CO on a regional and localized or microscale basis can consequently be predicted appropriately. As discussed above in the affected environment section, TOG and NO_x emissions from mobile sources are of concern primarily because of their role as precursors in the formation of O_3 and particulate matter. O_3 is formed through a series of reactions that occur in the atmosphere in the presence of sunlight over a period of hours. Since the reactions are slow and occur as the pollutants are diffusing downwind, elevated O_3 levels are often found many miles from sources of the precursor pollutants. The impacts of TOG and NO_x emissions are therefore generally examined on a regional level. CO_2 emission burdens, because of their global impact, are currently expressed only on the statewide level by CARB and EPA. In this analysis, therefore, CO_2 impacts are discussed on the statewide level. It is appropriate to predict concentrations of PM10 on a regional and localized basis. EPA is currently developing a standardized methodology to evaluate PM10 on a local level.

Pollutant Burdens

The air quality analysis for this Program EIR/EIS focuses on the potential statewide, regional, and localized impacts on air quality. The regional pollutant burdens were estimated based on changes that would occur, including the following, under each of the alternatives.

- Highway vehicle miles traveled (VMT).
- Number of plane operations.
- Number of train movements (proposed HST and existing LOSSAN system).
- Power requirements for the proposed HST system.

Localized air quality impacts were estimated near proposed station locations and airports potentially affected by the Modal and HST Alternatives. The potential impacts of these alternatives were compared to existing conditions and the No Project Alternative.

A comparison of the 2002 conditions to the 2020 No Project conditions illustrates the expected trends in air quality. The potential impacts from proposed alternatives were then added to the 2020 conditions. Changes in VMT for on-road mobile sources (vehicles) and for off-road mobile sources (number of plane operations and train movements) were estimated for each of the alternatives. Changes in emissions of stationary sources (electrical power generators) were also assessed.

Highway VMT: On-road pollutant burdens were calculated as a ratio of baseline VMT to estimated VMT changes under each alternative. Although vehicular speeds affect emission rates, the potential basin-wide speed changes were considered too small to affect overall emission estimates; thus changes in future on-road mobile source emission burdens for the project were based solely on VMT changes and did not consider speed.

Number of Plane Operations: The Federal Aviation Administration's (FAA's) Emission and Dispersion Modeling System (EDMS) is used to estimate airplane emissions. The EDMS model estimates the emissions generated from a specified number of landing and take-off (LTO) cycles. Along with the emissions from the planes themselves, emissions generated from associated ground maintenance requirements are also included. Average plane emissions are calculated based on a typical 737 aircraft. The pollutant burdens generated by the LTOs under each alternative were added to CARB's off-road mobile sources (planes) emission budgets for each air basin to determine the potential impacts of the alternatives.

Number of Train Movements: Ridership projections for the HST system varied between 42 million and 68 million passengers (including 10 million long-distance commuters) for 2020, with potential for significantly higher ridership beyond 2020 (Charles River Associates 1996). The figures on the lower end of these estimates are considered investment-grade forecasts, which were used in the California High Speed Rail Authority's (Authority's) final business plan (Business Plan) and are based conservatively on current costs, travel times, and congestion levels of air and automobile transportation. The figures on the higher end are based on a sensitivity analysis, which assumes the increased costs and congestion associated with air and automobile travel would result in greater potential ridership for the intercity HST system. The sensitivity analysis started with the investment-grade ridership forecasts and applied variations in mode characteristics that tend to increase HST ridership and revenue to determine how sensitive HST ridership is to travel times, fares, etc. This sensitivity analysis produced a higher ridership forecast, which is used in this Program EIR/EIS to define a maximum impact potential of the Modal and HST Alternatives.

For this report and the overall Program EIR/EIS process, the higher demand forecast of 68 million riders (58 million intercity trips and 10 million commute trips), based on the sensitivity analysis, offers a more reasonable scenario to represent total capacity, while serving as a representative worst-case scenario for defining the physical and operational aspects of the alternatives in 2020. This higher forecast is generally used as a basis for defining the Modal and HST Alternatives and is referred to in this report as the representative demand. In some specific analyses such as this air quality analysis, the high-end forecasts result in a benefit because of additional VMT being removed from the road and a decrease in LTO cycles for planes. In those cases, additional analysis is included in this Program EIS/EIR also to address the impacts associated with the low-end (investment-grade) forecasts.

To determine the number of plane trips potentially replaced from the No Project scenario daily by the HST Alternative, the following calculations were performed using sensitivity ridership variation projections as defined above. The number of annual air trips that could be removed by the proposed HST system (25.3 million) was divided by an average number of passengers per flight (101.25). The resulting number of flights per year (250,551) was then divided by the number of days per year to reach the number of flights per day (771) that could potentially be removed by the proposed HST system. (See Chapter 2 Alternatives, for definition of system alternatives.)

> 25.3 million trips = 25.3 million flying passengers (1 trip = 1 takeoff and 1 landing)
>
> 1 flight = 101.25 passengers (135 seats X 75% load factor, as per Table 3.2-3 in the System Definition Report)
>
> Therefore,
>
> 250,551 flights/year = (25,368,285 passengers/year) / (101.25 passengers/flight)
>
> 771 flights/day = 250,551 flights/year X 1 year / 325 days

Similar calculations were prepared for the proposed HST Alternative based on the investment-grade ridership forecasts.

Additional train emissions from potentially increased feeder service to the proposed HST service were also assessed based on predicted ridership forecasts.

<u>Power Requirements</u>: In addition to the on-road and off-road emission burdens, emissions resulting from the power generated to run the HST system were estimated and included in the emission burden of the HST Alternative. Emission estimates are based on British thermal unit (BTU) requirements calculated in the energy analysis for the project (see Section 3.5). BTU emission factors are based on information from Conserving Energy and Preserving the Environment: The Role of Public Transportation (Shapiro et al. 2002), and the Transportation Energy Data Book (U.S. Department of Energy 2002).

Pollutant burdens generated by on-road (vehicles), off-road (planes, trains), and stationary (electric power generation) sources were combined and compared to the No Project Alternative and to each other, i.e. among the Modal and HST Alternatives. Because of the nature of electrical power generation and the use of a grid system to distribute electrical power, it is not yet clear which facilities would be supplying power to the proposed HST system. Emission changes from power generation can therefore be predicted on a statewide level only.

C. RATING SCHEME

The relevance of the potential emission changes was assessed from a total pollutant burden and percentage change compared to the No Project Alternative in the affected air basins and statewide. Depending on each air basin's attainment status (see Table 3.3-3), the predicted differences were ranked as a high (+ or -), medium (+ or -), or low (+ or -) impact. The ranking of high, medium, or low is based on the potential magnitude of the emission changes compared to U.S. EPA's General Conformity threshold levels for nonattainment and maintenance areas and the No Project emission inventory (for on-road sources, planes, and trains) for each air basin.

This assessment is based on the total pollutant burden of an area under the No Project Alternative and the change in emissions estimated under a proposed alternative. Both positive and negative impacts were considered. A positive (+) impact indicates a potential benefit (i.e., a decrease in emissions) to an air basin for a specific pollutant; a negative (-) impact indicates a potential detriment (i.e., an increase in emissions) to an air basin.

The following factors were used to rate the potential affects of each proposed project alternative:

- The threshold values provided in EPA's Conformity Rule (see Table 3.3-2) that determine when a detailed conformity analysis is required for a proposed federal project located in a nonattainment or maintenance area;
- The conformity rule's definition (40 C.F.R. P 55.852) of a regionally significant project, which is one that would increase emissions of an applicable pollutant in a nonattainment or maintenance area by 10 percent or more; and
- CARB's emission inventories, which are the estimated amounts of pollutants emitted into the atmosphere in 2020 in each air basin from major stationary, area-wide, and natural source categories.

For the purpose of this analysis, a project alternative is considered to cause a low impact for a pollutant when it is estimated to increase or decrease the emissions of that pollutant in an air basin by an amount less than the appropriate conformity threshold value. A project alternative is considered to cause a medium impact when it is estimated to increase or decrease emissions by an amount greater than the conformity threshold value but less than 10 percent of the total emissions generated in the basin. A project alternative is considered to cause a high impact when it is estimated to increase or decrease emissions by an amount greater than 10 percent of the total emissions generated in the basin.

Changes in the amounts of carbon dioxide (which is a major component of greenhouse gases) as a result of the project alternatives were estimated on a statewide basis. These results are provided to indicate how changes in CO2 emissions, as a result of the HSR alternatives, might affect global warming. These estimates were based on the estimated changes in fuel use and electrical energy production associated with each alternative.

Table 3.3-2
General Conformity's Significant Impact Thresholds

Pollutant	Area's Attainment Status	Impact Thresholds (Tons (Metric Tons)/Year)
O_3 (VOCs or NO_x)	Nonattainment—serious	50 (45)
	Nonattainment—severe	25 (23)
	Nonattainment—extreme	20 (18)
	Nonattainment—outside an ozone transport region	100 (91)
	Nonattainment—moderate/marginal inside an ozone transport region	50/100 (45/91) (VOC/NO_x)
	NO_x maintenance	100 (91)
	VOC maintenance—outside ozone transport region	100 (91)
	VOC maintenance—inside ozone transport region	50 (45)
CO	Nonattainment—all	100 (91)
	Maintenance	100 (91)
PM10	Nonattainment—moderate	100 (91)
	Nonattainment—serious	70 (64)
	Maintenance	100 (91)

VOC = volatile organic compound.

Source: Code of Federal Regulations, Title 40, Part 51, Subpart W.

D. LOCALIZED AIR QUALITY IMPACTS

To quantify a project's impact on local pollutant levels, a screening analysis was conducted based on overall traffic volumes and projected changes in volume-to-capacity (V/C) ratios and level of service estimates. Per state and national guidelines (California Department of Transportation 1997), baseline intersection level of service estimates of D or below that would degrade because of a project have the potential to affect local air quality. Similarly, volume increases of greater than 5% could potentially impact local air quality levels. The traffic analyses determined which roadways would experience an impact (positive or negative) under the project alternatives.

For this level of analysis, however, detailed intersection information has not been generated. Rather, traffic screenlines have been developed. Screenlines describe defined segments of a roadway that were selected to reasonably represent the routes affected by the proposed alternatives, as discussed in detail in Section 3.1, Traffic and Circulation. The estimated traffic volume generated or reduced by the Modal and HST Alternatives was added to No Project traffic volumes and expressed as overall screenline volumes (typical values based on averages over time), level of service, and V/C ratios. These factors were compared to No Project values, and locations with potentially high impacts were identified. The screenlines do not include an analysis of intersections and are therefore not detailed enough to be used for an air quality intersection screening analysis. However, the screenline numbers provide a general idea of the project's impact on the roadway network. Based on these numbers, general potential impacts on the local roadway network for each of the alternatives are discussed below.

3.3.2 Affected Environment

A. STUDY AREAS DEFINED

California is divided into 15 air basins (17 C.C.R. § 60100 et seq.). Each has unique terrain, meteorology, and emission sources. This analysis has been structured to estimate the potential impacts on the six air basins directly affected by the proposed alternatives, as illustrated in Figure 3.3-1. The following basins are considered in this study.

- Sacramento Valley.
- San Francisco Bay Area.
- San Joaquin Valley.
- Mojave Desert.
- South Coast.
- San Diego County.

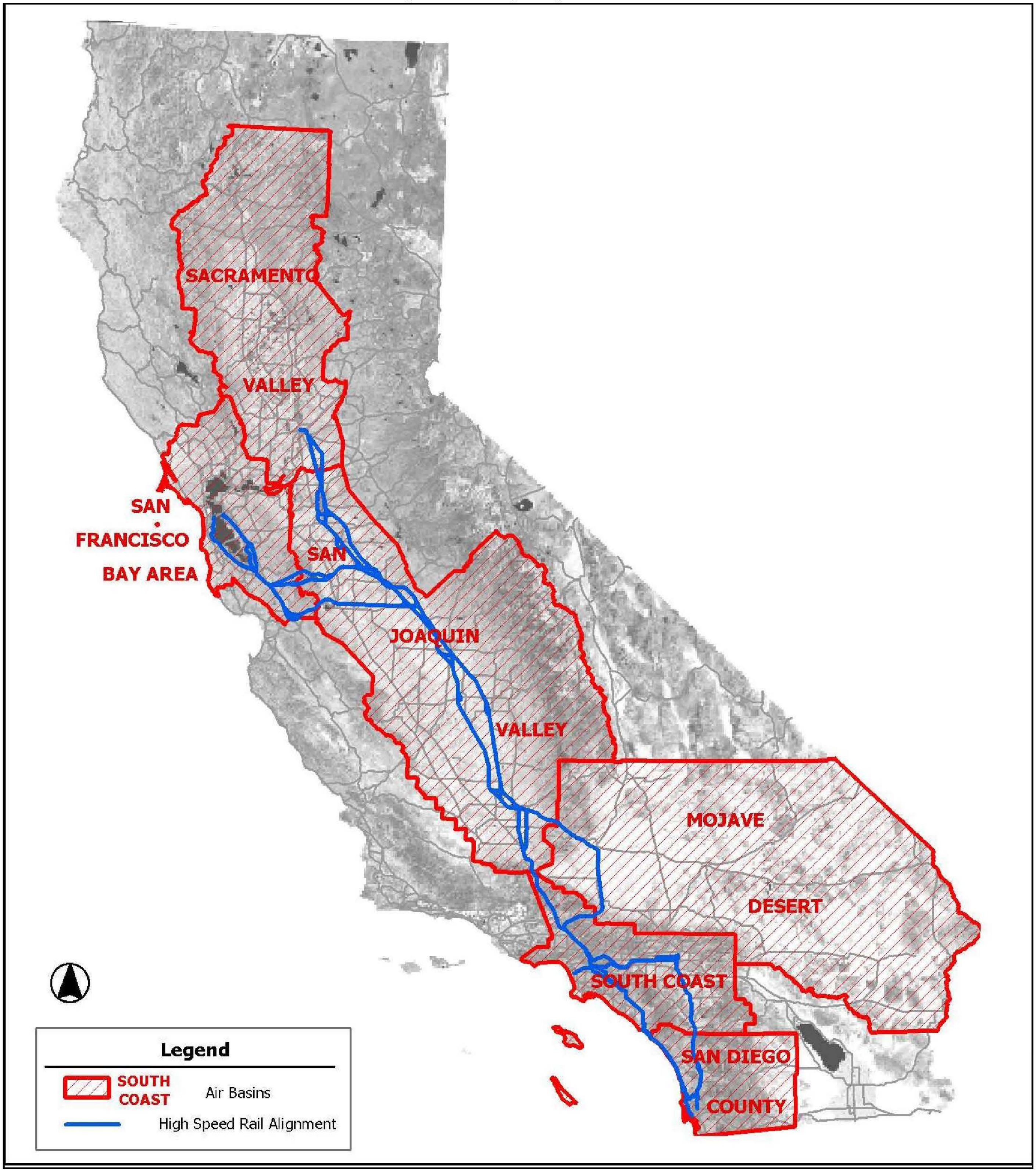
Air quality in nearby air basins could also be affected by changes in travel patterns, miles traveled, and regional pollutant transport resulting from the proposed alternatives. These effects are expected to be less than those experienced by the basins that physically contain the project. For this program-level analysis, potential impacts on air quality are described only for the air basins that physically contain the proposed alternatives. Nearby air basins are not discussed in this program-level analysis. Once the alternatives are refined and more detailed analyses are conducted, nearby basins should be studied.

B. GENERAL DISCUSSION OF AIR QUALITY RESOURCES

Each pollutant is briefly described below.

- Carbon monoxide (CO) is a colorless, odorless gas that is generated in the urban environment primarily by the incomplete combustion of fossil fuels in motor vehicles. Relatively high concentrations of CO can be found near crowded intersections and along heavily used roadways carrying slow-moving traffic. CO chemically combines with the hemoglobin in red blood cells to decrease the oxygen-carrying capacity of the blood. Prolonged exposure can cause headaches, drowsiness, or loss of equilibrium.
- Sulfur oxides (SO_x) constitute a class of compounds of which sulfur dioxide (SO_2) and sulfur trioxide (SO_3) are of great importance in air quality. SO_x is also generated by the incomplete combustion of fossil fuels in motor vehicles. However, relatively little SO_x is emitted from motor vehicles. The health effects of SO_x include respiratory illness, damage to the respiratory tract, and bronchio-constriction.
- Hydrocarbons (HC) comprise a wide variety of organic compounds, including methane (CH_4), emitted principally from the storage, handling, and combustion of fossil fuels. Hydrocarbons are classified according to their level of photochemical reactivity: relatively reactive or relatively non-reactive. Non-reactive hydrocarbons consist mostly of methane. Emissions of total organic gases (TOG) and reactive organic gases (ROG) are two classes of hydrocarbons measured for California's emission inventory. TOG includes all hydrocarbons, both reactive and non-reactive. In contrast, ROG includes only the reactive HC. TOG is measured because non-reactive HC have enough reactivity to play an important role in photochemistry. Though HC can cause eye irritation and breathing difficulty, their principal health effects are related to their role in the formation of ozone. HC is also considered a greenhouse gas.

Figure 3.3-1.
Air Basins Potentially Affected by Project Alternatives



- Nitrogen oxides (NO_x) constitute a class of compounds that include nitrogen dioxide (NO_2) and nitric oxide (NO), both of which are emitted by motor vehicles. Although NO_2 and NO can irritate the eyes and nose and impair the respiratory system, NO_x, like HC, is of concern primarily because of its role in the formation of ozone. Nitrogen oxide is also considered a greenhouse gas.
- Ozone (O_3) is a photochemical oxidant that is a major cause of lung and eye irritation in urban environments. It is formed through a series of reactions involving HC and NO_x that take place in the atmosphere in the presence of sunlight. Relatively high concentrations of O_3 are normally found only in the summer because low wind speeds or stagnant air coupled with warm temperatures and cloudless skies provide the optimum conditions for O_3 formation. Because of the long reaction time involved, peak ozone concentrations often occur far downwind of the precursor emissions. Thus, ozone is considered a regional pollutant rather than a localized pollutant.
- Particulate matter includes both airborne and deposited particles of a wide range of size and composition. Of particular concern for air quality are particles smaller than or equal to 10 microns and 2.5 microns in size, PM10 and PM2.5, respectively. The data collected through many nationwide studies indicate that most PM10 is the product of fugitive dust, wind erosion, and agricultural and forestry sources, while a small portion is produced by fuel combustion processes. However, combustion of fossil fuels account for a significant portion of PM2.5. Airborne particulate matter mainly affects the respiratory system.
- Lead (Pb) is a stable chemical element that persists and accumulates both in the environment and in humans and animals. There are many sources of lead pollution, including mobile sources such as motor vehicles and other gasoline-powered engines, and non-mobile sources such as petroleum refineries. Lead levels in the urban environment from mobile sources have significantly decreased due to the federally mandated switch to lead-free gasoline. The principal effects of lead on humans are on the blood-forming, nervous, and renal systems.
- Carbon dioxide (CO_2) is a colorless, odorless gas that occurs naturally in the earth's atmosphere. Significant quantities are also emitted into the air by fossil fuel combustion. CO_2 is considered a greenhouse gas. The natural greenhouse effect allows the earth to remain warm and sustain life. Greenhouse gases trap the sun's heat in the atmosphere and help determine our climate. As atmospheric concentrations of greenhouse gases rise, so may temperatures. Higher temperatures may result in more emissions, increased smog, and respiratory disease.

The existing (Year 2001) baseline pollutant burden for each of the six air basins is described in the following section. The existing baseline represents the current air quality conditions in each of the air basins in the study area. The future No Project conditions are considered the estimated 2020 future baseline pollutant burden for each of the affected air basins. The existing and future baseline information was developed using the CARB pollutant burden projections for the years 2001 and 2020 available at the CARB Web site, with the year 2020 corresponding to the comparison year for the system alternatives. CARB projections are based on future growth levels in stationary, area-wide, and mobile sources. CARB projections account for emission reductions resulting from clean vehicles and clean fuel programs. There are two categories of mobile sources: on road and off road. Vehicles licensed for highway use are considered on-road mobile sources; airplanes, marine vessels, locomotives, construction and garden equipment, and recreational off-road vehicles are considered off-road mobile sources.

C. AIR RESOURCES BY AIR BASIN

The air quality attainment status based on state and federal standards for CO, particulate matter, and O_3 for each of the air basins in the study area is shown in Table 3.3-3. All air basins are assigned an attainment status for air pollutants based on meeting state and federal pollutant standards. There are some differences between state and federal standards, so a pollutant might not have the same status under each standard. A basin is considered in attainment for a particular pollutant if it meets the standards set for that pollutant. A basin is considered in maintenance for a pollutant if the standards were once violated but are now met. And a basin is considered nonattainment for a particular pollutant if its air quality exceeds standards for that pollutant. A basin is considered unclassified if the area cannot be classified on the basis of available information as meeting or not meeting the applicable standard. The standards and status designations are discussed in more detail above in Section 3.3.1, Regulatory Requirements and Methods of Evaluation.

Table 3.3-3
Attainment Status of Affected Air Basins

	COCO		PM2.5	PM10		O_3	
Air Basin	**National Standard**	**State Standard National Standard**	**National State Standard**	**National Standard**	**State Standard**	**National Standard**	**State Standard**
Sacramento Valley	Maintenance	Unclassified/ Attainment Maintenance	Attainment Unclassified/ attainment	Portions Unclassified/ Portions Moderate nonattainment	Nonattainment	Portions Unclassified-Attainment/ Portions Serious/ Nonattainment	Nonattainment /Portions Nonattainment -Transitional
San Francisco Bay Area	Maintenance	Attainment Maintenance	Attainment	Unclassified	Nonattainment	Marginal Nonattainment	Nonattainment
San Joaquin Valley	Maintenance	Unclassified/ Attainment Maintenance	Nonattainment Unclassified/ attainment	Serious Nonattainment	Nonattainment	Serious Nonattainment	Nonattainment
Mojave Desert	Unclassified/ Attainment	Unclassified/ Attainment Unclassified/ attainment	Attainment Unclassified/ attainment	Moderate Nonattainment	Nonattainment	Portions Unclassified-Attainment/ Portions Moderate Nonattainment	Nonattainment
South Coast	Serious Nonattainment	Nonattainment /Transitional Nonattainment	Nonattainment Non-attainment/ transitional	Serious Nonattainment	Nonattainment	Severe Nonattainment	Nonattainment
San Diego County	Maintenance	Attainment Maintenance	NonAttainment	Unclassified	Nonattainment	Nonattainment	Nonattainment

Source: California Air Resources Board 2002.

<u>San Francisco Bay Area Air Basin</u>

The San Francisco Bay Area Air Basin covers California's second largest metropolitan area. The counties in the air basin include Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, and Santa Clara, as well as the southern half of Sonoma County and the southwestern portion of Solano County. The unifying feature of the basin is the San Francisco Bay, which is oriented north-south and covers about 400 square miles (sq mi) (1,036 square kilometers [sq km]) of the area's total 5,545 sq mi (14,361 sq km). Approximately 20% of California's population resides in this air basin. The area is surrounded by hills, but low passes and the Sacramento–San Joaquin River Delta, which extends to the San Francisco Bay, allow some air pollutant transport to the Central Valley.

Pollution sources in the basin account for about 16% of the total statewide criteria pollutant emissions. The basin is classified as follows: maintenance for CO, attainment for PM2.5, unclassified for PM10, and marginal nonattainment for ozone.

Emissions of O_3 precursors (NO_x and TOG) have decreased since 1975 and are projected to continue declining through 2010. This is the result of strict motor vehicle controls that have reduced emissions from mobile sources of these pollutants. Stationary source emissions of TOG have declined over the last 20 years because of new controls on oil refinery fugitive emissions and new rules for control of TOG from various industrial coatings and solvent operations.

PM10 emissions are predicted to increase through 2010. This increase is due to growth in emissions from area-wide sources, primarily fugitive dust sources. Mobile source emissions from diesel motor vehicles have been decreasing since 1990 even though population and VMT have been growing. This is due to stringent emission standards.

CO emissions have been declining in the basin over the last 25 years, and this trend is expected to continue. Motor vehicles and other mobile sources are the largest sources of CO emissions in the air basin. Due to stringent controls measures, CO emissions from motor vehicles have been declining.

Sacramento Valley Air Basin

The Sacramento Valley Air Basin encompasses the northern portion of the Central Valley. The air basin includes the counties of Butte, Colusa, Glenn, Sacramento, Shasta, Sutter, Tehama, Yolo, and Yuba, along with the western urbanized portion of Placer County and the eastern portion of Solano County. The basin covers more than 15,000 sq mi (38,850 sq km) and accounts for approximately 6% of the state's population. It is the fifth-most-populated air basin in California.

Portions of the basin are classified as follows: maintenance for CO, attainment for PM2.5, unclassified and moderate attainment for PM10, and unclassified/attainment and serious nonattainment for ozone.

Population in the air basin grew between 1981 and 2000 by 51%, a rate higher than the 39% increase statewide. VMT increased by 95%, slightly higher than the 91% increase statewide. However, emissions of the O_3 precursors, NO_x and TOG, have decreased since 1990 and are projected to continue declining through 2010 because of more stringent mobile source emission standards and cleaner-burning fuels. TOG levels have also declined because of new rules controlling various industrial coating and solvent operations.

While emission levels of O_3 precursors are decreasing, peak O_3 values in the Sacramento Valley Air Basin have not declined as quickly as in other urban areas. Additional emission controls will be needed to bring the area into attainment for the state and national ozone standards.

Direct emissions of PM10 are increasing in the basin. This increase is due to growth in emissions from area-wide sources, primarily fugitive dust from paved and unpaved roads, construction and demolition, and residential fuel combustion. These area-wide emission sources have increased because of population growth and increased VMT.

CO emissions are declining in the basin. With new stringent emission standards, CO emissions from motor vehicles have declined. Stationary and area-wide source CO emissions have remained relatively steady, with additional emission controls offsetting growth. These controls will help keep the area in attainment for both the state and national CO standards.

San Joaquin Valley Air Basin

The San Joaquin Valley Air Basin encompasses the southern two-thirds of California's Central Valley. The counties in this basin include Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, Tulare, and the western portion of Kern. The basin spreads across 25,000 sq mi (64,750 sq km). The basin is mostly flat and unbroken with most of the area below 400 ft (122 m) elevation. The San Joaquin River runs along the western side of the basin from south to north. The San Joaquin Valley has cool wet winters and hot dry summers. Generally the temperature increases and rainfall decreases from north to south.

Air quality is not dominated by emissions from one large urban area in this basin. Instead, there are a number of moderately sized urban areas spread along the main axis of the valley. Approximately 9% of the state's population lives in the San Joaquin Valley. Pollution sources in the region account for about 14% of the total statewide criteria pollutant emissions.

The basin is classified as follows: maintenance for CO, nonattainment for PM2.5, serious nonattainment for PM10, and serious nonattainment for ozone.

The population in the San Joaquin Valley Air Basin increased by 56% from 1981 to 2000. This is a much higher rate than the statewide average of 39%. During the same time period, the daily VMT increased by 136%, again much higher than the overall statewide average of 91%. Overall, except for PM10, the emission levels in the San Joaquin Valley Air Basin have been decreasing since 1990. The rate of improvement, however, has not been the same as for other air basins. This is due mainly to the large growth rates this area has experienced.

Emissions of the O_3 precursors, NO_x and TOG, are decreasing in the air basin. NO_x emissions have decreased by approximately 24% since 1985, and are predicted to decrease another 26% by 2010. ROG emissions have decreased by approximately 48% since 1985. They are predicted to decrease another 11% by 2010. These reductions have resulted from more stringent mobile and stationary source emission controls and standards. The basin has shown less improvement than other areas due in large part to the growth rates in population and VMT.

Direct emissions of PM10 have been increasing in the air basin and are expected to continue increasing. This increase is due to growth in emissions from area-wide sources, primarily fugitive dust from vehicle travel on unpaved and paved roads, waste burning, and residential fuel combustion. These increases are a direct result of the large growth in population and VMT. Mobile sources (emissions directly emitted from motor vehicles) are predicted to decrease through 2010 because of new diesel standards.

CO emissions have been trending downward since 1985 and are expect to continue downward through 2010. Motor vehicles are the largest source of CO emissions in the air basin. Emissions from motor vehicles have been declining since 1985, despite increased VMT. This is due to stringent emission control measures and standards.

Mojave Desert Air Basin

The Mojave Desert Air Basin is located in the southeastern section of California. It is bordered on the south by the Salton Sea Air Basin, on the west by the South Coast and the San Joaquin Valley Air Basins, on the north by the Great Basin Valleys Air Basin, and on the east by the states of Nevada and Arizona. It encompasses the high desert region of San Bernardino County and the desert portions of Kern and Los Angeles Counties. With an area in excess of 25,950 sq mi (67,210 sq km), it is the second largest of California's air basins and accommodates approximately 2.5% of the state population. Air quality is dominated by emissions from urban areas in the western portions of the basin and from transported emissions from the large urban areas to the south and west.

Communities such as Hesperia and Phelan, which are in close proximity to the Cajon Pass, historically experience the highest O_3 levels in the basin. This is due to pollutants funneled into the high desert through the pass from Los Angeles and the San Bernardino Valley. These pollutants are dispersed as they are blown inland. Locally generated O_3 precursor emissions of NO_x and ROG also contribute to the high O_3 levels that affect the basin. Emission controls, mainly for exhaust emissions, have resulted in reductions in NO_x, ROG, and CO levels. Emissions of the O_3 precursors NO_x and ROG have been trending downward since 1990, as have been CO emissions. PM10 emissions in the basin, however, continue to rise as the volume of vehicles on unpaved roads and off road increases.

Portions of the basin are classified as follows: unclassified/attainment for CO, attainment for PM2.5, moderate attainment for PM10, and unclassified/attainment and moderate nonattainment for ozone.

<u>South Coast Air Basin</u>
The South Coast Air Basin encompasses 6,729 sq mi (17,428 sq km). It includes California's largest metropolitan region: all of Orange County, the western highly urbanized portions of San Bernardino and Riverside Counties, and the southern two-thirds of Los Angeles County. It accommodates a population of 14.9 million, or more than 40% of California's population, and is the most populous air basin in the state. About 30% of the state's total criteria pollutant emissions are generated in the basin. The basin is generally a lowland plain bounded by the Pacific Ocean on the west and by mountains on the other three sides.

The population in the South Coast Air Basin grew at high rates from 1981 to 2000, increasing 34% from 11.1 million in 1981 to 14.9 in 2000. Daily VMT increased about 84% during that same period. While high growth rates are generally associated with increased emissions, the implemented control programs in the basin have resulted in emission decreases.

The warm weather associated with predominantly high-pressure systems in the basin is conducive to the formation of O_3. The surrounding mountains help cause frequent low inversion heights and stagnant air conditions. These factors combine to trap pollutants in the air basin, and resulting concentrations are among the highest in the state. Aggressive emission controls have resulted in a downward trend in O_3 levels.

The basin is classified as follows: serious nonattainment for CO, nonattainment for PM2.5, serious nonattainment for PM10, and serious nonattainment for ozone.

NO_x emissions in the basin fell by about 38% from 1985 to 2000 and are forecasted to continue that trend to 2010. ROG emissions remained relatively flat from 1975 to 1985. Between 1985 and 2000 they decreased by approximately 60%. ROG emissions are predicted to decrease another 40% by 2010. Emissions of CO in the South Coast Air Basin have been trending downward since 1975, even though VMT has increased and industry activity has grown.

Direct emissions of PM10 have increased in the South Coast Air Basin since 1975. The increase is attributed to emissions from area-wide sources such as fugitive dust from paved and unpaved roads. Growth in activity of the area-wide sources reflects the increased population growth and VMT in the basin. PM10 continues to be a problem in the South Coast Air Basin, which is designated as nonattainment for both the state and national ambient air quality standards. More controls specific to PM10 will be needed to reach attainment.

San Diego Air Basin

The San Diego Air Basin is located in the southwestern corner of California and comprises all of San Diego County. It is bounded on the south by Mexico, on the west by the Pacific Ocean, on the north by Orange and Riverside Counties, and on the east by Imperial County. Its 4,260-sq-mi (11,033-sq-km) area accommodates a population of 2.9 million, or 8% of the state's population, and produces about 7% of the state's criteria pollutant emissions.

In the last 20 years, the San Diego Air Basin has experienced one of the highest population growth rates of the state's urban areas. Population grew from more than 1.9 million in 1981 to 2.9 million in 2000. VMT more than doubled during that same period from 35 million to approximately 74 million mi (56 million to 119 million km). Despite this growth trend, the overall air quality of the basin has improved, reflecting the benefits of cleaner technology.

Much of the San Diego Air Basin has a relatively mild climate due to its southern location and proximity to the ocean. The majority of the population is concentrated in the western portion of the basin, and the emissions are concentrated there. The basin is impacted by locally produced emissions as well as pollutants transported from other areas. O_3 and O_3 precursor emissions are transported from the South Coast Air Basin and Mexico. Implemented controls have resulted in a downward trend in O_3 levels and reductions in emissions from its precursors NO_x and TOG in the basin. However, O_3 levels continue to pose problems because exceedances of the state and national ambient air quality standards persist.

CO concentrations in the San Diego Air Basin decreased approximately 56% from 1981 to 2000. As a result, the national CO standards have not been exceeded since 1989, and the state standard has not been exceeded since 1990. The basin will likely maintain its attainment status for both national and state standards by continuing the enforcement of the stringent motor vehicle regulations currently in place.

Direct emissions of PM10 in the San Diego Air Basin increased 69% from 1975 to 2000, and the forecast is for a continued increase at a rate of approximately 7% to 2010. Growth in area-wide source emissions, mainly fugitive dust from vehicles on paved and unpaved roads, dust from construction and demolition operations, and particulates from residential fuel combustion are mainly responsible for this increase. The growth in these area-wide sources primarily derives from the increase in population and VMT in the basin.

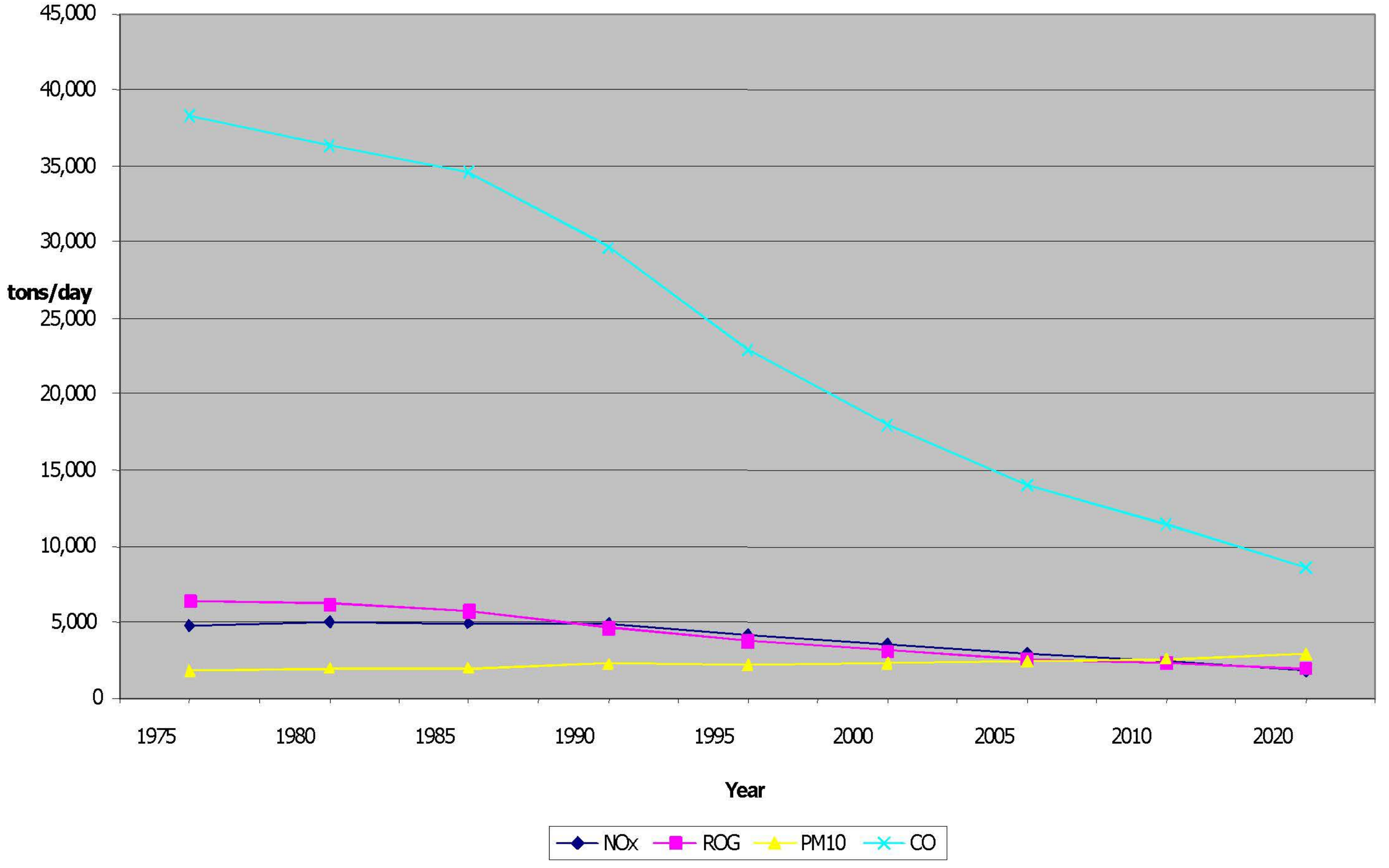
The basin is classified as follows: maintenance for CO, attainment for PM2.5, unclassified for PM10, and nonattainment for ozone.

3.3.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

Pollutant burden levels of CO, NO_x, and TOG are predicted to decrease statewide through 2020 compared to 2002 levels (Figure 3.3-2). This decrease is due to the implementation of stringent standards, control measures, and state-of-the-art emission control technologies. Emissions per vehicle are dropping significantly in California as a result of CARB's clean vehicle and clean fuel programs. Consequently, motor vehicle emissions are declining overall despite an increase in VMT. The low emission vehicle (LEV) and LEVII regulations adopted in 1990 and 1998, respectively, require a declining average fleet emission rate for new cars, pickup trucks, and medium-duty vehicles (including sport utility vehicles). These regulations, which are being implemented between 1994 and 2010, are expected to result in about a 90% decline in new vehicle emissions. Similar emission reductions are occurring in the heavy-duty diesel truck fleet as progressively lower emission standards for new trucks are introduced. The next phase of tighter diesel truck standards, scheduled

Figure 3.3-2
Statewide Emissions (tons/day, annual average)



to be implemented between 2007 and 2010, is expected to produce an overall reduction of 98% from uncontrolled engine emissions.

According to CARB pollutant burden projections, emissions of PM10 are expected to increase statewide for the No Project Alternative compared to existing conditions. The upward trend in PM10 emissions is primarily due to increased emissions from area-wide sources, including dust from increased VMT on unpaved and paved roads. PM10 emissions from stationary sources are also expected to increase slightly in the future because of industrial growth.

CO_2 levels for 2002 are not currently available. In the November 2002 report "Inventory of California Greenhouse Gas Emissions and Sinks: 1990–1999," by the California Energy Commission, 1999 CO_2 emissions are estimated at 362.8 million metric tons. This estimate is not broken down by source type; therefore a direct comparison to No Project, which includes only on-road mobile, planes, trains, and electric power sources, cannot be made.

The percentage of each pollutant source that may be affected by the proposed alternatives is shown in Figure 3.3-3. Of the four sources of concern shown in the figure, on-road mobile is the largest single contributor for all the pollutants. For CO, on-road mobile sources would contribute 32% of the statewide total; for NO_x on-road mobile sources would contribute 24% of the statewide total. By detailing the potential overall contribution to statewide pollution levels of each of these sources, the relationship between changes in sources and overall pollution concentrations becomes clearer.

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HIGH–SPEED TRAIN ALTERNATIVES

No Project Alternative Compared to Modal Alternative (Sensitivity Analysis Variations in Ridership Forecast)

Roadways: The highway component of the Modal Alternative would add approximately 2,970 lane mi (4,780 km) to the highway system. According to the analysis in Chapter 5 addressing economic growth effects, the added lanes of the Modal Alternative would result in approximately 1.1% more VMT in 2020 than the No Project Alternative in 2020. Therefore, the Modal Alternative is predicted to increase the amount of on-road mobile source regional pollutants by 1.1% compared to No Project (Table 3.3-4).

Air Travel: The same number of air trips would occur under both the No Project and Modal Alternatives. In the No Project Alternative these trips would be handled in an inefficient manner (i.e., more flights leaving at off-peak times). In the Modal Alternative these flights would be handled in a more efficient manner. Airport gates would need to be added, however, to efficiently handle the forecasted future demand (representative demand). The air travel component of the Modal Alternative is based on an estimated additional 91 airport gates required statewide to efficiently service the 34 million trips (68 million boarding/departing passengers) as defined for the Modal Alternative in Chapter 2. The additional gates would handle the trips projected for year 2020 more efficiently than No Project. Since additional gates would be built under the Modal Alternative to serve demand already projected under No Project, the Modal Alternative would generate no more LTOs than the No Project Alternative; therefore, no more airplane pollutant burdens would be generated as compared to the No Project Alternative. No Project and Modal Alternative plane emission burdens are shown in Table 3.3-5.

Train Travel and Electrical Power: Conventional rail service is not predicted to increase nor is additional electrical power predicted to be required under the Modal Alternative. Thus, the Modal Alternative would generate no more train or electrical power stationary pollutant burdens than No Project.

Figure 3.3-3

CO, PM_{10} NOX, TOG Source Distribution – Year 2020

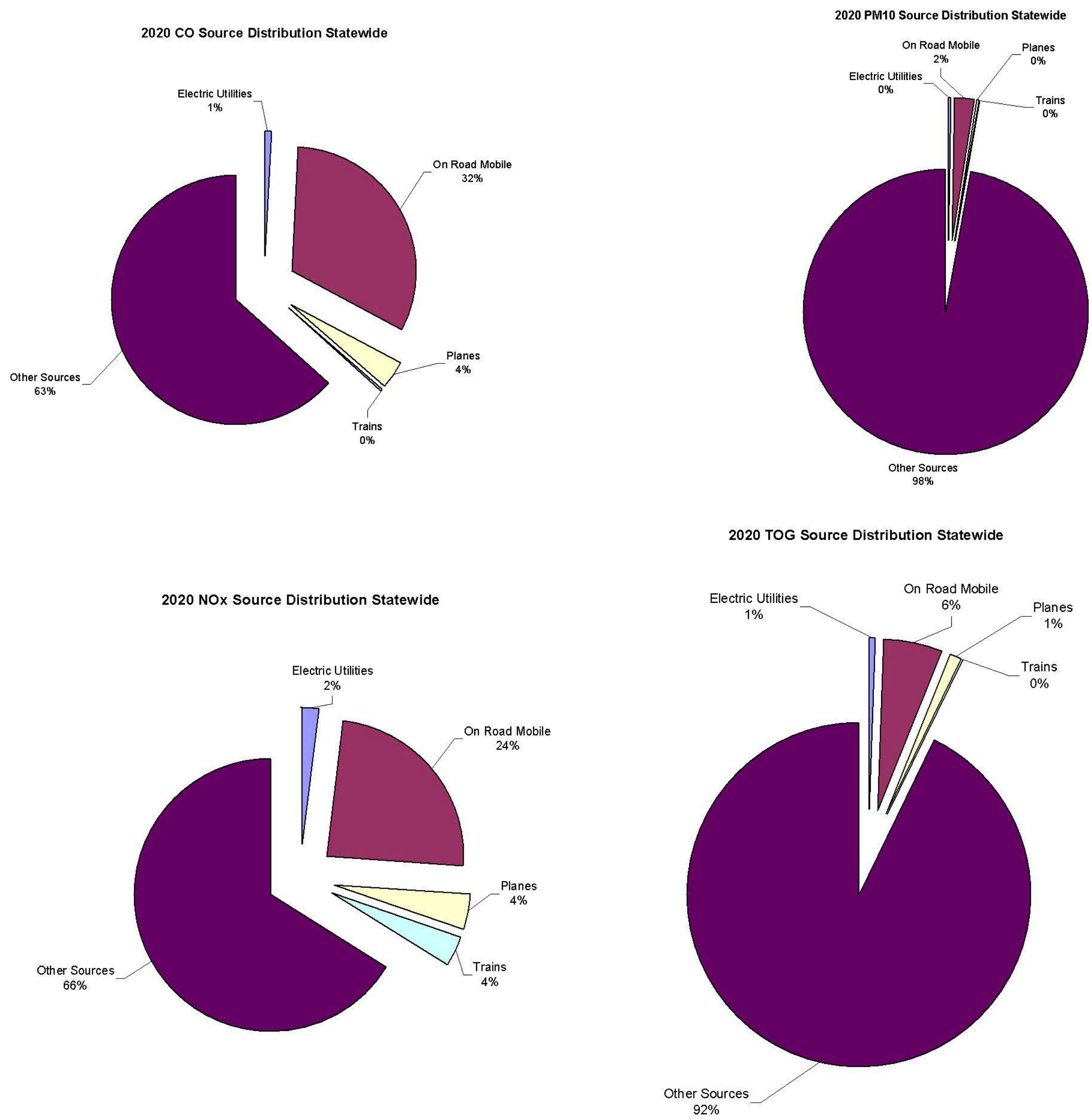


Table 3.3-4
On-Road Mobile Source Regional Analysis—No Project and Modal Alternatives

Air Basin	No Project VMT (Km) (2020) (in millions)	Modal VMT (Km) (2020) (in millions)	No Project Emission Burden in Tons (Metric Tons)/Day				Modal Alternative Emission Burden in Tons (Metric Tons)/Day				Incremental Change from No Project in Tons (Metric Tons)/Day and % Change from No Project			
			CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	84.079 (135.312)	85.004 (136.801)	187.28 (169.90)	3.79 (3.44)	35.85 (32.52)	26.12 (23.7)	189.34 (171.77)	3.83 (3.47)	36.24 (32.88)	26.41 (23.96)	2.06 (1.87) /1.1 %	0.04 (0.04) / 1.1%	0.39 (0.35) / 1.1%	0.28 (.25)/ 1.1 %
San Francisco Bay Area	213.901 (344.240)	216.253 (348.025)	522.13 (473.38)	10.71 (9.72)	101.30 (91.90)	66.81 (60.6)	527.87 (478.89)	10.83 (9.83)	102.41 (92.91)	67.54 (61.27)	5.74 (5.21)/ 1.1%	0.12 (0.11)/ 1.1%	1.11 (1.01)/ 1.1%	0.73 (0.66)/ 1.1%
San Joaquin	135.617 (218.254)	137.109 (220.656)	297.28 (269.69)	6.78 (6.15)	68.28 (61.94)	36.68 (33.3)	300.55 (272.66)	6.85 (6.21)	69.03 (62.62)	37.08 (33.64)	3.27 (2.97)/ 1.1%	0.07 (0.06)/ 1.1%	0.75 (0.68)/ 1.1%	0.4 (0.36)/ 1.1%
Mojave Desert	44.681 (71.907)	45.172 (72.697)	95.33 (86.48)	2.07 (1.88)	15.82 (14.35)	9.81 (8.9)	96.38 (87.44)	2.09 (1.90)	15.99 (14.51)	9.92 (8.99)	1.05 (0.95)/ 1.1%t	0.02 (0.02)/ 1.1%	0.17 (0.15)/ 1.1%	0.14 (0.13)/ 1.1%t
South Coast	402.116 (647.143)	406.539 (654.261)	944.92 (857.23)	19.57 (17.75)	180.01 (163.31)	121.67 (110.4)	955.31 (866.66)	19.79 (17.95)	181.99 (165.10)	123.01 (111.6)	10.39 (9.43)/ 1.1 %	0.22 (0.20)/ 1.1 %	1.98 (1.80)/ 1.1 %	1.34 (1.22)/ 1.1 %
San Diego County	97.542 (156.977)	98.614 (158.704)	224.86 (204.00)	4.77 (4.33)	41.48 (37.63)	28.45 (25.8)	227.33 (206.23)	4.82 (4.37)	41.94 (38.05)	28.76 (26.1)	2.47 (2.24)/ 1.1 %	0.05 (0.05)/ 1.1 %	0.46 (0.42)/ 1.1 %	0.31 (0.28)/ 1.1 %
Statewide (on-road mobile only)	1,109.510 (1,785.583)	1,099.637 (1,769.694)	2649.61 (2403.7)	53.58 (48.61)	515.11 (467.31)	341.44 (309.8)	2674.6 (2426.4)	54.1 (49.08)	519.98 (471.73)	344.62 (312.6)	24.99 (22.67) / 0.9 %	0.52 (0.47)/ 0.9 %	4.87 (4.42)/ 0.9 %	5.19 (4.7)/ 0.9 %

Table 3.3-5
Airplane Pollutant Burdens—No Project and Modal Alternatives

Air Basin	2020 Planes No Project Alternative in Tons (Metric Tons)/Day				2020 Burden per Flight in Tons (Metric Tons)/Day*				Number of Additional Planes for Modal Alternative	2020 Additional Burden Modal Alternative in Tons (Metric Tons)/Day				2020 Total Plane Burden Modal Alternative in Tons (Metric Tons)/Day			
	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG		CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	19.35 (17.55)	0.16 (0.15)	2.45 (2.22)	2.50 (2.27)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	19.35 (17.6)	0.16 (0.15)	2.45 (2.2)	2.50 (2.3)
San Francisco Bay Area	54.46 (49.4)	2.66 (2.4)	28.60 (25.9)	14.59 (13.2)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	54.46 (49.4)	2.66 (2.41)	28.60 (25.9)	14.59 (13.2)
San Joaquin	76.98 (69.8)	0.45 (0.4)	4.29 (3.9)	15.96 (14.5)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	76.98 (69.8)	0.45 (0.41)	4.29 (3.9)	15.96 (14.5)
Mojave Desert	24.63 (22.3)	3.15 (2.9)	3.77 (3.4)	6.18 (5.6)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	24.63 (22.3)	3.15 (2.86)	3.77 (3.4)	6.18 (5.6)
South Coast	67.57 (61.3)	0.52 (0.5)	25.49 (23.1)	8.93 (8.1)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	67.57 (61.3)	0.52 (0.47)	25.49 (23.1)	8.93 (8.1)
San Diego County	19.65 (17.83)	1.69 (1.53)	8.42 (7.64)	3.81 (3.46)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	19.65 (17.8)	1.69 (1.53)	8.42 (7.6)	3.81 (3.5)
Statewide (on-road mobile only)	310.94 (282.1)	9.25 (8.4)	76.61 (69.5)	58.26 (52.9)	0.024 (0.022)	.0001 (.00009)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	310.94 (282.1)	9.25 (8.39)	76.61 (69.5)	58.26 (52.9)

* Flight emissions from FAA EDMS model. Flight emission information is for default 737 and associated ground support.

No Project Alternative Compared to High-Speed Train Alternative (Sensitivity Analysis Variations in Ridership Forecast)
The proposed HST Alternative (with sensitivity analysis forecasts) would have the capacity to accommodate an estimated 68 million annual trips that would otherwise use roadways and airports statewide. The highway component is based on potential VMT reductions resulting from 42.7 million annual trips. The air travel component is based on potential reductions from 25.3 million trips.

Roadways: The proposed HST Alternative could potentially take the place of a 42.7 million city-to-city annual trips using on-road mobile sources and would therefore potentially reduce VMT on the state highway system compared to the No Project and Modal Alternatives. Changes in VMT and estimated on-road mobile source emission reductions resulting from the use of the proposed HST have been calculated for each of the five air basins (Table 3.3-6). The highest on-road mobile source emission reductions are predicted for the San Joaquin Valley Air Basin. The HST Alternative is predicted to reduce the 2020 CARB CO mobile source emission budget for San Joaquin Valley Air Basin by about 3.3% or 9.8 tons (8.9 metric tons). The South Coast Air Basin would receive the next highest potential pollutant reductions (on-road mobile source only), followed by the San Francisco Bay Area, San Diego County, Sacramento Valley, and Mojave Desert Air Basins.

Air Travel: The air-travel component is based on 25.3 million trips (1 trip = 1 takeoff and 1 landing) being shifted from the airplane component of No Project future conditions to the proposed HST. The emission burden reductions projected from the reduced number of flights, shown in Table 3.3-7, was calculated by determining the number of flights that could be accommodated by the proposed HST and multiplying that number by the emission estimates of an average flight, as described above in the discussion of methods of evaluating impacts. The emission changes by air basin resulting from the reduced number of flights range from an estimated 17% reduction in NO_x in the Sacramento Valley Air Basin to no change in the Mojave Desert Air Basin. The South Coast Air Basin is projected to have the largest potential reductions, followed by San Francisco Bay Area, San Diego County, Sacramento Valley, and San Joaquin Valley Air Basins. No reductions would be expected in the Mojave Desert Air Basin.

Statewide, an estimated 99% reduction is predicted in the plane portion of the CO_2 budget estimated for the No Project Alternative. This is approximately 37% of the calculated CO_2 budget for the No Project. CO_2 calculations for No Project Alternative reflect only emissions from electrical power stations, planes, and a portion of on-road VMT. For the plane portion of CARB's projected 2020 emission burden budgets, an 8% reduction is predicted in NO_x, a 6% reduction is predicted in CO, a 2% reduction in TOG, and a 1% reduction in PM10.

Train Travel and Electrical Power: Conventional rail service is not predicted to increase under the proposed HST Alternative therefore no change in pollutant burdens is predicted due to train travel.

Additional electrical power would be required to operate the HST system. Because of the nature of electrical power generation and the use of a grid system to distribute electrical power, it is not yet clear which facilities would be supplying power to the HST system. Emission changes from power generation can therefore be predicted on a statewide level only. As shown in Table 3.3-8, CO, PM10, NO_x, and TOG burden levels would be predicted to increase because of the power requirements of the proposed HST Alternative. A 11.6% increase representing approximately 14 tons (13 metric tons) statewide daily is predicted in the electric utilities portion of the CO 2020 CARB emission burden projection. This increase would represent less than 0.2% of the overall CO budget for the State of California.

Summary of Pollutants by Alternative: Table 3.3-9 summarizes the combined source categories for the existing conditions and No Project, Modal, and HST (with sensitivity analysis forecasts) Alternatives. Compared to the No Project Alternative, the HST Alternative (with sensitivity analysis forecasts) is predicted to decrease the amount of pollutants statewide in all air basins analyzed. Potential air quality benefits range from medium to low. CO_2 levels are also detailed in Table 3.3-9. CO_2 burden levels were estimated based on energy projections developed for each alternative.

Local Impacts: A total of 508 local screenline locations were analyzed. The general trend in screenline data shows that the level of service in the vicinity of proposed HST station locations would degrade under the HST Alternative. Capacity improvements under the Modal Alternative would generally prevent degradation in level of service at the proposed station sites, but V/C ratios would increase slightly. A V/C ratio is the comparison of the roadway volume to roadway capacity. A V/C of 1.0 would indicate a roadway at capacity. As the alternatives are refined and more in-depth studies are undertaken in future analyses, intersections near proposed HST station locations and any location where volumes would likely increase and V/C ratios degrade should be screened to determine if more detailed local analyses should be conducted to insure that the project does not cause a violation of the ambient air quality standards.

Table 3.3-6
On-Road Mobile Source Regional Emissions Analysis—No Project Alternative and HST Sensitivity Analysis Alternative

Air Basin	No Project VMT (Km) 2020 (in millions)	HST Sensitivity Analysis Alt. VMT (Km) 2020 (in millions)	No Project Emission Burden in Tons (Metric Tons)/Day				HST Sensitivity Analysis Alternative Emission Burden in Tons (Metric Tons)/Day				Incremental Change from No Project in Tons (Metric Tons)/Day and % Reduction from No Project			
			CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	84.079 (135.312)	83.832 (134.914)	187.28 (169.90)	3.79 (3.44)	35.85 (32.52)	26.12 (23.7)	186.73 (169.40)	3.78 (3.43)	35.74 (32.42)	26.04 (23.6)	-0.55 (0.50)/ 0.29 %	-0.01 (0.01)/ 0.3 %	-0.11 (0.10)/ 0.3 %	-0.078 (0.07)/ 0.29 %
San Francisco Bay Area	213.901 (344.240)	212.734 (342.362)	522.13 (473.38)	10.71 (9.72)	101.30 (91.90)	66.81 (60.6)	519.28 (471.09)	10.65 (9.66)	100.75 (91.40)	66.45 (60.28)	-2.85 (2.56)/ 0.52 %	-0.06 (0.05)/ 0.5 %	-0.55 (0.50)/ 0.5 %	-0.37 (0.33)/ 0.55 %
San Joaquin	135.617 (218.254)	131.132 (211.037)	297.28 (269.69)	6.78 (6.15)	68.28 (61.94)	36.68 (33.3)	287.45 (260.78)	6.56 (5.95)	66.02 (58.89)	35.47 (32.18)	-9.83 (8.92)/ 3.3 %	-0.22 (0.20)/ 3.3 %	-2.26 (2.05)/ 3.3 %	-1.21 (1.10)/ 3.2 %
Mojave Desert	44.681 (71.907)	44.671 (71.891)	95.33 (86.48)	2.07 (1.88)	15.82 (14.35)	9.81 (8.9)	95.31 (86.47)	2.07 (1.88)	15.82 (14.35)	9.81 (8.90)	-0.02 (.02)/ 0.02 %	0.0 (0.0)/ 0.0 %	-.004 (.003)/ 0.0 %	-0.002 (0.002)/ 0.02 %
South Coast	402.116 (647.143)	398.682 (641.617)	944.92 (857.23)	19.57 (17.75)	180.01 (163.31)	121.67 (110.4)	936.85 (849.91)	19.40 (17.60)	178.47 (161.91)	120.63 (109.44)	-8.07 (7.32)/ 0.85 %	-0.17 (0.15)/ 0.9 %	-1.54 (1.40)/ 0.9 %	-1.04 (0.94)/ 0.85 %
San Diego County	97.542 (156.977)	97.013 (156.127)	224.86 (204.00)	4.77 (4.33)	41.48 (37.63)	28.45 (25.8)	223.64 (202.89)	4.74 (4.30)	41.25 (37.42)	28.30 (25.67)	-1.22 (1.11)/ 0.53 %	-0.03 (0.02)/ 0.5 %	-0.23 (0.20)/ 0.5 %	-0.154 (.14)/ 0.54 %
Statewide (on-road mobile only)	1,109.510 (1,785.583)	1,088.880 (1,752.382)	2649.61 (2403.7)	53.58 (48.61)	515.11 (467.31)	341.44 (309.8)	2,627.07 (2,383.29)	53.09 (48.16)	438.06 (397.4)	338.59 (307.17)	-22.54 (20.5)/ 0.85 %	-0.49 (0.44)/ 0.9 %	-4.68 (4.25)/ 0.9 %	-2.85 (2.59)/ 0.85 %

Table 3.3-7
Airplane Emission Burdens—No Project Alternative and HST Sensitivity Analysis Alternative

	2020 Airplanes—No Project in Tons (Metric Tons)/Day				2020 Emissions Burden per Flight in Tons (Metric Tons)/Day*				Number of Planes Removed	2020 Additional Emissions Burden—HST Sensitivity Analysis Alternative in Tons (Metric Tons)/Day				2020 Total Plane Emissions Burden—HST Sensitivity Analysis Alternative in Tons (Metric Tons)/ Day and % Change from No Project			
Air Basin	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG		CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	19.35 (17.55)	0.16 (0.15)	2.45 (2.22)	2.50 (2.27)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-52	-1.26 (-1.2)	-0.003 (-0.003)	-0.41 (-0.4)	-0.07 (-0.1)	18.09 (16.4)/ -7%	0.16 (0.2)/ -2%	2.05 (1.86)/ -17%	2.43 (2.20)/ -3%
San Francisco Bay Area	54.46 (49.41)	2.66 (2.41)	28.60 (25.95)	14.59 (13.24)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-297	-7.22 (-6.5)	-0.018 (-0.02)	-2.31 (-2.1)	-0.38 (-0.4)	47.24 (42.8)/ -13%	2.64 (2.4)/ -1%	26.29 (23.9)/ -8%	14.21 (12.9)/ -3%
San Joaquin	76.98 (69.84)	0.45 (0.41)	4.29 (3.89)	15.96 (14.48)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-15	-0.37 (-0.4)	-0.001 (-0.001)	-0.12 (-0.1)	0.02 (.02)	76.62 (69.5)/ 0%	0.45 (0.4)/ 0%	4.17 (3.8)/ -3%	15.94 (14.4)/ 0%
Mojave Desert	24.63 (22.34)	3.15 (2.86)	3.77 (3.42)	6.18 (5.61)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	0	0.0	0.0	0.0	0.0	24.60 (22.3)/ 0%	3.15 (2.9)/ 0%	3.77 (3.42)/ 0%	6.18 (5.61)/ 0%
South Coast	67.57 (61.30)	0.52 (0.47)	25.49 (23.12)	8.93 (8.10)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-305	-7.42 (-6.7)	-0.018 (-0.02)	-2.37 (-2.2)	-0.39 (-0.4)	60.16 (54.6)/ -11%	0.50 (0.5)/ -4%	23.12 (21.0/ -9%	8.54 (7.75)/ -4%
San Diego County	19.65 (17.83)	1.69 (1.53)	8.42 (7.64)	3.81 (3.46)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-102	-2.48 (-2.25)	-0.006 (-0.005)	-0.79 (-0.72)	-0.13 (-0.1)	17.17 (15.6)/ -13%	1.68 (1.5)/ 0%	7.63 (6.9)/ -9%	3.68 (3.3)/ -3%
Statewide (on-road mobile only)	310.94 (282.09)	9.25 (8.39)	76.61(6 9.50)	58.26 (52.85)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	-771	-18.74 (-17.0)	-0.05 (-0.04)	-6.0 (-5.4)	-0.98 (-0.9)	292.2 (265.1)/ -6%	9.20 (8.4)/ -1%	70.61 (64.1)/ -8%	57.28 (51.9)/ -2%

Table 3.3-8
Electrical Power Station Emissions—No Project Alternative and HST Sensitivity Analysis Alternative

	No Project Emission Burden—Electric in Tons (Metric Tons)/Day				HST Sensitivity Analysis Alternative Emission Burden—Electric in Tons (Metric Tons)/Day				Incremental Change from No Project in Tons (Metric Tons)/Day and % Change from No Project			
Air Basin	**CO**	**PM10**	**NO_x**	**TOG**	**CO**	**PM10**	**NO_x**	**TOG**	**CO**	**PM10**	**NO_x**	**TOG**
Statewide	120.1 (109.)	10.5 (9.6)	71.9 (65.3)	36.8 (33.4)	134.1 (121.7)	10.6 (9.6)	72.1 (65.4)	37.9 (34.4)	14. (12.7)/ 11.6 %	0.02 (.02)/ 0.19 %	0.14 (.13)/ 0.19 %	1.09 (.99)/ 2.96 %

Table 3.3-9
Potential Impacts on Air Quality Statewide—Existing, No Project, Modal, and HST Sensitivity Analysis Alternatives

	Sacramento Valley Air Basin	San Francisco Bay Area Air Basin	San Joaquin Valley Air Basin	Mojave Desert Air Basin	South Coast Air Basin	San Diego County Air Basin	Statewide
Existing (2002) on-road mobile, trains, planes, and electrical utilities* emission burdens in tons (metric tons)/day							
CO	726.8 (659.35)	1,841.27 (1,670.4))	1,142.85 (1,036.8)	339.47 (307.9)	3,468.44 (3,146.5)	795.49 (721.7)	9,726.42 (8,823.8)
PM10	4.24 (3.8)	12.14 (10.9)	7.0 (6.4)	5.12 (4.6	19.74 (17.9)	6.19 (5.6)	66.29 (60.14)
O_3 precursor—NO_x	153.93 (139.6)	360.42 (326.9)	245.74 (222.93)	80.49 (72.9)	691.62 (627.43)	142.63 (129.39)	1,978.6 (1,795.00)
O_3 precursor—TOG	83.63 (75.8)	211.69 (192.0)	126.1 (114.4)	36.57 (33.2)	379.26 (344.1)	85.24 (77.3)	1,109.06 (1,006.1)
No project on-road mobile, trains, planes, and electrical utilities* emission burdens in tons (metric tons)/day							
CO	208.62 (189.26)	578.00 (524.36)	376.75 (341.79)	126.32 (114.60)	1,017.37 (922.96)	244.70 (221.99)	3,101.17 (2,813.39)
PM10	4.20 (3.81)	13.50 (12.2)	7.46 (6.77)	5.68 (5.15)	20.59 (18.7)	6.49 (5.89)	75.37 (68.4)
O_3 precursor—NO_x	46.24 (41.95)	134.58 (122.10)	80.78 (73.28)	33.99 (30.84)	217.91 (197.7)	50.77 (46.06)	722.97 (655.9)
O_3 precursor—TOG	29.06 (26.36)	81.72 (74.14)	53.21 (48.27)	17.54 (15.91)	131.83 (119.6)	32.31 (29.31)	466.24 (423)
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,438,816.9 (1,305,272.7)
Modal Alternative (2020) burden in tons (metric tons)/day and % change in CO, PM10, NO_x, TOG, CO_2 emission burdens compared to No Project							
CO	210.68 (191.13)/ 0.99 %	583.74 (529.6)/ 0.99 %	380.0 (344.7)/ 0.87 %	127.4 (115.6)/ 0.83 %	1,027.8(932.9)/ 1.02 %	247.2 (224.2)/ 1.01 %	3,126.2 (2,836.1)/ 0.81 %
PM10	4.24 (3.85)/ 0.99 %	13.62 (12.4)/ 0.87 %	7.53 (6.84)/ 1.00 %	5.70 (5.17)/ 0.40 %	20.81 (18.9) / 1.05 %	6.54 (5.94) / 0.81 %	75.89 (68.9) / 0.70 %
O_3 precursor—NO_x	46.63 (42.31) / 0.85 %	135.69 (123.1) / 0.83 %	81.53 (73.97) / 0.93 %	34.16 (30.99) / 0.51 %	219.89 (199.5) / 0.91 %	51.23 (46.47) / 0.90 %	727.8 (660.3) / 0.67 %
O_3 precursor—TOG	29.35 (26.62) / 0.99 %	82.45 (74.8) / 0.90 %	53.61 (48.64) / 0.76 %	17.65 (16.01) / 0.62 %	133.2 (120.8) / 1.02 %	32.62 (29.6) / 0.97 %	469.4 (425.9) / 0.68 %
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,439,163.08 (1,305,586.78) / 0.00 %

	Sacramento Valley Air Basin	San Francisco Bay Area Air Basin	San Joaquin Valley Air Basin	Mojave Desert Air Basin	South Coast Air Basin	San Diego County Air Basin	Statewide
Potential Modal Impacts*							
CO	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -
PM10	Low -	Low -	Low -	Low -	Medium -	Low -	Medium -
NO_x	Medium -	Medium -	Medium -	Low -	Medium -	Medium -	Medium -
TOG	Medium -	Medium -	Medium -	Low -	Medium -	Medium -	Medium -
CO_2	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -
HST Alternative (2020) burden in tons (metric tons) and % change in CO, PM10, NO_x, TOG, CO_2 emission burdens compared to No Project							
CO	206.81 (187.62) / -0.87 %	567.93 (515.23) / -1.74 %	366.55 (332.54) / -2.71 %	126.30 (114.58) / -0.02 %	1,001.89 (908.91) / -1.52 %	241.00 (218.64) / -1.51 %	3,073.86 (2,788.62) / -0.88 %
PM10	4.19 (3.8) / -0.34 %	13.42 (12.2) / - 0.56 %	7.23 (6.56) / - 3.02 %	5.68 (5.15) / - 0.01 %	20.40 (18.5) / - 0.90 %	6.46 (5.86) / - 0.49 %	74.86 (67.9) / -0.68 %
O_3 precursor—NO_x	45.73 (41.49) / -1.10 %	131.7 (119.5) / - 2.13 %	78.41 (71.13) / - 2.94 %	33.99 (30.83) / - 0.01 %	214.0 (194.1) / - 1.79 %	49.75 (54.13) / - 2.01 %	712.4 (646.3) / -1.46 %
O_3 precursor—TOG	28.92 (26.23) / -0.49 %	80.98 (73.46) / - 0.91 %	51.98 (47.15) / - 2.32 %	17.54 (15.91) / - 0.01 %	130.4 (118.3) / - 1.08 %	32.03 (29.05) / - 0.88 %	463.5 (420.5) / -0.59 %
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,418,265.15 / -1.43 %
Potential HST Regional Impacts*							
CO	Medium +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
PM10	Low +	Low +	Low +	Low +	Low +	Low +	Medium +
NO_x	Medium +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
TOG	Medium +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	Low +

	Sacramento Valley Air Basin	San Francisco Bay Area Air Basin	San Joaquin Valley Air Basin	Mojave Desert Air Basin	South Coast Air Basin	San Diego County Air Basin	Statewide

Notes:

Potential impacts determined using threshold levels and attainment status detailed in Section 3.3.1.

+ = Benefit to air quality.

- = Deterioration in air quality.

N/A = Not Applicable.

CO_2 is analyzed only on a statewide level.

* Emission burdens from electrical utilities are included only in the statewide totals. CO_2 burdens do not include train emissions.

No Project Alternative Compared to High-Speed Train Alternative (Investment-Grade Ridership Forecasts)
The proposed HST Alternative, using investment-grade ridership forecasts, would potentially accommodate an estimated 42 million annual trips, which would otherwise use roadways and airports statewide. The highway component is based on potential VMT reductions from 26.6 million annual trips. The air-travel component is based on 15.4 million trips.

Roadways: The proposed HST Alternative (using investment-grade ridership forecasts) would accommodate city-to-city trips, reducing VMT on the state highway system compared to the No Project and Modal Alternatives. Changes in VMT and on-road mobile source emission burdens have been calculated for each potentially affected air basin (Table 3.3-10) resulting from the estimated 26.6 million vehicle trips that would use the proposed HST Alternative. The highest on-road mobile source emission burden reductions are projected for the San Joaquin Valley Air Basin. The proposed HST system is predicted to reduce the 2020 CARB CO mobile source emissions for the San Joaquin Valley Air Basin by approximately 1.6% or 4.75 tons (4.31metric tons) daily. The South Coast Air Basin would have the next highest predicted pollutant burden reductions (on-road mobile source only), followed by the San Francisco Bay Area, San Diego County, Sacramento Valley, and Mojave Desert Air Basins.

Air Travel: The HST Alternative would replace city-to-city trips using off-road mobile (air) travel modes. The air-travel component is based on 15.4 million trips (1 trip = 1 takeoff and 1 landing) from the airplane component of No Project conditions. The emissions projected to be saved from the reduced flights, shown in Table 3.3-11, were calculated by determining the number of flights that could be reduced by the proposed HST and multiplying that number by the emission estimates for an average flight, as described above in the discussion of methods of evaluating impacts. The emission burdens by air basin calculated for the reduced flights would range from a 10% reduction in NO_x for the Sacramento Valley Air Basin to no change in the Mojave Desert Air Basin. The South Coast Air Basin is projected to have the largest burden reductions, followed by San Francisco Bay Area, San Diego County, Sacramento Valley, and San Joaquin Valley Air Basins. No reductions would be expected in the Mojave Desert Air Basin.

Statewide, a 60% reduction is projected in the plane portion of the CO_2 budget estimated for No Project. This reduction would be approximately 23% of the calculated CO_2 budget for the No Project Alternative. CO_2 calculations for the No Project Alternative reflect only emissions from electrical power stations, planes, and a portion of on-road VMT. For the plane portion of CARB's projected 2020 emission budgets, a 5% reduction is projected in NO_x; a 4% reduction is predicted in CO; a 1% reduction in TOG; and a reduction of less than 1% in PM10.

Train Travel and Electrical Power: Conventional rail service is not predicted to increase under the proposed HST Alternative.

Additional electrical power would be required to operate the proposed HST system. Because of the nature of electrical power generation and the use of a grid system to distribute electrical power, it is not yet clear which facilities would be supplying power to the proposed HST system. Emission changes from power generation can therefore be predicted on a statewide level only. As shown in Table 3.3-12, CO, PM10, NO_x, and TOG burden levels are predicted to increase statewide because of the power requirements of the HST. A 9.9% increase in emissions representing approximately 12 tons (11 metric tons) daily is predicted in the electric utilities portion of the CO 2020 CARB emission projection. This increase would represent less than 0.2% of the overall CO budget for the State of California.

Table 3.3-10
On-Road Mobile Source Emission Regional Analysis—No Project Alternative and HST Investment-Grade Ridership Forecast Alternative

Air Basin	No Project VMT (Km) 2020 (in millions)	HST Investment -Grade Ridership Forecast Alt. VMT (Km) 2020 (in millions)	No Project Emission Burden in Tons (Metric Tons)/Day				HST Investment-Grade Ridership Forecast Alternative Emission Burden in Tons (Metric Tons)/Day				Incremental Change from No Project in Tons (Metric Tons)/Day and % Reduction from No Project			
			CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	84.079 (135.312)	83.948 (135.101)	187.28 (169.90)	3.79 (3.44)	35.85 (32.52)	26.12 (23.7)	186.99 (169.64)	3.78 (3.43)	35.79 (32.47)	26.08 (23.66)	-0.29 (0.26) / -0.2 %	-0.01 (0.01) / -0.2 %	-0.06 (0.05) / -0.2 %	-0.04 (0.04) / -0.2 %
San Francisco Bay Area	213.901 (344.240)	213.215 (343.136)	522.13 (473.38)	10.71 (9.72)	101.30 (91.90)	66.81 (60.6)	520.45 (472.16)	10.68 (9.68)	100.97 (91.60)	66.60 (60.42)	-1.68 (1.52) / -0.3 %	-0.03 (0.03) / -0.3 %	-0.33 (0.29) / -0.3 %	-0.21 (0.19) / -0.3 %
San Joaquin Valley	135.617 (218.254)	133.449 (214.765)	297.28 (269.69)	6.78 (6.15)	68.28 (61.94)	36.68 (33.3)	292.53 (265.38)	6.67 (6.05)	67.19 (60.95)	36.09 (32.74)	-4.75 (4.31) / -1.6 %	-.11 (0.10) / -1.6 %	-1.09 (0.99) / -1.6 %	-0.59 (0.53) / -1.6 %
Mojave Desert	44.681 (71.907)	44.673 (71.894)	95.33 (86.48)	2.07 (1.88)	15.82 (14.35)	9.81 (8.9)	95.31 (86.47)	2.07 (1.88)	15.82 (14.35)	9.81 (8.90)	-0.02 (0.02) / 0.0 %	0.00 (0.00) / 0.0 %	0.00 (0.00) / 0.0 %	-0.002 (0.002) / 0.0 %
South Coast	402.116 (647.143)	399.899 (643.575)	944.92 (857.23)	19.57 (17.8)	180.01 (163.3)	121.67 (110.4)	939.71 (852.51)	19.46 (17.66)	179.02 (162.41)	121.00 (109.8)	-5.21 (4.73) / -0.6 %	-0.11 (0.10) / -0.6 %	-0.99 (0.90) / -0.6 %	-0.67 (0.61) / -0.6 %
San Diego County	97.542 (156.977)	97.279 (156.555)	224.86 (204.00)	4.77 (4.33)	41.48 (37.63)	28.45 (25.8)	224.25 (203.44)	4.76 (4.32)	41.37 (37.53)	28.37 (25.74)	-0.61 (0.55) / -0.3 %	-0.01 (0.01) / -0.3 %	-0.11 (0.10) / -0.3 %	-0.67 (0.61) / -0.6 %
Statewide (on-road mobile only)	1,109.510 (1,785.583)	1,104.036 (1,776.774)	2649.61 (2403.7)	53.58 (48.6)	515.11 (467.3)	341.44 (309.8)	2637.06 (2,392.3)	53.31 (48.3)	512.53 (464.97)	339.85 (308.3)	-12.55 (11.39) / -0.5 %	-0.27 (0.24) / -0.5 %	-2.58 (2.34) / -0.5 %	-1.59 (1.44) / -0.5 %

Table 3.3-11
Airplane Emission Burdens—No Project Alternative and HST Investment-Grade Ridership Forecast Alternative

	2020 Planes—No Project in Tons (Metric Tons)/Day				2020 Emission Burden per Flight in Tons (Metric Tons)/Day*				# of Planes Removed by HST Invest-ment Grade Rider-ship Forecast Alt.	2020 Additional Emission Burden—HST Investment-Grade Ridership Forecast Alternative in Tons (Metric Tons)/Day				2020 Total Plane Emissions Burden—HST Investment-Grade Ridership Forecast Alternative in Tons (Metric Tons)/Day and % Change from No Project			
Air Basin	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG		CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Sacramento Valley	19.35 (17.55)	0.16 (0.15)	2.45 (2.22)	2.50 (2.27)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	31	-0.75 (-0.68)	-0.002 (-0.002)	-0.241 (-0.219)	-0.039 (-0.035)	18.596 (16.87)/ -4 %	0.16 (0.14)/ -1 %	2.21 (2.000)/ -10 %	2.46(2.23)/ -2 %
San Francisco Bay Area	54.46 (49.41)	2.66 (2.41)	28.60 (25.95)	14.59 (13.24)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	181	-4.4 (-4.0)	-0.011 (-0.010)	-1.408 (-1.277)	-0.230 (-0.209)	50.06 (45.41)/ -8 %	2.65 (2.40)/ 0 %	27.192 (24.67)/ -5 %	14.36 (13.03)/ -2 %
San Joaquin Valley	76.98 (69.84)	0.45 (0.41)	4.29 (3.89)	15.96 (14.48)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	9	-0.219 (-0.199)	-0.001 (-0.001)	-0.070 (-0.064)	-0.011 (-0.010)	76.76 (69.64)/ 0 %	0.45 (0.41)/ 0 %	4.220 (3.83)/ -2 %	15.95 (14.47)/ 0 %
Mojave Desert	24.63 (22.34)	3.15 (2.86)	3.77 (3.42)	6.18 (5.61)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	0	0.00	0.00	0.00	0.00	24.63 (22.34)/ 0 %	3.15 (2.86)/ 0 %	3.77 (3.42)/ 0 %	6.18 (5.61)/ 0 %
South Coast	67.57 (61.30)	0.52 (0.47)	25.49 (23.12)	8.93 (8.10)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	186	-4.522 (-4.102)	-0.011 (-0.010)	-1.447 (-1.313)	-0.236 (-0.214)	63.05 (57.20)/ -7 %	0.51 (0.46)/ -2 %	24.04 (21.81)/ -6 %	8.69 (7.89)/ -3 %
San Diego County	19.65 (17.83)	1.69 (1.53)	8.42 (7.64)	3.81 (3.46)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	62	-1.507 (-1.367)	-0.004 (-0.004)	-0.482 (-0.437)	-0.079 (-0.072)	18.14 (16.46)/ -8 %	1.69 (1.53)/ 0 %	7.94 (7.20)/ -6 %	3.73 (3.39)/ -2 %
Statewide (on-road mobile only)	310.94 (282.09)	9.25 (8.39)	76.61 (69.50)	58.26 (52.85)	0.024 (0.022)	.0001 (.0001)	.008 (.007)	.001 (.0009)	469	-11.40 (-10.34)	-0.028 (-0.025)	-3.649 (-3.310)	-0.596 (-0.541)	299.54 (271.74)/ -4 %	9.22 (8.37)/ 0 %	72.96 (66.19)/ -4 %	57.66 (52.31)/ -1 %

Table 3.3-12
Electrical Power—No Project Alternative and HST Investment-Grade Ridership Forecast Alternative

	No Project Emission Burden—Electric in Tons (Metric Tons)/Day				HST Investment-Grade Ridership Forecast Alternative Emission Burden—Electric in Tons (Metric Tons)/Day				Incremental Change from No Project in Tons (Metric Tons)/Day/Percent Change from No Project			
Air Basin	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG	CO	PM10	NO_x	TOG
Statewide	120.1 (108.96)	10.53 (9.55)	71.92 (65.25)	36.79 (33.38)	132.0 (67.01)	10.5 (5.55)	72.0 (34.88)	37.7 (36.43)	11.88 (10.78)/9.9 %	0.02 (0.02)/ 0.16 %	0.12 (0.11)/ 0.16 %	1.93 (0.84)/ 2.51 %

Table 3.3-13
Potential Impacts on Air Quality Statewide—Existing, No Project, Modal, and HST Investment-Grade Ridership Alternatives

	Sacramento Valley Air Basin	San Francisco Bay Area Air Basin	San Joaquin Valley Air Basin	Mojave Desert Air Basin	South Coast Air Basin	San Diego Air Basin	Statewide
Existing (2002) on-road mobile, trains, planes, and electrical utilities* emission burdens in tons (metric tons)/day							
CO	726.8 (659.35)	1,841.27 (1,670.4))	1,142.85 (1,036.8)	339.47 (307.9)	3,468.44 (3,146.5)	795.49 (721.7)	9,726.42 (8,823.8)
PM10	4.24 (3.8)	12.14 (10.9)	7.0 (6.4)	5.12 (4.6	19.74 (17.9)	6.19 (5.6)	66.29 (60.14)
O_3 precursor—NO_x	153.93 (139.6)	360.42 (326.9)	245.74 (222.93)	80.49 (72.9)	691.62 (627.43)	142.63 (129.39)	1,978.6 (1,795.00)
O_3 precursor—TOG	83.63 (75.8)	211.69 (192.0)	126.1 (114.4)	36.57 (33.2)	379.26 (344.1)	85.24 (77.3)	1,109.06 (1,006.1)
No Project (2020) on-road mobile, trains, planes, and electrical utilities* emission burdens in tons (metric tons)/day							
CO	208.62 (189.26)	578.00 (524.36)	376.75 (341.79)	126.32 (114.60)	1,017.37 (922.96)	244.70 (221.99)	3,101.17 (2,813.39)
PM10	4.20 (3.81)	13.50 (12.2)	7.46 (6.77)	5.68 (5.15)	20.59 (18.7)	6.49 (5.89)	75.37 (68.4)
O_3 precursor—NO_x	46.24 (41.95)	134.58 (122.10)	80.78 (73.28)	33.99 (30.84)	217.91 (197.7)	50.77 (46.06)	722.97 (655.9)
O_3 precursor—TOG	29.06 (26.36)	81.72 (74.14)	53.21 (48.27)	17.54 (15.91)	131.83 (119.6)	32.31 (29.31)	466.24 (423)
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,438,816.9 (1,305,272.7)
Modal Alternative (2020) burden in tons (metric tons)/day and % change in CO, PM10, NO_x, TOG, CO_2 emission burdens compared to No Project							
CO	210.68 (191.13)/ 0.99 %	583.74 (529.6)/ 0.99 %	380.0 (344.7)/ 0.87 %	127.4 (115.6)/ 0.83 %	1,027.8(932.9)/ 1.02 %	247.2 (224.2)/ 1.01 %	3,126.2 (2,836.1)/ 0.81 %
PM10	4.24 (3.85)/ 0.99 %	13.62 (12.4)/ 0.87 %	7.53 (6.84)/ 1.00 %	5.70 (5.17)/ 0.40 %	20.81 (18.9) / 1.05 %	6.54 (5.94) / 0.81 %	75.89 (68.9) / 0.70 %
O_3 precursor—NO_x	46.63 (42.31) / 0.85 %	135.69 (123.1) / 0.83 %	81.53 (73.97) / 0.93 %	34.16 (30.99) / 0.51 %	219.89 (199.5) / 0.91 %	51.23 (46.47) / 0.90 %	727.8 (660.3) / 0.67 %
O_3 precursor—TOG	29.35 (26.62) / 0.99 %	82.45 (74.8) / 0.90 %	53.61 (48.64) / 0.76 %	17.65 (16.01) / 0.62 %	133.2 (120.8) / 1.02 %	32.62 (29.6) / 0.97 %	469.4 (425.9) / 0.68 %
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,439,163.08 (1,305,586.78)/ 0.00 %
Potential Modal Impacts*							
CO	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -	Medium -
PM10	Low -	Low -	Low -	Low -	Medium -	Low -	Medium -

	Sacramento Valley Air Basin	San Francisco Bay Area Air Basin	San Joaquin Valley Air Basin	Mojave Desert Air Basin	South Coast Air Basin	San Diego Air Basin	Statewide
NO_x	Medium -	Medium -	Medium -	Low -	Medium -	Medium -	Medium -
TOG	Medium -	Medium -	Medium -	Low -	Medium -	Medium -	Medium -
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	Low -
HST Investment Grade Alternative (2020) burden in tons (metric tons)/day and % change in CO, PM10, NO_x, TOG, CO_2 emission burdens compared to No Project							
CO	207.58 (188.31) / -0.50 %	571.92 (518.85) / -1.05 %	371.78 (337.28) / -1.32 %	126.30 (114.58) / -0.01 %	1007.64 (914.13) / -0.96 %	242.59 (220.07) / -0.86 %	3089.10 (2802.44) / -0.39 %
PM10	4.19 (3.80) / -0.18 %	13.45 (12.21) / -0.34 %	7.35 (6.67) / -1.46 %	5.68 (5.15) / -0.01 %	20.47 (18.57) / -0.58 %	6.47 (5.87) / -0.26 %	75.09 (68.12) / -0.37 %
O_3 precursor—NO_x	45.94 (41.68) / -0.64 %	132.85 (120.52) / -1.29 %	79.62 (72.23) / -1.44 %	33.99 (30.83) / --0.01 %	215.5 (195.5) / -1.12 %	50.18 (45.52) / -1.17 %	716.9 (650.3) / -0.85 %
O_3 precursor—TOG	28.98 (26.29) / -0.28 %	81.28 (73.73) / -0.54 %	52.61 (47.73) / -1.12 %	17.54 (15.91) / -0.01 %	130.9(118.8) / -0.69 %	32.15 (29.17) / -0.48 %	464.98 (421.8) / -0.27 %
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	1,432,412.18 (1,299,488.38)/-0.45 %
Potential HST Investment Grade Regional Impacts*							
CO	Medium +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
PM10	Low +	Low +	Low +	Low +	Low +	Low +	Low +
NO_x	Medium +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
TOG	Low +	Medium +	Medium +	Low +	Medium +	Medium +	Medium +
CO_2	N/A	N/A	N/A	N/A	N/A	N/A	Low +

Notes:

Potential Impacts determined using threshold levels and attainment status as detailed in Section 3.3.1.

\+ = Benefit to air quality

\- = Deterioration in air quality

N/A = Not Applicable

CO_2 is analyzed only on a statewide level.

* Emission burdens from electrical utilities are included only in the statewide totals. CO_2 burdens do not include train emissions.

Summary of Pollutants by Alternatives: Table 3.3-13 summarizes the combined source categories for existing conditions and the No Project, Modal, and HST Alternatives. Compared to the No Project Alternative, the proposed HST Alternative (with investment-grade ridership forecasts) is projected to result in a decrease in the amount of pollutants statewide and in all air basins analyzed. Potential air quality benefits would range from a medium to a low rating.

Local Impacts: A total of 508 local screenline locations were analyzed. The general trend in screenline data shows that the level of service in the vicinity of proposed HST station locations would degrade under the HST Alternative. Capacity improvements under the Modal Alternative would generally prevent degradation in level of service at the proposed station sites, but V/C ratios would increase slightly. As the alternatives are refined and more in-depth studies are undertaken in future analyses, intersections near proposed HST station locations and any location where volumes would likely increase and V/C ratios degrade should be screened to determine if more detailed local analyses should be conducted to insure that the project does not cause a violation of the ambient air quality standards.

3.3.4 Design Practices

The HST system would use electrical propulsion to serve the forecast ridership, which is primarily diverted from highway or air travel. The HST Alternative is estimated to have a beneficial effect on the emissions levels throughout the air basins involved. In addition, the Authority will pursue the identification and utilization of energy produced from clean/efficient sources to the extent possible.

As described in Section 3.1 Traffic and Circulation, utilizing existing/planned multimodal hubs for station locations would also minimize air emission increases in and around station areas.

3.3.5 Mitigation Strategies and CEQA Significance Conclusions

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for air quality, the proposed HST system alternative would have a less than significant effect on air quality when viewed on a systemwide basis. Continued improvements in air pollution controls on vehicles, as new vehicles replace older vehicles, will result in an overall reduction of the average air pollutant emissions per vehicle mile of operation in the future. Use of the proposed HST system, however, would reduce vehicle miles otherwise traveled and result in an air quality benefit when viewed on a systemwide basis. Temporary, short-term increases in emissions associated with construction activities would be reduced with the application of mitigation strategies. The potential for localized air pollutant increases associated with traffic near proposed HST stations would be addressed by mitigation strategies discussed in section 3.1.6, as well as design practices, applied to reduce these impacts. See section 3.1.6.

The program-level analysis in this document reviews the potential statewide air quality impacts of a proposed HST system and the analysis would support determination of conformity for the proposed HST system. At the project level potential mitigation strategies should be explored to address potential localized impacts. Emissions from power plants supplying power to the proposed HST system could be controlled at those power plants as required under air pollution control permits. The proposed HST system could be designed to use state-of-the-art, energy-efficient equipment to minimize potential air pollution impacts associated with power used by the proposed HST system. Potential localized impacts could be addressed at the project level by promoting the following measures.

- Increase use of public transit.
- Increase use of alternative-fueled vehicles.
- Increase parking for carpools, bicycles, and other alternative transportation methods.

Potential construction impacts, which should be analyzed once more detailed project plans are available, can be mitigated by following local and state guidelines.

Potential mitigation strategies for air quality impacts associated with the HST Alternative would focus on the alleviation of traffic congestion around passenger station areas as described in the Traffic and Circulation section and on the reduction of air emissions during the construction process. The potential strategies listed below are related to the reduction of air emissions during construction.

- Water all active construction areas at least twice daily.
- Cover all trucks hauling soil, sand, and other loose materials or require that all trucks maintain at least two feet of freeboard.
- Pave, apply water three times daily, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.
- Sweep daily (with water sweepers) all paved access roads, parking areas and staging areas at construction sites.
- Sweep streets daily (with water sweepers) if visible soil material is carried onto adjacent public streets.
- Hydroseed or apply (non-toxic) soil stabilizers to inactive construction areas (previously graded areas inactive for ten days or more).
- Enclose, cover, water twice daily or apply (non-toxic) soil binders to exposed stockpiles (dirt, sand, etc.).
- Limit traffic speeds on unpaved roads to 15 miles per hour.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways.
- Replant vegetation in disturbed areas as quickly as possible.
- Use alternative fuels for construction equipment when feasible.
- Minimize equipment idling time.
- Maintain properly tuned equipment.

The proposed HST system alternative is expected to result in an air quality improvement when viewed on a systemwide basis. Temporary, short-term emissions increases associated with construction activities, and potential localized air pollution increases associated with traffic near proposed HST stations would be substantially reduced by the application of mitigation strategies and design practices. See section 3.1.6 for further discussion of mitigation strategies for increased traffic near stations. At the second-tier, project-level review, applications of these mitigation strategies are expected to reduce localized air quality impacts to a less-than-significant level in most locations. Additional environmental assessment will allow more precise evaluation in the second-tier, project-level environmental analyses.

3.3.6 Subsequent Analysis

More detail on the impact of the potential changes in vehicle hours traveled (VHT) in the regional analysis should be available for the next phase of the environmental analysis. HST alignment options should also be refined for the next phase of analysis. Once alignments are selected, if a decision is made to proceed with the proposed HST system, then local traffic counts could be conducted at access roads serving major station locations. These counts would provide more accurate information for determining potential local air quality hotspot locations. Hotspots are areas where the potential for elevated pollutant levels exist. Once hotspot locations (if any) are determined, a detailed analysis following the guidelines at the time of analysis should be conducted.

Potential construction impacts and potential mitigation measures should also be addressed in subsequent analyses. Once an alternative and alignment is established a full construction analysis should be conducted. This analysis should quantify emissions from construction vehicles, excavation, worker trips, and other related construction activities. Mitigation measures, if required, should be detailed and a construction monitoring program, if required should be established.

3.4 NOISE AND VIBRATION

This section identifies potential noise and vibration impacts on sensitive receptors or receivers, such as people in residential areas, schools, and hospitals, for the No Project, Modal, and High-Speed Train (HST) Alternatives. This analysis generally describes the sensitive noise receptors in the five regions and the methodology for determining the potential noise and vibration impacts on those receptors for each alternative. The differences in potential impacts of all three alternatives are compared to each other. This comparison considers the potential noise impacts from airplanes, automobiles on intercity highways, and the proposed HST system. The section also discusses the potential benefits of adding grade separations[1] for existing railroads in some areas, thereby reducing noise generated at grade crossings. Since this is a program-level environmental document, the analysis of potential noise and vibration impacts broadly compares the relative differences in potential impacts between the alternatives and HST alignment options.

3.4.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY REQUIREMENTS

Noise and vibration are among the environmental issues to be evaluated for a proposed HST project under NEPA and CEQA. The FRA has a regulation governing compliance with the Noise Emission Regulation adopted by the U.S. Environmental Protection Agency (EPA) for noise emissions from interstate railroads. The FRA's Railroad Noise Emission Compliance Regulation (49 C.F.R. Part 210) prescribes minimum compliance regulations for enforcement of the railroad noise emission standards adopted by the EPA (40 C.F.R. Part 201). The FRA has also established criteria for assessment of noise and vibration impacts for high-speed ground transportation projects (U.S. Department of Transportation 1998). The methodology and impact criteria for noise and vibration from the FRA guidance manual have been used in the assessment of the HST Alternative.

Assessment of the components comprising the No Project and Modal Alternatives are based on relevant criteria adopted by the U.S. Department of Transportation Federal Highway Administration (FHWA), Federal Aviation Administration (FAA), and Federal Transit Administration (FTA), each of which has established criteria for assessing noise impacts. As described below, each agency's criteria were used to define a screening distance for assessing the potential for noise impact from relevant sources. The FRA and FTA have also established vibration impact criteria related to rail transportation. The other transportation agencies have not established vibration criteria for the transportation modes under their jurisdiction, airports and highways.

At the state level, the California Noise Control Act was enacted in 1973 (Health and Safety Code § 46010 et seq.) and provides for the Office of Noise Control in the Department of Health Services to 1) provide assistance to local communities developing local noise control programs, and 2) work with the Office of Planning and Research to provide guidance for the preparation of the required noise elements in city and county general plans, pursuant to Government Code § 65302(f). In preparing the noise element, a city or county must identify local noise sources and analyze and quantify to the extent practicable current and projected noise levels for various sources, including highways and freeways, passenger and freight railroad operations, ground rapid transit systems, commercial, general, and military aviation and airport operations, and other ground stationary noise sources. Noise level contours must be mapped for these sources, using both community noise equivalent level (CNEL) and day-night average level (L_{dn}) and are to be used as a guide in land use decisions to

[1] For this analysis, a grade separation is the literal separation, using overpasses or underpasses, of the rail and roadway components of an at-grade crossing. This eliminates the need for trains to blow horns or sound warning devices at the grade separated (previous grade crossing) locations.

minimize the exposure of community residents to excessive noise. Airports are subject to the noise requirements set by the FAA and noise standards under C.C.R. Title 21, § 5000.

B. METHOD OF EVALUATION OF IMPACTS

Two basic evaluation techniques were used for this analysis: a screening analysis for each travel mode (highway, air, and HST) and more specific analysis of typologies derived from representative locations for the proposed HST Alternative. The screening analysis for each travel mode provides a basis for a comparison of relative differences in potential noise impacts between the No Project, Modal, and HST Alternatives. The representative typologies were used to verify screening level assumptions and to provide a basis for comparison of HST options, including consideration of the potential effectiveness of mitigation and the potential impacts or benefits associated with grade separation of existing rail lines.

Screening Procedure

Transportation noise impacts are assessed according to the number of people and noise-sensitive land uses potentially impacted by new noise sources from a project. However, for a statewide project such as the proposed HST Alternative (especially before many project-level details have been defined) it is not possible to develop a specific measure of the potential noise impacts because information necessary for performing a detailed noise analysis is not available. Consequently, a screening method was used to develop a general estimate of the relative potential for impact among alternatives. Screening distances were applied from the center of potential alignments to estimate all potentially impacted land uses in noise-sensitive environmental settings. Appendix 3.4-A defines the screening distances used. The number of people and noise-sensitive land uses were tabulated within the defined screening distance. Appendix 3.4-B describes the rating methods used to determine these numbers. The method is conservative in that it overestimates the potential impact. The method identifies all potentially impacted developed lands by type of use within the study area, but subsequent project-level analysis using better-defined system parameters and affected populations is likely to indicate lower levels of potential impact. Because potential noise impacts decrease dramatically if a structure blocks the path to the receptor, this is a conservative approach.

Noise screening analyses were performed for the No Project, Modal, and HST Alternatives. Screening distances were selected for the HST, railroads, highways, and airports based on criteria established by the agencies that regulate these modes.

- FRA and FTA for HST and conventional rail (see Appendix 3.4-C).
- FHWA for highways.
- FAA for aircraft and airports.

The analyses were accomplished using available GIS data for land use and alignment geometry for each alternative. The number of people potentially affected and the area of noise-sensitive land uses within the screening distance were determined using GIS and census data.

The potential impacts were subsequently combined to develop an impact rating for each HST and highway sub-segment assessed for the No Project, Modal, and HST Alternatives (Appendix 3.4-B). The impact rating for each segment is described as low, medium, or high, as an indication of the potential for noise impact.

Application of Screening Method to Highway and Air Modes

Highway noise impact measures used by FHWA are slightly different from the other transportation modes. Highway noise impact is based on the traffic equivalent noise level (L_{eq})

during 1 hour of the day, the hour with the greatest impact on a regular basis. For comparison with the proposed HST Alternative, the potential impacts associated with peak hourly L_{eq} are methodologically equivalent with impacts based on the FRA and FAA modal-specific criteria based on L_{dn} and CNEL. This is because, despite the different ways of measuring noise impacts, the FHWA, FRA, FTA, and FAA criteria are based on similar patterns of negative reaction exhibited by people exposed to gradations of noise from the different transportation modes. Screening distances for highways were calculated for various roadway types by number of lanes, using the FHWA traffic noise model to determine the distance at which the noise contour of 65 A-weighted decibels (dBA) L_{eq} is reached. Highway noise screening distances are described in Appendix 3.4-A.

The screening distances were applied to all of the highway segments that would be improved (additional lanes) under the highway component of the Modal Alternative. In general, the highway-related noise is a function of the volume and speed of traffic (given a representative mix of autos, trucks, and buses) and the road surface. The additional capacity (lanes) added as part of the Modal Alternative would increase both the volume and speed of traffic on the improved highway segments.

Aviation noise was assessed using the CNEL figure used in California, and noise impact would be considered to occur where CNEL exceeds 65 dBA, which is the equivalent to the 65-dBA L_{dn} contour used by the FAA for impact purposes. Noise contours around airports are routinely developed to identify the area and number of people exposed to noise levels in excess of the 65-dBA L_{dn} impact threshold.

For each of the airport improvements (additional gates and runways) that would be part of the aviation component of the Modal Alternative, the 65-dBA L_{dn} noise contour was redrawn and reassessed and overlaid with census data to assess the potential for noise impact. In general, airport noise contours expand around an airport depending on the number of operations of each type of aircraft. A 40% increase in number of flights will result in about a 17% increase in area enclosed by a given noise contour, (i.e., the 65-dBA CNEL noise contour). New runways result in new noise contours, encompassing relatively large areas of previously unexposed land uses—often including homes and other sensitive receptors to aircraft noise. While this area might increase the number of people potentially affected, it would not necessarily increase the severity of potential impact.

Vibration is assumed not to be an issue with highways or aviation primarily because there are no FHWA or FAA regulations that mandate its consideration.

<u>Application of Screening Method to Conventional Rail and High-Speed Train Modes</u>
Railroad noise and vibration criteria developed by FTA are consistent with criteria adopted by the FRA for high-speed trains. They were used to assess conventional rail operations in the No Project and Modal Alternatives as well as the HST Alternative.

Criteria for HST noise impact assessment are based on activity interference and annoyance ratings developed by EPA. These criteria, described and presented in graphical form in Appendix 3.4-C, provide the basis for the rail noise analysis procedures used in the screening and the representative typologies (U.S. Department of Transportation 1998).

The screening procedure used by the FRA takes into account the noise impact criteria, the type of corridor, and the ambient noise conditions in typical communities. Distances within which potential impacts may occur are defined based on operations of a typical HST system. These distances were developed from detailed noise models based on empirical measurements of noise emissions of existing steel-wheel/steel-rail high-speed trains, expected maximum operation levels and speeds, and residential land use. The width of the potential impact along the length of the HST alignment is the area in which there is potential for noise impact. The FRA screening procedure was developed for HST speeds from 125 mph to 210 mph (201 kph to 338 kph). For speeds less than 125 mph (201 kph) and for areas near stations, the FTA screening method was used in concert with the FRA method. The FRA and FTA screening distances for noise are included in Appendix 3.4-A.

The screening distances are different for the different types of developed areas along a potential alignment according to their estimated existing ambient noise. "Urban" and "noisy suburban" areas are grouped together. These areas are assumed to have ambient noise levels greater than 60 dBA L_{dn}. Similarly, "quiet suburban" and "rural" or "natural open-space" areas are grouped as areas where ambient noise levels are less than 55 dBA L_{dn}. For developed land with L_{dn} between 55 and 60 dBA, the classification is dependant on other factors such as proximity of major transportation facilities and density of population. The screening procedure was applied to first allow for the comparison of impacts between alternatives and to identify areas of potential impacts for further consideration in project-level analysis. The screening procedure estimates the affected receptors to ensure that all potential impacts are included at the program level.

While the screening procedure is based on the type of equipment (technology and power type), operational characteristics of the new services (speeds and frequencies), the type of support structure (aerial or at grade), and the general ambient noise level, it does not address the horn and bell noise associated with existing passenger and freight trains because these are regarded as part of the existing environment and are assumed to be held constant for all three alternatives. To develop a relative comparison of the HST and Modal Alternatives, the results of the screening analysis were adjusted to account for noise reductions from the elimination of grade crossings on existing rail lines, where the HST alignment options would share the rail corridor. The degree of adjustment was based on the representative typologies for similar circumstances and is defined in the following section.

As a final step for those areas rated medium or high for potential impacts, the screening analysis assessed the potential use of noise barriers and other mitigation options to assess the potential for reducing noise impacts. The mitigation analysis is discussed in Section 3.4.5.

Vibration impact screening was performed for the HST Alternative only. The highway and aviation modes are assumed to cause less-than-significant ground-borne vibration, and neither FHWA nor FAA have adopted vibration impact assessment criteria. The vibration screening procedure is used to compare potential impacts among regional HST alignment design options and to provide an estimate of the length of alignments where consideration of vibration attenuation features may be appropriate.

Representative Typologies for High-Speed Trains

To better understand the potential impacts of the HST Alternative, several noise impact assessment studies were prepared for representative situations of noise- and vibration-sensitive land uses. The more detailed General Assessment Method of FTA's and FRA's guidance manuals were used to provide noise impact estimations. The FRA and FTA noise impact criteria of severe impact, impact and no impact were applied to the results. These typological studies verified the general results from the screening procedure. Representative situations were chosen to provide a range of potential impact types and levels. This approach provides a means of considering at the program level the potential impacts on communities along any potential proposed HST alignment. The typology locations are illustrated on maps by region in Appendix 3.4-F.

Developed land use categories consist of individual medium- and low-density residential zones, schools, hospitals, parks, and other unique institutional receptors such as museums, libraries, etc.

Residential land uses were chosen for the typologies for new and shared corridors that varied in local zoning densities, ambient noise conditions, set back distances from the alternative corridors, and HST operational speeds. Institutional uses as mentioned above and parks were individually identified for each focused study. These representative typologies were evaluated on the topics listed below.

- Verification of screening distances (noise and vibration).
- Effectiveness of noise barriers.
- Benefits from elimination of grade crossings.
- Costs and benefits of a high-speed downtown bypass loop.

Verification of Screening Distances (Noise and Vibration)

The results of the representative typologies confirm that the screening method used an appropriate upper boundary as an indicator of potential for noise impact. Impacts were found to occur in 90% of the cases identified in the screening procedure; in 75% of those studied, consideration of mitigation may be appropriate. Those that would have insignificantly low noise impact were either at outer edges of the screening distance or were shielded sufficiently by other buildings. Shielding by terrain features or buildings is not taken into account in the screening process, except to indicate some receptors would not need further analysis.

Representative studies were also completed that assess the range of the potential vibration impact levels that are likely to be encountered in project-level analyses. The results generally show that the nearer buildings would be to a proposed alignment, the greater the likelihood of impact. Where speeds are expected to be low, the vibration potential impacts are confined to within 100 ft (30 m) of the track. At top speeds, the potential impacts extend to 200 ft (61 m). The special typologies generally validate the vibration screening distances that are included in Appendix 3.4-A.

Effectiveness of Noise Barriers

Noise barriers are used extensively in Europe and Japan to mitigate noise impacts from HST systems. The representative typology studies generally indicated that mitigation by sound barrier walls can be an effective means of reducing the potential impacts by one category, for example, from severe impact (mitigation appropriate) to impact. Noise barrier mitigation is shown to be especially effective for receivers close to the tracks. While noise barrier walls would not be the only potential mitigation strategy to be considered, they were used to represent mitigation potential in this Program EIR/EIS.

Benefits from Elimination of Grade Crossings

The representative typology studies were also used to estimate the potential benefit of noise reduction resulting from grade separations. A focused noise study in the Bay Area to Merced region (at Charleston Road in Palo Alto) showed the potential benefit of eliminating horn blowing at a typical Caltrain grade crossing on the Peninsula. Assessment of noise impact from horns at grade crossings was performed with FRA's horn noise model and annoyance based criteria. The horn noise model indicated an 81% reduction in the number of people impacted within 0.25 mi (0.40 km) of that intersection by elimination of horn noise from commuter trains. Another focused noise study in the Los Angeles to San Diego via Orange County region showed similar results. The elimination of the grade crossing at Tamarak Street in Oceanside was analyzed and found to result in a 77% reduction in the number of people impacted in the vicinity. Although the results vary depending on the local population density and proximity of residences and other sensitive land uses at each grade crossing, they illustrate the magnitude of the potential change to be expected if the sounding of horns and bells at existing rail crossings could be eliminated.

Removing all potential remaining horn noise would not eliminate noise impacts, however, because the sound of the trains would remain. The proposed HST would add its own noise to that of other trains using the railroad corridor. Carrying the focused study further, it was found that approximately 75% of the grade crossings to be eliminated with the proposed HST are located adjacent to residential areas with a high potential noise impact rating. There would be a clear benefit from the elimination of the horns and warning signals. While with the HST, there would be additional train noise and vibration primarily from the high train speed and frequency of service.

Based on these results, the potential noise impact ratings from screening were adjusted to account for segments where grade crossings would be eliminated for existing passenger and freight trains as part of the implementation of HST service along that segment. A reduction in one impact rating level (high to medium or medium to low) was made only for segments where HST speeds would be less than 150 mph (241 kph). Where speeds are above that level, no adjustment was made since the noise created by the proposed new service at higher speeds would likely overshadow the reduction in horn and bell noise due to grade separation.

This adjustment was made on the segments listed below.

- Caltrain corridor from San Francisco to San Jose.
- Hayward/Niles/Mulford Line from south of Oakland to north of Union City.
- Metrolink/UPRR from south of Sylmar to Burbank.
- LOSSAN from Fullerton to Irvine.

Costs and Benefits of a High-Speed Bypass Loop

The HST Alternative has rail alignment options that would allow express trains to bypass certain intermediate stations in urban centers. Such bypass tracks are referred to as express loops. The costs and benefits of express loops are based on the analysis of one line through the city (express tracks and off-line station tracks) versus two lines for the city (line through the city for stopping trains at reduced speeds < 125 mph [200 kph] and express tracks bypassing the urban area at high speeds). Without a high-speed loop, there is a greater potential for noise impacts on people in urban areas because of the higher speed of express trains, the greater number of trains, and the greater density of people along urban alignments. Express loops considered skirt the populated areas of several cities in the Central Valley, including Modesto, Atwater, Merced, Fresno, and Tulare. A noise analysis for the Sacramento to Bakersfield region was used to quantify and compare the differences between the two configurations, i.e., with and without high-speed loops.

The high-speed loop that skirts Fresno was chosen as an example to illustrate the potential noise benefits that might be obtained by implementing high-speed loops. The focused evaluation compares the number of people impacted by the option without the loop and the number of people impacted by the option that includes the high-speed loop around Fresno. Fresno has two potential high-speed loops, depending on which of the two rail alignments is selected as the mainline HST route, Union Pacific Railroad (UPRR) or Burlington Northern Santa Fe (BNSF).

The screening distance used for the high-speed loop is the distance associated with express high-speed trains at a maximum operating speed of 220 mph (354 kph). With the high-speed loop included as part of the option, the screening distance used for the mainline is that associated with stopping or accelerating trains at the station, or speeds slower than 125 mph (201 kph). Using the GIS database, the numbers of people potentially impacted for the two scenarios were determined.

The UPRR alignment high-speed loop option analysis indicates that if express trains use the mainline track (no high-speed loop), the number of people potentially impacted by noise would be somewhat higher (16%) particularly in the downtown area compared to the number of people potentially impacted by including a high-speed loop. The BNSF high-speed loop option analysis indicates that 12% more people would be potentially impacted if all trains use the mainline compared with the high-speed loop option. This comparative evaluation shows that fewer people would be impacted by noise with the high-speed loop, although the difference would not be large. While the high-speed loops would reduce noise impacts along the HST line through the urban center, the implementation of two lines (express loop and stopping tracks in the city) creates some additional noise impacts around the outskirts of the urban area and would affect a greater total area. The marginal reduction in potential noise impact in the urban locations from using an express (high-speed) loop might be achieved at a lower cost through noise barrier mitigation of the direct route in which all the trains (both stopping and express trains) pass through all the stations in urban areas.

3.4.2 Affected Environment

A. STUDY AREA DEFINED

The study area for the noise and vibration assessment is defined by the screening distances that are used by the FRA (U.S. Department of Transportation 1998) and FTA (U.S. Department of Transportation 1995) to evaluate rail and highway corridors. Rail and highway study areas are within 1,000 ft (305 m) of the centerline of the alignment options for each alternative. For airport noise in California, the study area is the area within the 65-decibel (dB) CNEL noise contour established for the particular airport. This is the extent of the area where a change in noise would be most noticeable to receptors, and noise impacts from new projects could begin to dominate the noise environment.

B. GENERAL DISCUSSION OF NOISE AND VIBRATION

This section describes the characteristics and associated terms and measurements used for transportation-related noise and vibration. When noise from a highway, plane, or train reaches a receptor, whether it is a person outdoors or indoors, it combines with other sounds in the environment (the ambient noise level) and may or may not stand out in comparison. The distant sources may include traffic, aircraft, industrial activities, or sounds in nature. These distant sources create a background noise in which usually no particular source is identifiable and to which several sources may contribute, but is fairly constant from moment to moment and varies slowly from hour to hour. Superimposed on this slowly varying background noise is a succession of identifiable noisy events of relatively brief duration. Examples include the passing of a train, the over flight of an airplane, the sound of a horn or siren, or the screeching of brakes. These single events may be loud enough to dominate the noise environment at a location for a short time, and when added to everything else, can be an annoyance. The descriptors used in the measurement of noise environments are summarized below.

The fundamental measure of noise is the dB, a unit of sound level based on the ratio between two sound pressures—the sound pressure of the source of interest (e.g., the HST) and the reference pressure (the quietest sound that a human can hear). Because the range of actual sound pressures is very large (a painful sound level can be over 1 million times the sound pressure of the faintest sound), the expression of sound is compressed to a smaller range with the use of logarithms. The resulting value is expressed in terms of dB. For example, instead of a sound pressure ratio of 1 million, the same ratio is 120 dB.

The human ear does not respond equally to high- and low- pitched sounds. In the 1930s, acoustical scientists determined how humans hear various sounds and developed response characteristics to represent the sensitivity of a typical ear. One of the characteristics, called the A-curve, represents the sensitivity of the ear at sound levels commonly found in the environment. The A-curve has been standardized. The abbreviation dBA is intended to denote that a sound level is expressed as if a measurement has been made with filters in accordance with that standard.

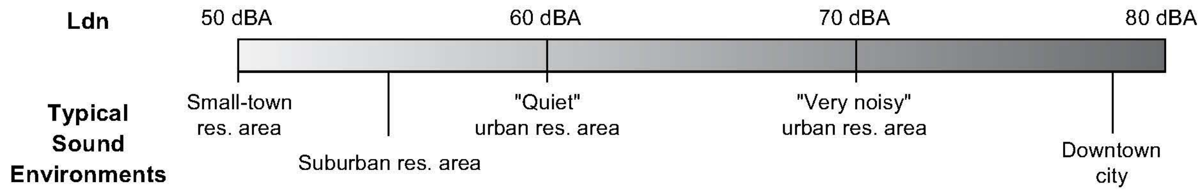
- Maximum Sound Level (L_{max}), measured in dBA, is the highest noise level achieved during a noise event.
- Equivalent Sound Level (L_{eq}), measured in dBA, describes a receptor's cumulative noise exposure from all noise events that occur in a specified period of time. The hourly L_{eq} is a measure of the accumulated sound exposure over a full hour. The L_{eq} is computed from the measured sound energy averaged over an hour (nothing one would read from moment to moment on a meter) representing the magnitude of noise energy received in that hour. FHWA uses the peak traffic hour L_{eq} as the metric for establishing highway noise impact.
- Day-Night Sound Level (L_{dn}) describes a receptor's cumulative noise exposure from all noise events that occur in a 24-hour period, with events between 10 p.m. and 7 a.m. increased by 10 dB to account for greater nighttime sensitivity to noise. The L_{dn} is used to describe the general noise environment in a location, the so-called "noise climate." The unit is a computed number, not one to be read from moment to moment on a meter. Its magnitude is related to the general noisiness of an area. EPA developed the L_{dn} descriptor and now most federal agencies, including the FRA, use it to evaluate potential noise impacts. Typical L_{dns} in the environment are shown in Figure 3.4-1.
- CNEL, a variant of Ldn, is used in noise assessments in California. Rather than dividing the day into two periods, daytime and nighttime, CNEL adds a third to account for increased sensitivity to noise in the evening when people are likely to be engaged in outdoor activities around the home. An evening addition of 5 dB is applied to noise events between the hours of 7 p.m. and 10 p.m. to reflect the additional annoyance noise causes at that time. In general, the difference between Ldn and CNEL is slight and the two measures will be considered interchangeable for purposes of this noise analysis.

The way people react to noise in their environment has been studied extensively by researchers throughout the world. Based on these studies, noise impact criteria have been adopted by the FRA (U.S. Department of Transportation 1998) and other federal agencies to assess the contribution of the noise from a source like HST to the existing environment. The FRA bases noise impact criteria on the estimated increase in L_{dn} (for buildings with nighttime occupancy) or increase in L_{eq} (for institutional) buildings caused by the project for direct and indirect impacts. Criteria are discussed in Section 3.4.1 and Appendix 3.4-C.

<u>Transportation Noise</u>
Noise from highways, airports, and rail lines tends to dominate the noise environment in its immediate vicinity. Each mode has distinctive noise characteristics in both shape and source levels. Highway and rail noise affects an area that is linear in shape, extending to both sides of the alignment. Airport noise, in contrast, affects a closed area around the facility, with the shape of the closed loop determined by runway orientation.

<u>Highway Noise and Vibration</u>: Individual highway vehicles are generally relatively quiet, but the accumulation of noise from the volume of traffic throughout the majority of the day and night results in a nearly continuous high sound level. Noise from road traffic is generated by a wide variety of vehicle types, makes, and models. In general, the noise associated with highway vehicles can be divided into three classes of vehicle: automobiles, medium trucks, and heavy trucks. Each class has its own noise characteristic depending on vehicle type, speed, and the condition of the roadway surface.

Figure 3.4.1 Typical Day-Night Sound Level Environments



The cumulative effect of all the vehicles added together comprises the noise environment in the vicinity of a highway. The noise level along a highway facility is strongly influenced by the traffic flow—its speed and the number of vehicles of each type using it. Busy freeways have a nearly continuous noise, whereas rural roads have noise levels that rise and fall depending on clusters of traffic. Multi-lane freeways spread the noise sources out over many lanes, resulting in a large area affected by noise. However, highway noise is generated at or very near the ground surface so that topographical conditions at the roadside have a major effect on propagation. Highway noise is described as a line source, since the noise is generated along a long line of highway. Noise levels are mapped using contour lines for given noise levels and they are roughly parallel to the highway. While these contours are directly influenced by the width of the facility (number of lanes), the volume and speed of the traffic are the primary factors that influence the amount of noise and the location of the noise contour.

Vibration created by truck traffic can be felt in areas adjacent to highways. However, there are no established vibration criteria for highways and consequently highway vibration is not part of this analysis.

Aircraft and Airport Noise and Vibration: Airport noise sources can be among the loudest sounds in the environment, but the aircraft pass-bys tend to be rather short in duration and are concentrated along the alignments of the runways. The area of noise impact around an airport depends on the number of operations, the type of aircraft, and the flight tracks used at that airport. Noise near airports is generated by a complex sound source consisting of flight operations and ground operations. Flight operations associated with an airport include takeoffs and landings, requiring extra power, and increased noise levels. When the aircraft are airborne, they propagate sound to great distances. For airborne operations, sound reaching the ground depends highly on atmospheric conditions. Ground operations include aircraft taxiing, run-up operations, and surface transportation near the terminal and its runways. Noise generated by ground operations has to spread out over the ground, thereby being strongly affected by topographical conditions, vegetation, ground types, and buildings.

Noise levels can vary considerably for different types of aircraft, by type, engine power settings, and flight paths. As with highway noise, the cumulative effect of airport noise depends on the number of flight operations and runway utilization. As opposed to a highway where the source is linear in nature, an airport is described as an aerial source, affecting a defined area with closed contours around the airport. The noise contours tend to be elongated in the direction of the major runways.

Vibrations from aircraft, particularly low flying aircraft and their engines, can potentially impact homes and businesses; however since the FAA does not have a criteria for measuring these vibrations, it is not included in this analysis.

Conventional and High-Speed Train Noise and Vibration: While high-speed trains have some similar noise and vibration characteristics to conventional trains, they also have several unique features resulting from the reduced size and weight, the electrical power, and the higher speed of travel. The proposed HST would be a steel-wheel, steel-rail electrically-powered train operating in an exclusive right-of-way. Because there would be no roadway grade crossings, the annoying sounds of the train horn and warning bells would be eliminated. The use of electrical power cars would eliminate the engine rumble associated with diesel-powered locomotives. The above factors allow HST to generate lower noise levels than conventional trains at comparable speeds below 100 mph (161 kph). At higher speeds above 150 mph (241 kph), however, HST noise levels would increase over conventional trains due to aerodynamic effects. A mitigating factor is that high speeds would enable HST noise to occur for a relatively short duration compared with conventional trains (a few seconds at the highest speeds versus 10 to 20 seconds for conventional passenger trains and over 1 minute for freight trains).

For the proposed HST system higher operating speeds of 150 to 220 mph (241 to 354 kph) would be planned for the less constrained areas, in terms of alignment (i.e., flat and straight). In contrast, much lower operating speeds <125 mph (201 kph) would be planned in the more developed areas. Figures 3.4-2 and 3.4-3 illustrate the maximum operating speeds for express service along each of the proposed HST alignment options. Local and semi-express services would not necessarily reach these maximum speeds because they would stop and start for more stations.

Noise from a high-speed train is expressed in terms of a source-path-receiver framework as illustrated in Figure 3.4-4. The source of noise is the train moving on its tracks. The path describes the intervening course between the source and the receptor wherein the noise levels are reduced by distance, topographical and human-made obstacles, atmospheric effects, and other factors. Finally, at each receptor, the noise from all sources combine to make up the noise environment at that location.

The total noise generated by a train is the combination of sounds from several individual noise-generating mechanisms, each with its own characteristics, including location, intensity, frequency content, directivity, and speed dependence. The distribution of noise sources on a typical HST is shown in Figure 3.4-5. These noise sources can be grouped into three categories according to the speed of the train.

For low speeds, below about 40 mph (64 kph), noise emissions are dominated by the propulsion units, cooling fans, and under-car and top-of-car auxiliary equipment such as compressors and air conditioning units. The HST would be electrically powered and considerable quieter at low speeds than conventional trains that are usually diesel powered.

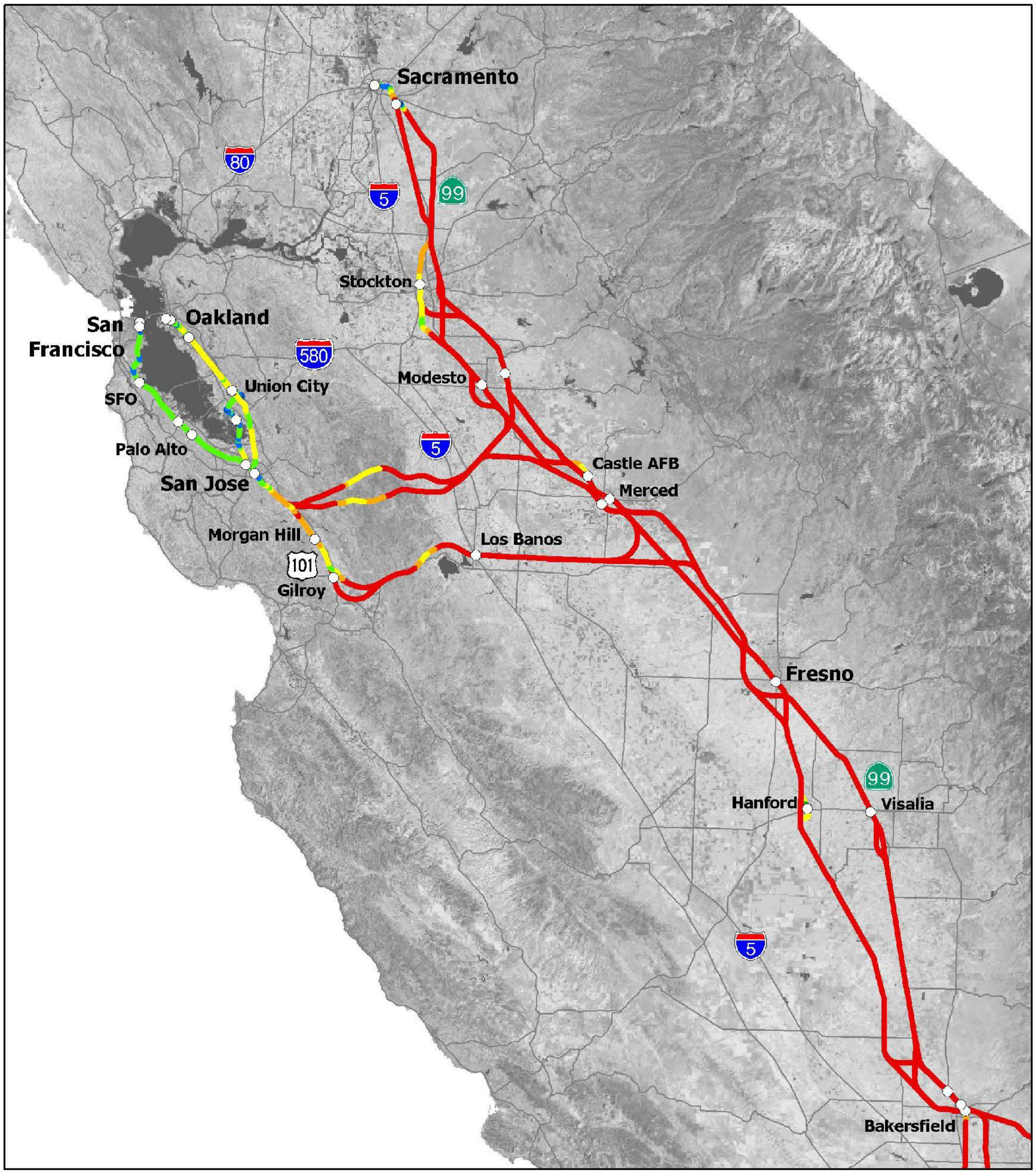
In the speed range from 60 mph to about 150 mph (98 kph to 241 kph), mechanical noise resulting from wheel/rail interactions and structural vibrations dominate the noise emission from trains. In the existing rail corridors within California, conventional trains seldom exceed 79 mph (127 kph), so this speed range, which represents a medium range for HST, is the top end of noise characteristics for trains with which most people are familiar. Speed has a strong influence on noise in the medium speed range.

Above approximately 170 mph (274 kph), aerodynamic noise sources tend to dominate the radiated noise from the HST. Conventional trains are not capable of attaining such speeds. HST noise in the transition speeds between each of the three foregoing ranges is a combination of the sources in each range.

Noise from HST also depends on the type and configuration of its track structure. Typical noise levels are expressed for HST at grade on ballast and tie track, the most commonly found track system. For trains on elevated structure, HST noise is increased, partially due to the loss of sound absorption by the ground and partially due to extra sound radiation from the bridge structure. Moreover, the sound from trains on elevated structures spreads about twice as far as it does from at-grade operations of the same train, due to raising the sound source higher above ground.

Horns are an example of a train noise source that is a dominant noise source at any speed. Audible warnings at grade crossings, including train horns and warning bells, are a common feature of conventional trains and a vital safety component of railroad operations. These noise sources often prove to be a source of annoyance to people living near railroad tracks. In the

Figure 3.4-2 Maximum Operating Speeds (Northern California)



September 23, 2003

California High Speed Train Program EIR/EIS

Legend

Speed Ranges

MPH	KPH
0 - 31	0 - 50
31 - 62	50 - 100
62 - 93	100 - 150
93 - 124	150 - 200
124 - 155	200 - 250
155 - 186	250 - 300
186 - 217	300 - 350

10 0 10 Miles

10 0 10 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Express Trip Time
Train Service Speeds
Northern California

Figure 3.4-3 Maximum Operating Speeds (Southern California)

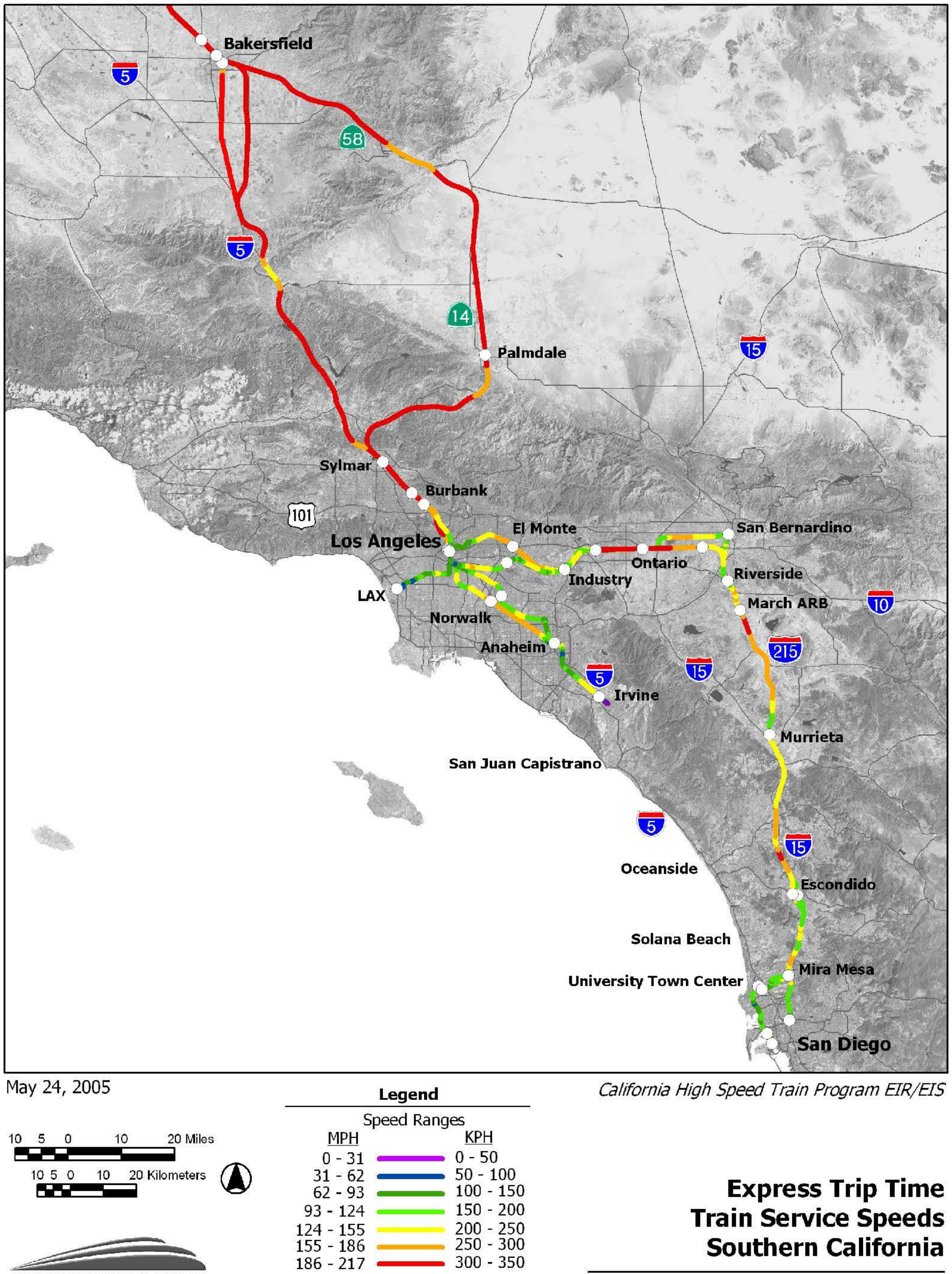


Figure 3.4.4. HST Source-Path-Receiver Framework

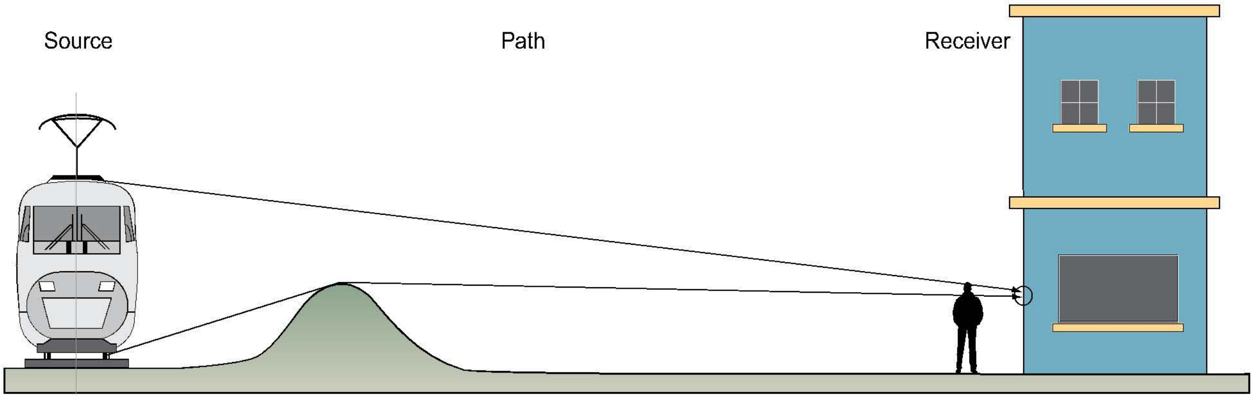
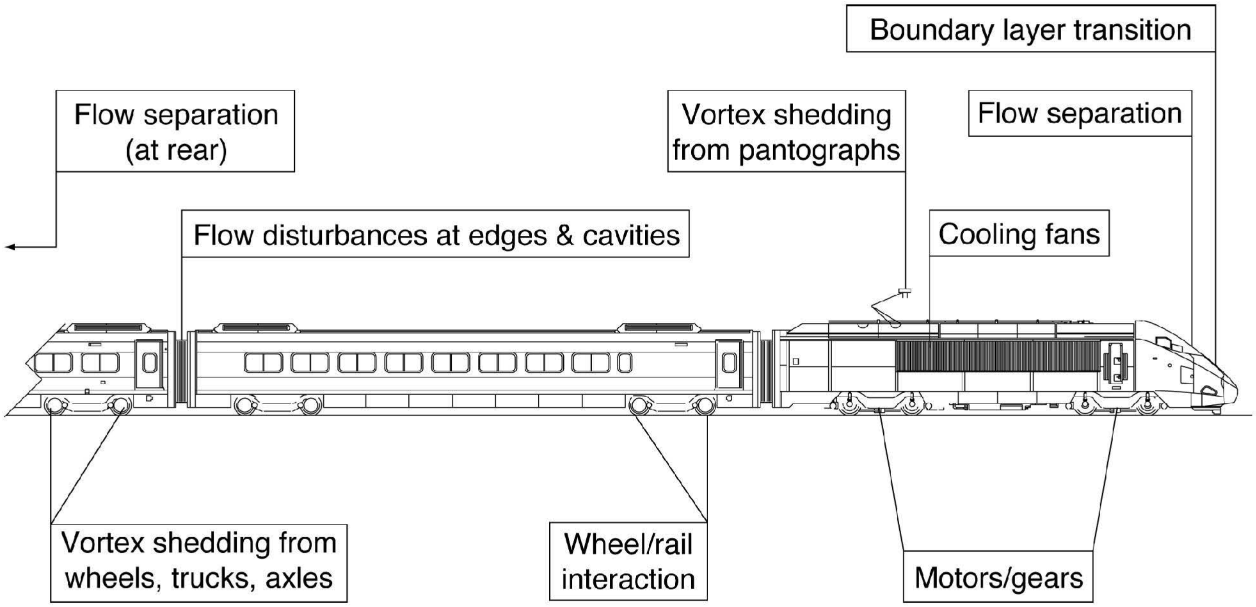


Figure 3.4-5. Noise Sources on HST



case of HST, however, horn and warning bell noise at grade crossings are absent except in the case of emergencies because grade crossings are eliminated for reasons of safety. Elimination of horns and bells at existing grade crossings would provide a noise benefit associated with the implementation of HST for alignments along existing rail corridors, but only in locations where grade separations also served the existing rail service, thereby removing the need for grade crossing warnings and train horns.

Vibration of the ground caused by the pass-by of the HST is similar to that caused by conventional steel wheel/steel rail trains. However, vibration levels associated with the HST are relatively lower than conventional passenger and freight trains due to new track construction and smooth track and wheel surfaces resulting from high maintenance standards required for high-speed operation.

Ground-borne vibration from trains refers to the fluctuating motion experienced by people on the ground and in buildings near railroad tracks. In general, people are not commonly exposed to vibration levels from outside sources that they can feel. Little concern results when a door is slammed and a wall shakes or something heavy is dropped and the floor shakes momentarily. Concern results, however, when an outside source like a train causes homes to shake. The effects of ground-borne vibration in a building located close to a rail line could at worst include perceptible movement of the floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. None of these effects is great enough to cause damage, but could result in annoyance if repeated many times daily.

As with noise, ground-borne vibration can be understood as following a source-path-receptor framework, as shown in Figure 3.4-6. The source of vibration is the train wheels rolling on the rails. They create vibration energy that is transmitted through the track support system into the track bed or track structure. The path of vibration involves the ground between the source and a nearby building. The receptor of vibration is the building.

Mode Noise Level Comparisons

Noise levels of typical individual transportation vehicles are compared in Figure 3.4-7 with each other and with other commonly experienced sounds in the environment. Jet aircraft are clearly the noisiest of the transportation sources, followed by train horns and diesel trucks. Noise levels of high-speed trains at speeds of 100 to 150 mph (161 to 241 kph) are similar to that of freight and commuter trains at speeds of 50 to 80 mph (80 to 129 kph). The descriptor for the figure is the L_{max} which represents the highest sound level associated with a single event such as the passage of a train, aircraft, or truck.

As described above, the descriptor used in environmental assessments is the L_{dn}, which represents the cumulative noise exposure during a 24-hour period, rather than the L_{max}. A comparison of noise associated with surface transportation sources at various distances on either side of an unobstructed highway or railway is shown in Figure 3.4-8. This example is based on conventional passenger and freight trains at typical operating speeds compared with high-speed trains at a range of speeds, for a hypothetical situation of one train per hour. The graph shows the relative differences between these types and speeds of trains in terms of cumulative noise exposure. The graph also includes the cumulative noise levels over a 24-hour period of an 8-lane freeway with traffic traveling at 65 mph (105 kph) in relation to the train examples.

The graph in Figure 3.4-9 shows the difference in cumulative noise exposure for the same train types and speeds given typical frequency levels. In this case, since commuter trains and high-speed trains share many of the same noise profile characteristics (frequency, relative speed, and length) commuter trains and high-speed trains are assumed to have much higher frequencies than freight trains based on typical commuter operations and conceptual operating assumptions

Figure 3.4-6. Vibration Propagation from HST

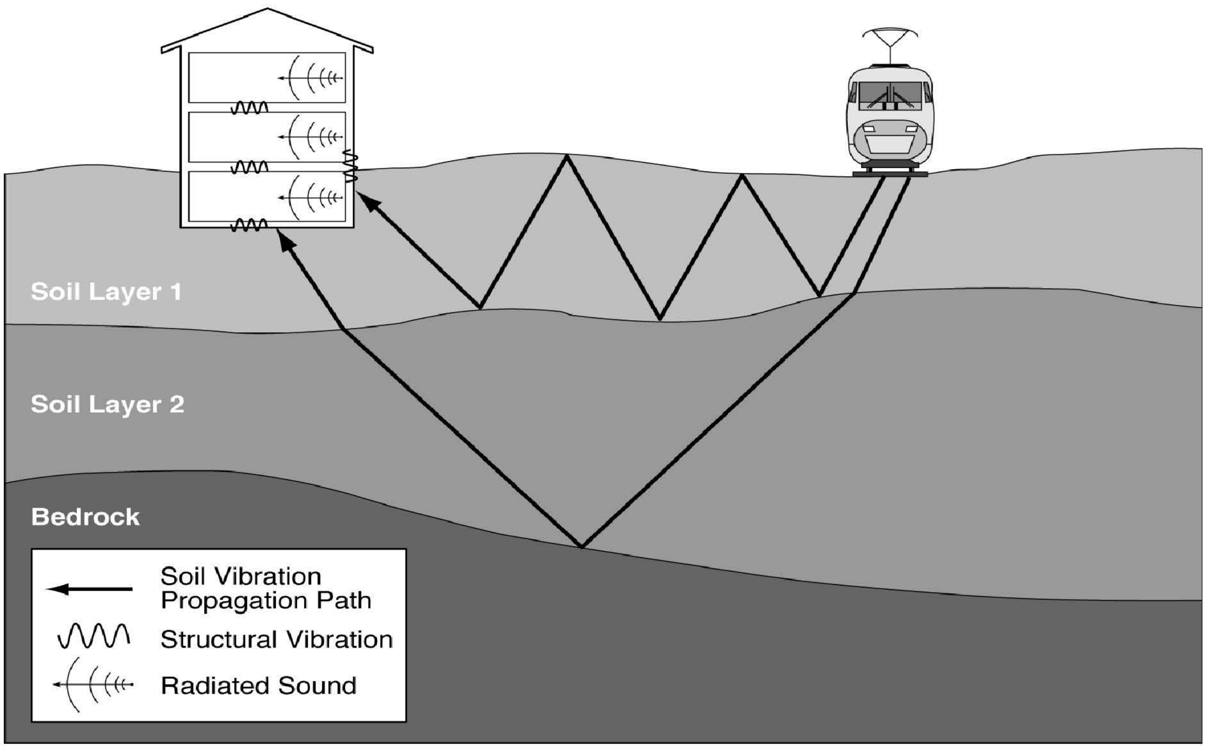


Figure 3.4-7. Typical Lmax Values

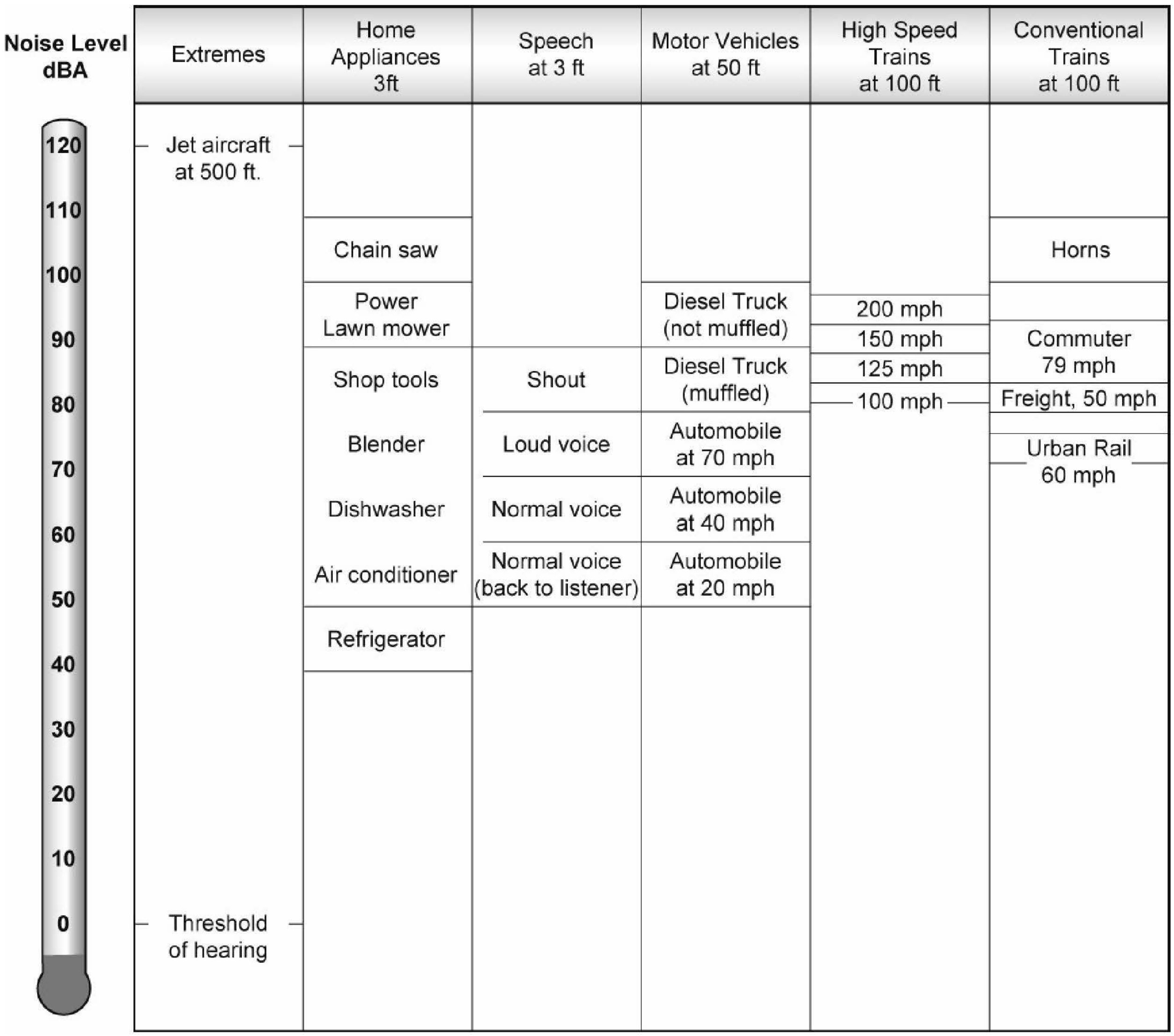


Figure 3.4-8 - Example of Noise Exposure vs. Distance with Normalized Frequency

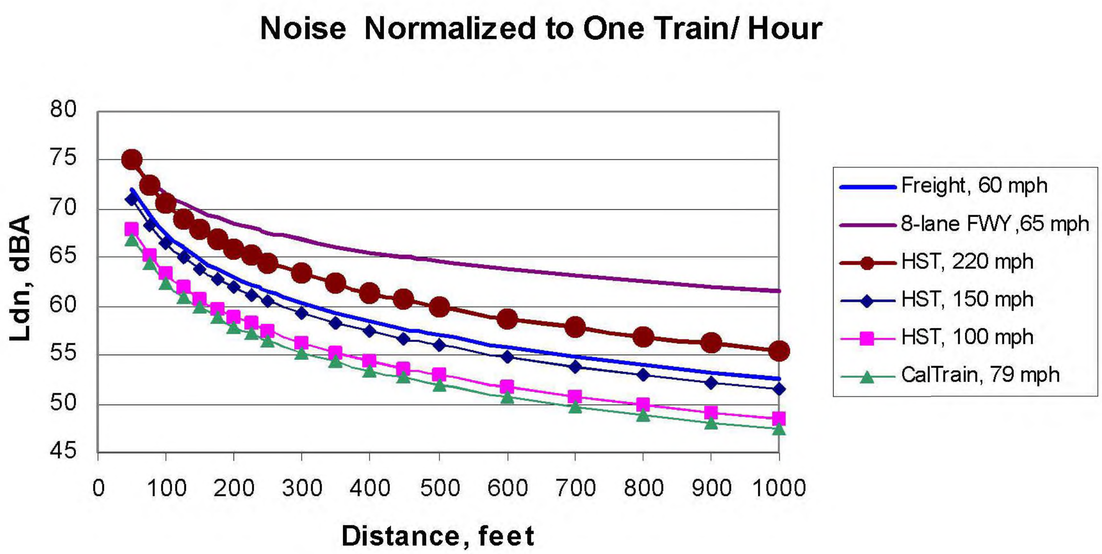
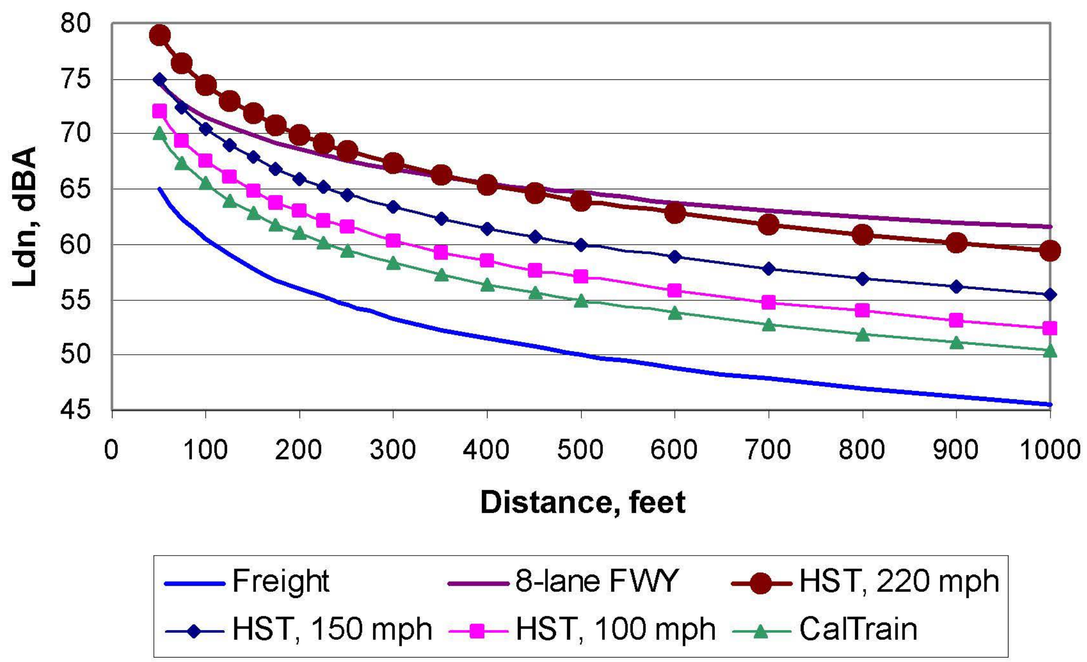


Figure 3.4-9 - Example of Noise Exposure vs. Distance with Typical Frequencies



for HST. For this illustration, HST is assumed to have 118 day and 14 night trains made up of 1 power car and 15 coaches; commuter trains are assumed to have 46 day and 28 night trains made up of 1 locomotive and 5 coaches; and freight trains are assumed to have 10 day and 3 night trains made up of 2 locomotives and 40 freight cars. The 8-lane freeway in this and the preceding plot is assumed to carry 1,885 vehicles/hour/lane with 2% medium trucks and 3% heavy trucks. This example shows that as frequencies and speeds are increased (e.g., the addition of HST trips) the noise exposure is increased relative to the existing conventional rail services. Again, the graph includes the cumulative noise levels of a typical 8-lane freeway with traffic traveling at 65 mph (105 kph) in relation to the train examples. This example also shows how the cumulative noise diminishes with distance from the linear-type surface transportation sources. In the first 300 ft (91 m) from the centerlines, L_{dn} from rail sources tends to diminish more with respect to distance than that from a busy freeway. The freeway constitutes a continuous long source of noise, whereas a rail line has a series of transient noise events with relatively short sources.

Because of its aerial nature, airport noise cannot be represented in the same format used for surface transportation sources. Contours of noise exposure surround the airport in an irregular pattern depending on the orientation of its runways and their use. The frequency of operations (takeoffs and landings) has a direct impact on the noise levels in the vicinity of the airports. The area within each contour grows with the number of operations of aircraft. For example, the area of the L_{dn} 65-dBA airport noise contour used as the impact criterion in FAA's planning guide increases 17% (affecting additional land area) for every 1.5-dB increase in L_{dn} (approximately a 40% increase in number of operations), according to FAA's area equivalent method.

C. NOISE ENVIRONMENTS BY REGION

Regional noise and vibration environments are generally dominated by transportation-related sources, including vehicle traffic on freeways, highways, and other major roads, existing passenger and freight rail operations, and aviation sources, including civilian and military. Existing noise along highway and proposed HST corridors has been estimated using data in the noise element from the general plan for cities and counties in the region, along with general methods provided by FHWA, FRA, and FTA for estimating transportation noise. Ambient noise levels are characterized for each region in the sections below. Ambient vibration conditions are very site-specific in nature and are not characterized as part of the program environmental process.

Bay Area to Merced

This region includes central California from the San Francisco Bay Area (San Francisco and Oakland) south to the Santa Clara Valley and east across the Diablo Range to the Central Valley. The ambient noise in the northern portion of the Bay Area to Merced region is dominated by motor vehicle traffic in densely populated areas and along freeways. All the regional freeways considered in the No Project and Modal Alternatives are major contributors to the ambient noise environment. In this region the potential HST alignments would primarily follow or parallel existing rail tracks. Along the proposed HST alignment on the San Francisco Peninsula, the existing Caltrain passenger service is a major contributor to the ambient noise levels, especially at grade crossings where horn noise dominates the noise environment within 0.25 mi (0.40 km) of the intersections. Along the proposed HST alignment in the East Bay, existing Amtrak passenger service and freight rail contribute to the ambient noise levels, with horns at grade crossings being a major factor. In southern San Jose and as far as Gilroy to the south, Caltrain, Amtrak, and freight rail are major contributors to the ambient noise levels.

In the urban areas and suburban areas of the East Bay, San Francisco Peninsula, and San Jose, the ambient noise is estimated to range from L_{dn} 57 to 66 dBA. In many of the residential areas close to the international airports at San Francisco (SFO), Oakland (OAK), and San Jose (SJC), the ambient levels exceed L_{dn} 65 dBA. In the more rural areas of the region to the southeast, the ambient noise ranges from 52 to 57 dBA. Henry Coe State Park is characterized by a low ambient noise environment, approximately L_{eq} 40 dBA, being in a remote location and removed from transportation noise sources, except along SR-152, which is also part of the Modal Alternative.

Sacramento to Bakersfield
This region of central California includes a large portion of the Central Valley (San Joaquin Valley) from Sacramento south to Bakersfield. The proposed HST alignment options in the Sacramento to Bakersfield region primarily follow two major railroad alignments, UPRR and BNSF. Most of the UPRR corridor runs parallel to SR-99. The proposed UPRR alignment generally has more populated land use development than the one following BNSF. The highway improvements included in the Modal Alternative are primarily focused on SR-99 and I-5. These railroad lines and the highways are major contributors to the ambient noise environment.

The land use along the corridor corresponds to a quiet suburban or rural area, changing into a noisy suburban or urban area primarily inside of the city and town limits such as Fresno and Merced, in the middle and at Sacramento and Bakersfield on each end, where typical moderate to high noise levels exist. Due to the proximity of the existing railroad and highway corridors to the proposed alignment/improvement options, the non-developed areas or areas of low population density are also relatively noisy. The non-residential, rural, and quiet suburban areas along the alignment options and existing transportation corridors in this region correspond primarily to agricultural land use where low noise levels predominate. There are some commercial and industrial areas next to the alignments, but only within the boundaries of the towns and cities. Ambient levels are estimated to be between L_{dn} 50 to 58 dBA for rural and quiet suburban, and L_{dn} 60 to 68 dBA for noisy suburban urban areas.

Bakersfield to Los Angeles
This region of southern California encompasses the southern portion of the Central Valley south of Bakersfield, the mountainous areas between the Central Valley and the Los Angeles basin, and the northern portion of the Los Angeles basin from Sylmar to downtown Los Angeles. The ambient noise from Bakersfield to Sylmar is dominated by motor vehicle traffic along the I-5 corridor and by both motor vehicle traffic and freight and passenger trains throughout portions of the Antelope Valley option. From Sylmar to Los Angeles Union Station (LAUS) the ambient noise is dominated by motor vehicle traffic and near rail lines by freight and passenger trains. The ambient noise levels in the densely populated urban areas and areas near existing highways or rail corridors range from L_{dn} 58 to 67 dBA or even higher. In the more rural areas of the region, the ambient noise levels range from L_{dn} 50 to 53 dBA.

Los Angeles to San Diego via Inland Empire
This region of southern California includes the eastern portion of the Los Angeles basin from downtown Los Angeles east to the Riverside and San Bernardino areas and south to San Diego generally along the I-215 and I-15 corridors. Between Los Angeles and Riverside, the ambient noise environment in the study area is dominated by a combination of noise from freeways, major roads, and existing railroads. With close proximity to a freeway or rail line, the transportation noise will typically dominate the local noise environment. Ambient noise in these areas ranges from L_{dn} 58 to 68 dBA.

Along portions of the alternative corridors between Riverside and Escondido, which follow I-15 and I-215, freeway noise is the dominant component of the existing ambient noise. Although this portion of the region is fairly rural, ambient noise near the existing highways is high. The most rural area of this portion is mountainous, where ambient noise ranges from L_{dn} 54 to 65 dBA.

The Escondido to San Diego portion of the Inland Empire region is less urban than the Los Angeles area, but major freeways and existing rail lines have similarly high local noise environments. Ambient noise in the Escondido to San Diego areas along the study corridors ranges from L_{dn} 55 to 68 dBA.

Los Angeles to San Diego via Orange County

This region includes the western portion of the Los Angeles basin between downtown Los Angeles and Los Angeles International Airport (LAX) and the coastal areas of southern California between Los Angeles and San Diego, generally following the existing I-5 highway corridor. The ambient noise in the northern portion of the region is dominated by motor vehicle traffic in densely populated areas and along freeways. Along the connection to LAX, and in particular near freeways, motor vehicle traffic dominates. Closer to the airport, aircraft noise becomes dominant.

Along the conventional rail alignment south from LAUS, existing passenger service (Amtrak, Metrolink, and Coaster) and freight rail contribute to the local noise. Throughout this portion of the region, roadway traffic also contributes to the ambient. Along the HST alignment, freight rail and motor vehicle traffic comprise the sources of ambient noise. Along the coast, local roadway traffic and passenger rail service contribute to the ambient noise conditions, most notably horn blowing at grade crossings. Freeway noise is the dominant noise source in this region.

In the urban areas and suburban areas of Los Angeles and northern Orange Counties, the ambient noise ranges from L_{dn} 63 to 68 dBA depending on the proximity to noise sources such as rail, roadway and airport. In the more suburban areas of the region, the ambient noise ranges from 58 to 63 dBA. Along the coast, the ambient noise environment ranges from L_{dn} 54 to 64 dBA depending on proximity to local noise sources.

3.4.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

The No Project Alternative includes programmed and funded transportation improvements that will be implemented and operational by 2020 in addition to the existing conditions. These improvements are not major system-wide capacity improvements (e.g., major new highway construction or widening or additional runways) and will not result in a general improvement of intercity travel conditions across the study area.

For purposes of this analysis, it is assumed that there will be no additional noise and vibration impacts associated with the development of No Project as compared to existing conditions. The potential significant impacts associated with programmed projects would be addressed with mitigation measures in a manner consistent with existing conditions in accordance with the project-level environmental documents and approvals for the projects as prepared by the project sponsors. While the implementation of the No Project Alternative may result in some increases, any estimate of such increases would be speculative.

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

The No Project Alternative is used as the basis for comparison. It is assumed that any improvements associated with the proposed Modal and HST Alternatives would be in addition to No Project conditions.

The relative level of potential noise impact for the Modal Alternative is illustrated in Figures 3.4-10 and 3.4-11. The figures show the relative noise impact in terms of high, medium and low categories for all of the potentially improved highway segments included in this alternative. The Modal Alternative has over 200 mi (322 km) of highway segments with potential for high noise impacts. The segments of high potential impact generally result from the high total traffic volumes (existing plus the representative demand) and the capacity improvements associated with the Modal Alternative, which result in increased speeds and wider facility cross sections. The segments with existing noise barriers are assumed to have less than high potential because most improvements would include noise walls.

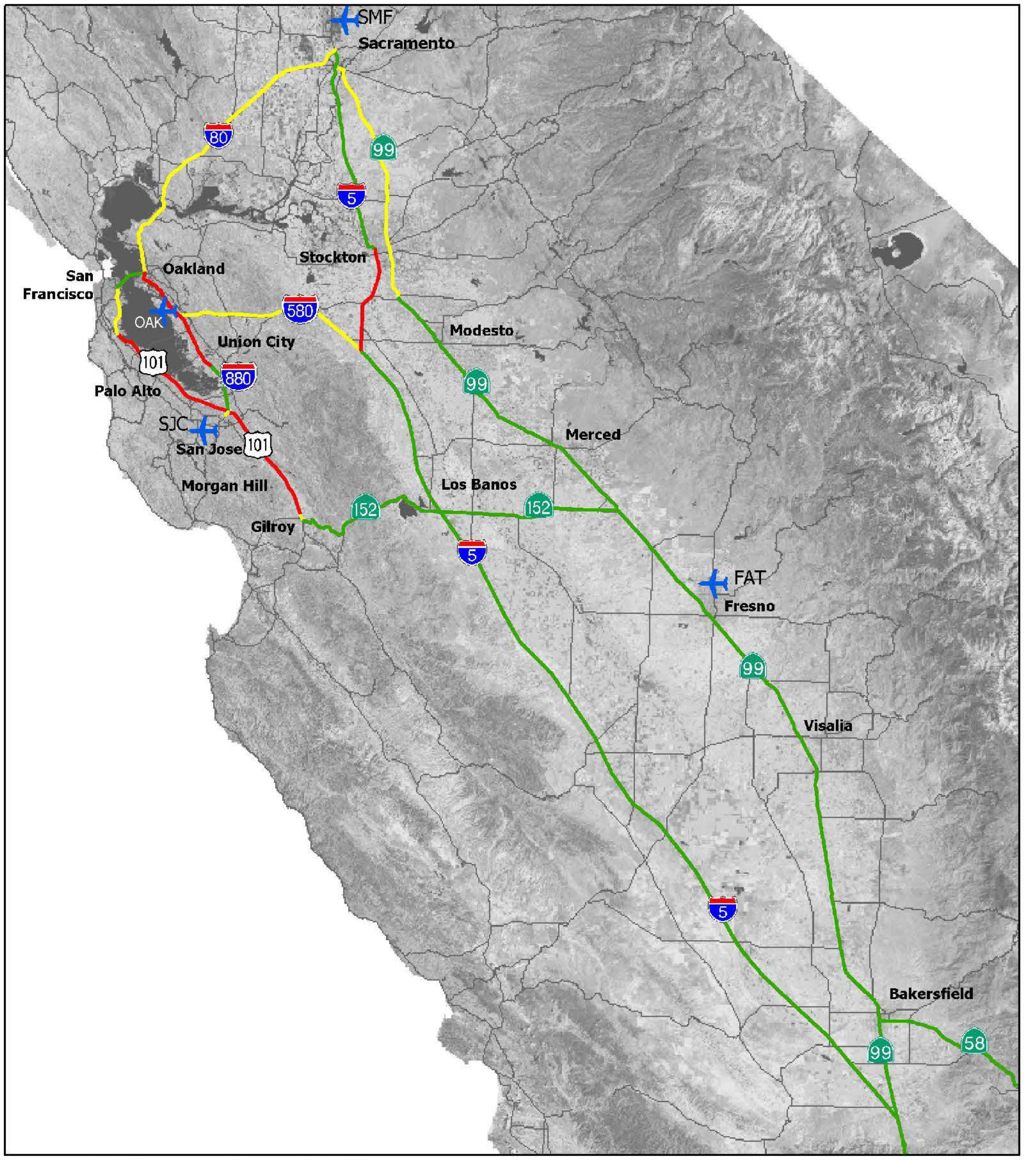
The noise levels for airports are not categorized as high, medium, and low. The available data indicate that the number of people affected by the aviation component is a small portion of the number affected by the Modal Alternative (see Appendix 3.4-D). Although aircraft and airport improvements contribute less to the Modal Alternative's potential noise impacts than the more extensive highway improvements, it should be acknowledged that noise from aircraft and airport operations can impact relatively large areas of land including large numbers of people surrounding the airport. Noise is one of the most prominent factors for the environmental acceptability of airport improvement or expansion and is often the limiting factor in the approval of such projects. There is typically strong community resistance to airport expansions due to noise issues. Many of the airports in urban areas like Burbank, San Jose, and Orange County all have operating restrictions based on the noise from the aircraft and the airport operations.

The relative level of potential noise impacts for the HST Alternative is illustrated in Figures 3.4-12 and 3.4-13. The figures show the relative noise impacts in terms of high, medium and low categories for all of the HST alignment options. The potential noise impact ratings account for the reduction of horn and bell noise associated with the elimination of grade crossings on existing rail lines, where appropriate.

The relative level of potential noise impact for each alternative is shown in Table 3.4-1 in terms of the total lengths of alignment (highway or HST) in each rating (high-medium-low) category. The sections of alignment options with high, medium, and low potential noise impact ratings for the HST Alternative are compared with the equivalent sections of the Modal Alternative. In addition, the potential impact ratings of HST alignments are shown without mitigation. The impact levels shown for the Modal Alternative assume that sound barriers (walls) are maintained or rebuilt along the segments of each improved highway where they currently exist. The results show the HST Alternative would have less total mileage of high potential for noise impact than the Modal Alternative. A full range of HST alignment options were assessed assuming a statewide system comprising the alignment options with the greatest potential for noise impact (GPI) and those with the least potential for noise impact (LPI).

Based on the percentage of total system-wide length that would experience potential high noise impacts, the HST Alternative is close to the Modal Alternative. For example, 14% of the improvements associated with the Modal Alternative are rated with a high potential for noise impact, whereas the HST Alternative ranges from 3% for LPI to 14% for GPI.

Figure 3.4-10
Potential Modal Alternative Noise Impact Levels-Northern California



Source: Landsat 1985 September 12, 2003 *California High Speed Train Program EIR/EIS*

Legend

Modal Alternative Noise Impacts

- High
- Medium
- Low
- FAT Modal Alternative Airports

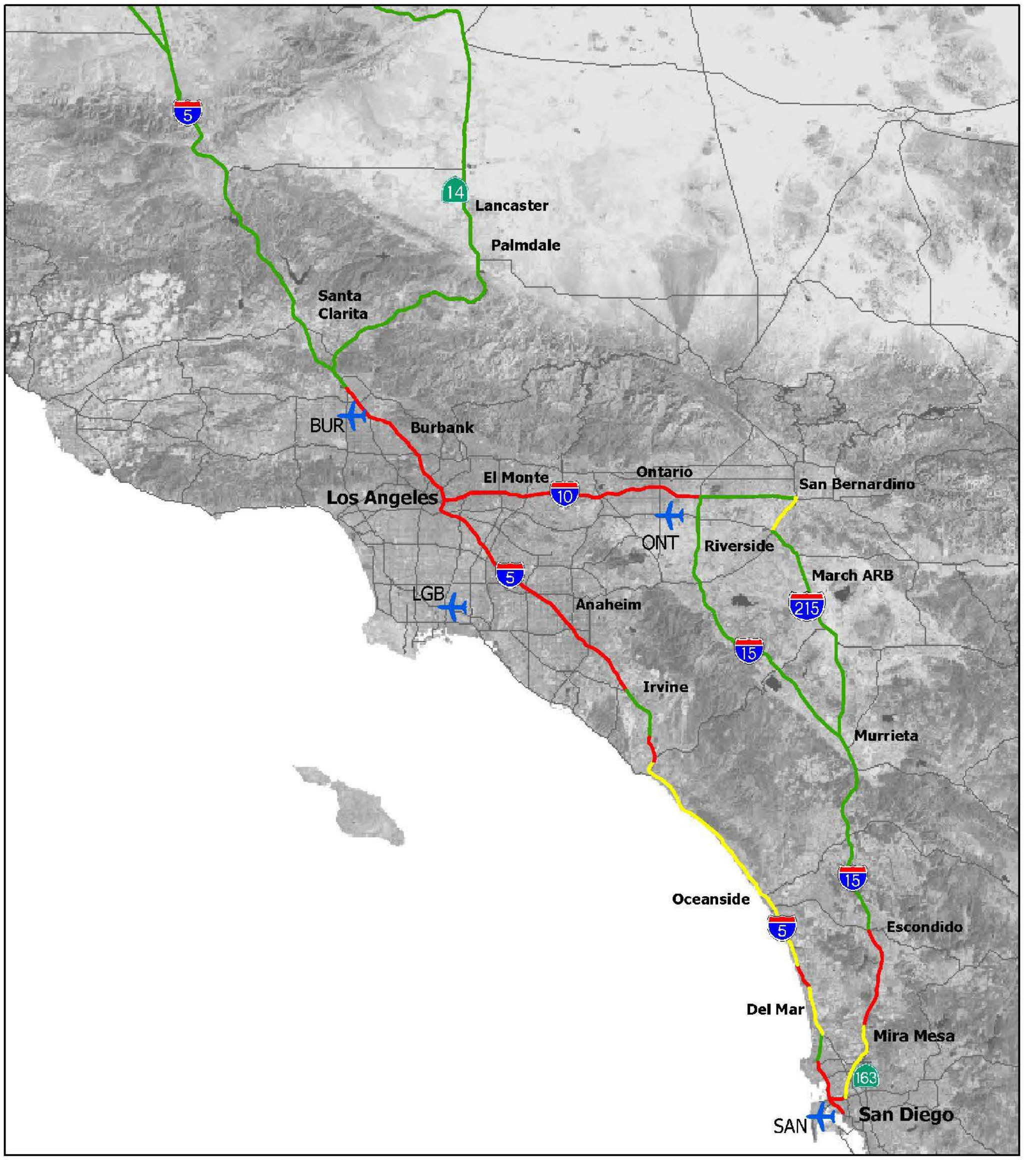
10 5 0 10 20 30 40 Miles

10 5 0 10 20 30 40 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Noise Impacts
Modal Alternative
Northern California

Figure 3.4-11
Potential Modal Alternative Noise Impact Levels-Southern California



Source: Landsat 1985

September 12, 2003

California High Speed Train Program EIR/EIS

5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Legend

Modal Alternative Noise Impacts

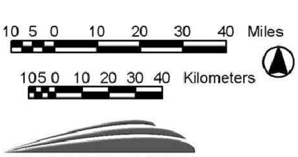
- High
- Medium
- Low
- FAT Modal Alternative Airports

Noise Impacts
Modal Alternative
Southern California

Figure 3.4-12
Potential HST Alternative Noise Impact Levels-Northern California

Source: Landsat 1985 September 19, 2003

California High Speed Train Program EIR/EIS



Legend

Potential Noise Impact Levels
- High
- High (in Urban Areas)
- Medium
- Low
- Potential Station Locations

Potential Noise Impact Levels
Accounting for Grade Crossing Elimination
High Speed Rail Alternative
Northern California

Figure 3.4-13
Potential HST Alternative Noise Impact Levels-Southern California

Source: Landsat 1985   September 19, 2003

California High Speed Train Program EIR/EIS

Legend

Potential Noise Impact Levels

- High
- Medium
- Low
- Potential Station Locations

5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Potential Noise Impact Levels
Accounting for Grade Crossing Elimination
High Speed Rail Alternative Southern California

Table 3.4-1
Summary of Noise Impact Ratings for Alternatives

Length (miles) with Potential Noise Impact Ratings[a]	Modal[b]			HST (GPI)			HST (LPI)		
REGION	H	M	L	H	M	L	H	M	L
System-wide totals[c]	210	258	1040	107	181	484	21	111	601
System-wide percentage of total[c]	14	17	69	14	23	63	3	15	82
Bay Area to Merced	93	153	131	26	103	70	0	50	103
Sacramento to Bakersfield	26	63	611	11	23	258	5	3	284
Bakersfield to Los Angeles	23	0	199	13	10	88	6	17	114
Los Angeles to San Diego via Inland	68	42	100	57	45	68	10	41	100
LOSSAN	61	43	14	42	65	50	5	65	50

[a] See Appendix 3.4-B for rating method.
[b] Assumed with maintenance or replacement of existing highway noise mitigation.
[c] Totals without LOSSAN.

The potential for direct effects of train noise on wildlife in natural areas is not well documented. Current research suggests that the noise effects of trains traveling at very high-speed could have limited influence on some species close to the tracks. Some research has been performed regarding the reactions of animals to low-flying aircraft, but the specific levels of significance and specific effects related to high-speed trains are not known. Long-term changes in behavior tend to be strongly influenced by factors other than intermittent noise exposure (as would occur with high-speed trains), such as weather, predation, disease and other disturbances to animal populations. Conclusions from research conducted to date provide only preliminary indications of the appropriate noise descriptor, rough estimates of threshold levels for observed animal disturbance, and habituation characteristics of only a few species. Long-term effects continue to be a matter of speculation. Since high-speed trains always will be on the same track and on a schedule, habituation may be likely to occur. Sound levels from train passes are also not as high, nor are onset rates as great as they are from low altitude military aircraft, hence, the observed effects of aircraft may not apply to high-speed trains.

3.4.4 Comparison of Alternatives by Region

A. BAY AREA TO MERCED

Modal Alternative

Under the Modal Alternative, the noise impact ratings for the various highway segments range from high in the urbanized areas to low in the rural areas. Two areas of high impact are the I-880 corridor from I-238 to Fremont/Newark in the East Bay and the US-101 corridor from SFO to Gilroy going south from the Peninsula. In both locations the highway and freeway corridors are adjacent to residential areas. The corridors from San Francisco over the bridge to I-880 and south to SFO have medium noise impact ratings because of less sensitive land uses adjacent to the freeways in those areas. The part of the region from Gilroy to Merced has low population density, which results in a low potential noise impact rating. Noise impacts on wilderness areas would also be relatively low since the highway improvements identified are expansions of existing facilities (noise corridors).

Increases in railroad operations are another potential source of noise impacts for the Modal Alternative. Potential noise impacts in residential areas are caused by increased train operations and by horns and bells at grade crossings. Commuter rail operations by Caltrain on the Peninsula and, to a lesser extent, Amtrak and freight operations on East Bay are major contributors. However, the change in projected commuter/intercity rail operations between Modal and No Project Alternatives is anticipated to be relatively small compared to the significant increases in highway traffic that will have a greater effect on noise.

The Modal Alternative included a new runway for both Oakland and San Jose airports to accommodate intercity traffic in lieu of HST. Adding runways in a dense urban environment would affect large additional areas due to the size of the physical improvement as well as the increased noise level associated with the improvement. In San Jose, an additional runway would impact a large area of residential and commercial land uses. In Oakland, the increased number of operations would impact the noise levels in surrounding areas. Overall, the Modal Alternative would have a greater number of miles with a high impact rating than the HST Alternative, although the total number of people newly impacted would not be as great in this region, primarily due to prior exposure from the existing highway, rail and air noise components.

High-Speed Train Alternative

The existing Caltrain alignment along the San Francisco Peninsula and the East Bay railroad alignments pass through densely populated communities where there is high potential for noise impacts. The potential noise impacts of the proposed HST service through these areas would result primarily from the greater frequency of trains, since the HST service would be operating at reduced speeds and would create similar noise levels to the existing services. The HST system would be expected to result in the elimination of up to 48 grade crossings on the Peninsula and up to 38 grade crossings on the East Bay. Grade separation of existing rail services would result in considerable benefits from the elimination of the warning bells at existing at-grade crossings and the horn blowing of the existing commuter/intercity services along these alignments. Although the HST service would be going through densely populated communities, the Caltrain alignment and the Hayward/Niles/Mulford Line in the East Bay were rated as having a medium level of potential noise impacts because the HST would be traveling at reduced speeds, and the communities would benefit from grade separation improvements for existing services and electrification of the railroad.

Between San Jose and Gilroy, the HST is rated as having medium potential for noise impacts. While the HST system could reach speeds as great as 186 mph (299 kph) through this area, the densities are less than on the Peninsula or the East Bay, and the communities would receive considerable benefit from the elimination of up to 24 grade crossings.

All the options for mountain crossings between the Bay Area and the Central Valley are through sparsely populated areas, but would introduce new noise sources along corridors through wilderness areas where the alignment is at grade or elevated.

High-Speed Train Alignment Option Comparison

Of the two options in the East Bay, the Hayward/I-880 alignment was given a higher ranking for potential impacts than the Hayward/Niles/Mulford Line, since the former would be elevated and would add noise from the already grade-separated freeway corridor. However, the Mulford Line would pass through the Don Edwards Wildlife Refuge and would have more impacts on wildlife than the I-880 freeway option.

Between San Jose and Merced, the Pacheco Pass alignments have higher potential for community impacts than the Diablo Range direct crossing options because of the potential for noise impacts through the urban and suburban areas of south Santa Clara County. For the Pacheco Pass alignment options, the Morgan Hill/Caltrain/Pacheco Pass option would minimize potential noise impacts on Gilroy. The Diablo Range direct alignment through Henry Coe State Park at grade would have more potential impacts on wildlife than the other two Diablo Range options because these options would have about 5 mi (8 km) of additional at-grade track rather than tunnel in the wilderness area.

Serving both the Peninsula and the East Bay would increase the number of alignment miles for Bay Area noise impacts, but reduce the frequency of HST service to either side of the bay.

B. SACRAMENTO TO BAKERSFIELD

Modal Alternative

From Sacramento to Bakersfield the potential noise impacts would be generally low. One area of potentially high impact is the I-5 corridor from the middle of Stockton to I-5 due to the close proximity of residential land along this alignment segment. Two segments with a medium rating are along SR-99 south from Sacramento to Manteca and also south from Bakersfield to I-5. Overall, the Modal Alternative has a greater distance with a high impact rating than the proposed HST Alternative, although the total number of people newly impacted is not as great as other regions, primarily due to existing exposure to highway noise. These highway corridors are heavily used by truck traffic, which generates high noise levels through the evening hours.

Potential improvements at the Sacramento Airport and Fresno Airport would not be extensive in terms of additional land area required (additional runways) and would have low potential noise impacts.

High-Speed Train Alternative

Through the Central Valley most of the alignment options for the HST Alternative are rated as low potential noise impact, due generally to the sparseness of residential land use and the extent of open space along most of the length of the options—even though the proposed HST service would be operating at maximum speeds throughout most of the Central Valley. However, there are a number of locations throughout the San Joaquin Valley where the various alignment options pass through populated areas and have high potential noise impact ratings for short segments. Examples include portions of Sacramento, Fresno, Tulare, and Manteca that could be exposed to high noise levels from HST operations.

Through many of the cities in the Central Valley, the HST is proposed to be on aerial structure, primarily to reduce potential conflicts with freight railroad spur tracks or freight railroad yards. The vertical elevation of the aerial structure would allow potential noise impacts to extend further than they would at grade.

Through several of the urban areas, the HST mainline (express or high-speed) alignment could pass through the city or community or avoid it by passing through surrounding areas (primarily farmlands). A representative typology study of the proposed high-speed loop around Fresno concluded there would only be a 12% to 16% reduction in noise impacts by moving the high-speed mainline (express) tracks outside the urbanized areas. The relatively modest decrease in noise impacts is attributed to three factors: 1) there would be some residential impacts along the new express loop; 2) many of the land uses surrounding the freight line through downtown

Fresno are industrial; 3) the express loop results in noise impacts on two corridors as opposed to one. Figure 3.4-14 shows the mainline alignment through Fresno and the express loop options together with the surrounding land uses.

All alignment options in this region would have a low potential vibration impact rating. A few short segments of populated areas would have medium potential vibration impact ratings.

HST Alignment Option Comparison

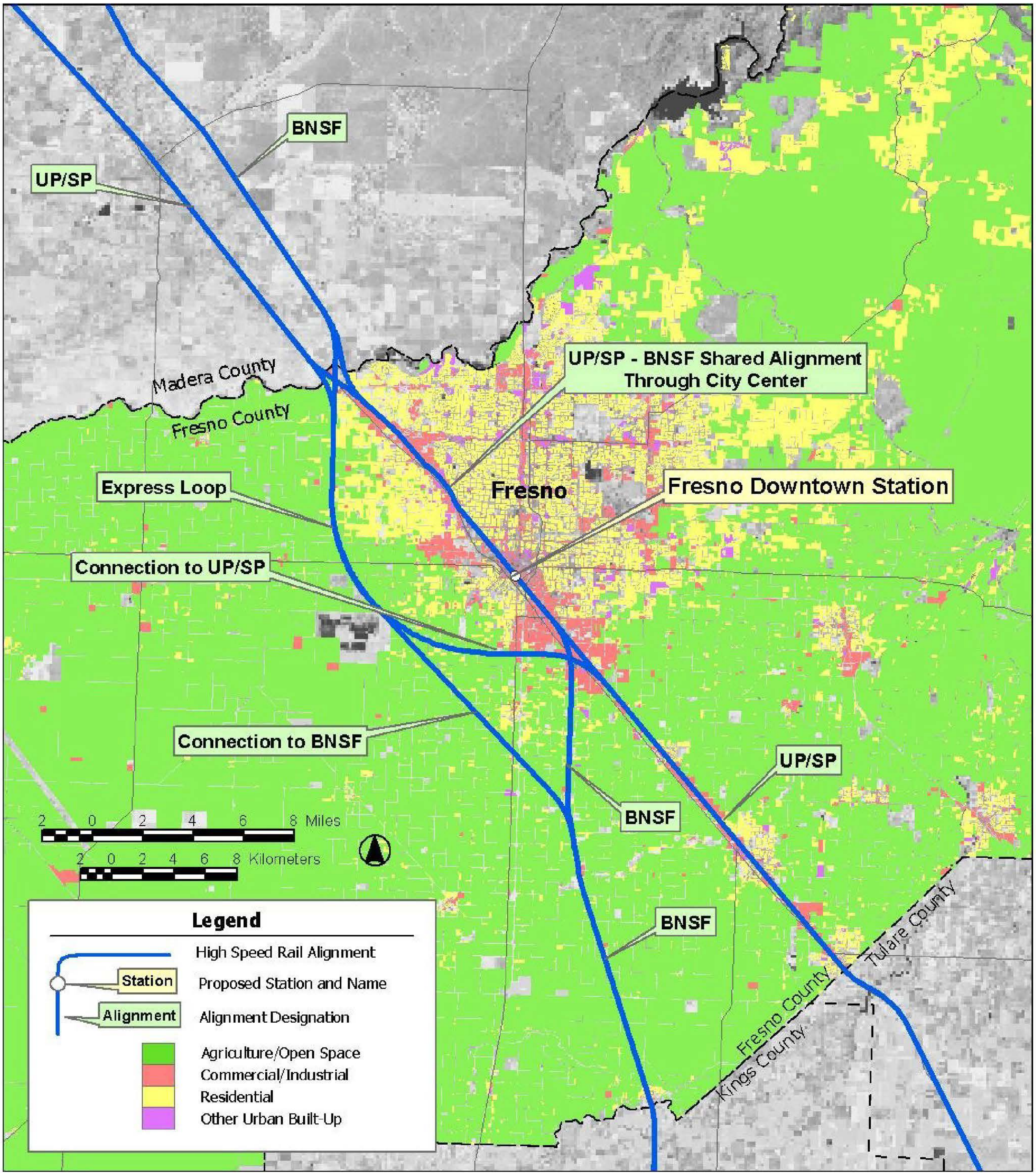
Between Sacramento and Bakersfield there are two potential alignment options for the proposed HST Alternative along railroad rights-of-way, UPRR and BNSF, along with some combinations. The UPRR alignment would have a considerably greater potential for noise impacts than the BNSF alignment. The UPRR alignment passes through much more urban area. The UPRR has more freight activity to the Central Valley cities it bisects, which results in more spur lines, service lines, and freight yards in these communities along the freight alignment. The proposed HST line would be grade-separated from these freight railroad facilities, typically on an elevated structure. Therefore, the UPRR passes through more communities, and would require more elevated structures through these communities. The Central California Traction (CCT) alignment option would have fewer potential noise impacts than the UPRR alignment between Sacramento and Stockton because there are fewer residential areas near the alignment. South of Power Inn Road in Sacramento, both CCT and UPRR would be predominately at grade. Along the UPRR, some grade-separation benefits would result from reducing noise from the existing freight services, whereas the CCT is a recently abandoned freight corridor.

Between Stockton and Merced, the UPRR alignment would have much higher potential noise impacts than the BNSF alignment. UPRR goes through much more urban area as it passes through the cities and communities that developed around the railroad line, and is proposed to be on aerial structure through many of these communities. Conceptually, the alignment options along UPRR would have a substantial amount of aerial structure through Manteca, Modesto, Keyes, Turlock, and Atwater, whereas the alignment through Salida, Ceres, Delhi, Livingston, and Merced would be at grade. The alignment options along BNSF would have a substantial amount of aerial structure through Escalon and Riverbank. Through Riverbank, however, the downtown and most of the populated area would be at grade. BNSF would be at grade through the outskirts of Modesto (Briggsmore), Hughson, Denair, Winton, Atwater, and Merced. Much of the potential noise impact of BNSF may be offset by the noise benefits from grade separating the adjacent freight service when operating at grade.

Between Merced and Fresno, the UPRR alignment option would have higher potential noise impacts than the BNSF alignment. UPRR goes through more urban areas, and is proposed to be on aerial structure through these communities. Conceptually, the alignment options along the UPRR corridor have a substantial amount of aerial structure through both Chowchilla and Madera. The BNSF corridor does not go through much developed area between Merced and Fresno. The BNSF alignment options would be at grade through Le Grand and the outskirts of Madera. Much of the potential noise impact of BNSF may be offset by the noise benefits from grade separating the adjacent freight service when operating at grade. Through Fresno, only the UPRR alignment option is being considered for further evaluation. A majority of the UPRR alignment through Fresno is expected to be at grade.

Between Fresno and Bakersfield, the UPRR alignment option would have much higher potential noise impacts than the BNSF alignment option. However, BNSF would have more potential noise impacts through Bakersfield. UPRR goes through many more urban areas and is proposed to be on aerial structure through many of these communities. Conceptually the alignment options along the UPRR corridor would have a substantial amount of aerial structure through Selma, Traver, Goshen, Tulare, Pixley, and Delano, whereas the alignment through Fowler, Kingsburg

Figure 3.4-14
Mainline and Express Loop at Fresno



(on aerial structure south of the Kingsburg urban area), Tipton, Earlimart, and McFarland would be at grade. The alignment options along the BNSF corridor would have a substantial amount of aerial structure through the outskirts of Corcoran, through Hanford, and Shafter, whereas the BNSF would be at grade through Laton. Through Bakersfield, a majority of the UPRR alignment option is at grade and travels through industrial land uses. The BNSF alignment option would include more aerial structure through Bakersfield and impact more residential areas than the UPRR alignment option.

Through Modesto, Merced, Fresno, and Tulare, the high-speed train mainline (express or high-speed) alignment could pass through the city or community or avoid it by passing through surrounding areas (primarily farmlands). As previously noted, the focused study on the high-speed loop around Fresno concluded there would only be a modest (12% to 16%) reduction in noise impacts by moving the high-speed mainline (express) tracks outside the urbanized areas. The Fresno typology is representative of the express loop bypass design options for other Central Valley communities, and it is expected that the express loop design options for Modesto, Merced, and Tulare would yield similar results to the Fresno typology.

C. BAKERSFIELD TO LOS ANGELES

Modal Alternative

From Bakersfield to Los Angeles there would be more potential noise impacts in the urban areas such as Bakersfield and Los Angeles than in the rural areas. As the highway alternative crosses the sparsely populated Tehachapi Mountains potential noise impacts on residents would be minimal; however, there may be noise impacts on sensitive wildlife.

The expansion of the Burbank airport and the associated higher frequency of take offs and landings would have potential noise impacts in the area surrounding the airport. The addition of a runway would impact a large area of residential and commercial land uses and the increased number of operations would impact the noise levels in surrounding areas. Overall, the Modal Alternative's potential noise impacts would be expected to be greater than potential noise impacts from the HST Alternative. Because the highway would be expanded by as much as 6 lanes through the mountain passes and would not use tunneling, it would have substantial noise impacts on wildlife, recreational use of nature trails, and other outdoor recreation activities and uses.

High-Speed Train Alternative

The proposed HST Alternative would have low potential noise impact ratings between Bakersfield and Sylmar due to the sparseness of residential land use and the extent of open space along most of the two routes. Within Bakersfield, where HST express services would achieve maximum speeds, the two alignment options would pass through areas with residential population and have greater potential noise impacts. As the alignments near Los Angeles, the potential for noise impact increases as the population density increases. The alignment segment between Sylmar and Burbank would be expected to reach relatively high speeds as great as 186 mph (299 kph) and has a high potential for impact through Sylmar and a medium potential for impact through Burbank. Elimination of nine grade crossings between Sylmar and Los Angeles would result in noise reduction benefits to people who live near those crossings. South of Glendale, the proposed HST system would operate at reduced speeds. Most of the segment between Sylmar and Los Angeles is considered to have medium potential noise impacts because of the relatively long trench section proposed and the reduction in noise associated with the removal of grade separations over a long portion of this segment.

High-Speed Train Alignment Option Comparison
The HST Alternative has low potential noise impact ratings along both the I-5 and SR-58/Soledad Canyon alignment options due to the sparseness of residential land use and open space along most of these two routes. However, more of the SR-58/Soledad Canyon alignment option passes through populated areas. In addition, the I-5 alignment would require more tunneling through the open space and natural areas, which would result in fewer potential noise impacts on wildlife, hiking trails, and other outdoor recreational uses.

D. LOS ANGELES TO SAN DIEGO VIA INLAND EMPIRE

Modal Alternative
Between Los Angeles and San Diego along the inland routes, freeway traffic is extremely heavy throughout the area. The high population density in close proximity to the freeways between Los Angeles and San Bernardino/Riverside results in high noise impact ratings for that area. South of March Air Reserve Base (ARB) to Mira Mesa, the lower population density along the highway segments is reflected in a low noise impact rating. Potential noise impacts are rated as medium in the stretch from Mira Mesa to San Diego.

The expansion of the Ontario and San Diego airports and the associated higher frequency of takeoffs and landings would have high potential impacts on the noise levels in the areas surrounding the airports. An additional runway at each of these airports would impact large areas of residential and commercial land uses and the increased number of operations will impact the noise levels in surrounding areas. Overall, the number of potential noise impacts associated with the Modal Alternative falls between the HST GPI and with the LPI in this region.

High-Speed Train Alternative
The high population density in Los Angeles and San Bernardino/Riverside results in both medium and high noise impact ratings for the proposed HST Alternative throughout that area. However, compared to the freeway alignments, the rail alignments generally abut less sensitive industrial and commercial land uses that are less vulnerable to noise. There are also considerable stretches of grade-separation improvements that would reduce impacts from existing freight rail services along portions of the alignment. Between Pomona and Riverside, the UPRR Colton alignment is very straight and contains mostly industrial land uses where the HST system would be expected to achieve maximum speeds for this segment. South of March ARB to Mira Mesa, the lower population density along the I-215 and I-15 highway alignments is reflected in a low noise impact rating. South of Escondido, the HST service would largely be reduced to speeds of 125 mph (201 kph) or less because of alignment issues. Potential noise impacts are rated as medium and high in the stretch from Mira Mesa to downtown San Diego via either Miramar Road or Carol Canyon. All alignment options in this region have potential vibration impact ratings of medium or low.

High-Speed Train Alignment Option Comparison
The HST Alternative alignment option along the UPRR Colton Line (northern alignment option) alignment between Los Angeles and East San Gabriel Valley would have a high potential for noise impacts due to the proximity of residential land use along most of this route, whereas the UPRR Riverside/UPRR Colton alignment is largely surrounded by industrial land uses and is ranked as having a medium potential for noise impacts.

The alignment that would most directly serve San Bernardino would have considerably higher potential noise impacts than the UPRR Colton alignment because it would impact more residential areas. Between Ontario Airport and Colton, the UPRR Colton alignment is within a wide, sparsely developed industrial corridor.

From Los Angeles to March ARB, the low potential vibration rating would be along the UPRR Colton Line option, as compared to a medium rating along the UPRR Colton Line to San Bernardino, due to the lower population within the screening distance along the former alignment.

The Miramar Road alignment option from Mira Mesa to San Diego would have a higher potential noise impact rating than the Carol Canyon alignment option, which would traverse less populated areas. Both the Miramar Road and Carol Canyon alignments would have considerably higher potential noise impacts than the option along I-15 to Qualcomm Stadium. The Qualcomm Stadium option would also have a lower potential for vibration impacts.

E. LOS ANGELES TO SAN DIEGO VIA ORANGE COUNTY

Modal Alternative

Under the Modal Alternative, the potential for high noise impacts would occur along the I-5 corridor from downtown Los Angeles to Irvine and also in San Juan Capistrano, Encinitas, and San Diego. These potential noise impacts would be due primarily to the close proximity of residential land along these alignment segments. The coastal area south of Dana Point up to Encinitas would not be as highly impacted due to the relatively open agricultural areas along the freeways. The Modal Alternative would have generally greater impact than the proposed HST options through this region. South of Encinitas along the coastal areas to San Diego and across lagoons with sensitive habitat and numerous birds, the noise impacts of expanded highways would be added to existing noise levels.

High-Speed Train Alternative

The HST Alternative would be expected to have potential impacts that are high along the LAX connection alignment for the proposed HST and the UPRR Santa Ana alignment from Los Angeles to Anaheim. Although the proposed HST speeds along the LAX alignment would be well under 100 mph (161 kph), a new, frequent, passenger service would be introduced into a dense urban area, resulting in a new and significant noise source.

Overall, the LOSSAN alignment would receive benefits from grade crossing eliminations that would be part of the proposed improvements. A major benefit is the elimination of horn noise at the grade crossings. Horn noise dominates the area within 0.25 mi (0.40 km) of a grade crossing, such that its elimination would more than make up for the increased train noise. It is estimated that potential noise impacts can be reduced by approximately 80% at adjacent receptors by eliminating freight and passenger train horns, according to the noise study results.

High-Speed Train Alignment Option Comparison

The LOSSAN rail alignment between Los Angeles and Anaheim has a considerably lower noise impact rating than the UPRR Santa Ana alignment. The communities along the LOSSAN alignment would receive benefits from full grade separation due to the elimination of warning bells and train horn noise from existing services (Amtrak, Metrolink, and freight) along this heavily used rail line. In contrast, UPRR Santa Ana would be introducing a new, frequent, passenger service to a lightly used freight alignment.

Between Anaheim and Irvine, both the HST alignment option (to bring direct service to Irvine), and the high end conventional rail improvements option would result in a fully grade-separated LOSSAN rail alignment. The communities along the LOSSAN alignment (Orange, Santa Ana, and Tustin) would receive benefits from full grade separation due to the elimination of warning bells and train horn noise from existing services (Amtrak, Metrolink, and freight) along this heavily used rail line from these options. In contrast, the low end conventional rail improvements would permit additional frequencies of service, which would have additional noise impacts without the benefits of grade separation.

3.4.5 Design Practices

Because of the high-speed alignment requirements of the HST system, over nearly 10% of the preferred alignments are in a tunnel or trench section. For these segments of the system the potential for noise impacts are mostly eliminated. The tunnel cross sections are designed (per established engineering criteria) to provide sufficient cross sectional area to avoid potential aerodynamic effects at the tunnel portals due to trains operating at maximum speed.

At similar speeds high-speed trains generate significantly less noise than existing commuter and freight trains. This is primarily due to the use of electric power versus diesel engines, higher quality track interface, and smaller, lighter and more aerodynamic trainsets. The use of electric power units would not have the engine rumble associated with diesel-powered locomotives. While wheel/track interface is a significant source of train noise, HST track beds and rails are designed and maintained to very high geometric tolerances and standards which would greatly minimize track noise that is prevalent with existing commuter/freight tracks throughout the study area.

Another reason HST noise impacts are less than commuter or freight trains is that high speeds would result in short duration noise events compared with conventional trains (a few seconds at the highest speeds versus 10 to 20 seconds for conventional passenger trains and well over 1 minute for freight trains).

The HST system would be fully grade separated from all roadways. In the urban areas where potential for noise impacts is typically at the highest levels, the HST system is predominantly in or adjacent to existing rail corridors and the HST Alternative often includes the grade separation of the existing tracks. Grade separations completed with the HST system in corridors such as these would eliminate current horn sounding and bells at existing grade crossings and would result in a noise benefits that would offset much of the HST noise impacts.

3.4.6 CEQA Significance Conclusions and Mitigation Strategies

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for noise and the FRA guidance manual discussed in section 3.4.1, the HST alternative would have a potentially significant impact on noise when viewed on a system-wide basis. The HST alternative would create construction-related short-term noise impacts. The HST alternative would also create long-term noise impacts from introduction of a new transportation system, including potential vibration impacts. At the same time, the HST alternative would create some long-term noise reduction benefits due to elimination of noise sources with grade separation of existing grade crossings. While the significance of the impacts is dependent on the sensitivity of the landscape and noise receptors, the analysis finds some high impacts on noise-sensitive land uses and populations and these impacts are therefore considered significant. Mitigation strategies, as well as the design practices discussed in section 3.4.5, will be applied to reduce this impact.

General mitigation strategies are discussed in this programmatic review of potential noise impacts associated with proposed alternatives. More detailed mitigation strategies for potential noise and vibration impacts would be developed in the next stage of environmental analysis. Noise and vibration mitigation measures can generally be applied to the source (train and associated structures), the path (area between train and receiver) and/or the receiver (property or building). A new HST system would be designed and developed to meet state-of-the-art technology specifications for noise and vibration, based on the desire to provide the highest-quality train service possible. Trains and tracks would be maintained in accordance with all applicable standards to provide reliable operations.

Treatments such as sound insulation or vibration controls to impacted buildings may be difficult to implement for the potentially numerous properties adjacent to the right-of-way. Such treatments require protracted implementation procedures and separate design considerations. The most feasible and effective mitigation treatments are typically those involving the path. These mitigation measures can often be applied to the path within the right-of-way, either under or adjacent to the tracks. Potential noise impacts can be reduced substantially by the installation of sound barrier walls constructed to shield receivers from train noise. For vibration mitigation, a number of track treatments may be considered for reducing train vibrations. Determining the most appropriate treatment would depend on the site-specific ground conditions found along the corridor. This program-level analysis has identified areas where future analysis should be given to potential HST-induced vibrations.

A. NOISE BARRIERS

Noise barriers are often a practical way to reduce noise impacts from transportation projects including the proposed HST system. The representative typologies considered mitigation with noise barriers for certain areas. In most cases the potential noise impacts could be reduced from the severe impact category to the FRA's impact category, and to the no impact category in some locations, with the application of appropriately dimensioned noise barriers next to the tracks. The design of noise barriers appropriate for the proposed HST right-of-way line would depend on the location and height of noise-sensitive buildings, as well as the speeds of the trains. Noise barriers 8 to 10 ft (2 to 3 m) tall could be installed where speeds are relatively low such that wheel/rail noise dominates. Higher noise barriers of 12 to 16 ft (4 to 5 m) might be used to reduce noise to taller buildings, or where speeds are high in noise-sensitive areas. In many locations noise barriers could be installed on one side of the track only, due to he location and proximity of noise-sensitive areas.

Application of mitigation to the proposed HST system would result in a considerable reduction of potential noise impacts. The estimates obtained from the results of the representative typologies showed noise barriers to be effective in reducing the potential noise impact rating by one category, for example, from high to medium or from medium to low. Consequently, HST segments with high rating would be adjusted down to, at most, a medium rating. With mitigation applied to the HST Alternative, both the GPI and LPI scenarios would represent substantially lower levels of potential impacts as compared to the Modal Alternative.

To estimate the reduction in noise impacts, the percentage reduction in noise for each segment was applied to the total number of people impacted in that segment, assuming the mitigation removed that many people from being impacted. The number of people remaining in the impact category was then summed for each region and system-wide. The lengths of the routes requiring noise barriers were then tabulated to provide an estimate of the mitigation costs.

The cost of constructing a noise barrier on one side of a highway or a rail line is estimated at approximately $1 million per mi ($625,000 per km) for a concrete wall of 12 ft (4 m) in height. Conservatively, a unit cost of $1.5 million per mi ($937,500 per km) was applied to the alignment segments in the HST Alternative with high potential noise impact ratings. The procedure was repeated for all segments with a medium rating in addition to those with high rating, thereby reducing all HST noise impact ratings to low. The same costs were applied to the Modal Alternative for comparison using segment lengths with a high noise impact rating. This approach was intended to provide a rough estimate of potential mitigation costs, recognizing that specific mitigation would be developed as a part of project-level review.

The results in Table 3.4-2 show that potential mitigation costs for the HST Alternative, applied to the segments rated at high potential for noise impacts only, would be less than the costs of similar mitigation applied to the Modal Alternative. This analysis included noise mitigation (barrier walls) for 8 of the 731 route miles (13 of the 1,176 route km) of the proposed HST segments with LPI and 133 of the 773 route miles (214 of the 1,244 route km) with GPI. With mitigation applied to both high- and medium-rated segments, the HST potential impacts would be reduced further below the Modal Alternative, including noise mitigation (barrier walls) for 144 and 369 route miles (232 and 594 route km), for the LPI and GPI, respectively.

Table 3.4-2
Potential Length and Cost of Noise Mitigation[a] by Alternative

Alternative	Mitigation length in miles (km)	Noise Barrier Cost (millions)
MODAL—highway component (high level only)	210 (338)	$315
HST mitigating (high levels only)	8–133 (13–214)	$12–$200[b]
HST mitigating (high and medium levels)	144–369[b] (232–594)	$216–$554[b]

[a] Mitigation refers to barrier walls only.
[b] Range for LPI and GPI.

Not included in the costs for the Modal Alternative are noise abatement measures at airports that may involve extensive programs of sound insulation of homes. A typical sound insulation program limits the costs to approximately $30,000 per home. Referring to tables in Appendix 3.4-D where the number of people impacted by aviation noise is shown as approximately 12,000 people, and assuming there are four people to a house, the cost for noise mitigation around airports associated with the Modal Alternative could be an additional $90 million.

B. VIBRATION MITIGATION

Vibration mitigation is less predictable at a program level of analysis due to the site-specific nature of vibration transmission through soil conditions along the alignment. However, an estimate can be made of the length of corridor where special mitigation may need to be considered by totaling the segments with potential vibration impact rating of high. The results are shown in Appendix 3.4-E. The range is 10 to 60 mi (16 to 97 km) to be considered for mitigation depending on which alignment is chosen.

C. CONSTRUCTION MITIGATION

Potential mitigation strategies for construction noise impacts associated with the HST Alternative are listed below.

- Construction noise could be reduced by using enclosures or walls to surround noisy equipment, installing mufflers on engines, substituting quieter equipment or construction methods, minimizing time of operation and locating equipment farther from sensitive receptors.
- Construction operations could be suspended between 7:00 p.m. and 7:00 a.m. or on weekends or holidays in residential areas.
- Contractors could be required to comply with all local sound control and noise level rules, regulations and ordinances.
- Ensure that each internal combustion engine would be equipped with a muffler of a type recommended by the manufacturer.
- Other measures that should be considered include the following:
- Specifying the quietest equipment available would reduce noise by 5 to 10 dBA.
- Turning off construction equipment during prolonged periods of non-use would eliminate noise from construction equipment during those periods.

- Requiring contractors to maintain all equipment and train their equipment operators would reduce noise levels and increase efficiency of operation.
- Locating stationary equipment away from noise sensitive receptors would decrease noise impact from that equipment in proportion to the increased distance.

The above mitigation strategies are expected to reduce the short-term and long-term noise impacts of the HST alternative to a less-than-significant level. Additional environmental assessment will allow a more precise evaluation in the second-tier project-level environmental analyses.

3.4.7 Subsequent Analysis

A. NOISE ANALYSIS

The FRA provides guidance for two levels of analysis in project environmental review, a general assessment method to further quantify the potential noise impacts in locations identified by the screening procedure, and a detailed analysis procedure for evaluating suggested noise mitigation at locations where further studies show there is potential for significant impacts. The process is designed to focus on problem areas as more detail becomes available during project development. Subsequent analysis would proceed along the following lines.

<u>Ambient noise conditions</u>
The existing ambient noise environment is described by assumptions in the screening procedure. However ambient noise values would be estimated at the project-level analysis based on limited measurements in the general assessment and would be thoroughly measured in the detailed analysis. A measurement program involving both long-term and short-term noise monitoring would be performed at selected locations to document the existing noise environment. As it would be impractical to measure everywhere, the monitoring would be supplemented by estimates of noise environments at locations considered to be typical of others. Guidelines for characterizing the existing conditions are provided by the FRA.

<u>Project Noise Conditions</u>
A generic HST is used in the screening procedure, but a specified train type, speed profile and operation plan would be available for more refined projections of noise levels in the next stage of environmental analysis.

<u>Noise Propagation Characteristics</u>
The screening procedure assumes flat terrain with noise emanating from a source unhindered by landforms and human-made structures. The next stage of analysis would incorporate topography as well as consideration of shielding by buildings, vegetation, and other natural features in a particular corridor.

<u>Impact Criteria</u>
The screening procedure accounts for all noise-sensitive land use categories that may be exposed to noise levels exceeding the threshold of impact. In the next stage of analysis, assessments using the full, three-level FRA impact criteria would be performed (U.S. Department of Transportation 1998). This more detailed assessment would more specifically identify locations where potential impacts may occur and locations where potentially high impact may occur and would provide for consideration of specific mitigation measures where appropriate.

<u>Mitigation</u>
Noise abatement is discussed generally in the screening procedure, and areas are identified where more detailed analysis should be focused in the future to integrate a proposed HST system into the existing environment. As more detail becomes available in the general assessment

phase, there may be many areas that were identified as potentially impacted during screening analysis for which further analysis would not be needed, because they would not be impacted. The detailed analysis would provide information useful for the engineering design of mitigation measures. These measures would be considered in the project-level environmental review, and potential visual and shadow impacts of noise barriers would also be considered.

B. VIBRATION ANALYSIS

The steps involved in the more detailed analysis of ground-borne vibration would be similar to those for noise. The major difference would be the need for study of site-specific ground-borne vibration characteristics. Considerable variation of soil conditions may occur along the corridor, resulting in some locations with significant levels of vibration from the HST and other locations at the same distance from the track where vibrations can hardly be perceived. Determining the potential vibration characteristics in the detailed analysis would involve a measurement program performed according to the method described in the FRA guidance manual (U.S. Department of Transportation 1998). This method would allow for the prediction of vibration levels and frequency spectrum information valuable not only in the assessment of impact, but also in the consideration of mitigation measures.

3.5 ENERGY

This analysis provides an overview of the potential operation and construction impacts associated with both the general overall use of energy and the more specific use of electrical energy for the existing conditions and the No Project, Modal, and High-Speed Train (HST) Alternatives.

3.5.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY REQUIREMENTS

Federal Regulations

Federal Energy Regulatory Commission: The Federal Energy Regulatory Commission (FERC) is an independent agency that regulates the interstate transmission of natural gas, oil, and electricity. FERC also regulates natural gas and hydropower projects. As part of that responsibility, FERC regulates the transmission and sale of natural gas for resale in interstate commerce, the transmission of oil by pipeline in interstate commerce, and the transmission and wholesale sales of electricity in interstate commerce. FERC also licenses and inspects private, municipal, and state hydroelectric projects; approves the siting of and abandonment of interstate natural gas facilities, including pipelines, storage, and liquefied natural gas; oversees environmental matters related to natural gas and hydroelectricity projects and major electricity policy initiatives; and administers accounting and financial reporting regulations and conduct of regulated companies.

Corporate Average Fuel Economy Standards: Corporate Average Fuel Economy (CAFE) standards are federal regulations that are set to reduce energy consumed by on-road motor vehicles. The standards specify minimum fuel consumption efficiency standards for new automobiles sold in the United States. The current standard for passenger cars is 27.5 miles per gallon (mpg) (44.3 kilometers per gallon [kpg]). The 1998 standard for light trucks was 20.7 mpg (33.3 kpg) (Competitive Enterprise Institute 1996). In April 2002, the National Highway Traffic Safety Administration, part of the U.S. Department of Transportation (DOT), issued a final rule for CAFE standards for model-year 2004 light trucks that codified a standard of 20.7 mpg (33.3 kpg); this level is now in effect (U.S. Department of Transportation 2002a).

Transportation Equity Act for the 21st Century: The Transportation Equity Act for the 21st Century (TEA21), passed in 1998, builds on the initiatives established in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), which was the prior authorizing legislation for surface transportation. The ISTEA identified planning factors for use by Metropolitan Planning Organizations (MPOs) in developing transportation plans and programs. Under the ISTEA, MPOs are required to "protect and enhance the environment, promote energy conservation, and improve quality of life" and are required to consider the consistency of transportation planning with federal, state, and local energy goals (U.S. Department of Transportation 2002b).

Section 403(b) of the Power Plant and Industrial Fuel Use Act of 1978 (P.L. 95-620): This section of the Power Plant and Industrial Fuel Use Act encourages conservation of petroleum and natural gas by recipients of federal financial assistance.

Executive Order 12185, Conservation of Petroleum and Natural Gas (December 17, 1979, 44 F.R. § 75093): This executive order encourages additional conservation of petroleum and natural gas by recipients of federal financial assistance.

State Regulations

Public Resources Code Section 21100(b)(3) provides that an EIR shall include a statement setting forth the mitigation measures proposed to minimize the significant effects on the environment, including measures to reduce the wasteful, inefficient, and unnecessary consumption of energy. Appendix F to the California Environmental Quality Act (CEQA) Guidelines addresses energy conservation goals, notes that potentially significant energy implications of a project should be considered in an EIR, and contains general examples of mitigation measures for a project's potentially significant energy impacts.

CEQA Guidelines Section 15126.2 discusses requirements for an EIR to address potentially significant effects, and although it does not include energy specifically, it mentions use of nonrenewable resources. CEQA Guidelines Section 15126.4(a)(1)(C) requires an EIR to discuss energy conservation measures, if relevant.

California Code of Regulations, Title 24, Part 6, Energy Efficiency Standards: Title 24, Part 6 of the California Code of Regulations, Energy Efficiency Standards, promotes efficient energy use in new buildings constructed in California. The standards regulate energy consumed for heating, cooling, ventilation, water heating, and lighting. The standards are enforced through the local building permit process. These standards may apply to any buildings (e.g., stations) constructed as part of or in association with the No Project, Modal, and HST Alternatives.

B. METHOD OF EVALUATION OF IMPACTS

This evaluation of energy supply and demand compares potential energy use for intercity travel of the proposed alternatives. This section explains the methodology used to evaluate the potential energy impacts and benefits attributable to operation (direct energy) and construction (indirect energy) of the alternatives under study. This section also explains the criteria used to determine whether a potential impact on energy consumption would be significant. The evaluation is based on available data and forecasts.

Direct Energy

Analyses were performed as described below to determine the operational impact of the alternatives on overall statewide transportation-related energy supply[1] and statewide electricity supply during peak demand.

Overall Statewide Transportation-Related Energy Supply: Overall direct energy consumption by the alternatives involves potential energy use by the operation of vehicles (automobiles, airplanes, and HSTs) and related infrastructure in the state. The potential direct impacts on overall transportation-related energy supply were evaluated both quantitatively and qualitatively.

The quantitative analysis focused on the direct relationship between projected vehicle miles traveled (VMT) and energy consumption to estimate the potential change in total energy consumption between the No Project, Modal, and HST Alternatives. Only intercity trips that would be served by the HST system, including some long-distance commute trips, were considered when modeling VMT. Local commute and other regional and intercity trips were not considered. The quantitative assessment of direct energy impacts considered the following.

- VMT for automobiles, airplanes, and HST within the study area, as described below in Section 3.5.2 (consistent with the analysis conducted for Section 3.3, Air Quality).
- Variation of fuel consumption rates by vehicle type.

Ridership projections for the HST system varied between 42 million and 68 million passengers (including 10 million long-distance commuters) for 2020, with potential for significantly higher

[1] Overall energy refers to the combination of energy derived from petroleum fuels and electrical energy.

ridership beyond 2020. The figures on the lower end of these estimates are considered investment-grade forecasts and are based conservatively on year 2000 costs, travel times, and congestion levels of air and automobile transportation. The figures on the higher end are based on a sensitivity analysis, which assumes the increased costs and congestion associated with air and automobile travel would result in greater potential ridership for the proposed intercity HST. The sensitivity analysis assumed investment-grade ridership forecasts and applied variations in mode characteristics that would tend to increase HST ridership and revenue in order to determine how sensitive HST ridership would be to increases in air and automobile rates of travel, air and automobile travel times, and airfares. This sensitivity analysis produced a higher ridership forecast, which is used in this Program EIR/EIS to estimate or project a maximum impact potential for the Modal and HST Alternatives.

For this Program EIR/EIS, the higher demand forecast of 68 million riders (58 million intercity trips and 10 million commute trips), based on the sensitivity analysis, offers a more reasonable estimate to represent total capacity of the proposed HST system, while serving as a representative worst-case scenario for defining the physical and operational aspects of the alternatives in 2020. This higher forecast is generally used as a basis for defining the Modal and HST Alternatives and is referred to in this report as the representative demand. In some specific analyses, such as this energy analysis, the high-end forecasts result in a benefit because the additional HST riders would make the HST more energy efficient (i.e., it would use less energy per passenger), thus creating a higher energy benefit to the overall intercity transportation system than the low-end (investment-grade) forecasts. In cases where the investment-grade forecasts result in greater impact levels than would result with representative demand, additional analysis is included to address the differences in potential energy impacts between what is expected under each of the ridership scenarios.

Projections of HST ridership and the number of trips that would otherwise use other modes were calculated and reported by Charles Rivers Associates in Independent Ridership and Passenger Revenue Projections for High Speed Rail Alternatives in California (California High Speed Rail Authority 2000). These projections were the basis for determining projected statewide VMT for each mode. Projections in the ridership report were based on surveys of current intercity air, conventional rail, and private vehicle travelers, historical and forecast population, income, traffic data, and an airline simulation model. HST trip durations and departure frequencies, fares, station locations, and amenities also affected ridership projections.

This energy analysis applies the higher-end forecasts from the Charles River Associates' sensitivity analysis. Automobile VMT modeling for the proposed HST Alternative was developed as part of this Program EIS/EIR and used to develop VMT values for existing conditions and the No Project and Modal Alternatives.

The VMT fuel consumption method used herein is outlined in the Technical Guidance, Section 5309 New Starts Criteria (Federal Transit Authority, Office of Planning 1999). Energy consumption factors for the first two modes identified in Table 3.5-1 were developed by Oak Ridge Laboratory and published in the 2002 Transportation Energy Book (Edition 22) (Oak Ridge Laboratory 2002). These results are based on national averages for road, traffic, and weather conditions, and are intended for general comparisons. The energy consumption factor for the HST mode is based on energy used by similarly designed trains, such as the Trains à Grande Vitesse in France and the Intercity Express in Germany (DE Consult 2003). This report assumes a 16-car trainset (engines and cars) with a 1,200-passenger carrying capacity.

Table 3.5-1
Direct Energy Consumption Factors

Mode	Factor
Passenger vehicles (auto, van, light truck)[a]	5,669 Btus/VMT
Airplanes[a]	334,086 Btus/VMT
High-speed trains[b]	924,384 Btus/VMT

Btus = British thermal units

Sources:
[a] Oak Ridge Laboratory 2002; based on nationally averaged conditions and fleet composition.
[b] DE Consult 2003, based on a 16-vehicle trainset.

Overall direct energy, measured in British thermal units (Btus), was converted to equivalent barrels of crude oil to represent potential energy impact and/or savings. (Btus are the standard units used by industry and government literature for such comparisons. Metric units for energy [i.e., Joules] are not used in this report.) Annual direct-energy consumption values for intercity travel were calculated for existing conditions and the No Project, Modal, and HST Alternatives, and compared. The potential change in commuter-derived direct energy consumption from the future No Project condition (in Btus) was calculated for the Modal and HST Alternatives.

The qualitative analysis of overall direct energy consumption considers the estimated or assumed levels of service for each of the alternatives and the effect that each would have on congestion and travel speeds, which would have a substantial impact on fuel efficiency and, therefore, energy use.

In addition to the overall direct energy analysis, average energy consumption per passenger mile was calculated for each of the transportation modes essential to the development of the Modal and HST Alternatives.

Statewide Electricity Supply During Period of Peak Demand: For the HST Alternative, peak-period electricity demand was determined using an energy consumption factor for HSTs obtained from DE Consult Peer Review Report (DE Consult 2000) and the operation plan from the California High Speed Rail Authority's (Authority's) final business plan (Business Plan). The demand was calculated in terms of megawatts and compared to current estimates of peak demand and supply capacity within grid controlled by the California Independent State Operator (Cal-ISO). Peak demand for electricity for the future No Project and Modal Alternatives is discussed qualitatively, as it is not possible to measure at the program level. This approach is reasonable because the possible increase in transportation-related electricity use associated with these alternatives would likely be small and considered insignificant.

Indirect Energy

The indirect energy impacts considered here include two potential construction-related energy consumption factors: construction of proposed alternatives and construction of secondary facilities.

Construction of Alternatives: Projected construction-related energy consumption refers to energy used for the construction of HST trackway and support facilities under the HST Alternative and highway expansion and airport runway improvements under the Modal Alternative, and transportation of materials and equipment to and from the work site. Construction-related energy consumption factors for the proposed HST system cannot be compiled because of the relative dearth of available HST examples from which to draw data. Data gathered for typical heavy rail systems and a heavy rail commuter system, San Francisco Bay Area Rapid Transit District (BART), were used to estimate projected construction-related energy consumption of the proposed HST system. Projected construction-related energy consumption for the Modal and HST Alternatives is presented in Table 3.5-2. These estimates are appropriate for comparison purposes.

The construction energy payback period measures the number of years that would be required to pay back the energy used in construction with operational energy consumption savings. The payback period was calculated for this section by dividing the estimate of each alternative's construction energy by the amount of energy that would later be saved by each of the proposed alternatives compared to the No Project condition. It was assumed that the amount of energy saved in the study year (2020) would remain constant throughout the payback period.

Table 3.5-2
Construction-Related Energy Consumption Factors

Mode	Facility	Rural Compared to Urban[f]	Factor (billions of Btus)
Modal Alternative			
Automobile	Highway (at grade)	Rural[a]	17.07/one-way lane mi
		Urban[b]	26.28/one-way lane mi
	Highway (elevated)	Rural[a]	130.38/one-way lane mi
		Urban[b]	327.31/one-way lane mi
Airplane	Runway	N/A[g]	6,312/runway
	Gate	N/A[g]	78[c]/gate
HST Alternative			
High-Speed Train	At grade	Rural[d]	12.29/one-way guideway mi
		Urban[e]	19.11/one-way guideway mi
	Elevated	Rural[d]	55.46/one-way guideway mi
		Urban[e]	55.63/one-way guideway mi
	Below grade (cut)	Rural[d]	117.07/one-way guideway mi
		Urban[e]	163.14/one-way guideway mi
	Below grade (tunnel)	Rural[d]	117.07/one-way guideway mi
		Urban[e]	328.33/one-way guideway mi
	Station	N/A[g]	78[c]/station

[a] Estimates reflect average roadway construction energy consumption.
[b] Estimates reflect range maximum for roadway construction energy consumption.
[c] Value for construction of freight terminal. Used as proxy for unknown air gate and HST station consumption factors.
[d] Estimates reflect typical rail system construction energy consumption.
[e] Estimates reflect BART system construction energy consumption as surrogate for HST construction through urban area.
[f] Differences between the construction-related energy consumption factors for urban and rural settings reflect differences in construction methods, demolition requirements, utility accommodation, etc.
[g] Discreet (i.e., non-alignment-related facilities) are not differentiated between rural or urban because the data used to develop the respective values were not differentiated as such. Some difference between the actual values might be expected.

Sources: Congressional Budget Office 1977; Congressional Budget Office 1982 Congressional Budget Office in Energy and Transportation Systems, Prepared for the Federal Highway Administration, Sacramento, CA, by California State Department of Transportation (California Department of Transportation 1983); based on construction for air freight services.

Secondary Facilities: A secondary facility is a facility that consumes energy in the production of materials related to the project alternatives. For example, a factory that produces construction materials and machinery that would be used in the construction and maintenance of the alternatives' structures and attendant facilities would be a secondary facility. Potential impacts resulting from energy consumption of secondary facilities are discussed qualitatively. Consideration was given to whether nonrenewable resources would be consumed in a wasteful, inefficient, or unnecessary manner, (with special attention given to the efficiency of production of construction materials and machinery and the choices made regarding construction methodology and procedures, including equipment maintenance).

C. CRITERIA FOR DETERMINING SIGNIFICANCE OF IMPACTS

According to Appendix F of the CEQA Guidelines, the means to achieve the goal of conserving energy include 1) decreasing overall per capita energy consumption, 2) decreasing reliance on natural gas and oil, and 3) increasing reliance on renewable energy sources. The significance criteria discussed herein are used to determine whether the alternatives would have a potentially significant effect on energy use, including energy conservation.

The No Project Alternative is the primary basis against which potential impacts of the Modal and HST Alternatives are compared. Significant potential operational energy impacts would occur if the Modal or HST Alternative would result in either substantial demand on statewide and/or regional energy supply, or a significant additional capacity requirement; or significant increase in peak- and base-period electricity demand.

Significant potential construction-related energy impacts would occur if construction of either the Modal or HST Alternative would consume nonrenewable energy resources in a wasteful, inefficient, or unnecessary manner. Implementation of the Modal or HST Alternative would have a significant adverse effect if it, together with regional growth, would contribute to a collectively significant shortage of regional or statewide energy. By contrast, if the implementation of either alternative resulted in energy savings or alleviated demand on energy resources, the alternative would contribute to energy conservation and would have a beneficial effect.

3.5.2 Affected Environment

A. STUDY AREA DEFINED

The areas potentially affected by overall energy use of the alternatives are the regions comprising six of California's 15 air basins. (See Figure 3.3-1 in Section 3.3, Air Quality, for a map of the state's 15 air basins.) The following six air basins fall within the study area defined for overall energy use.

- San Francisco Bay Area.
- Sacramento Valley.
- San Joaquin Valley.
- Mojave Desert.
- South Coast.
- San Diego County.

At this program level of analysis, the data needed to model overall energy use are similar to those used to analyze air quality effects, which were also analyzed at the air basin level. (See discussion of air quality in Section 3.3.) The air basins used in this analysis were identified because the majority of intercity trips taken in California occur within them. Nearby air basins could also be affected by the project alternatives, but any impact would likely be minimal compared to impacts on the basins that physically contain the project alternatives.

At this program level of analysis, the area studied to determine the potential effects of the proposed alternatives on electricity generation and transmission was the entire state of California, since most of this infrastructure in the state contributes to the statewide grid. In general, any potential effects on electrical production which may result from the proposed alternatives would affect statewide electricity reserves and, to a lesser degree, transmission capacity. Some general discussion of potential effects on regional electricity production and transmission is included.

B. GENERAL DISCUSSION OF ENERGY RESOURCES

California is the tenth-largest worldwide energy consumer and is ranked second in consumption in the U.S. behind Texas. Of the overall energy consumed in the state, the transportation sector represents the largest proportion at 46%. The industrial sector follows at 31%, residential at 13%, and commercial at 10%. Petroleum satisfies 54% of California's energy demand, natural gas 33%, and electricity 13%. Coal fuel in California accounts for less than 1% of total energy demand. Electric power and natural gas in California are generally consumed by stationary users, whereas petroleum consumption is generally accounted for by transportation-related energy use (California Energy Commission 2000). A description of the existing energy resources and market conditions that could be potentially affected by the proposed alternatives is provided below.

Petroleum

Demand for transportation services (and, therefore, petroleum/gasoline consumption) in California mirrors the growth of the state's population and economic output. Historical trends coupled with current population and economic growth projections indicate that transportation sector use of gasoline and diesel fuels can be expected to increase by approximately 40% over the next 20 years; gasoline demand is projected to increase from 13.9 billion gallons (gal) (52.6 billion liters [L]) in 1999 to 19.9 billion gal (75.3 billion L) by 2020, and diesel from 2.4 billion gal (9.1 billion L) to 4.8 billion gal (18.2 billion L) over the same period. The California Energy Commission (CEC) projects that in-state oil refining capacity will lag behind this forecasted growth if major changes to the in-state oil refining industry are not made, which could contribute to long-term volatility in the price of both gasoline and diesel fuel (California Energy Commission 2000). Foreign petroleum imports account for approximately 29% of the state's petroleum supply, a percentage that would be expected to increase as in-state and Alaskan oil production declines (California Energy Commission 2002c).

The combination of the strong growth in gasoline demand, recently phased-out fuel additive methyl tertiary butyl ether (MTBE), significantly expanded use of ethanol necessitated by the federal minimum oxygen requirement, and transition to Phase 3 reformulated gasoline (RFG) could negatively affect the balance between supply of and demand for transportation fuels in California and impair the ability of refiners to supply consistent volumes of gasoline to meet California's demand. MTBE is a gasoline-blending component that was used as a gasoline oxygenate to help control carbon monoxide emissions before being phased out of gasoline sold in California (December 31, 2002). Phase 3 RFG prohibits use of MTBE and directs use of only ethanol as an oxygenate. Revisions of state and federal regulations to further tighten specifications for diesel fuel have been adopted to reduce environmental impacts. Together, these efforts to improve the environmental performance of petroleum fuels pose challenges for producing fuel volumes required to satisfy California's growing transportation-related fuel consumption. According to CEC staff, it would be difficult for the state to rely solely on petroleum-based fuels in the future, assuming a stable transportation fuel market is the desired outcome. (California Energy Commission 2000.)

Electricity
Electric energy is given consideration in this analysis because of the projected use of electric energy to power the proposed HST.

Existing State Electricity Supply and Demand: In-state electricity generation, which accounted for 85% of the 2001 total electrical supply, is fueled by natural gas (42.7%); nuclear sources (12.6%); coal[2] (10.4%); large hydroelectric resources (8.0%); petroleum (0.5%); and renewable resources, including wind, solar, and geothermal (10.5%). Electricity imports in 2001 were 15% of total production. Imports from the Pacific Northwest accounted for 2.6%, and 12.8% came from the Southwest. (California Energy Commission 2003.)

According to the CEC, total statewide electricity consumption grew from 166,979 gigawatt-hours (GWh) in 1980 to 228,038 GWh in 1990, at an estimated annual growth rate of 3.2%.[3] The 1990s saw a slowdown in demand growth because of the recession that lasted through the early and middle parts of the decade. The statewide electricity consumption in 1998 was 244,599 GWh, reflecting an annual growth rate of 0.9% between 1990 and 1998 (California Energy Commission 2002a). In 2001, statewide consumption was about 250,000 GWh (California Energy Commission 2002b).

Peak electricity demand, expressed in megawatts (MW), measures the largest electric power requirement during a specified period, usually integrated over one hour. A single MW is enough power to meet the expected electricity needs of 1,000 typical California homes (California Energy Commission 2003b). For comparison, one GW would be enough power for 1,000,000 typical homes. Peak demand is important in evaluating system reliability, determining congestion points on the electrical grid, and identifying potential areas where additional transmission, distribution, and generation facilities might be needed. California's peak demand typically occurs in August between 3 p.m. and 5 p.m. High temperatures lead to increased use of air conditioning, which, in combination with industrial loads, commercial lighting, office equipment, and residential refrigeration, comprise the major consumers of electricity consumption in the peak-demand period in California (California Energy Commission 2000). In 2003, according to CEC, peak electricity demand for California is predicted to be about 52,150 MW.[4] Peak-generating capacity for the state was expected to be about 59,696 MW[5] in 2003 (California Energy Commission 2003c).

Cal-ISO controls the electrical grid that distributes about 82% of the electricity consumed in the state, with the remainder being distributed by municipal utilities. A potential HST system would likely draw most of its electricity from the Cal-ISO-controlled grid, illustrated in Figure 3.5-1.

Electricity Supply and Demand Outlook
The CEC has conducted studies to predict the short- and long-term outlooks for electricity supply and demand balance in California. According to its 2003 staff report, California's Electricity Supply and Demand Balance over the Next Five Years, the CEC believes that the near-term

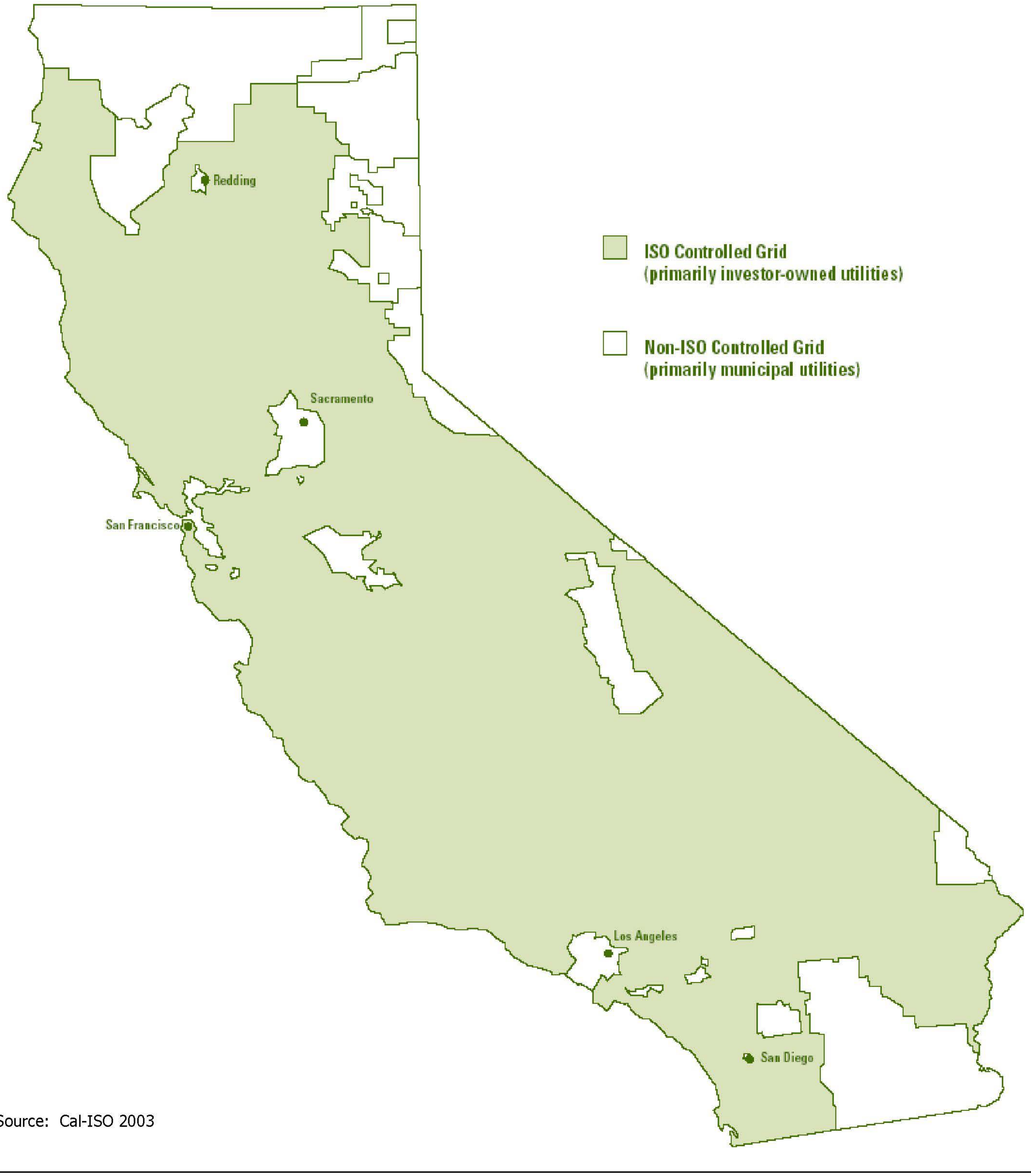
[2] Intermontane and Mohave coal plants are considered to be in-state facilities because they are in Cal-ISO-controlled areas.

[3] Electric energy is measured in watts (W): 1,000 watts is a kilowatt (kW); 1,000 kilowatts is a megawatt (MW); 1,000 megawatts is a gigawatt (GW). Electric consumption over time is measured in kilowatt-hours (kWh), megawatt-hours (MWh), and gigawatt-hours (GWh).

[4] Figure does not include 7% operating reserve.

[5] Figure includes net dependable generating additions of about 3,600 MW, as of July 2003, and forced and planned outages of 3,750 MW. Does not include spot market imports of 3,721 MW.

Figure 3.5-1.
Cal ISO-Controlled Grid



Source: Cal-ISO 2003

outlook for supply adequacy is promising. A 16% operating margin[6] is estimated for summer 2003 (assuming a 1-in-2-year peak temperature condition) in the Cal-ISO-controlled grid where supply is expected to outpace demand by approximately 6,000 MW[7] (California Energy Commission 2003c). According to CEC staff, a statewide planning reserve margin[8] of 8.8% is projected as far out as August 2008, when statewide supply capacity is anticipated to be 64,669 MW, outpacing a statewide projected demand of 59,459 MW[9] (California Energy Commission 2003c). The apparent decline in margins between the summers of 2003 and 2008 is due to the fact that the planning horizon for electric power resource additions is usually only two to three years out and does not necessarily indicate a downward trend in generating capacity.

This short planning horizon interjects uncertainty into the assessment of supply and reserve margin in 2020, the study year for the No Project, Modal, and HST Alternatives. However, the state has added substantial generating capacity in the last two years and it is reasonable to assume it will continue to add capacity. Between 2000 and February 2003, California licensed and added 18 new power plants which have contributed 4,980 MW to the statewide generating capacity. Power plants representing an additional 3,106 MW of generating capacity were anticipated to come online between February 2003 and August 2003 (California Energy Commission 2003d). Statewide demand in 2012 would most likely be around 64,845 MW, assuming normal summer temperatures (California Energy Commission 2002b). Using the growth trend that fits CEC demand predictions through 2012, published in the 2002–2012 Electricity Outlook (California Energy Commission 2002b), demand for electricity in 2020 can be estimated to be on the order of 77,000 MW.[10] The Cal-ISO estimates that net additions of domestic electricity generation capacity and electricity imports of 1,000 to 1,500 MW/year will be necessary to maintain current operating margins (California Independent State Operator 2002b).

Electricity Transmission Capacity Outlook: Electricity transmission capacity refers to the maximum amount of power that can be carried from the generating source to the utility provider and is a key component in the electrical power delivery system. In the years since the start of the electricity crisis in the summer of 2000, the transmission capabilities of some portions of the state's electrical grid have occasionally been inadequate to transmit electricity at a rate that would satisfy demand. This phenomenon is known as transmission bottlenecks. An example of one such current bottleneck occurs through what is known as Path 15, a major transmission line between northern and southern California through the Central Valley. According to the Western Area Power Administration (WAPA), the Pacific Gas and Electric Company (PG&E) plans to increase the rating of Path 15 from 3,900 MW to 5,400 MW. This process is expected to be completed by 2004 (Western Area Power Administration 2002). Improvements to other transmission paths are also planned, for example the link between California and the Southwest (Palo Verde-Devers Path) and the interconnect with the Tehachapi wind resource area (Consumer Power and Conservation Financing Authority, Energy Resources Conservation and Development Commission, and California Public Utilities Commission 2003).

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[6] Operating margin means the percentage by which supply outpaces demand; figure includes a 7% operating reserve in calculation (California Energy Commission 2003b).

[7] Figure includes operating reserve of 5,707 MW.

[8] Planning reserve margin differs from operating margin because it does not including the 7% operating reserve in calculation and does not account for forced outages or include spot market purchases. It is used in extended planning horizons (California Energy Commission 2003c).

[9] Demand projection assumes a normal summer. A hot summer increases projected demand to 62,914 MW, which corresponds to a 3.0% planning reserve margin.

[10] Projection to 2020 assumes an average annual growth rate of about 2.0%, with a range from between 1.5% and 3.9%. This projection is for comparison purposes only.

Natural Gas

California is the second largest consumer of natural gas in the nation, with consumption at more than 5.5 billion cubic feet (Bcf) (0.2 billion cubic meters [Bcm]) per day in 1997. Approximately 33% of this total daily consumption was for electricity generation. Residential consumption accounts for 25%, followed by industrial, resource extraction, and commercial. CEC's gas demand forecast projects continued growth at 1.3% annually, with volumes exceeding 7 Bcf (0.2 Bcm) daily by 2019. Natural gas supplies to California will remain plentiful for the next several decades. The total resource base (gas recoverable with today's technology) for the lower 48 states is estimated to be about 975 trillion cubic feet (Tcf) (28 trillion cubic meters [Tcm]), enough to continue current production levels for more than 50 years. Technology enhancements will continue to enlarge this resource base; however, increases to production capacity are less certain (California Energy Commission 1999). Production in the continental U.S. is expected to increase from 19.36 Tcf (0.55 Tcm) in 2001 base year to 32.14 Tcf (0.91 Tcm) in 2020 (U.S. Department of Energy 2003). As of 2001, in-state natural gas production accounted for 15% of total consumption. Out-of-state production areas include the Southwest (50%), the Rocky Mountains (10%), and Canada (25%) (California Energy Commission 2003a).

California's Natural Gas Market: Although California's natural gas market is affected by nationwide price conditions, it has taken steps to insulate itself from the full magnitude of the price swing amplitudes. Starting in 2000 to 2001, during the last major price elevation, the state's natural gas utilities obtained additional interstate pipeline capacity rights on the El Paso Interstate Pipeline in the fall of 2002. This addition allowed the state to maintain adequate inflow rates and reduce harm from price swings. During the recent price spike, pipelines serving California were running at 50% to 70% of capacity, indicating that excess capacity was available if it had been needed. The trend toward more pipeline capacity is being continued in California by projects such as the Kern River Expansion pipeline project, which became operational on May 1, 2003. Utilities in California have also invested in underground storage capacity, an effective mechanism for controlling annual costs that will allow them to dampen the effect of future severe price increases by drawing on stored gas instead of buying high-priced natural gas on the open market. Storage capacity was added in 1999 and in 2002 with the construction of Wild Goose Storage, located in Butte County, which can accommodate 14 Bcf (0.4 Bcm) (with the further expansion of 15 Bcf [0.4 Bcm] expected in 2004) and Lodi Gas, which can accommodate 12 Bcf (0.3 Bcm).

The State of California has also provided utilities with the flexibility and tools to manage gas costs by purchasing natural gas supplies under different contract lengths and pricing terms, and from a variety of supply sources. In addition, California is in the process of increasing its supplies of electricity from renewable power sources such as wind, geothermal, and solar energy. California legislation enacted in 2002 (Senate Bill 1078) created the Renewable Portfolio Standard (RPS) Program which will require retail sellers of electricity to increase their purchases of electricity generated by renewable sources, and establishes a goal of having 20% of California's electricity generated by renewable sources by 2017. Increasing California's renewable supplies will diminish the state's heavy dependence on natural gas as a fuel for electric power generation (California Energy Commission/California Public Utilities Commission 2003).

Relationship between Natural Gas and Electricity Resources in California

Increases in gas prices directly affect the price of electricity because of the large role that natural gas plays in electricity production throughout the Southwest—and in California in particular, where natural gas fueled 42.7% of electricity production in 2001. This percentage is likely to grow as the trend toward building natural gas power plants continues. During the spot-market price spike of February 2003, regional electricity prices rose 45% between early February 2003 and February 24, 2003, and an additional 150% between February 24 and February 26, 2003.

Since late February, natural gas prices have steadily fallen, and prices for electricity have followed suit (California Energy Commission/California Public Utilities Commission 2003).

Notwithstanding the relationship between conditions in the natural gas market and electricity prices, the functioning of the natural gas market, as well as the consequences of price changes in the natural gas market, are fundamentally different from the electricity market. Unlike electricity, natural gas has the property of storability, which gives natural gas an advantage as a commodity over electricity. Because electricity is not storable, a true long-term futures market cannot function as it does for durable commodities, and rates are determined almost solely by electricity spot markets. The lack of a futures market makes electricity rates susceptible to the effects of extreme swings in supply and demand. Conversely, the storability of natural gas provides the advantages that a fairly well-functioning futures market[11] offers with regard to upward pressure that risk puts on prices, and it allows utilities to buy natural gas when prices are low and store it until prices rise. In short, natural gas acts as any other durable commodity in the marketplace, including oil. Short-term shortages are mitigated by the above-stated mechanisms. Long-term price increases are corrected by increases in production capacity, the expectation of which, in turn, acts to bring prices down. Since the projected national in-the-ground natural gas reserves are expected to last for at least the next 50 years, actual supplies are not considered to be limiting, and short- and long-term prices are mostly a function of market conditions, assuming the trend toward improvements in production and transmission capacity continues (California Energy Commission/California Public Utilities Commission 2003).

Transportation Energy Consumption

Transportation accounts for a large portion of the California energy budget, with approximately 46% of the state's energy consumption resulting from the transport of goods and people. Between 1997 and 2020, according to the State Department of Finance, the state is forecasted to grow by about 11 million people, or approximately 30% (California Department of Finance 1998). During this same period, intercity travel is projected to grow by almost 40% to almost 215 million trips per year (California High Speed Rail Authority 2000). Although the average fuel economy of vehicles in the state has improved, the fuel savings achieved are overshadowed by the increased number of miles traveled and the marked shift in personal vehicle preference, from the standard passenger automobile (sedan) toward larger vehicles such as sport utility vehicles (SUVs) and pick-up trucks. Currently, California's 24 million automobiles consume more than 17 billion gal (64 billion L) of petroleum, most of which is consumed in southern California. The state is the third-largest consumer of petroleum fuel in the world. Only the United States as a whole and the former Soviet Union exceed this volume. Because of this dependence on petroleum fuels, events in the international petroleum market can immediately and adversely affect the price and adequacy of California's fuel supply (California Energy Commission 1999).

There are currently four options for intercity travel among the major urban areas of California: automobiles on interstate and state highways, commercial airlines, conventional passenger trains (Amtrak) on freight and/or commuter rail tracks, and long-distance commercial bus transit. These four modes of intercity travel represent a wide range of service characteristics, such as travel time and frequency. Automobiles and airplanes are the predominant modes of intercity trips longer than 150 mi (241 km).

The effects of transportation congestion on energy consumption and air emissions can be major. Automobiles are most efficient when operating at steady speeds of 35 mph to 45 mph (56 kph to 72 kph) with no stops (Oak Ridge National Laboratory 2002). Fuel consumption increases by about 30% when average speeds drop from 30 mph to 20 mph (48 kph to 32 kph), while a drop

[11] The quality of data available to market analysts has been a source of some concern recently, although steps are currently being taken on the national level to remedy this situation.

from 30 mph to 10 mph (48 kph to 16 kph) results in a 100% increase in fuel use. Studies estimate that approximately 10% of all on-road fuel consumed is a result of congestion (California Energy Commission 1990).

The analysis of transportation energy focuses on the overall energy consumption differences between the No Project, Modal, and HST Alternatives. This approach captures the two major transportation fuel inputs, petroleum oil and natural gas (a large component of electricity production). Electricity consumption as a specific item will also be analyzed because of the special nature of electricity, specifically its non-storability and its lack of suitability for trading in futures markets. It is reasonable that the analysis of energy consumed by the HST system is confined to electricity and does not include specific reference to natural gas. The price of natural gas is just one variable in the overall ability of the state's electricity-generating infrastructure to deliver adequate power to users. Moreover, it is not the total reserves of in-the-ground natural gas that is uncertain; it is the market conditions and production capacity trends that affect this commodity, just as is the case for the other major transportation fuel, petroleum oil.

3.5.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

In 1997, the number of intercity passenger trips taken between regions of California that would be served by the proposed HST system was about 154 million (Charles River Associates 2000). Of these trips, 98% are attributable to automobiles or airplanes, and only 2% were taken via intercity conventional rail and bus. This result corresponds to 14,237 VMT (22,912 million vehicle kilometers traveled [VKT]) and 62 million airplane VMT (100 million VKT).

In 2020, under the No Project Alternative, the number of intercity passenger trips estimated to be taken in California is projected to be about 215 million (Charles River Associates 2000). This corresponds to about 18,866 million automobile VMT (30,362 million VKT) and 102 million airplane VMT (164 million VKT). The increase in intercity passenger trips is reflective of population growth expected over the same period, which is estimated by the California Department of Finance to be on the order of an additional 11 million people (California Department of Finance 1998).

Operational (Direct) Energy

As indicated in Table 3.5-3, the existing (1997 figures) energy used to power the estimated 154 million intercity passenger trips was 101,525,630 million Btus (MMBtus), or 17.5 million barrels of oil. The 215 million passenger trips estimated under the No Project Alternative would consume the equivalent of about 141,023,720 MMBtus, or 24.3 million barrels of oil. This increase of 39% from existing to No Project conditions would be caused primarily by a population increase of 11 million people. This is a conservative estimate because, as noted in Section 3.5.1, automobile fuel efficiency decreases considerably as travel speed decreases below 30 mph (48 kph) and stop-and-go traffic increases. Since congestion levels under the No Project Alternative would likely be higher than they are under existing conditions, the increase in direct energy used in 2020 would be higher than the projected 39% increase. To illustrate, if the direct energy consumption factor for automobiles under a congested No Project scenario increased by 5%, from 5,669 Btus/VMT to 5,952 Btus/VMT, the total direct energy consumption under the No Project Alternative would increase from 141,023,720 MMBtus to 146,371,202 MMBtus, which would represent a 44% increase over existing levels, compared to the 39% increase in direct energy consumption with the assumption of similar levels of service.

The No Project Alternative would potentially place additional demand on statewide energy supplies compared to existing conditions as a result of increased passenger trips, higher levels of congestion, and slower speeds on intercity highways.

Table 3.5-3
Annual Intercity Operational Energy Consumption in the Study Area

	1997 Existing	2020 No Project Alternative[f]
Annual VMT[b,c,g] (mi [km]) (millions)		
Auto	14,237 (22,912)	18,866 (30,362)
Airplane	62 (100)	102 (164)
HST	0	0
Annual Energy Consumption (Btus) (millions)		
Auto	80,711,153	106,949,635
Airplane	20,814,476	34,074,085
HST	0	0
Total Energy Consumption (MMBtus[a])	101,525,630	141,023,719
Change in Total Energy from Existing (MMBtus[a])		39,498,090
Total Energy Consumption (Barrels of Oil[e]) (millions)	17.5	24.3
Change in Total Energy from Existing (Barrels of Oil[e]) (millions)		6.8

[a] One British thermal unit (Btu) is the quantity of energy necessary to raise 1 pound of water 1 degree Fahrenheit.

[b] VMT based on average number of passengers per vehicle, by mode, as follows:
- Intercity auto: 2.4 passengers/automobile
- Airplane: 101.25 passengers/airplane (70% load factor per Business Plan)

HST VMT based on Business Plan (California High Speed Rail Authority 2000)

[c] Intercity travel only; long distance commute travel not included

[d] Rounded.

[e] One barrel of crude oil is equal to 5.8 MMBtus.

[f] Fuel consumption for No Project would increase beyond the figures presented here as speeds drop below 30 mph (48 kph) on congested highways.

Sources: [g] Charles River Associates 2002, Paul Taylor (Kaku Associates) pers. comm.

Peak-Period Electricity Demand

The No Project Alternative electricity consumption would increase slightly over existing conditions related to the programmed and funded airport expansion under the No Project Alternative. The possible future electrification of Caltrain, commuter rail systems, and/or Amtrak, which, though not part of the current No-Project Alternative, are being considered, would also increase electricity use. While these projects would be regionally significant, they are small in scale compared to overall electricity usage and would be captured by routine electricity consumption forecasts by CEC, allowing electricity generation and transmission planning to account for and accommodate their additions.

Potential electricity demand under the No Project Alternative would be satisfied by expected expansion in generating capacity. No significant potential impacts on electricity generating capacity have been identified.

Construction (Indirect) Energy
The No Project Alternative is based on the assumption that projects currently included in existing plans and programs, including local, state, and interstate transportation system improvements, would be implemented. It is assumed that construction of the projects included in the No Project Alternative would not result in the consumption of energy resources in a wasteful, inefficient, or unnecessary manner.

3.5.4 Comparison of Alternatives by Region

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HST ALTERNATIVES (with sensitivity analysis ridership forecasts)

Operational (Direct) Energy
The 39% increase in energy use of the No Project Alternative over existing conditions is similar to the potential increase that would be expected with implementation of the proposed Modal Alternative, which would increase direct energy consumption by 40% over existing conditions, as summarized in Table 3.5-4. By contrast, the proposed HST Alternative would increase direct energy consumption by 10% over existing conditions, a much slower rate than the Modal or No Project Alternatives.

Statewide: As indicated by the VMT-based analysis, energy requirements for intercity transportation would be greater under the Modal Alternative than under the No Project Alternative because of induced demand for automobile travel related to extra highway capacity. Table 3.5-4 shows that, although the number of airplane VMT would remain the same under Modal and No Project Alternatives,[12] the number of automobile intercity trips taken would increase statewide by 1.1% over the No Project Alternative,[13] which would increase the number of annual VMT by 208 million (335 million VKMT) to 19,073 million (30,695 million VKMT). These additional VMT translate into an additional energy use of 1,176,446 MMBtus, which is the equivalent of 0.2 million barrels of oil. However, as indicated in Section 3.5.1, automobile fuel efficiency decreases considerably as travel speeds decrease and stop-and-go traffic increases. This means that the higher energy consumption resulting from more VMT would be offset by the Modal Alternative's lower level of congestion in rural highway segments. For example, if the direct energy consumption factor for automobiles increased by 5% because of congestion under the No Project Alternative, from 5,669 Btus/VMT to 5,952 Btus/VMT, the total energy consumption under No Project would increase from 141,023,720 MMBtus to 146,371,202 BTUs. In this scenario, the Modal Alternative would consume 3% less direct energy than No Project. This compares to a 1% increase in direct energy consumption when comparing the Modal Alternative to a more congested No Project Alternative.

By comparison, the HST Alternative would potentially decrease intercity automobile VMT from 18,865 million (30,360 million VKT) under the No Project Alternative scenario to 15,816 million (25,453 million VKT), decrease airplane VMT from 102 million (164 million VKT) to 1 million (2 million VKT), and increase HST VMT attributable to intercity trips from 0 to 22 million (35 million VKT). Under the HST Alternative, commuter automobile VMT (based on 1.0 passenger per automobile) would also potentially decrease by 509 million VMT (819 million VKT) compared to the No Project Alternative, although HST VMT attributable to commuter trips would increase from 0 to 2 million (3 million VKT). Where the HST system would use 20,304,566 MMBtus for trips related to intercity travel, the overall direct energy for intercity

[12] It is assumed that an increase in the level of service for air travel under the Modal Alternative compared to the No Project Alternative would not increase the number of trips, but instead would meet peak travel demand. This could also be thought of as satisfying rush hour demand.

[13] Trips that would be induced (also called latent demand) as a result of the improved level of service.

travel would be 30,717,124 MMBtus, or the equivalent of 5.2 million barrels of oil, less per year than the 2020 No Project Alternative. This potential reduction represents a 22% energy savings for intercity trips over the No Project Alternative and a 9% increase over direct energy consumption under existing conditions (1997). Proposed HST operations related to commuter travel would use 1,630,199 MMBtus. However, the 10 million commute-related passenger trips that could be diverted from automobiles to the proposed HST system would result in a potential decrease in energy use by automobiles of 2,886,699 MMBtus. This would result in a net reduction in commute-related direct energy consumption of 1,256,500 MMBtus, compared to the No Project Alternative.

Table 3.5-4
Annual Intercity Operational Energy Consumption in Study Area

	1997	2020		
	Existing	No Project Alternative	Modal Alternative	HST Alternative
Annual VMT[b, c, g] (mi [km]) (millions)				
Auto	14,237 (22,912)	18,866 (30,362)	19,073 (30,695)	15,816 (25,453)
Airplane[d]	62 (100)	102 (164)	102 (164)	1 (2)
HST	0	0	0	22 (35)
Annual Energy Consumption (MMBtus[a])				
Auto	80,711,153	106,949,635	108,126,081	89,661,289
Airplane	20,814,476	34,074,085	34,074,085	340,741
HST	0	0	0	20,304,566
Total Energy Consumption (MMBtus)	101,525,630	141,023,720	142,200,166	110,306,596
Change in Total Energy from Existing (MMBtus)		39,498,090	40,674,536	8,780,967
Change in Total Energy from No Project (MMBtus)			1,176,446	-30,717,124
Total Energy Consumption (Barrels of Oil[f]) (millions)	17.5	24.3	24.5	19.1
Change in Total Energy from Existing (Barrels of Oil[f]) (millions)		6.8	7.0	1.5
Change in Total Energy from No Project (Barrels of Oil[f]) (millions)			0.2	-5.2

[a] One British thermal unit (Btu) is the quantity of energy necessary to raise 1 pound of water 1 degree Fahrenheit.

[b] VMT based on average number of passengers per vehicle, by mode, as follows:
- Intercity auto: 2.4 passengers/automobile
- Airplane: 101.25 passengers/airplane (70% load factor)

HST VMT based on Business Plan (California High Speed Rail Authority 2000)

[c] Intercity travel only; long-distance commute travel not included.

[d] Does not include airplane VMT resulting from passengers making connections to other flights to continue or complete their journey because these are a minor portion of the HST-served market.

[e] Rounded.

[f] One barrel of crude oil is equal to 5.8 MMBtus.

[g] Fuel consumption for the No Project Alternative would increase beyond the figures presented here as speeds drop below 30 mph on congested highways.

Sources: [h] Charles River Associates 2002; Paul Taylor (Kaku Associates) pers. comm.

The VMT-based energy calculations above do not account for congestion levels. As congestion levels decrease, so does vehicular energy use for transportation. Therefore, the 22% energy consumption reduction projected under the HST Alternative is probably conservative because intercity route congestion levels would be expected to lessen in rural areas if it is implemented. Using the example of a 5% increase in the energy consumption factor for automobiles due to congestion, explained above under Modal Alternative, a congested No Project Alternative could hypothetically result in direct energy consumption of 146,371,202 MMBtus, compared to the 141,023,720 MMBtus anticipated in a less-congested No Project scenario. The congested scenario would result in additional intercity potential direct energy savings with the proposed HST Alternative of about 5,347,482 MMBtus, which would represent a potential 17% increase in the amount of energy saved. Thus, the total energy savings with the proposed HST Alternative and high-end ridership could be as great as 25% over the No Project Alternative.

An energy intensity analysis of the alternatives was also calculated using passenger miles traveled (PMT) for each of the modes. This is useful for anticipating how each of the alternatives would affect energy use. Table 3.5-5 lists the energy consumption factors of each of the modes. HST service offers a sharp reduction in energy consumption per passenger mile compared to other modes.

Table 3.5-5
Energy Consumption Based on Passenger Miles Traveled (PMT)

Mode	Energy Consumption[e]
Intercity Passenger Vehicles (Auto, Van, Light Truck)[a]	2,400 Btus/PMT
Commute Passenger Vehicles (Auto, Van, Light Truck)[b]	5,700 Btus/PMT
Airplanes[c]	3,300 Btus/PMT
High-Speed Trains[d]	1,200 Btus/PMT

[a] Based on 2.4 passengers per vehicle.
[b] Based on 1.0 passenger per vehicle.
[c] Based on 101.25 passengers per vehicle (70% load factor).
[d] Based on 761 passengers per 16-car trainset (63% load factor, which accommodates projected 2020 sensitivity case high-end demand for HST service within the existing Business Plan).
[e] Rounded.

Regional: In addition to the statewide direct automobile VMT savings that would result from travelers choosing HST travel, the proposed HST Alternative would potentially provide additional regional VMT reductions, compared to the No Project Alternative conditions. Proposed HST station-stops would be more numerous than airports, which would result in a lessening of the average distances required for passengers to travel from their points of origin to the mode transfer point (and vice versa) because of the likelihood that one or more of the stations would be closer to their point of origin than would their respective regional airport.

Implementation of the HST Alternative would also potentially decrease regional transportation-related energy consumption through proposed improvements to rail corridors in the Bay Area to Merced and Los Angeles to San Diego via Orange County (LOSSAN) regions. Grade separations are proposed for Caltrain and the LOSSAN corridor as part of the proposed HST system, which would increase traffic flow in the affected areas, thereby increasing fuel efficiency and decreasing energy consumption.

The comparison of the Modal and HST Alternatives to the No Project Alternative shows that only the proposed HST Alternative would potentially decrease energy use statewide. Compared to the Modal Alternative, the HST Alternative would save 31,893,570 MMBtus, or about 5.5 million barrels of oil annually, which equates to an approximate 22% savings. Regional analysis indicates that regional efficiencies, which would be precipitated by implementing the proposed HST Alternative, would increase these projected savings.

The Modal Alternative would have no potential impact because it would likely consume about the same, if not slightly less, energy than the No Project Alternative because of reduced congestion.

Peak-Period Electricity Demand

The small projected increase in electricity demand over existing conditions with the No Project Alternative would be somewhat smaller than what would be expected with implementation of the Modal Alternative. Conversely, the proposed HST Alternative would increase electricity demands on the state's generation and transmission infrastructure, increasing peak demand on the order of 480 MW[14].

Statewide: Compared to the No Project Alternative, there would be some increase in electricity demand in the peak period under the Modal Alternative due to new/expanded airport facilities. It would be small, and it would be covered by CEC projections of electricity demand and supply capacity.

By comparison, electrical power demanded by the HST system would increase the load on the statewide system on the order of 480 MW during peak electricity demand in 2020. Electricity supply and demand projections are not available for 2020. Such a long-time horizon has uncertainty, especially on the supply side, where capacity additions are difficult to predict more than two to three years into the future. However, it is useful to compare the expected HST-related operational electricity demand to surplus projections through 2008, the year that is farthest into the future for which electricity production capacity projections are available. CEC estimates that statewide electricity surplus generating capacity[15] in 2008 will be 5,210 MW, based on a total generating capacity of 64,669 MW and a demand of 59,459 MW (California Energy Commission 2003c). If the system were to become operational in 2008, the additional load (i.e., demand) placed on the system by the HST Alternative would be about 10% of the state's anticipated electricity surplus. Prediction horizons for demand estimates are longer than for capacity additions. The additional 480-MW load that would be placed on statewide electricity generating resources by the HST Alternative would represent approximately 0.7% of the CEC-predicted 2012 statewide electricity demand of 64,845 MW. Projecting the demand horizon to the study year of 2020, the HST Alternative-generated load would represent 0.6% of an estimated 77,000 MW statewide demand.[16] Though the HST Alternative could cause potentially considerable impacts on the state's electricity grid if the generation and transmission capacity were not equipped to handle the additional load, the short-term electricity generation outlook is favorable, and the medium- to long-term demand scenarios indicate that the proposed HST Alternative would represent a very small portion of statewide demand.

[14] Figure based on an average electricity use of 74.2 kW/train mi, which equates to an average electricity use rate of about 12 MW per trainset when integrated over 1 hour. These are averages and do not reflect acceleration or changes in grade; they are for planning purposes only.

[15] This assumes a normal summer and including existing generation, retirements, high-probability California additions, net firm imports, and spot-market imports.

[16] Calculation based on CEC demand projections from 2002 to 2012 for normal temperature years, published in 2002–2012 Electricity Outlook (California Energy Commission 2002b). Projection to 2020 assumes an average annual growth rate of about 2.0% with a range from between 1.5% and 3.9%. This projection is for comparison purposes only.

The demand growth extrapolation based on CEC demand predictions assumes an average annual electricity demand growth in California on the order of 1,400 MW through 2020, about three times the 480-megawatt load that the HST operations are expected to place on the statewide system. The HST Alternative would be built and become operational in stages, which indicates that, instead of placing an additional 480-MW load on the state's production and transmission resources abruptly, the system would gradually increase its electricity consumption rate to 480 MW. A first segment from Los Angeles to San Francisco, for example, would place an additional load on electricity resources on the order of 350 MW,[17] which is about 72% of the load anticipated for the entire system. This gradual increase would allow the in-state and out-of-state electricity generation and transmission industries and planners to anticipate and respond to the effects of the proposed HST Alternative on generating and transmitting resources.

Regional: Regional impacts on the electricity grid could occur if the proposed HST Alternative contributed to electricity transmission deficiencies, or bottlenecks, which were described in Section 3.5.2. If bottlenecks were to be aggravated by the HST Alternative, a potential adverse impact could result. However, through careful HST electrification design (i.e., design system so that it draws power from the electricity grid at several places throughout the state), it would be possible to minimize or eliminate such potential problems. Also, bottlenecks in the current grid system are being addressed by such projects as the Path 15 upgrade (see Section 3.5.2). If planning transmission line capacity continues to grow to anticipate statewide needs, the HST Alternative would not have the potential to cause a significant impact on transmission. The Modal Alternative is not expected to cause substantial electricity demand increases in any of the regions.

The HST Alternative could cause potentially considerable impacts on the state's electricity grid if the generation and transmission capacity were not equipped to handle the additional load. However, the short-term electricity generation outlook is favorable, and the medium- to long-term demand scenarios indicate that the proposed HST Alternative would represent a very small portion of statewide demand. If current trends continue as expected, electricity generation and transmission capacity would satisfy the underlying growth in demand, estimated to average about 2% per year. The HST Alternative would represent a small percentage of generating and transmission capacity required to satisfy projected overall demand. Staging of the completion of construction and the start of major operations would make the load additions by each of the HST Alternatives less abrupt than would be the case if the start of the full planned operations were to occur simultaneously.

Construction (Indirect) Energy

Construction of the programmed and funded transportation improvements under the No Project Alternative would require less energy than construction of either the Modal or HST Alternative.

Project Construction: The Modal Alternative construction-related energy consumption would result in the one-time, non-recoverable energy costs associated with construction of new/expanded airport runways, airport facilities, roadways—an estimated 2,970 lane-mi (4,780 km) statewide—interchanges, ramps, and other support facilities (e.g., rest areas, maintenance facilities). The HST Alternative construction-related energy consumption would also result in a one-time, non-recoverable energy cost, which would occur during construction of on-the-ground, underground and aerial facilities such as trackwork, guideways, structures, maintenance yards, stations, and support facilities. Details regarding energy conservation practices have not been specified for the HST Alternative, which has not been designed in detail,

[17] Figure determined by using the proportion of train-miles programmed into the operating plan between Los Angeles and San Francisco to the total number of train-miles for the entire completed project. Assumes that the rest of the operating plan (i.e., peak frequency) would remain the same.

nor have construction methods and staging been planned at this time. Given the scope and scale of the improvements proposed as part of the HST Alternative, however, it is anticipated that the construction-related energy requirement would be substantial. Table 3.5-6 shows estimates of potential construction-related indirect energy consumption for both the Modal and HST Alternatives.

Table 3.5-6
Non-Recoverable Construction-Related Energy Consumption

Alternative	Structure	Rural vs. Urban[a]	Facility Quantity[b]	Energy Consumption[c] (MMBtus)
Modal	Highway (at grade)	Rural	1,476 one-way lane mi (2,375 km)[d]	25,187,000
		Urban	795 one-way lane mi (1,279 km)[d]	20,879,000
	Highway (elevated)	Rural	455 one-way lane mi (732 km)[d]	59,323,000
		Urban	245 one-way lane mi (394 km)[d]	80,191,000
	Subtotal			185,580,000
	Airport (runway)	N/A	6 runways	37,872,000
	Airport (gates)	N/A	91 gates	7,098,000
	Subtotal			44,970,000
	Modal Alternative total			230,550,000
HST	HST guideway (at grade)	Rural	2,263 guideway mi (3,642 km)	27,807,000
		Urban	640 (1,030 km)	12,224,000
	HST guideway (elevated)	Rural	333 guideway mi (536 km)	18,442,000
		Urban	161 (259 km)	8,972,000
	HST guideway (below grade, cut)	Rural	19 guideway mi (31 km)	2,239,000
		Urban	30 (48 km)	4,868,000
	HST guideway (below grade, tunnel)	Rural	242 guideway mi (389 km)	28,322,000
		Urban	146 (235 km)	47,958,000
	HST station	N/A	20 stations	1,560,000
	HST Alternative total			152,390,000

[a] Assumes the HST and Modal Alternatives would be constructed in rural and urban areas at the following proportions:
- Bay Area to Merced: Rural (70%), Urban (30%)
- Sacramento to Bakersfield: Rural (95%), Urban (5%)
- Bakersfield to Los Angeles: Rural (70%), Urban (30%)
- LOSSAN: Rural (30%), Urban (70%)
- Los Angeles to San Diego via Inland Empire: Rural (60%), Urban (40%)

[b] Measured in guideway miles for non-discrete structures (e.g., highways and HST guideways), and in structure quantities for discrete structures (e.g., airport runways and terminals, and HST stations).

[c] Rounded.

[d] Based on 2,970 mi (4,780 km) of highway lane additions; distribution between at-grade (65%) and elevated (35%) estimated for comparison purposes. True values are not known at current level of planning.

[f] Differences between the construction-related energy consumption for urban and rural settings reflect differences in construction methods, demolition requirements, utility accommodation, etc.

As shown in the table, the construction of the proposed HST Alternative would consume 34% less energy during construction than the Modal Alternative. Assuming that the 2020 energy savings for each of the system alternatives remain constant, and assuming an un-congested No Project scenario, the Modal Alternative would not repay the construction energy estimated to be consumed as a result of its implementation because more operational energy would be consumed by the Modal Alternative than by the No Project Alternative. If a 5% increase in the No Project Alternative automobile operational energy is assumed, the Modal Alternative would consume less energy than this congested No Project Alternative and would result in a construction energy payback period of 55 years. Energy savings projected for the proposed HST Alternative would repay the construction energy consumption in 5 years with an uncongested No Project scenario and would have a 4-year payback period if a 5% automobile congestion energy consumption penalty is assumed.

Secondary Facilities: It is reasonable to assume that secondary facilities, such as those used in the production of cement, steel, etc., would employ all reasonable energy conservation practices in the interest of minimizing the cost of doing business. Industry in California reduced electricity usage (which is mostly generated by natural gas, a nonrenewable fuel) from 54.7 million MWh in 2000 to 52.2 million MWh in 2001, a 4.6% reduction, even as the state's population increased by 513,352, or 1.5% (California Energy Commission 2002d). Therefore, it can reasonably be assumed that construction-related energy consumption by secondary facilities would not consume nonrenewable energy resources in a wasteful, inefficient, or unnecessary manner under either the Modal or HST Alternative.

Construction of either the Modal or HST Alternative is anticipated to take about 10 years, beginning in 2005 and finishing in 2016. Construction would occur in stages, and some segments would be open for operation while others are still under construction. Given the scope and scale of the Modal and HST Alternatives, it is anticipated that secondary construction-related energy requirements would be substantial.

Due to the scope and scale of the improvements proposed as part of the Modal and HST Alternatives, construction-related energy impacts, both project and secondary, would be potentially significant. Though the construction energy consumption factors presented in Table 3.5-6 indicate that the HST Alternative would consume less energy during construction than the Modal Alternative, how much less is unknown because limited data is available. Construction of the Modal and HST Alternatives would potentially represent a significant use of nonrenewable resources.

C. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HST ALTERNATIVES (with investment-grade ridership forecasts)

Operational (Direct) Energy

Statewide: Based solely on VMT, the HST Alternative with the investment-grade ridership forecast would potentially reduce overall direct energy use for intercity travel in 2020 by 11,749,680 MMBtus, or the equivalent of 2.0 million barrels of oil compared to the No Project Alternative, as shown in Table 3.5-7. This reduction represents an 8% energy savings for intercity trips over the No Project Alternative, and a 27% increase over direct energy consumption under existing conditions (1997). This compares to a 22% reduction over the No Project Alternative and a 9% increase over existing conditions (1997) with the high-end sensitivity analysis ridership forecast. Using the example of a 5% increase in the energy consumption factor for automobiles under congested No Project conditions, intercity direct energy savings with the HST Alternative would be 17,097,162 MMBtus with the assumption of investment-grade ridership projections, compared to a savings of 36,064,605 million Btus with the high-end ridership forecast. Commuter diversion to HST would not change with the investment-grade forecast.

Table 3.5-7
Annual Intercity Operational Energy Consumption in Study Area
(Assuming Investment-Grade Ridership Forecasts)

	1997	2020		
	Existing	No Project Alternative[g]	Modal Alternative[e]	HST Alternative[e]
Annual VMT[b,c,h] (mi [km]) (millions)				
Auto	14,237 (22,912)	18,866 (30,362)	19,073 (30,695)	17,367 (27,949)
Airplane[d]	62 (100)	102 (164)	102 (164)	41 (66)
HST	0	0	0	22 (35)
Annual Energy Consumption (MMBtus)				
Auto	80,711,153	106,949,635	108,126,081	98,458,799
Airplane	20,814,476	34,074,085	34,074,085	13,556,367
HST	0	0	0	17,258,873
Total Energy Consumption (MMBtus[a])	101,525,630	141,023,720	142,200,166	129,274,040
Change in Total Energy from Existing (MMBtus[a])		39,498,090	40,674,536	27,748,410
Change in Total Energy from No Project (MMBtus[a])			1,176,446	-11,749,680
Total Energy Consumption (Barrels of Oil[f]) (millions)	17.5	24.3	24.5	22.3
Change in Total Energy from Existing (Barrels of Oil[f]) (millions)		6.8	7.0	4.8
Change in Total Energy from No Project (Barrels of Oil[f]) (millions)			0.2	-2.0

[a] One British thermal unit (Btu) is the quantity of energy necessary to raise 1 pound of water 1 degree Fahrenheit.
[b] VMT based on average number of passengers per vehicle, by mode, as follows:
- Intercity auto: 2.4 passengers/automobile
- Airplane: 101.25 passengers/airplane (70% load factor)

HST VMT based on Business Plan (California High Speed Rail Authority 2000).
[c] Intercity travel only; long-distance commute travel not included.
[d] Does not include airplane VMT resulting from passengers making connections to other flights to continue or complete their journey, because they are a minor portion of the market served by HST.
[e] Rounded.
[f] One barrel of crude oil is equal to 5.8 MMBtus.
[g] Fuel consumption for the No Project Alternative would increase beyond the figures presented here as speeds drop below 30 mph (48 kph) on congested highways.

Sources: [h] Charles River Associates 2002, Paul Taylor (Kaku Associates) pers. comm.

With the investment-grade HST ridership projections, the energy consumption per passenger mile traveled on the HST would be about 1,800 Btus, compared to about 1,200 Btus when the high-end ridership forecast is assumed.

Regional: Regional energy savings with investment-grade ridership projections for the HST Alternative compared to the No Project Alternative would not be qualitatively different from those expected with the sensitivity analysis variations in the ridership forecast.

Peak-Period Electricity Demand
Whereas the proposed HST system would consume electricity at the rate of 480MW when fully operational with the sensitivity analysis variations in the ridership forecast, which would generally require 16-car trainsets to accommodate the expected passenger demand, the HST system would consume electricity at the reduced rate of 410MW[18] with the investment-grade ridership forecast, which would generally require 12-car trainsets to accommodate passenger demand.

Construction (Indirect) Energy
The HST Alternative would have a payback period of 12 years with the investment-grade ridership projections, compared to 5 years with the sensitivity analysis variations in the ridership forecast. Assuming a 5% increase in No Project automobile energy consumption due to congestion, the HST Alternative would have a payback period of 9 years with the investment-grade ridership projections, compared to 4 years with the sensitivity analysis variations in the ridership forecast.

3.5.5 Design Practices

The proposed electrically powered HST technology is energy efficient, requiring substantially less energy than other modes of intercity travel. Implementation of the HST Alternative is anticipated to reduce energy use over the No Project or Modal Alternatives.

3.5.6 CEQA Significance Conclusions and Mitigation Strategies

Based on the analysis above, and considering the discussion in CEQA Appendix F on Energy Conservation, the HST alternative would have a potentially significant effect related to long term electric power consumption when viewed on a system-wide basis. It is calculated that the HST alternative would contribute to statewide electricity demand by adding demand which is about 0.6% of projected statewide electricity demand in 2020. While this is an increase, the HST alternative represents a more energy efficient mode of transportation than travel by aircraft or car, such that the HST alternative would result in an overall reduction in total energy consumption (combined electric power demand and oil consumption). Mitigation strategies, as well as the design practices discussed in section 3.5.5, will be applied to reduce this impact.

This is a broad program-level analysis reviewing potential statewide energy use and impacts related to the proposed HST system and other alternatives. If the proposed HST Alternative were implemented, the HST system would be designed to minimize electricity consumption. The design particulars would be developed at the project-level of analysis, but would they include the following.

- Use regenerative braking to reduce energy consumption of the system.
- Minimize grade changes in steep terrain areas to reduce the use of electricity during peak periods.
- Use energy-saving equipment and facilities to reduce electricity demand.
- Maximize intermodal transit connections to reduce automobile VMT related to the HST system.
- Develop and implement a construction energy conservation plan.

[18] Based on an average electricity use of 63.07 kW/train mi, which equates to an average electricity use rate of the order of 10 MW per trainset when integrated over 1 hour. The rate of electricity use by a 12-car trainset was assumed to be 85% of the rate used by a 16-car trainset. These are averages and do not reflect acceleration or changes in grade; they are for planning purposes only.

- Develop potential measures to reduce energy consumption during operation and maintenance activities.

It is important to note that the proposed HST system is anticipated to reduce energy consumption overall. Any localized energy impacts would be avoided through proper planning and design of power distribution systems and their relationship with the overall power grid. The following measures could further reduce HST alternative energy consumption.

- Locate HST maintenance and storage facilities within close proximity to major stations/terminals.
- Locate construction material production facilities on-site or within close proximity to the project site.
- Use of newer, more energy efficient construction vehicles.
- Implementation of a program to encourage construction workers to carpool or use public transportation for travel to and from the construction site.

The above mitigation strategies are expected to reduce the short-term and long-term electric power consumption impacts of the HST alternative to a less-than-significant level. Additional environmental assessment will allow a more precise evaluation in the second-tier, project-level environmental analyses.

3.5.7 Subsequent Analysis

Subsequent analysis would be required in project-level environmental documentation for the proposed HST Alternative, if selected. Detailed analysis of base and peak-period electricity requirements and transmission infrastructure would be required to more precisely assess the adequacy of electricity generation and transmission capacity relative to demand for each segment to be pursued. Comprehensive traffic analysis for future conditions would be required to assess regional energy impacts in more detail for each segment.

Subsequent energy analysis at the project level would follow the methodology applied in this evaluation, but would employ the more detailed traffic and electrical input data for the energy consumption analysis. Energy consumption factors would be updated using the latest available published information. Detailed construction staging, sequencing, methods, and practices would be necessary to support a quantitative analysis of construction energy consumption.

3.6 ELECTROMAGNETIC FIELDS AND ELECTROMAGNETIC INTERFERENCE

This section describes the potential impacts of electromagnetic fields (EMFs) associated with operation of the No Project, Modal, and High-Speed Train (HST) Alternatives. The principal topics discussed in this section are potential impacts on personal health and potential impacts on electronic and electrical devices as a result of electromagnetic interference (EMI).

3.6.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY REQUIREMENTS

Neither the federal government nor the State of California has established regulatory limits for EMF exposure. The Federal Communications Commission (FCC) regulates sources of radiofrequency (RF) fields to maintain the quality of wireless communications across the spectrum. The FCC, which does not regulate for health and safety, has adopted regulations applicable to EMF exposure that were derived from health and safety evaluations made by the American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) and the National Council on Radiation Protection (NCRP). FCC regulations would apply to intentional radiators such as the proposed HST wireless systems for both operational and amenity purposes. FCC regulations would otherwise apply only if HST operations (RF interference) interfered with legitimate spectral uses.

Voluntary standards for EMF exposure have been developed by the International Committee on Electromagnetic Safety (ICES), which is sponsored by IEEE. The federal and state governments do not enforce these voluntary standards. The standards are based on studies of electrostimulation (i.e., nerve and muscle responses to the internal electric field in the body). ICES standards recommend maximum permissible 60-Hz magnetic field exposure levels that are a few thousand times higher than 0.3 to 0.4 microtesla (µT) (3 to 4 milligauss [mG]). Magnetic fields greater than 0.3 to 0.4 µT are relatively uncommon exposures that are found in a small percentage of homes that have been shown to have a possible association with childhood leukemia based on inconclusive evidence (National Institute of Environmental Health Sciences 1998, 1999; International Agency for Research on Cancer 2002). Unresolved scientific issues concerning health effects of power frequency extremely low frequency (ELF) magnetic fields were examined extensively by the California Department of Health Services (Neutra et al. 2002) in response to a request from the California Public Utilities Commission. There is no evidence to substantiate a relationship between ELF electric fields and cancer (International Agency for Research on Cancer 2002), and the low-level electric fields typically found in homes have not been associated with other diseases (National Institute of Environmental Health Sciences 1998; Institute of Electrical and Electronic Engineers 2002). The ANSI/IEEE standards; NCRP recommendations, International Commission on Non-Ionizing Radiation protection (ICNIRP) guidelines, American Conference of Governmental Industrial Hygienists, Inc. (ACGIH) guidelines suggest maximum permissible 60-hertz (Hz) electric field levels for public exposure at 4.2 to 10 kilovolts (kV) per meter.

B. METHOD OF EVALUATION OF IMPACTS

The Modal and HST Alternatives were analyzed for EMF/EMI by a search of existing literature and expert opinion (volunteer scientists and engineers from academia and industry working in accordance with IEEE rules) based on that literature. Issues concerning EMF[1] biological and health effects at all frequencies of concern for the HST alternative are the subject of the scientific discipline known as bioelectromagnetics, which is served by The Bioelectromagnetics Society, other scientific organizations, and an extensive scientific literature that has been critically reviewed by scientific expert committees convened by a number of national and international bodies. This body of

[1] EMF covers ELF and RF forms of electric and magnetic fields, and electromagnetic fields.

information is used in this Program EIR/EIS to describe the potential effects for each of the system alternatives. The medical and scientific communities have been unable to determine whether usual residential exposures to EMFs cause health effects or to establish any standard or level of exposure that is known to be either safe or harmful.

3.6.2 Affected Environment

A. STUDY AREA DEFINED

The study area for EMF/EMI associated with operation of the alternatives is limited to potentially affected land uses and populations in the vicinity of the alternative corridors.

B. GENERAL DISCUSSION OF ELECTROMAGNETIC FIELDS

EMFs occur both naturally and as a result of human activity. Naturally occurring EMFs include those caused by weather and the earth's magnetic field. EMFs also are generated by technological application of the electromagnetic spectrum for uses such as the generation, transmission, and local distribution of electricity; electric appliances; communication systems; marine and aeronautical navigation; ranging and detection equipment; industrial processes; and scientific research.

EMFs are described in terms of their frequency, or the number of times the electromagnetic field changes direction in space each second. Natural and human-generated EMFs encompass a broad frequency spectrum. In the United States, the electric power system operates at 60 Hz, or cycles per second, meaning that the field reverses its direction 60 times per second. In Europe, some parts of Japan, and many other regions, the frequency of electric power is 50 Hz. Radio and other communications operate at much higher frequencies; many are in the range of 500,000 Hz (500 kilohertz) to 3 billion Hz (3 gigahertz). In areas not immediately adjacent to transmission lines, 60-Hz EMFs exist because of electric power systems and uses such as building wiring and electrical equipment or appliances.

The strength of magnetic fields often is measured in µT or mG. As a baseline for comparison, the geomagnetic field ranges from 50 to 70 µT (500 to 700 mG) at the surface of the earth. Research on ambient magnetic fields in homes and buildings in several western states has found average magnetic field levels within rooms to be approximately 0.1 µT (1 mG), while measured values range from 0.9 to 2.0 µT (9 to 20 mG) in the immediate area of appliances (Severson et al. 1988, Silva et al. 1988).

Depending on the configuration of the source, the strength of an EMF decreases in proportion to distance or distance squared, or even more rapidly. Because the rate of decrease and the distance at which impacts become insignificant depend on technical specifications such as the source's geometric shape, size, height above the ground, and operating frequency, it is not possible to define a characteristic distance for the extent of field effects that applies in general for all sources. Because of their rapid decrease in strength with distance, EMFs in excess of background levels are likely to be experienced only comparatively near sources. Consequently, only persons on or in close proximity to the proposed HST system would be likely to experience such increases, and while HST operations could introduce some very low but measurable changes in 60-Hz magnetic fields up to 1,000 feet or more from the right-of-way, these low-level changes are not known to be hazardous. ELF is variously defined as having a lower limit of greater than zero (3 or 30 Hz) and an upper limit of 30, 100, 300, or 3000 Hz. The HST catenary and distribution systems will primarily have 60-Hz fields.

In addition to the 60-Hz EMFs generated by the power supply system, the HST Alternative would generate incidental RF fields, and would also use RF fields for wireless communications. The 60-Hz electric and magnetic fields from power-supply systems would occur everywhere near the energized conductors, but only the magnetic fields would vary in strength depending on load. Load would depend on the number of trains in the segment and their operating conditions (acceleration, speed, weight of vehicles, passengers and freight, grade). Hence, in time, the magnetic fields (MFs) are variable, whereas the electric fields (EFs) are constant. Similarly, EFs along the route would be similar for a given distribution and transmission voltage, whereas MFs along the route would depend on nearby loads. Therefore, daily MF averages would differ for different locales because of different local HST traffic. The information presented in this document primarily concerns EMFs at power frequencies of 50 or 60 Hz, and RFs produced intentionally by HST communications or unintentionally by electric discharges (arcing) between the catenary wire and the train's power pickup and other sources of corona discharge typical of high-voltage systems. EMI occurs when the EMFs produced by a source adversely affect operation of an electrical, magnetic, or electromagnetic device. EMI may be caused by a source that intentionally radiates EMFs (e.g., a broadcast station) or one that does so incidentally (e.g., an electric motor).

C. POTENTIALLY AFFECTED LAND USES AND POPULATIONS

Public and occupational exposure to EMFs is widespread and encompasses a broad range of field intensities and durations. Land uses of interest for potential impacts from exposure to EMFs are residences, schools, and daycare centers along the corridors for each of the alternatives. Specialized uses of interest for evaluation for possible sensitivity to EMI are wireless communication, health care, scientific, and military facilities. These facilities may be used for purposes that include public safety, commerce, radio and television broadcasting, scientific research, commercial fabrication, and military testing and operations. The levels of EMF generation are unlikely to impair radio and radar communications at an airport because of the distance between the control tower and the proposed alignments. Transportation alignments may abut property used for educational, medical, religious, and athletic activities. In rural settings, land is largely undeveloped or in agricultural use but can have any of the other uses noted for urban and suburban areas. In addition, transportation passengers and workers would be exposed to EMFs in or below the range of EMFs generated by other rapid transit and electric railroad systems.

3.6.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

Under the No Project Alternative, EMFs along existing roadways and railroad rights-of-way would be affected by technological developments in the period before 2020 and by technology- and population-driven changes in total energy consumption. General EMF levels may increase because of massive implementation of low-level RF and infrared for radar and radar-like purposes, as well as possible wireless data transfer for vehicle control by advanced automotive technologies such as collision-avoidance systems and automatic vehicle guidance systems implemented on freeways and highways. Expansion of conventional rail and transit systems using electric propulsion would also increase levels of ELF magnetic fields near new electrical infrastructure. However, any changes in transmission line loads would not directly change residential magnetic fields significantly (Swanson 1996). In addition, the large-scale use of electrically powered automobiles could increase general EMF exposure. The No Project Alternative is not likely to cause significant changes in EMF levels, or human exposure to EMFs or EMI.

B. NO PROJECT COMPARED TO MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

Modal Alternative

Under the Modal Alternative, improvements to airports may increase EMFs because of increased use of radar, radio communications, and instrument landing systems. ELF magnetic fields produced by the electric power system would increase because of additional power used by new or enlarged terminal facilities. However, an expanded airport operation would be local to the facility (control tower) and lines immediately serving it, not a general effect on surrounding neighborhoods or communities (noting that general residential magnetic field exposures are not directly related to transmission line loads) (Swanson 1996). Therefore, the Modal Alternative is not likely to cause significant changes in EMF levels, or human exposure to EMFs or EMI.

High-Speed Train Alternative

Under the HST Alternative, an electrified train system would require delivery of a variable amount of electric power (a maximum per trainset on the order of 10 megawatts) at ± 25 kV of 60 Hz power by an overhead catenary system (OCS) extending the length of the right-of-way. The OCS would be powered from multiple supply substations located near the right-of-way and connected via high-voltage transmission lines to the statewide electric power grid. Two-phase power at ±25 kV would be carried on overhead transmission lines or in cables from supply substations to the OCS. In addition, substations at intermediate locations would serve switching and power boosting functions, although they would not be connected to the power grid. Control, monitoring, safety, and communications systems for railroad operations would use a fiber-optic cable system. Wireless communications would connect trainsets to the fiber-optic cable system. In addition, there would be a standard railroad block control system that would use a small current in the rails to sense train location.

Various components of the HST infrastructure and the trains themselves would be sources of both ELF and RF EMFs. Many of the ELF sources resemble the power lines, substations, and transmission lines used for the statewide electric power system, with the distinction that wayside power uses two electrical phases rather than the three phases that the California and national power systems use. Three-phase 60-Hz power would be supplied from high-voltage transmission lines connected to the power grid for conversion at substations to two-phase ±25-kV, 60-Hz power supplied to the OCS and trains. RF EMF, a principal source of EMI, is produced at the right-of-way by intermittent contact (unintentional arcing) between the pantograph power pickup and catenary wire. RF of this type is characterized by a band of frequencies ranging from kilohertz to megahertz. For transfer of data and voice communications from the fiber-optic trunk to trains in motion, narrow-band RF EMF would be radiated at low power from a lossy coaxial cable or similar antenna design located within the right-of-way. These RF EMFs would resemble, in frequency and field strength, the signals from short-range radio technologies such as walkie-talkies and cellular telephone handsets.

Figure 3.6-1 illustrates overall average magnetic field levels in five frequency bands for 14 transportation systems. Magnetic fields at 50 Hz in a French Train à Grande Vitesse (TGV) vehicle were averaged for measurements made at the head, ankle, and waist of passengers riding in several different vehicles and at several times. The overall 50-Hz magnetic field average was less than 0.5 µT (5 mG). This was several times less than for passengers on a conventional electrified train or electric shuttle bus, but several times greater than for passengers on ferry boats, non-electrified trains, escalators, and people-mover walkways. Localized magnetic fields in an HST vehicle can significantly exceed the overall average. Railroad EMFs decrease with distance from the right-of-way, substation, or power line and have negligible regional or statewide impact.

The HST system would traverse diverse geography and land uses in California with a diversity of potential EMF exposure in urban, suburban, rural, agricultural, and industrial regions. The populations potentially exposed to EMFs from the HST system include passengers, train crew, and other HST workers, as well as people in residences immediately adjacent to the distribution lines or rail line and at adjacent commercial, industrial, educational, medical care, military, and recreational facilities. Present understanding of health effects from long-term exposure to ELF magnetic fields is incomplete but shows that risks to the health of children and adults are either low or nonexistent. Effects of EMI may occur depending on distance to HST facilities and operating conditions. The variable nature of HST power consumption, which changes with

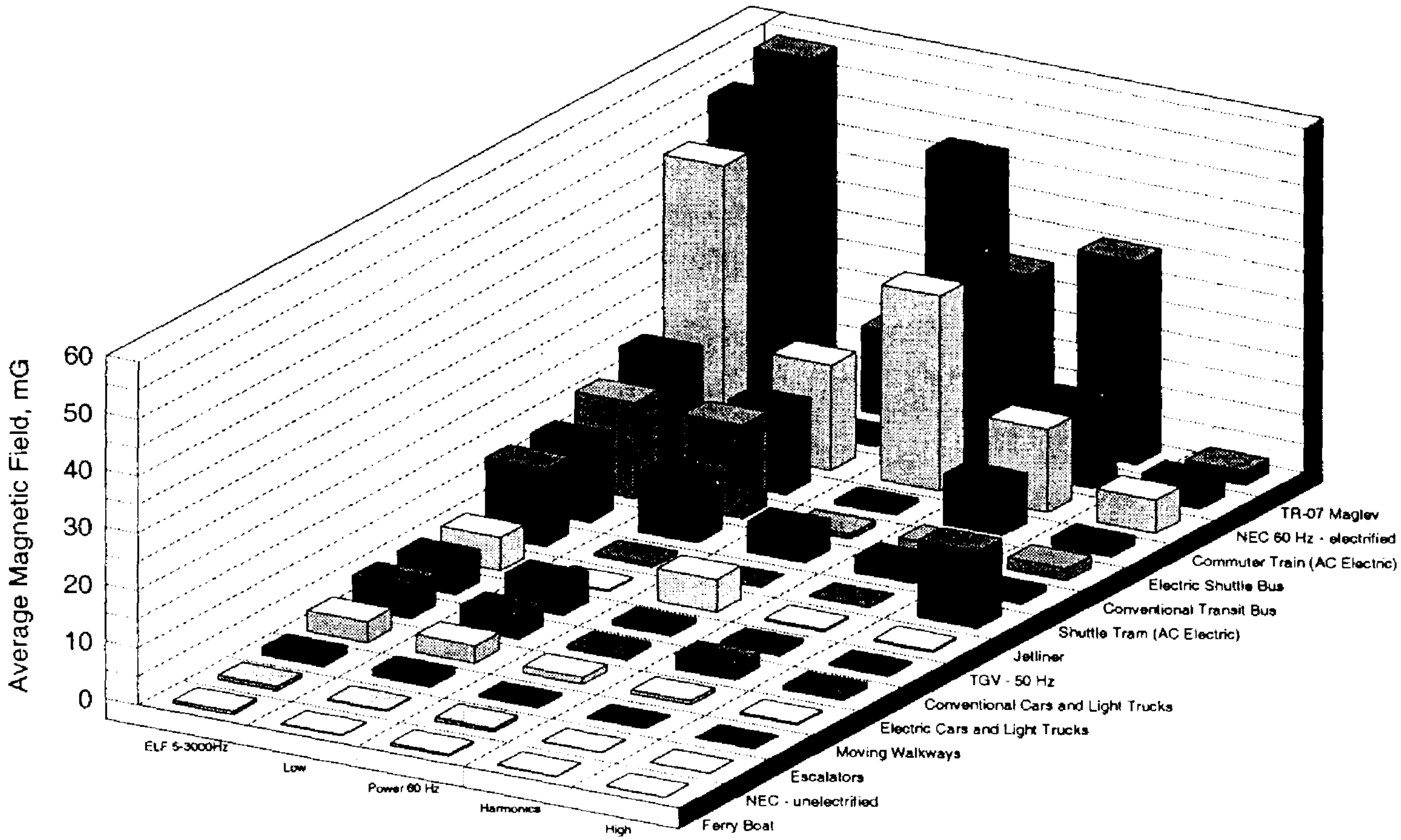


Figure 3.6-1. Magnetic Field Levels for 14 Transportation Systems

Dietrich and Jacobs, 1999

operational conditions that include the distance to a moving train, number of operational trains, and train acceleration and velocity, indicates that comparisons to less variable sources of ELF EMF fields may not be appropriate. There is little potential for strong ELF EMFs that can interfere with implanted biomedical devices (cardiac pacemakers, defibrillators, and infusion pumps) to be generated, with the possible exception of potential exposures of HST maintenance workers. For current data and designs, it is not likely that the MF inside an HST vehicle could interfere with even the most susceptible pacemaker. Overall, it can be expected that the HST Alternative would introduce additional EMF exposures or EMI at levels for which there are no established adverse impacts.

3.6.4 Design Practices

Standard design practices for overhead catenary power supply systems and vehicles include the use of appropriate materials, spacing, and shielding to avoid potential EMF/EMI impacts.

3.6.5 Mitigation Strategies and CEQA Significance Conclusions

ELF magnetic fields can best be mitigated by design features that reduce fields at the source, but shielding of large sources (bigger than a transformer in a building, or 4 to 8 cubic m) in affected environments would not be not practical. Careful design of the OCS, substations, and transmission lines could reduce ELF magnetic fields to a practical minimum.

Mitigation of ELF electric fields is sometimes possible by changes in the design of the source, and some shielding of a large source can be achieved by increasing vegetation. Relatively effective shielding of 60-Hz electric fields is afforded by ordinary building materials, and very good shielding is afforded by metal panels or screens.

EMI can be reduced at the project level through designs that minimize arcing and radiation of RF energy. Additional mitigation by shielding of sources is not practical, but susceptibility to EMI can be reduced by choosing RF devices designed for a high degree of electromagnetic compatibility. In some cases, electronic filters can be added to attenuate RF EMI. Relocation of receiving antennas and changes in antenna design to models with greater directional gain could mitigate EMI impacts, particularly for sensitive receptors near the HST system.

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for effects on human beings, it is expected that potential adverse effects from electromagnetic fields due to the proposed HST alternative could be avoided or mitigated to a less-than-significant level. Many of the design practices and mitigation strategies will be dependent on the project-level analysis and refinement of mitigation measures to address site-specific impacts. Specific structures and receptors evaluated at the project-level will influence the design of power supply systems and vehicles to shield and avoid EMF/EMI impacts, and mitigation measures refined from the mitigation strategies in this program EIR/S are expected to avoid or substantially lessen the impacts. Additional environmental assessment will allow more precise evaluation in the second-tier, project-level environmental analysis.

3.6.6 Subsequent Analysis

The following issues would be evaluated as part of the project-level analysis of an HST system.

- Proximity of occupied structures to high-voltage transmission lines serving supply stations.
- EMFs at passenger stations.
- EMFs in the vehicle compartment. This would require train design to take EMFs into account (e.g., seeking to limit them in the vehicle compartment to the extent practicable and feasible).

- EMFs at specific locations used by the train crew.
- Earth-return currents or power flows in circuits along the rails, where some fraction of the current finds its way back to substation or generating station through the earth for various regions and soil conditions, and the effects of different design and construction practices on these currents. The substations and generating stations would themselves be soundly connected to ground, allowing the earth currents to return there.
- Identification of specific structures (e.g., pipelines, cables, fences) that are particularly susceptible to induced ELF currents and methods for mitigation.
- Identification of receptors (e.g., telecommunications and research facilities) at specific locations with possibly greater sensitivity to EMI impacts.
- Spectral composition of RF generated by the pantograph-catenary contact under operational conditions.
- Technical features (e.g., frequency, field strengths, and modulation system) of the right-of-way-to-train wireless communications system.
- Consider development of an electromagnetic compatibility control plan (as described in APTA SS-E-010-98) to characterize EMI sources, reduction techniques, and susceptibility control procedures (shielding, surge protection, fail-safe circuit redesign, changed location of antennas or susceptible equipment, redesign of equipment, enclosures for equipment); include a safety analysis and failure analysis; and address grounding or shorting hazards.

3.7 LAND USE AND PLANNING, COMMUNITIES AND NEIGHBORHOODS, PROPERTY, AND ENVIRONMENTAL JUSTICE

This section evaluates the potential impacts of the No Project, Modal, and High-Speed Train (HST) Alternatives on land use compatibility, communities and neighborhoods, and property. This section also addresses environmental justice in accordance with the provisions of Executive Order (EO) 12898. This evaluation describes how existing conditions compare with the No Project Alternative and how the No Project Alternative compares with the potential impacts of the HST and Modal Alternatives, including a comparison among the HST alignment and station options within segments of the proposed HST system, in the five regions being studied.

3.7.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY PROVISIONS

Land Use, Communities and Neighborhoods, and Property

This section addresses the potential effects of each of the alternatives on existing and planned land uses. This section includes a discussion of the existing uses in and adjacent to areas where property acquisition may be needed for an alternative, an analysis of the changes to these uses which may occur with an alternative, a discussion of potential inconsistencies with land use plans, and identification of general mitigation strategies. The discussion of potential inconsistencies with planned land uses does not imply that the California High Speed Rail Authority (Authority), a state agency, would be subject to such plans or local ordinances, either directly or through the NEPA or CEQA process. The information is provided in order to indicate potential land use changes that could result in potential environmental impacts.

Environmental Justice

EO 12898, known as the federal environmental justice policy, requires federal agencies to address to the greatest extent practicable and permitted by law the disproportionately high adverse human health and environmental effects of their programs, policies, and activities, on minority populations and low-income populations in the United States. Federal agency responsibilities under this EO also apply to Native American programs. Department of Transportation (DOT) Order 5610.2 on environmental justice defines "disproportionately high and adverse effect on minority and low-income populations" to mean an adverse effect that is predominately borne by a minority population and/or a low-income population, or will be suffered by the minority population and/or low-income population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the non-minority population and/or non-low-income population (Department of Transportation Order 5610.2, Appendix Definitions, subd.[g]).

The California Government Code defines environmental justice as the "fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies" (California Government Code § 65040.12[e]). There are no specific state procedures prescribed for consideration of environmental justice issues related to the proposed HST system.

B. METHODS OF EVALUATION OF IMPACTS

The analysis was conducted using existing U.S. Census 2000 tract information/data compiled in a geographic information systems (GIS) format, local community general plans or regional plans, and land use information provided by the planning agencies in each of the regions. Existing and future conditions were described for the No Project Alternative by documenting existing information for existing and planned future land use policy in potential alignment, potential station and existing airport areas, development patterns for employment and population growth, demographics, communities and neighborhoods, housing, and economics. The No Project Alternative was compared to the planned uses reflected in general plans and regional plans to see if it may result in potential effects on future development. The general and regional plans consulted for this section are listed in Chapter 12, Sources Used in Document Preparation.

The ranking systems described below were used to evaluate potential impacts for all three alternatives for land use changes, land use compatibility, and property. Potential impacts on communities and neighborhoods were also considered. The presence of minority populations and low-income populations in the study area for the alternatives was identified in order to consider potential environmental justice issues. Because this is a programmatic environmental review, the analysis of these potential impacts was performed on a broad scale to permit a comparison of relative differences among the alternatives. Further evaluation of potential impacts would occur at the project-level environmental review, should a decision be made to proceed with the proposed HST system.

<u>Land Use Compatibility</u>

The potential compatibility of the alternatives with existing land use is evaluated based on the potential sensitivity of various land uses to the changes which would be included with the Modal and HST Alternatives, and the potential impact of these changes on existing and planned land uses. For example, homes and schools are more sensitive to changes that may result in increased noise and vibration (see Section 3.4, Noise and Vibration) or increased levels of traffic congestion (see Section 3.1, Traffic and Circulation). Industrial uses, however, are typically less sensitive to these types of changes because they interfere less with normal industrial activities. Since in this analysis an area's sensitivity or compatibility is based on the presence of residential properties, low, medium, and high levels of potential compatibility are identified based on the percentage of residential area affected, the proximity of the residential area to facilities included in the Modal or HST Alternatives, and the presence of local or regional uses (such as parks, schools, and employment centers.). For highway corridors (under the No Project and Modal Alternatives) and for proposed HST alignments, land use compatibility was assessed using GIS layers (or aerial photographs where available) to identify proximity to housing and population, and to determine whether the alignments would be within or outside an existing right-of-way in the study area. Potential impacts are considered low if existing land uses within a potential alignment, station, airport expansion area, or maintenance facility area are found to be compatible with the land use changes that may result from either the Modal or HST Alternative. The type of improvement that would be associated with either the Modal or HST Alternative would also affect the level of potential impact. Improvements such as potential widening of an existing right-of-way or the need for new right-of-way were considered to have a low compatibility with agricultural land. Conversely, if the improvement would be contained within the existing right-of-way or within a tunnel, the alternative was considered to be compatible with agricultural land.

Future land use compatibility is based on information from general plans and other regional and local transportation planning documents. These documents were examined to assess an alternative's potential consistency with the goals and objectives defined therein. The Modal Alternative is considered compatible if the highway or airport improvement is in the regional transportation plan (RTP) or regional airport master plan. The HST Alternative is considered highly compatible if it would be located in areas planned for transportation multi-modal centers or corridor development, redevelopment, economic revitalization, transit-oriented development, or high-intensity employment. Compatibility would be considered low if an alternative would be potentially inconsistent with local or regional planning documents. Table 3.7-1 summarizes the potential compatibility rating of existing and planned land use types with the alternatives, including potential HST alignment and station options. Thus, where potential compatibility would be rated low, the potential for impacts would be higher, and where potential compatibility would be rated high, the potential for impacts would be lower.

Table 3.7-1
Compatibility of Land Use Types

Low Compatibility	Medium Compatibility	High Compatibility
Single-family residential, neighborhood park, habitat conservation area, elementary/middle school, agricultural (widened or new right-of-way needed)	Multifamily residential, high schools, community parks, low-intensity industrial, hospitals	Business park/regional commercial, multifamily residential, existing or planned transit center, high intensity industrial park, service commercial, commercial recreation, college, transportation/utilities, high-intensity government facilities, airport or train station, agricultural (tunnel or no new right-of-way needed)

Communities and Neighborhoods

A potential impact on a community or neighborhood was identified if an alternative would create a new physical barrier, isolating one part of an established community from another and potentially resulting in a physical disruption to community cohesion. Improvements to existing transportation corridors, including grade separations, would not generally result in new barriers.

Property

Assessment of potential property impacts is based on the types of land uses adjacent to the particular proposed alignment, the amount of right-of-way potentially needed due to the construction type, and the land use sensitivity to potential impacts. Impacts include potential acquisition, displacement and relocation of existing uses, or demolition of properties.

In some instances, relatively minor strips of property would be needed for temporary construction easements or permanent right-of-way for the proposed HST alignments or highway expansions. In other instances, implementation of proposed facilities may result in acquisition, displacement, and/or relocation of existing structures. The types of property impacts that may occur include displacement of a residence or business or division of a farm or other land use in a way that makes it harder to use. Mitigation may also be required to maintain property access. Potential property impacts were ranked high, medium, or low as summarized below in Table 3.7-2.

Table 3.7-2
Rankings of Potential Property Impacts

	Type of Development						
	Residential			Non-residential			
Facility Requirements	Rural/ Suburban	Suburban/ Urban	Urban	Rural Developed	Suburban Industrial/ Commercial	Urban Business Parks/ Regional Commercial	Rural Non-developed
No additional right-of-way needed (also applies to tunnel segments for HST Alternative)	Low	Low	Low	Low	Low	Low	Low
Widening of existing right-of-way required	Medium	Medium	High	Low	Medium	High	Low
New corridor (new right-of-way required; includes aerial and at-grade arrangements)	High	High	High	Medium	Medium	High	Low to medium

To determine potential property impacts, the land uses within 50 feet (ft) (15 meters [m]) of either side of the existing corridor, or within 50 ft (15 m) of both sides of the centerline for new HST alignments, were characterized by type and density of development. Densities of structures, buildings, and other elements of the built environment are generally higher in urbanized areas. Rural/suburban residential refers to low-density, single-family homes. Suburban/urban is medium density, multifamily housing such as townhouses, duplexes, and mobile homes. Urban residential refers to high-density multifamily housing such as apartment buildings. Rural developed non-residential uses typically occur in non-urbanized areas and often include developed agricultural land such as vineyards and orchards. Suburban industrial/commercial refers to medium density non-residential uses and includes some industrial uses, as well as transportation, utilities, and communication facilities. Urban business parks/regional commercial refers to non-residential uses that occur in urbanized areas and includes such uses as business parks, regional commercial facilities, and other mixed use/built-up uses. Non-rural undeveloped land includes cropland, pasture, rangeland, and few structures. The classification of development types was based on land use information provided by the planning agencies in each of the regions.

Environmental Justice

This analysis is based on identifying the presence of minority populations and low-income populations in the study area (0.25 mi [0.40 km] from a potential alignment), and generally in the counties crossed by the alignments included in the alternatives. This assessment was done using U.S. Census 2000 information and alignment information to determine if minority or low-income populations exist within the study areas and if they do, whether the alignments would be within or adjacent to an existing transportation right-of-way (lower potential for impacts) or new alignments (higher potential for impacts).

Based on the above information, the analysis determined the following.

- Whether at least 50% of the population in the study area may be minority or low-income.
- Whether the percentage of minority or low-income population in the study area may be at least 10% greater than the average generally in the county or community.

The assessment of potential for impacts on minority and low-income populations considered the size and type of right-of-way needed for the alternatives. For example, if an alignment were within an existing right-of-way, the potential for impacts would be lower. If the alignment would be on new right-of-way, then the potential for impacts may be higher. The potential alignments, however, have been identified and described to largely use or be adjacent to existing transportation rights-of-way in order to avoid or reduce potential impacts on natural resources and existing communities to the extent feasible and practicable (see Chapter 2, Alternatives). Since this is a program-level document, the analysis considers the alternatives on a broad scale, including the proposed HST system as a whole. It is not expected that the proposed HST system as a whole would result in disproportionate impacts on minority or low-income populations. Additional analysis would take place during project-level analysis to consider potential localized impacts.

3.7.2 Affected Environment

A. STUDY AREA DEFINED

The study area for land use compatibility, communities and neighborhoods, and environmental justice, is 0.25 mi (0.40 km) on either side of the centerline of the rail and highway corridors included in the alternatives, and the same distance around stations, airports, and other potential HST-related facilities. This is the extent of area where either the Modal or HST Alternative might result in changes to land use; the type, density, and patterns of development; and socioeconomic conditions. For the property impacts analysis the study area is narrower—100 ft (30 m) on either side of the alignment centerlines—to better represent the properties most likely to be impacted by the improvements included in the alternatives (e.g., potential highway widenings or potential HST lines).

The planned land use for all regions is generally described by city and county general plans that encompass the alignments for the HST and Modal Alternatives. Several regulatory agencies and special districts also have future development plans that are considered in this analysis for lands these alternatives would cross. Communities have typically recognized and incorporated the existing rail and highway corridors in their general land use plans, and most communities encourage transit-oriented development and transit facilities to relieve highway congestion and improve mobility.

Other resources such as U.S. Census 2000 data, California Department of Finance data, aerial photos, and field observations were used to document existing and future (Year 2020) conditions for demographics, communities, and neighborhoods.

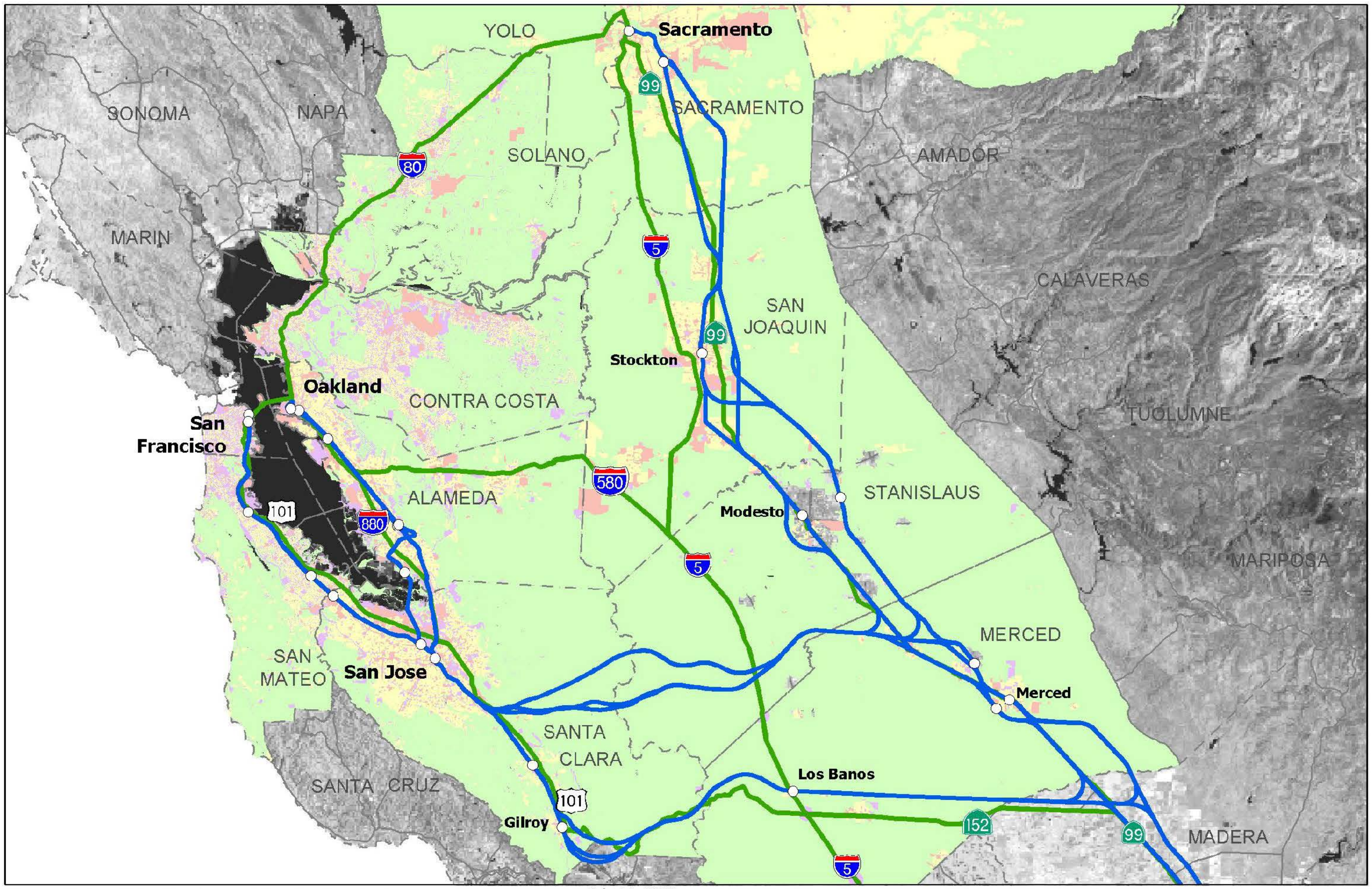
Figures 3.7-1 through 3.7-4 show the general land uses existing in each region.

B. DISCUSSION OF RESOURCES BY REGION

This section briefly describes the five regions the project would potentially traverse and briefly discusses the land use-related resources in the regions under the following five categories: existing and planned land use, population characteristics, income, neighborhood and community characteristics, and housing.

For this discussion, land use data came from local governments and regional agencies such as metropolitan planning organizations. The source of demographic information (existing population

Figure 3.7-1
Existing Land Use Bay Area to Merced, and Sacramento



Source: Various Cities, Counties, and Planning Organizations

July 14, 2003

California High Speed Train Program EIR/EIS

5 0 5 10 15 20 Miles

5 0 5 10 15 20 Kilometers

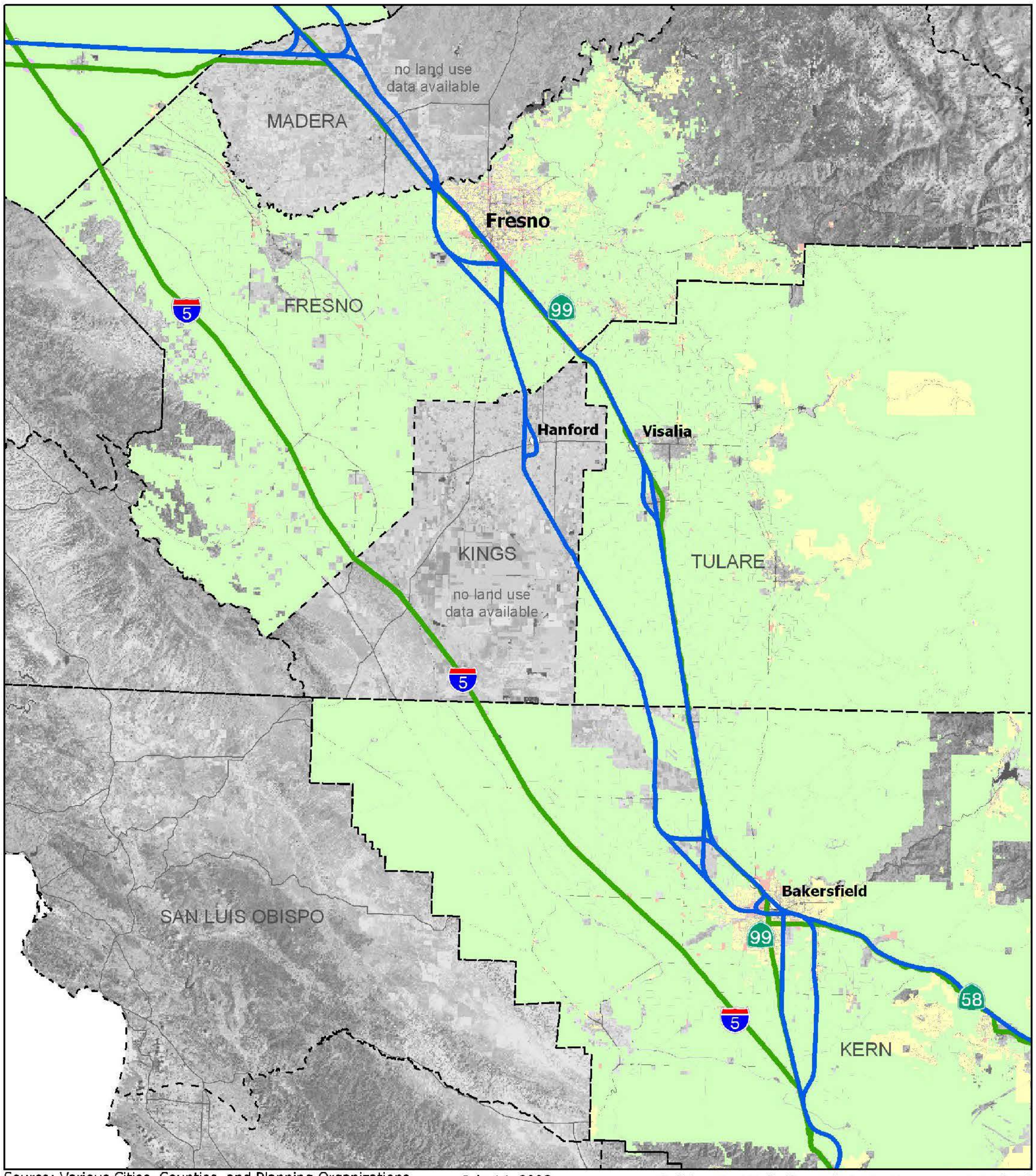
CALIFORNIA HIGH SPEED RAIL AUTHORITY

Legend

- Residential
- Commercial/Industrial
- Other Urban Built-Up
- Agricultural/Open Space
- High Speed Train Alignment and Stations
- Modal (Highway) Alignment

Land Use
Bay Area/Sacramento to Merced

Figure 3.7-2
Existing Land Use Merced to Bakersfield



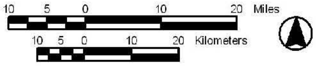
Source: Various Cities, Counties, and Planning Organizations

July 14, 2003

California High Speed Train Program EIR/EIS

Legend

- Residential
- Commercial/Industrial
- Other Urban Built-Up
- Agricultural/Open Space
- High Speed Train Alignment and Stations
- Modal (Highway) Alignment



CALIFORNIA HIGH SPEED RAIL AUTHORITY

Land Use
Merced to Bakersfield

Figure 3.7-3
Existing Land Use Bakersfield to Los Angeles

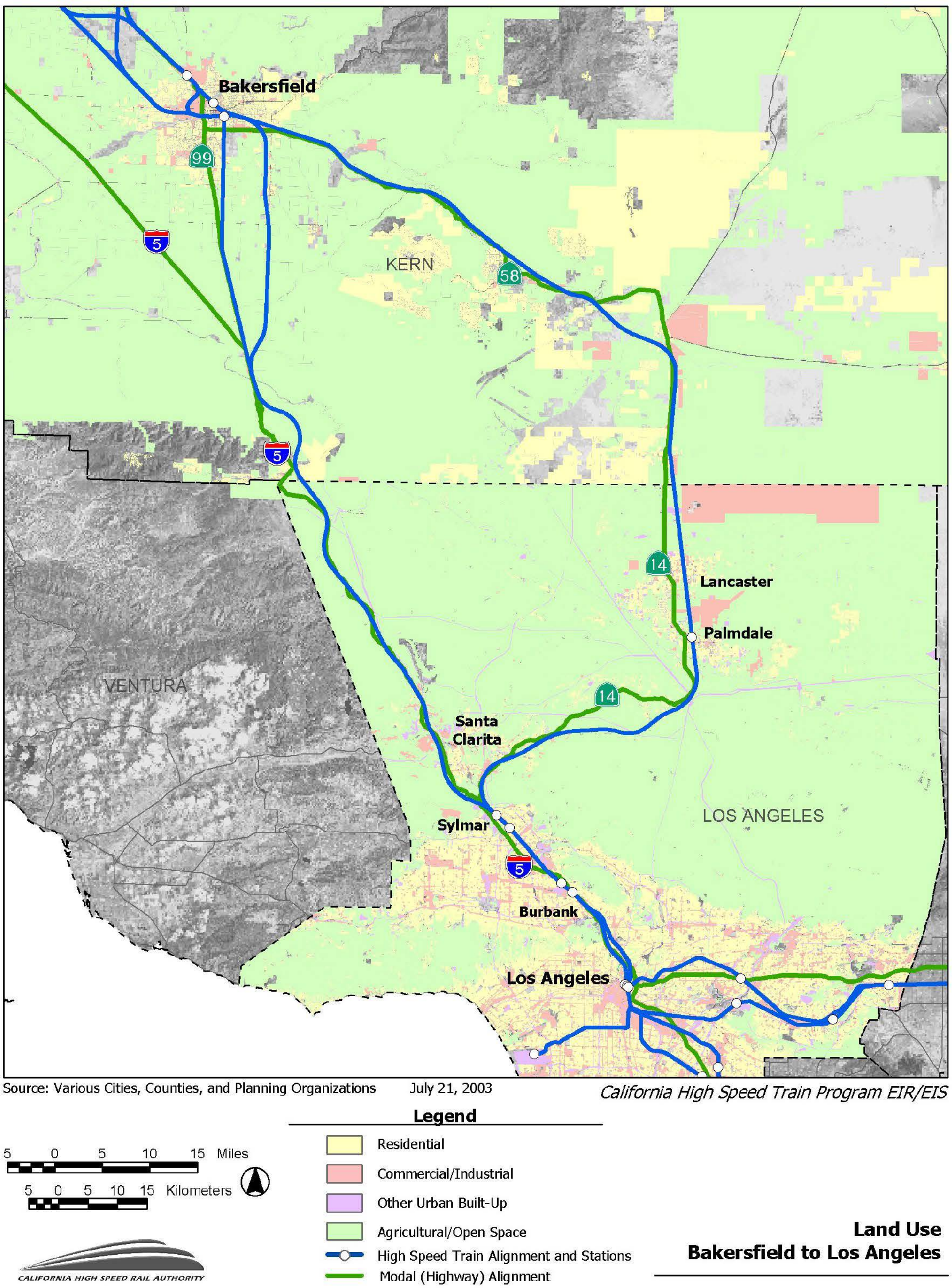
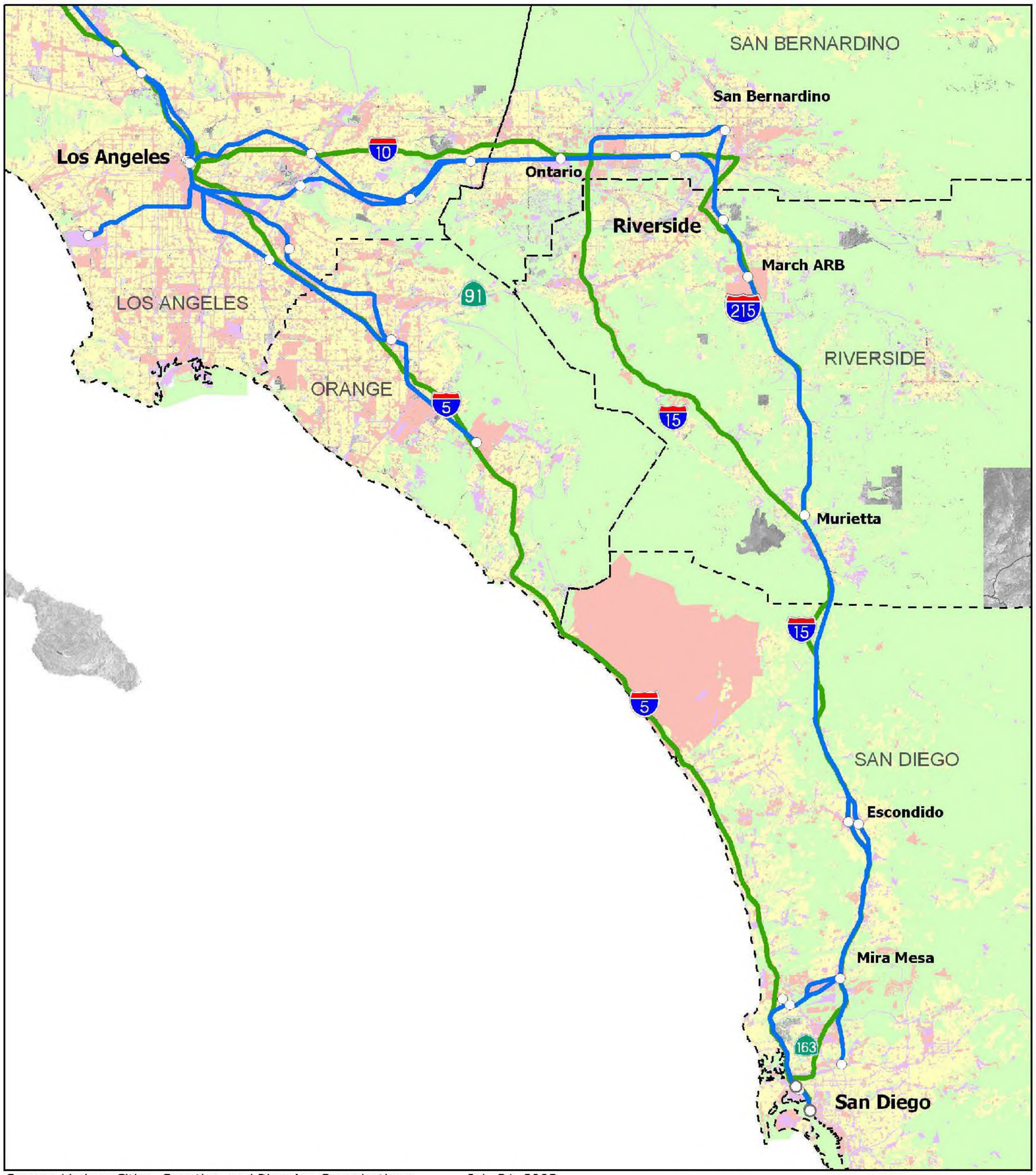


Figure 3.7-4
Existing Land Use Los Angeles to San Diego (via Inland Empire and Orange County)



Source: Various Cities, Counties, and Planning Organizations July 21, 2003

California High Speed Train Program EIR/EIS

Legend

- Residential
- Commercial/Industrial
- Other Urban Built-Up
- Agricultural/Open Space
- High Speed Train Alignment and Stations
- Modal (Highway) Alignment

5 0 Miles
5 0 5 10 15 Kilometers

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Land Use
Los Angeles to San Diego

and projects, ethnicity, income, and housing) was primarily the California Department of Finance and U.S. Census 2000. This data, as well as existing and planned land use information, were compiled in a GIS format.

Bay Area to Merced

This region includes the San Francisco Bay Area (San Francisco and Oakland) south to the Santa Clara Valley and east across the Diablo Range to the Central Valley.

Existing Land Use: For most of the northern part of the region, the highway (US-101, I-80, I-880, and SR-152) and rail corridors that the Modal and HST Alternatives would use are existing transportation corridors surrounded by the built-up urban areas that they serve. Adjacent land uses are a mix of residential, industrial, commercial, and other urban uses. Industrial uses are concentrated around San Francisco International Airport (SFO) off US-101, Norman Y. Mineta San Jose International Airport (SJC), and Oakland International Airport (OAK). SFO and OAK are adjacent to San Francisco Bay. Commercial and residential uses are located to the southwest of SJC. The Don Edwards San Francisco Bay National Wildlife Refuge lies on the east side of the Bay, as discussed in Section 3.15, Biological Resources and Wetlands. The southern part of the US-101 corridor in this region includes some agricultural uses and rangeland. The segment of SR-152 between US-101 and I-5 passes through the Diablo Mountain Range and continues through Pacheco State Park, Cottonwood Creek Wildlife Area, and other open space, wildlife, and recreational areas. Agriculture and rangeland uses are prevalent east of I-5. Proposed HST alignment options would pass through the Diablo Mountain Range north of or through Henry Coe State Park and north of the Andersen Reservoir. HST options that are proposed farther south would pass through or by Gilroy through primarily agricultural lands.

Population Characteristics: The Bay Area to Merced region includes 13 counties: Madera, Merced, San Benito, Stanislaus, Santa Clara, Alameda, San Mateo, San Francisco, Contra Costa, Solano, Yolo, Sacramento, and San Joaquin. Population in this region grew from 7.6 million people in 1990 to 8.7 million in 2000, an increase of 14%. By 2020, population in the region is expected to reach 10.8 million, an increase of 23% over 2000 levels. According to U.S. Census 2000, minority persons, defined as non-white persons including persons of Hispanic origin, accounted for the following percentages of total population in the counties in the region (lowest to highest): Yolo 42%, Sacramento 42%, Contra Costa 42%, Stanislaus 43%, San Mateo 50%, Solano 51%, San Joaquin 53%, Santa Clara 53%, Madera 53%, San Benito 54%, San Francisco 58%, Alameda 59%, and Merced 60%.

Income: According to U.S. Census 2000, the average federal poverty threshold for a family of four with two children under the age of 18 is an annual income of $17,603. The percentages per county of households identified as below federal poverty level in this region are (lowest to highest) San Mateo 6%, Santa Clara 8%, Contra Costa 8%, Solano 8%, San Benito 10%, Alameda 11%, San Francisco 11%, Sacramento 14%, Stanislaus 16%, Yolo 18%, San Joaquin 18%, Madera 21%, and Merced 22%.

Neighborhood and Community Characteristics: The portion of the region along the San Francisco Bay and southward into Santa Clara County is generally highly urbanized, and is characterized by a mix of residential communities, commercial, industrial, and public/institutional land uses. As the region continues south and east into the Central Valley, it includes undeveloped and agricultural areas, interspersed with suburban communities.

Sacramento to Bakersfield

This region of central California includes a large portion of the Central Valley (San Joaquin Valley) from Sacramento south to Bakersfield.

Existing Land Use: The existing land uses along the potential routes of the Modal and HST Alternatives in this region are predominantly agricultural, reflecting the Central Valley's heritage as one of the richest, most productive agricultural regions in the world (as discussed in Section 3.8, Agricultural Lands). Much of the land in the vicinity of the highway and rail corridors in the region proposed for improvements is cropland and orchards. Residential development comprises less than 10% of the land area, and commercial, service, and industrial uses together account for less than 10%. Development is focused in and around existing cities and towns where residential, commercial, and industrial uses are concentrated. Beyond city limits, land uses are predominantly agricultural, with scattered rural residences, small towns, and warehouse-style industrial development along the rail and highway corridors included in the Modal and HST Alternatives. Between Sacramento and Stockton, the easterly Central California Traction Company (CCT) alignment traverses more rural lands than the Union Pacific Railroad (UPRR). While much of the area between Stockton and Modesto is agricultural in nature, there are large residential tracts and smaller commercial areas along UPRR and, to a lesser extent, along the Burlington Northern Santa Fe (BNSF) alignment. South of Modesto to Merced, land uses are predominantly agricultural along the HST route that would follow BNSF. Near Merced Airport, a variety of government uses, many ranchettes, and rural residential or agricultural uses are located.

South of the City of Merced, the land uses mirror the predominant land use in this area of the valley: fragmented agricultural lands scattered with residences and a few small towns. As the UPRR rail alignment approaches the Fresno urban core, residential uses dominate the landscape to the east, and a mix of light industrial, heavy commercial, and open space line the stretch on the western side. Beyond industrial uses on the south side of Fresno, development becomes sparser, giving way to scattered rural residences and agricultural uses. Continuing into Tulare County, the various routes proposed for the Modal and HST Alternatives would pass farmlands and the Colonel Allensworth State Historic Park. South of this park all the way into Bakersfield, agriculture is the predominant land use, the only exception being small towns. Approaching Bakersfield, the rail alignments continue into the dense urban environment. At Bakersfield Airport, light industrial and heavy commercial uses line SR-99, with agricultural uses to the west.

Population Characteristics: The Sacramento to Bakersfield region includes nine counties: Sacramento, San Joaquin, Stanislaus, Merced, Madera, Fresno, Tulare, Kings, and Kern. In 2000, there were 4.6 million people living in this region. By 2020, the population is expected to increase by 46% to 6.7 million.

Throughout most of the region, the percentage of whites and Hispanics in the overall population by county is comparable (Fresno: whites 40%, Hispanics 44%; Kings: whites 42%, Hispanics 44%; Madera: whites 47%, Hispanics 44%; Merced: whites 41%, Hispanics 45%; and Tulare: whites 42%, Hispanics 51%). Counties that have non-agricultural industries or are within commuting range of the San Francisco Bay Area tend to have larger percentages of whites (e.g., Sacramento: whites 58%, Hispanics 16%; San Joaquin: whites 47%, Hispanics 31%; Stanislaus: whites 57%, Hispanics 32%; and Kern: whites 49%, Hispanics 38%).

Income: Per-capita income tends to be lower in communities that rely chiefly on an agricultural employment base. For example, Kings County, with a population of 129,500 in 2000, had a workforce of 45,880 people, 14% of which were unemployed, and an average per-capita income of $15,492. Counties that have a more diversified economy (including industries such as oil, healthcare, and technology), such as Kern and Sacramento Counties, tend to support larger workforces at higher average incomes. Sacramento County, with a population of 1.2 million in 2000, had a workforce of 605,500 people, only 4% of which were unemployed, and an average per-capita income of $26,257.

The percentage per county of households identified as below federal poverty level (less than $17,603 annually) in the Sacramento to Bakersfield region is (lowest to highest) Sacramento 14%, San Joaquin 18%, Stanislaus 16%, Kings 20%, Kern 21%, Merced 22%, Madera 21%, Fresno 23%, Tulare 24%.

Neighborhood and Community Characteristics: There are a number of established neighborhoods within the cities along the highways and roadways included as potentially feasible for modification under the Modal Alternative, and along the rail corridors proposed for HST Alternative alignments. There are also a number of older agricultural communities in the unincorporated portions of the counties.

Bakersfield to Los Angeles

This region of southern California encompasses the southern portion of the Central Valley south of Bakersfield, the mountainous areas between the Central Valley and the Los Angeles basin, and the northern portion of the Los Angeles basin from Sylmar to downtown Los Angeles.

Existing Land Use: Along SR-99 and I-5, the corridors relevant to the Modal and HST Alternatives, this region consists of three distinct sub-regions: north, central, and south. The northern portion of the region—from Bakersfield south to the northern base of the mountains—is largely agricultural until it enters the suburban mix of land uses in southern Bakersfield. The central portion of the region crosses the mountains and is characterized by rugged and largely undeveloped land. Much of this area is in national forest, and some is rangeland. A portion of the central segment passes through the high desert suburban communities of Palmdale and Lancaster. In the Santa Clarita area, some areas abutting proposed Modal and HST Alternative alignments are designated significant ecological areas (as described in Section 3.15, Biological Resources and Wetlands). The southern portion, extending from Sylmar to Los Angeles Union Station (LAUS), is an older, highly urbanized area characterized by a mix of residential, commercial, industrial, and public/institutional land uses. Burbank-Glendale-Pasadena Airport is located within this urban context.

Population Characteristics: The Bakersfield to Los Angeles region includes two counties: Kern and Los Angeles. Total population in the region increased from 9.4 million in 1990 to 10.2 million in 2000, an average annual growth of 0.8%. Population in Kern County increased by 118,000 people over that period, but the majority of the growth occurred in Los Angeles County, where population increased by 656,000 people between 1990 and 2000. Total population in the region is expected to increase to 12.7 million between 2000 and 2020, a 1% average annual growth rate. Los Angeles County is expected to contribute the majority (92%) to the forecast increase.

Minority persons, defined as non-white persons, accounted for 51% of Los Angeles County's population in 2000. Minorities accounted for 38% of the population in Kern County. The Hispanic population percentage in Los Angeles County is 45%; it is 38% in Kern County.

Income: Income in the region was $20,363 per capita in 1999, and 18% of the population had incomes below the federal poverty level ($17,603). In Kern County, per-capita income was $15,760, with 21% of the population below the federal poverty level. In Los Angeles County, per-capita income was $20,683, with 18% of the population below the federal poverty level.

Neighborhood and Community Characteristics: As noted above, the Bakersfield to Los Angeles study area consists of three distinct sub-regions: northern, central, and southern. The northern portion, extending from the northern toe of the mountains to Bakersfield, is largely agricultural until it enters the suburban mix of land uses in southern Bakersfield. The central portion crosses the mountains and is characterized by rugged and largely undeveloped land. Much of this area is in national forest. A portion of the central segment passes through the high desert suburban communities of Palmdale and Lancaster. The southern portion, extending from LAUS to Sylmar, is an older, highly urbanized area characterized by a mix of residential, commercial, industrial, and public/institutional land uses.

Los Angeles to San Diego via Inland Empire

This region of southern California includes the eastern portion of the Los Angeles basin from downtown Los Angeles east to the Riverside and San Bernardino areas and south to San Diego generally along the I-215 and I-15 corridors.

Existing Land Use: Existing land use in the LAUS to March Air Reserve Base (ARB) section of the study area in the region is largely developed. The major land use in this area is low-density residential. Combined residential uses comprise nearly 35% of the area adjacent to I-10, while industrial uses predominate along the railroad alignments under consideration for HST alignment options. Transportation and utility uses are present in or adjacent to both rail and freeway rights-of-way. Undeveloped land and commercial uses are also present. The majority of the surrounding land use is low-density residential in the proposed HST segment that would loop through San Bernardino. Industrial uses and undeveloped land comprise the next highest concentration.

Half of the segment between March ARB to Mira Mesa lies in Riverside County, and the other half is in the San Diego Association of Governments (SANDAG) planning area. Undeveloped land is the largest land use in the Riverside County portion of this segment, with agricultural use second. Within the southern section, undeveloped land also makes up the largest portion. Residential uses comprise the next highest land use, followed by agricultural uses. Transportation and utility uses define the land dedicated to the I-15 and I-215 corridors. The variety of land uses along the corridor between Mira Mesa and San Diego reflects the generally suburban nature of northern San Diego and the urban character of the city. Other than transportation-related uses, parks, undeveloped land, commercial, office, and military uses comprise the largest areas. Light industry and institutional uses are found along the proposed Miramar Road HST segment.

Population Characteristics: This region includes four counties: Los Angeles, San Bernardino, Riverside, and San Diego. The population of the region increased by 12% between 1990 and 2000, from 13.9 million people to 15.5 million. By 2020, population in this region is forecast to reach 20.4 million, a 31% increase.

Minority persons accounted for 51% of Los Angeles County in 2000, 35% of Riverside County, 41% of San Bernardino County, and 34% of San Diego County. Hispanic population accounted for 45% of Los Angeles County in 2000, 36% of Riverside County, 39% of San Bernardino County, and 27% of San Diego County.

Income: In Los Angeles County, per-capita income was $20,683, with 18% of the population below the federal poverty level ($17,603). In Riverside County, per-capita income was $18,689, with 14% of the population below the federal poverty level. San Bernardino County had a per-capita income of $16,865, with 16% of the population below the federal poverty level. San Diego County's per-capita income was $22,926, with 12% of the population below the federal poverty level.

Neighborhood and Community Characteristics: The Los Angeles to San Diego via Inland Empire region consists of the older, urbanized areas of central and eastern Los Angeles County, the more recently urbanized portions of western San Bernardino and Riverside counties, the urbanizing areas of central and southwest Riverside County, the urbanizing areas of northwestern San Diego County, and the urbanized portions of the city of San Diego.

Los Angeles to San Diego via Orange County
This region includes the western portion of the Los Angeles basin between downtown Los Angeles and LAX, and the coastal area of southern California between Los Angeles and San Diego, generally following the existing Los Angeles to San Diego via Orange County I-5 highway corridor.

Existing Land Use: This region is largely urbanized, with the exception of the Camp Pendleton military base between San Clemente and Oceanside. The major existing land uses in the study area in this region include single-family residential, commercial and industrial, transportation and utilities, and community parks.

Population Characteristics: This region includes three counties: Los Angeles, Orange, and San Diego. The region's population increased by 10% between 1990 and 2000, from 13.8 million persons to 15.2 million. By 2020, population in this region is forecast to reach 18.6 million, an increase of 23%.

Minority persons accounted for 51% of Los Angeles County in 2000, 35% of Orange County, and 34% of San Diego County. The Hispanic population is 45% in Los Angeles County, 31% in Orange County, and 27% in San Diego County.

Income: In Los Angeles County, per-capita income was $20,683, with 18% of the population below the federal poverty level ($17,603). Per-capita income in Orange County was $25,826, with 10% of the population below the federal poverty level. San Diego County had a per-capita income of $22,926, with 12% of the population below the federal poverty level.

Neighborhood and Community Characteristics: The proposed Modal and HST Alternative (HST and conventional rail) corridors would all pass through communities with similar characteristics. The corridors would cross the metropolitan area of Los Angeles, south Orange County, and the metropolitan area of San Diego. Communities in these areas have both common and unique characteristics shaped by a variety of political, physical, social, and economic factors. The Los Angeles metropolitan area can be characterized as a highly urbanized mix of single- and multifamily neighborhoods, with commercial and industrial development in such communities as Los Angeles, Norwalk, Fullerton, and Anaheim. The area is strongly influenced by the existing transportation network. The south Orange County area can be characterized as smaller communities with strong ties to the coastline. The communities comprise predominantly single-family neighborhoods with supporting commercial and industrial development. Communities such as San Juan Capistrano, Dana Point, and San Clemente represent this area. The San Diego metropolitan area can be characterized as a highly dense urban area rimmed by lower density suburban and coastal communities that have close interaction with coastal resources. Communities that represent this area are Oceanside, Carlsbad, Encinitas, Solana Beach, and Del Mar.

3.7.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

Land use and local communities will change between 2003 and 2020 as a result of population growth and changes of economic activity in the five regions studied (see Chapter 5, Economic Growth and Related Impacts). The No Project Alternative is based on existing conditions and the funded and programmed transportation improvements that will be developed and in operation by 2020. Although it is expected that the No Project Alternative would result in some changes related to land use compatibility, communities and neighborhoods, property, and environmental justice, it was assumed that projects included in the No Project Alternative would include typical design and construction practices to avoid or minimize potential impacts, and would be subject to a project-level environmental review process to identify potentially significant impacts and to include feasible mitigation measures to avoid or substantially reduce potential impacts. Although some changes would be likely, attempting to estimate such changes would be speculative. Therefore, no additional potential impacts were quantified for the No Project Alternative.

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

Land Use Compatibility

The Modal Alternative would be potentially incompatible with existing and planned land use in some segments to a greater extent than the No Project and HST Alternatives, because it would not be consistent with policies that support increased transit alternatives and reduced dependency on the automobile. The highway improvement options would support a dispersed pattern of development and would be inconsistent with local and regional planning objectives that promote transit-oriented higher-density development around transit nodes in order to encourage and increase planned in-fill for more efficient use of land and resources and sustainable growth.

The HST Alternative would include many potential new station locations, which were identified through consultation with local planning agencies and selected to be compatible to the extent possible with future planned land uses. Overall, the proposed HST Alternative would be highly compatible with local and regional plans that support rail systems and transit-oriented development. The HST Alternative would also provide improved inter-modal connectivity with existing local and commuter transit systems.

Communities and Neighborhoods

Similar to the No Project Alternative, the Modal Alternative would generally follow existing transportation corridors and rights-of-way, would not be expected to create new barriers within neighborhoods, and would not be expected to result in potential impacts on community cohesion. Though much of the HST Alternative would follow existing or planned transportation corridors, several alignment options would represent new transportation corridors. Along some of the potential alignments in all regions except the Los Angeles to San Diego via Orange County corridor, there would be potential for localized impacts on community cohesion, which would receive further study during project-level review, if a decision is made to proceed with the proposed HST system, and depending upon the alignments selected in the future.

Property

In the Bay Area to Merced and Los Angeles to San Diego via Orange County regions, potential right-of-way acquisition associated with transportation improvements under the No Project Alternative, such as the expansion of existing facilities and the construction of new facilities, could result in property impacts, which would be addressed in future project-specific environmental analyses prior to the implementation of these improvements. In the Sacramento to Bakersfield, Bakersfield to Los Angeles, and Los Angeles to San Diego via Inland Empire regions, the No Project Alternative is not anticipated to have substantial property impact potential. The No Project Alternative, which includes currently programmed and funded improvements and the mitigation for impacts that would be provided with these improvements as a result of environmental reviews, is the basis for analyzing the potential Modal and HST Alternatives.

Potential property impacts in addition to those under the No Project alternative would be expected to be substantially greater under the Modal Alternative than under the HST Alternative. In urban areas, highways are generally more constrained by denser development (which would have a higher potential for impacts, including residential uses) than railways. Therefore, highway expansion would have greater potential for impacts on land uses than rail expansion. Highways in urban areas also generally use most, if not all, of their existing right-of-way and would require additional right-of-way for expansion. Under the Modal Alternative, 309 mi (497 km) of highway alignment (20% of total Modal Alternative highway alignment in the region) would potentially affect high-impact land uses, and 289 mi (465 km) of alignment (19% of total Modal Alternative highway alignment) would affect medium-impact land uses.

Under the HST Alternative, between 53 mi (85 km) and 88 mi (142 km) of rail alignment and station locations (between 7% and 11% of total alignment distance) would potentially affect high-impact land uses, and between 92 mi (148 km) and 145 mi (233 km) of track alignment and station locations (between 11% and 17% of alignment distance) would potentially affect medium-impact land uses. Commercial and industrial uses are typically located along railways, and these uses buffer residential development from the railroad. Also, in several of the rail corridors under consideration, rail activity could be expanded within the existing right-of-way and would not require additional right-of-way.

Therefore, the HST Alternative would have less potential to affect high-impact land uses than the Modal Alternative. The Modal Alternative would potentially result in more than three times the mileage of high impacts on land uses than the HST Alternative. This potential for more property acquisition and residential and non-residential relocation, and the costs associated with these activities, represents a significant difference between the Modal and HST Alternatives.

Environmental Justice

Many of the alignments included in the Modal and HST Alternatives would be located in existing transportation corridors, which would serve to reduce potential for significant adverse environmental impacts generally. This broad-scale analysis considers the wide variety of landscape types and land uses, both low-density rural areas and developed communities, which would be adjacent to either the Modal Alternative (which would include nearly 3,000 additional highway lane miles [4,828 km] and certain airport expansions) or the HST Alternative (which includes more than 700 mi [1,127 km] of potential alignment and station options). Considering the alternatives on a system-wide basis, it is not expected that either the Modal or HST Alternatives would result in disproportionate impacts on minority populations or low-income populations. In addition, along with the potential environmental impacts analyzed in this Program EIR/EIS, general mitigation strategies are assessed which would be expected to be used to reduce potential impacts, if a decision were made in the future to proceed with the proposed HST system. If a decision were made to go forward with the proposed HST system, project-level review would include more detailed analysis of any potentially significant environmental impacts and mitigation measures to reduce such impacts. Project-level review would include additional consideration of potential localized impacts on neighborhoods and communities, in addition to potential community enhancements and benefits from the proposed HST system.

3.7.4 Comparison of Alternatives by Region

A. BAY AREA TO MERCED

Land Use Compatibility

Modal Alternative: All of the highway improvement options for US-101, I-880, SR-152, I-80, and I-580 would be constructed within or adjacent to existing transportation corridors. These improvements would be highly incompatible with existing land use in the US-101 and I-880 corridors, which are immediately adjacent to many residential neighborhoods and commercial businesses.

The airport improvement options at SJC would occur mostly on existing transportation, industrial, and commercial properties. However, the potential construction of runways on the eastern side of the facility would be highly incompatible with nearby existing residential neighborhoods and Santa Clara University to the west.

The Modal Alternative highway improvement options would be highly incompatible with local and regional plans that have policies favoring increased transportation alternatives and reduced dependency on the automobile. For example, the highway improvement options would support a long-term dispersed pattern of development in the Bay Area to Merced region, which would be inconsistent with local and regional land use planning objectives that promote transit-oriented development around transit nodes as the key to more orderly and sustainable growth. However, the proposed aviation improvements at OAK and SJC would both be compatible with regional RTPs and local general plans addressing airport expansion.

HST Alternative: The Hayward/Niles/Mulford UPRR option would require additional rail track through the Don Edwards San Francisco Bay National Wildlife Refuge, and the northern tunnel and tunnel under park options would require the construction of a new transportation corridor from an eastern terminus north of Merced to the intersection with the Caltrain/UPRR corridor. All three options would potentially be highly incompatible with existing land use because these new corridors would primarily pass through agricultural land and parkland, although the extensive tunnels proposed with these options would avoid most potential parkland impacts. The minimize tunnel option would also require the construction of a new transportation corridor north of Merced, which would be incompatible with existing land use because it would cross at grade through a portion of Henry W. Coe State Park. The Gilroy bypass alignment option (Morgan Hill/Caltrain/Pacheco Pass alignment) would require the construction of a new transportation corridor from its eastern terminus north of Merced to the intersection with the Caltrain/UPRR corridor just north of Gilroy. The new section between the proposed Los Banos Station and the Caltrain/UPRR corridor would have low to moderate compatibility with existing land uses as it passes at grade through agricultural lands, including the Pacheco Creek Valley and Santa Clara Valley. The Gilroy alignment option (Caltrain/Gilroy/Pacheco Pass alignment) would have similar impact levels to agricultural land. Most proposed station sites would be consistent with existing land uses. However, the proposed Gilroy Station site would be potentially incompatible with existing adjacent low-density residential uses and historic structures. Its location, however, would be consistent with policies and actions stated in the Gilroy general plan (City of Gilroy 2002) that place a high priority on strengthening and restoring the downtown area, including the development of an active multi-modal transit center. All of the proposed station sites for the HST Alternative in this region are consistent overall with local and regional plans emphasizing the development of intercity rail service, transportation alternatives, and transit-oriented development. No potentially high impacts are identified in this region.

Communities and Neighborhoods

Modal Alternative: The Modal Alternative highway improvement options would be constructed within or adjacent to existing transportation corridors and are not anticipated to create new physical barriers that would divide neighborhoods or communities.

High-Speed Train Alternative: In locations where the HST Alternative would create a new transportation corridor (such as between San Jose and Merced), the alignment would primarily pass through agricultural or open space lands and would not result in community cohesion impacts in neighborhoods. In the San Francisco to San Jose segment, the corridor would be primarily within an existing active commuter and freight corridor and therefore would not constitute any new physical barriers that would divide neighborhoods or communities. Also, proposed grade separations would not create new barriers. In the San Jose to Oakland segment, the alignment options would be constructed in a tunnel, on an aerial structure, or within an existing rail right-of-way and would not create community cohesion impacts.

Property

Modal Alternative: The highest potential for property impacts due to Modal Alternative highway improvements would occur primarily in urbanized and built-up areas, such as US-101 between San Francisco and San Jose, I-80 between Oakland and Solano County, and most of I-880. Other areas of potential high impacts include the western portion of I-580, and I-80 in the Dixon area. In these locations, the existing facility is built out to the edge of the right-of-way; expansion of these facilities would require additional right-of-way and would have a greater potential for impacting the adjacent dense development.

The lowest potential for property impacts would occur in areas where the densities of development are lower, such as I-580 west of I-5, SR-152, and US-101 south of the San Jose area. Overall, about 140 mi (225 km) of highway alignment improvements (40% of total highway length in the region) would potentially result in high property impacts, and 54 mi (87 km) of alignment (15% of total Modal Alternative highway alignment in the region) would potentially result in medium impacts. About 158 ac (64 ha) around OAK and SJC would potentially result in high property impacts, and 533 ac (216 ha) would potentially result in medium property impacts (see Figure 3.7-5).

High-Speed Train Alternative: The proposed San Jose to Merced alignment options would require new right-of-way. However, since these alignments would traverse areas with agricultural or open space land uses, they would be expected to result in a low potential for property impacts on homes or buildings. Areas of potentially higher property impacts would be expected in built-up locations where the alignments would be located adjacent to the existing transportation corridor or in a new corridor. This would occur in San Francisco south of the proposed 4th and King Station on the Caltrain alignment, and north of the proposed San Jose Station on the I-880 alignment. Between 3 mi (5 km) and 11 mi (18 km) of rail alignment and station locations in the Bay Area to Merced region (between 1% and 5% of total alignment) would potentially result in high property impacts, and between 4 mi (5km) and 9 mi (14 km) of alignment and station locations (between 2% and 5% of total alignment) would potentially result in medium land use impacts (see Figure 3.7-6). Overall, there would be a low potential for property impacts in this region because the rail improvements would be mostly contained within existing right-of-way or in new corridors that are in tunnels or traverse open space.

Environmental Justice

Modal Alternative: Substantial percentages of minority populations are located in the study area for the highway improvement options included in the Modal Alternative (with the exception of the I-580 corridor, which has 40%). For example, the US-101 corridor study area has 68% minority population, I-880 68%, SR-152 60%, and I-80 65%. The OAK and SJC airport study areas both have minority populations of 54% in their study areas.

However, the potential for disproportionate impacts would be expected to be low because most of the highway expansion would occur in the existing right-of-way and would incorporate mitigation to reduce potentially significant adverse effects.

High-Speed Train Alternative: The HST Alternative study area in this region includes a variety of neighborhoods and a diverse multiethnic population. The study areas for all of the proposed HST alignment options have substantial percentages of minority populations. For example, the San Francisco to San Jose study area has a minority population of 52%, Oakland to San Jose 71%, and San Jose to Merced 64%. Significant minority populations were also identified in the vicinity of eight proposed station locations (Los Banos, Gilroy, Santa Clara, Union City, Auto Mall Parkway, Coliseum BART, 12th Street/City Center, and West Oakland). With the exception of the San Jose to Merced alignment, the alignment options would be along existing transportation corridors, and would not be expected to result in disproportionate impacts. Because San Jose to

Figure 3.7-5
Potential Property Impacts Bay Area to Merced
Modal Alternative

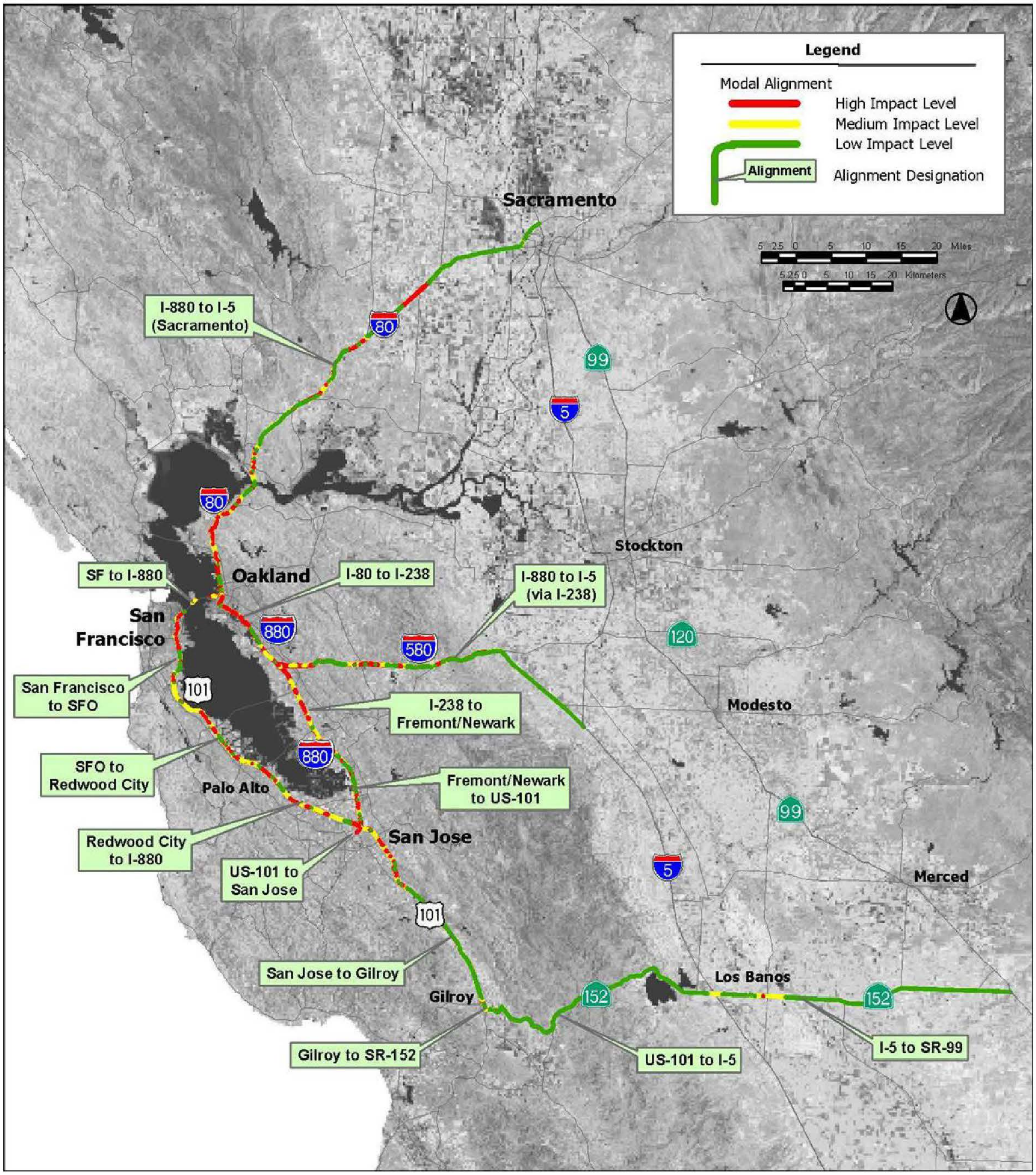
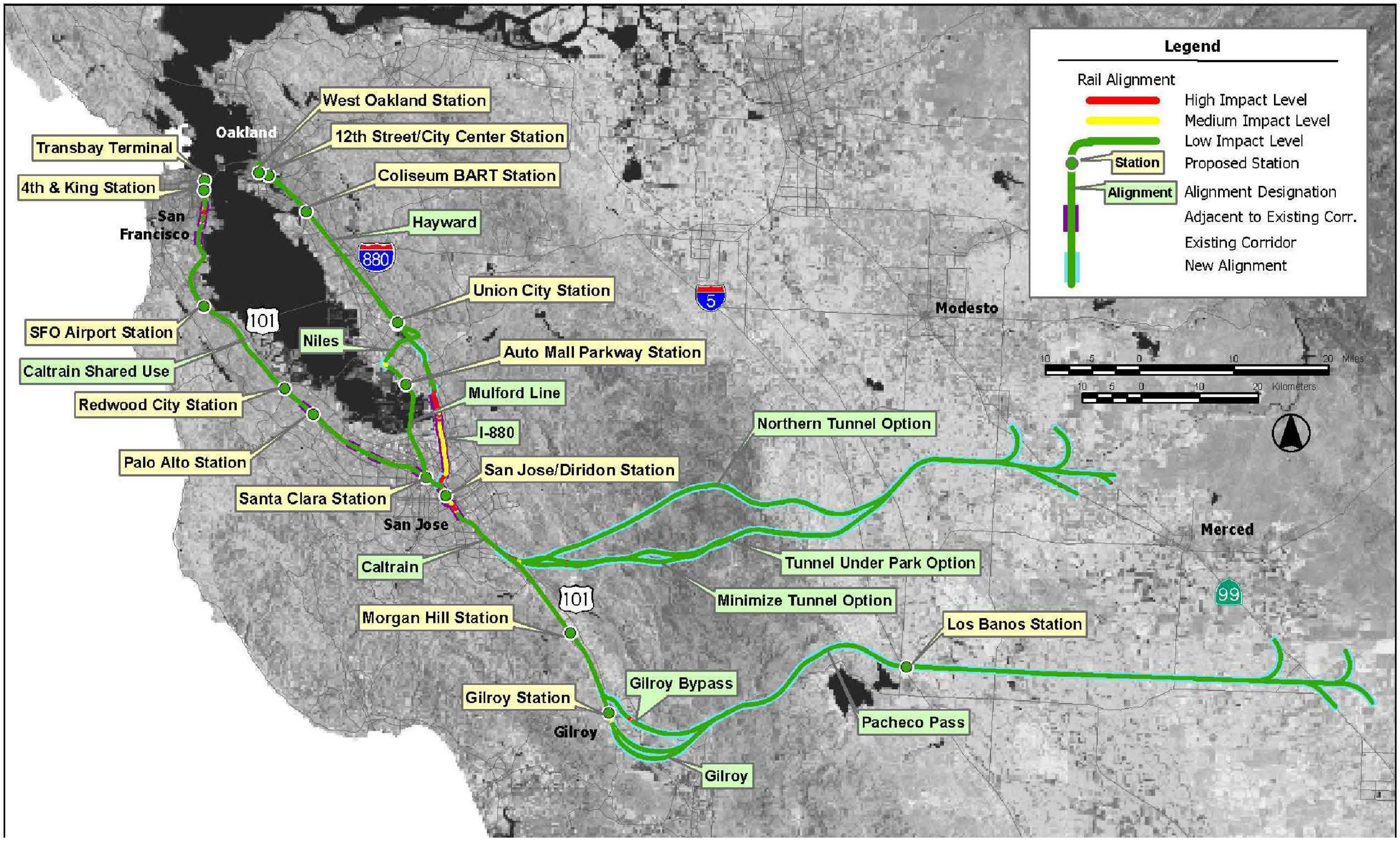


Figure 3.7-6
Potential Property Impacts Bay Area to Merced
HST Alternative



Merced would be a new alignment, there would be a somewhat higher potential for impacts, but impacts would be reduced through the inclusion of feasible mitigation measures.

High-Speed Train Alignment Options Comparison
The Merced to San Jose HST alignment options would be the least compatible with existing land use because these options would require the construction of a new transportation corridor from the eastern terminus near Merced to the intersection with the Caltrain/UPRR rail corridor. Land use compatibility ratings along these segments of the alignment options would range from low to medium. The minimize tunnel option in the Diablo Range direct alignment options would be the least compatible because it would cross at grade through a portion of the Henry W. Coe State Park. The Caltrain/Gilroy/Pacheco Pass alignment option would be the most compatible because it would extend further south to connect with the UPRR alignment and continue to a station at Gilroy. The Hayward/I-880 option would have a higher potential to impact residential property than the Mulford Line option. However, the Mulford Line option would impact the Don Edwards San Francisco Bay National Wildlife Refuge.

B. SACRAMENTO TO BAKERSFIELD

Land Use Compatibility
Modal Alternative: The Modal Alternative would include a wide range of highway improvements throughout the Sacramento to Bakersfield region, and expansions at the Sacramento and Fresno airports. The included changes to the transportation facilities would primarily occur at grade and involve widening of the major intercity travel routes, including changes on I-5, SR-99, SR-152, SR-33, I-80, and I-580 in this region. Because existing land use is predominantly agricultural and the improvements would involve widening of the existing right-of-way, the proposed highway and airport improvements would be potentially incompatible with surrounding land uses. About 44% of the land in the study area in this region is devoted to cropland and orchards, and more than half of the area along the roadways is designated for croplands and pasture. Residential land use comprises about 7%. About 9% of the land is designated for residential use, and a similar amount of commercial/services and industrial uses (about 7%) is proposed along the roadways.

Improvements that would involve widening of existing corridors would be potentially incompatible with future plans due to agricultural designation. The proposed widening of SR-99 would be potentially inconsistent with general plan policies that designate more than a third of land in this corridor for residential development. Similarly, more than half of the land along the I-5 corridor is designated for agricultural and natural open space uses, which would be considered incompatible with roadway improvements. In some locations that have been designated for predominantly agricultural use, the highway improvements would have a potentially high incompatibility because they would be inconsistent with general plan policies to protect and maintain agricultural production.

Future land use around Sacramento International Airport is projected to be primarily transitional uses (uses other than residential and agricultural); therefore, airport expansion would be largely compatible with future plans.

High-Speed Train Alternative: The potential effects of the proposed HST alignments would be similar to those of the Modal Alternative in that the vast majority of the land uses along the proposed right-of-way are designated agricultural. Most segments in this region would require additional right-of-way for HST, and therefore would not be compatible with existing land use. The proposed Truxton (Union Avenue) Station site was also rated as having a high potential incompatibility with existing land use. The area around the proposed station site currently contains a high percentage of low-density residential development. This station would be located in the Tulare to Bakersfield segment on the UPRR corridor. The proposed Castle Air Force Base (AFB) station site would also not be compatible with existing agricultural uses. The site is also designated for agricultural use in the City of Merced's general plan (City of Merced 1997). Castle AFB is designated for redevelopment. In the Sacramento to Stockton segment, most of the land adjacent to the eight proposed alignment options has been designated for agricultural use in general plans. Four of these alignments also traverse a high percentage of land designated for residential use and therefore would be considered to have a high potential incompatibility with land use plans. Two of these alignments would use the UPRR corridor; the other options would use the CCT corridor. Both the UPRR and CCT alignments have options to link the Sacramento Downtown Station and the Power Inn Road Station with Stockton. In general, the CCT route tends to traverse slightly more land designated for residential and agricultural use than the UPRR route, which would make the CCT route potentially less compatible with future land uses.

Between Stockton and Modesto, the alignment option that would use the UPRR corridor would pass through an area designated for a large portion of residential use (UPRR alignment to Modesto Downtown Station) and would therefore be incompatible with future land use.

Communities and Neighborhoods

Modal Alternative: For much of the Sacramento to Bakersfield region, the highway component of the Modal Alternative would involve widening I-5 and SR-99 by two lanes. Communities in the urbanized portion of Sacramento could be affected by widening I-5, but for much of its length from Sacramento to Bakersfield, I-5 is bordered by agricultural uses or highway commercial uses set back from the right-of-way. Widening SR-99, if it occurs within the existing right-of-way, would not be expected to result in a detrimental physical division of existing communities, because the existing roadway already creates a physical separation between land uses on either side of the highway. However, there are instances throughout the region where the widening would require additional right-of-way and involve displacement of adjoining land uses. The displacement of these uses could potentially increase physical separation that already exists.

High-Speed Train Alternative: For much of the Sacramento to Bakersfield region, the proposed HST routes follow existing rail lines—UPRR, BNSF, or CCT. In many cases, smaller rural communities developed along the railroad tracks. In larger communities, the rail lines already divide the community. A parallel, at-grade set of tracks for HST would therefore not generally be expected to result in a substantial increase in physical separation which exists between land uses on either side of the tracks.

Property

Modal Alternative: The highest potential for property impacts due to potential highway improvements included in the Modal Alternative would occur in the urbanized areas along I-5 and SR-99 in the vicinity of Sacramento, Stockton, Modesto, Merced, Fresno, and Bakersfield. More specifically, there would potentially be high and medium property impacts on I-5 and SR-99 in the Sacramento area and on I-5 between Sacramento and Stockton. The majority of the high-impact areas include the portion of SR-99 between Sacramento and Merced. Other areas of potentially high property impacts include areas further south on SR-99 from SR-152 to Bakersfield. The area along I-5 between Stockton and SR-99 has the potential to result in medium impacts on property. Overall, approximately 52 mi (84 km) of highway alignment (8% of total Modal Alternative highway alignment in the region) would have a high potential for property impacts, and 92 mi (153 km) of alignment (15% of total Modal Alternative highway alignment in the region) would have a medium potential for property impacts. The lowest potential for property impacts would occur in less-developed and rural areas along I-5 and SR-99 (see Figures 3.7-7 and 3.7-8).

Figure 3.7-7
Potential Property Impacts Sacramento to Bakersfield (North)
Modal Alternative

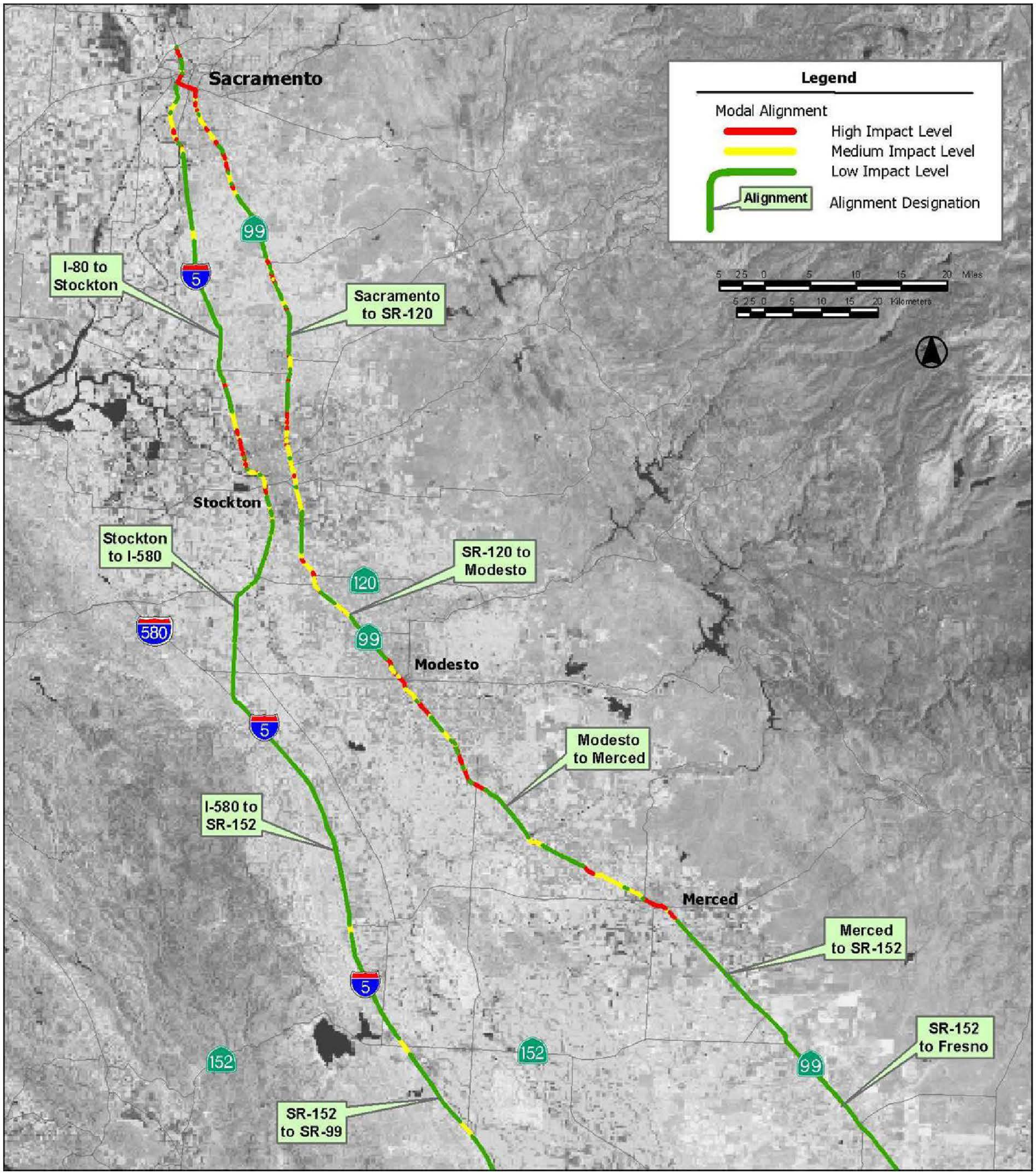
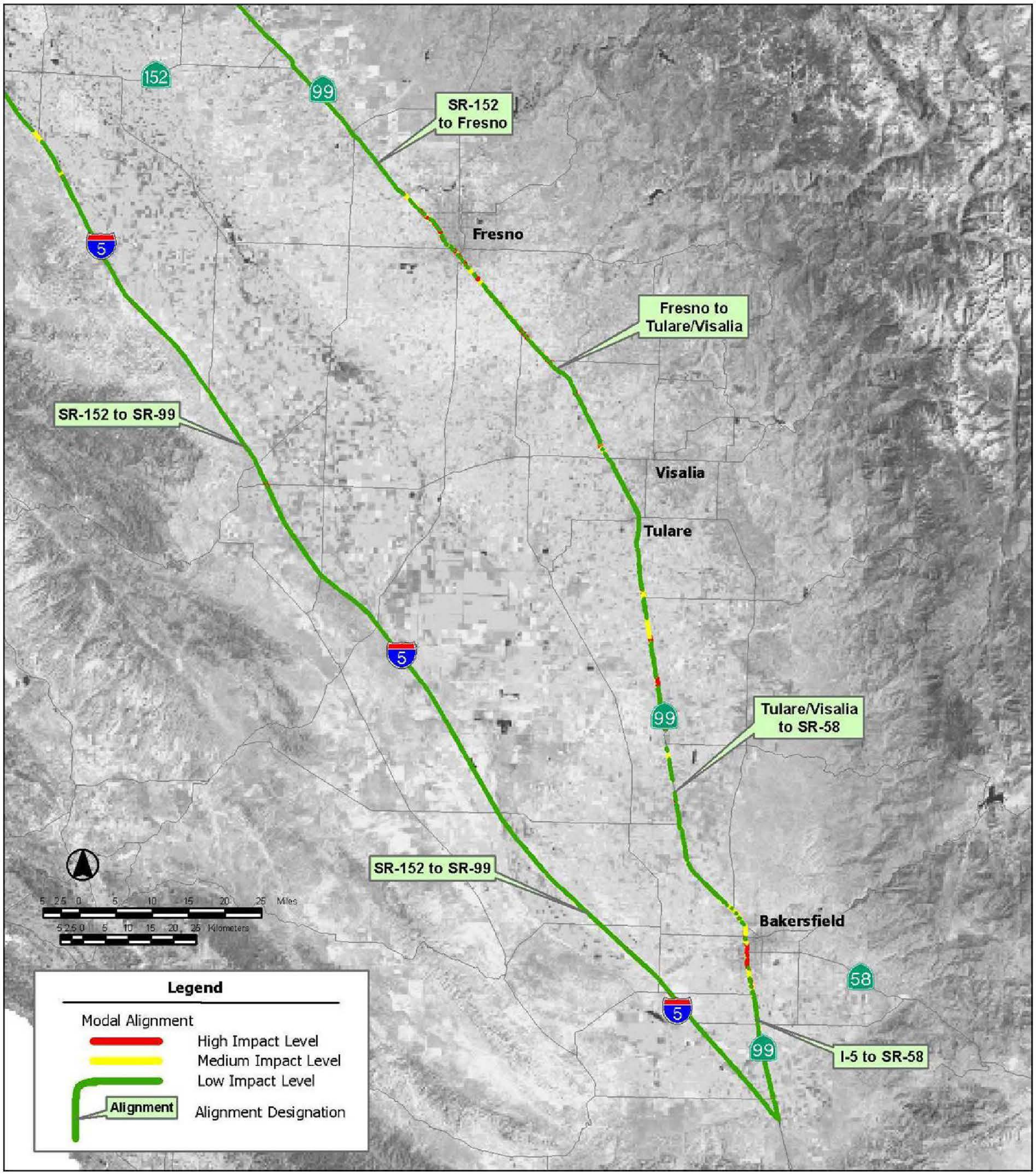


Figure 3.7-8
Potential Property Impacts Sacramento to Bakersfield (South)
Modal Alternative



High-Speed Train Alternative: Under the HST Alternative, areas of potentially high property impacts would occur in the vicinity of urbanized areas where the alignments would be located adjacent to an existing transportation corridor. Between Sacramento and Stockton, the proposed easterly CCT alignment traverses primarily rural lands resulting in a low property impact potential. However, there is a small section of this corridor segment approximately 10 mi (16 km) south of the Power Inn Road Station site that would potentially result in high property impacts. The Power Inn Road Station site is located adjacent to an existing corridor and would result in a medium potential for property impacts. Other areas of potentially high and medium impacts are located between Stockton and Merced along both the UPRR and BNSF alignments. These potential impacts are due to new alignments impacting existing development and alignments located adjacent to existing corridors but outside the existing right-of-way, thereby impacting existing development.

The area from Merced to Fresno is largely agricultural land and therefore the potential to impact property is low. However, potential impacts on property along the UPRR and BNSF alignments directly north of the Fresno Downtown Station and continuing south to Bakersfield would be considered high to medium due to new alignments, and because the property is adjacent to an existing corridor. Between 20 mi (32 km) and 25 mi (40 km) of rail alignment and station locations (between 6% and 8% of total HST alignment in the region) would potentially result in high property impacts, and between 23 mi (37 km) and 67 mi (108 km) of alignment and station locations (between 7% and 20% of total HST alignment in the region) would potentially result in medium property impacts (see Figures 3.7-9 and 3.7-10).

Environmental Justice

Modal Alternative: For the Modal Alternative, minority populations were identified in the Modesto to Merced corridor. Communities in this corridor include Ceres, Keyes, Turlock, Delhi, Livingston, Atwater, and Merced. In this study area for this portion of the SR 99 alignment included in the Modal Alternative, the percentage of minorities is about 46%, compared to 35% in the region as a whole. In other corridors in the Sacramento to Bakersfield region, the percentage of minority populations is lower.

High-Speed Train Alternative: For the HST Alternative, minority populations have been identified near several potential station location options. These include the proposed stations and maintenance facilities locations in the Sacramento area (downtown Sacramento Valley Station, Power Inn Road BNSF and UPRR options, and the Sacramento Maintenance Facility BNSF and UPRR options); Stockton ACE Downtown Station; the Modesto Downtown Station; both Merced station sites (Merced Downtown Station and Merced Municipal Airport Station); Fresno Downtown Station; Hanford Station; and Truxton stations (Union Avenue and Amtrak) in Bakersfield.

In addition, the alignment options between Merced and Fresno and from Tulare to Bakersfield would be expected to pass through areas with predominantly minority populations. The potential impacts, if any, for these communities would depend in part on the extent of new right-of-way that would be required for the HST Alternative. Where bypass options would be considered in addition to a mainline option, there would be greater potential for impacts.

High-Speed Train Alignment Options Comparison

The proposed Truxton (Union Avenue) Station site, which would be located in the Tulare to Bakersfield segment along the UPRR, is adjacent to a relatively high percentage of residential development, and the HST Alternative would be potentially incompatible with existing land uses. The Sacramento to Stockton corridor on the UPRR alignment is designated as predominantly agricultural and residential land uses, which would be potentially incompatible with the HST Alternative. The proposed UPRR alignment in the Stockton to Modesto corridor would also be incompatible with existing land uses due to proposed residential uses. In the Fresno to Tulare

Figure 3.7-9
Potential Property Impacts Sacramento to Bakersfield (North)
HST Alternative

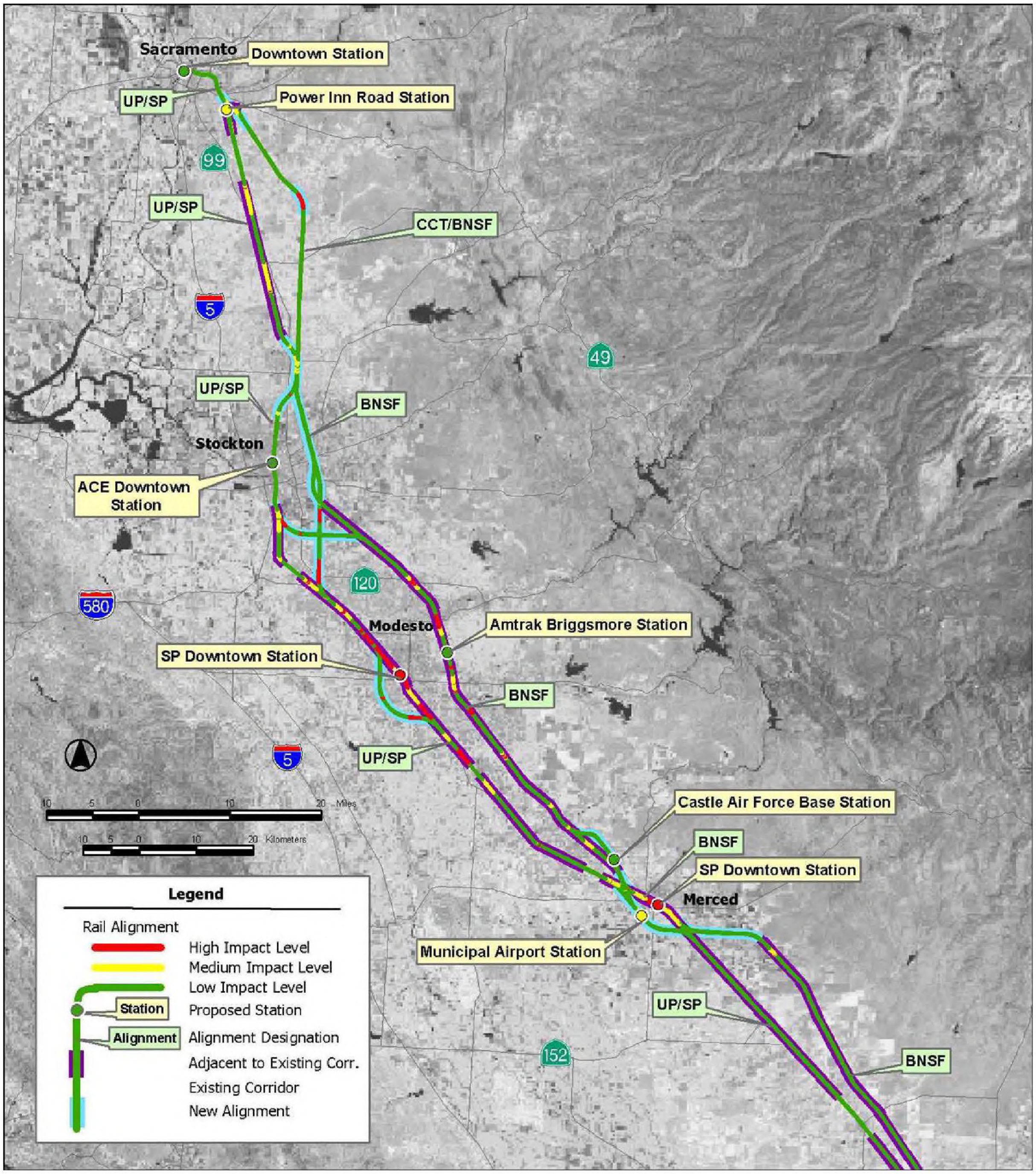
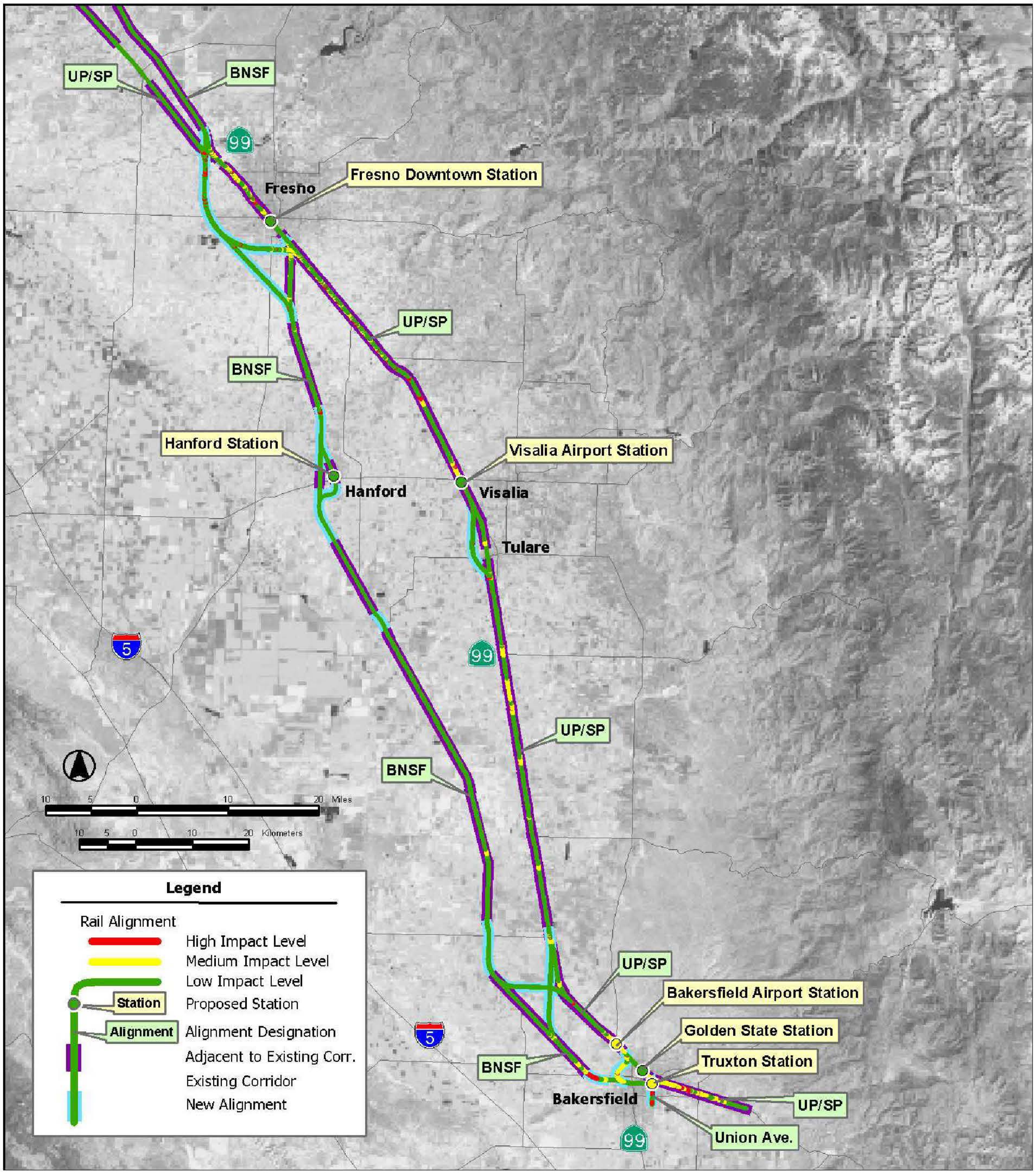


Figure 3.7-10
Potential Property Impacts Sacramento to Bakersfield (South)
HST Alternative



corridor, the proposed alignment along the BNSF route to Hanford Station would be potentially incompatible with existing land uses. In the Truxton to Bakersfield corridor, the proposed Truxton UPRR Station option and the main maintenance facility BNSF option would be potentially incompatible with the high percentage of land designated for future residential uses.

Minority or low-income populations exceeding 50% of the population as a whole, or 10% greater than the minority population in the community as a whole, were identified in the following alignment options and station study areas: all of the proposed sites for stations and maintenance facilities in the Sacramento to Stockton corridor, Modesto Downtown Station (Stockton to Modesto corridor on the UPRR alignment), all station areas in the Modesto to Merced corridor, Fresno Downtown Station area and all alignments in the Merced to Fresno corridor, Hanford Station area (Fresno to Tulare corridor on the BNSF corridor), Truxton (Union Station) and Truxton (Amtrak) Station areas, and most alignments in the Tulare to Bakersfield corridor.

In the Tulare to Bakersfield corridor, the proposed Truxton (Union Avenue) Station site would result in high land use incompatibility impacts. The Tulare express loop would somewhat reduce displacement impacts, but it would divide an established community.

C. BAKERSFIELD TO LOS ANGELES

Land Use Compatibility

Modal Alternative: The Modal Alternative includes potential highway improvements to I-5, SR-58, and SR-14. Widening that would require right-of-way outside of the existing corridor would be needed on most of the segments of I-5, as well as the segment of SR-14 between Palmdale and I-5. The widening of I-5 would be incompatible with the designated significant ecological areas (described in Section 3.15, Biological Resources and Wetlands) between SR-99 and SR-14 and other adjacent land uses. Similarly, the widening of SR-14 would be incompatible with existing agricultural and residential land uses.

The Modal Alternative would also include the expansion of the Burbank-Glendale-Pasadena Airport. Expansion of this airport would be incompatible with nearby residential neighborhoods as well as the local airport authority's plan to discontinue airport expansion.

High-Speed Train Alternative: Most of the proposed alignment options in this region would be constructed outside of existing transportation right-of-way, either highway or rail, and would require new right-of-way. The new right-of-way would generally follow the existing transportation corridor. In these locations, the alignments would be potentially incompatible with existing land uses. These locations include the I-5/Wheeler Ridge alignment option because it would not stay consistently within the SR-184 corridor and would traverse single-family residential neighborhoods and agricultural lands. A similar situation would occur with the SR-58/Soledad Canyon corridor alignment. Other alignment options that would require new right-of-way include the Palmdale Station siding (a length of track for passing trains at the Palmdale Station) and the MTA/Metrolink and combined I-5/Metrolink options, including the I-5 Burbank downtown siding, I-5 downtown Burbank to LAUS (cut and cover at Silver Lake), I-5 downtown Burbank to LAUS (aerial at Silver Lake), LAUS existing siding, LAUS existing south, LAUS south siding, LAUS existing east, and east connection.

The proposed I-5 Tehachapi Mountain crossing would also be constructed outside of an existing rail transportation right-of-way. However, the alignment would follow the existing road transportation corridor, and it would be constructed mostly within tunnels. Therefore, it would be compatible with existing uses. The section along cut and fill near Tejon Lake in Castaic Valley may be inconsistent with potential Tejon Ranch plans to build low-density residential units on lands adjacent to Tejon Lake. Two proposed HST station sites, at Sylmar and Burbank, were considered incompatible with existing land uses because they would be located in neighborhoods with a high proportion of low-density residential uses. However, these stations would be consistent with local plans to encourage mixed-use development and focus development near transit stations.

Communities and Neighborhoods

For the Modal Alternative, the included highway improvements would occur in existing transportation corridors and therefore would not create new divisions or barriers in existing neighborhoods.

For the HST Alternative, the alignment options were anticipated to have an adverse impact on community cohesion if they would divide an existing neighborhood, resulting in decreased access within the community. The new Union Avenue corridor would pass through and divide an established residential area in southern Bakersfield.

Property

Modal Alternative: The highest potential for property impacts due to Modal Alternative highway improvements would occur primarily in urbanized areas. The northern portion of this region is largely agricultural, and the potential for property impacts would be low. The central portion of this region traverses the mountains and is largely rugged and undeveloped land. This portion also crosses the high desert, including the communities of Palmdale and Lancaster. Although this segment crosses these communities, land uses remain mostly rural. The potential for property impacts in this area would also be low. Portions of the Modal Alternative along I-5 that would traverse urban development would potentially result in medium to high impacts.

Upon entering the southern portion of this region (Sylmar to Los Angeles), the land uses become a mix of suburban uses. This portion of the region contains greater potential for medium to high property impacts. Overall, 13 mi (21 km) of highway alignment (6% of total Modal Alternative highway alignment in the region) would potentially result in high property impacts, and 24 mi (39 km) of alignment (11% of total Modal Alternative highway alignment in the region) would potentially result in medium property impacts. Approximately 107 ac (43 ha) of land around the Burbank-Glendale-Pasadena Airport expansion would have a high potential for property impacts, and 350 ac (142 ha) of land around the airport would have a medium potential for property impacts (see Figure 3.7-11).

High-Speed Train Alternative: Much of the proposed I-5 and SR-58/Soledad Canyon alignments would require new right-of-way. A large majority of these alignments traverse areas with open space or agricultural land uses and would be expected to have a low potential for property impacts. However, portions of these alignments would pass through urbanized areas and would therefore have a medium to high potential for property impacts, e.g., the Sylmar to Los Angeles segment, including the alignment along I-5 between Burbank Metrolink/Media City Station and the existing LAUS. Overall, between 4 mi (6 km) and 15 mi (24 km) of rail alignment and station options (between 3% and 11% of total HST alignment in the region) would potentially result in high property impacts, and between 4 mi (6 km) and 15 mi (24 km) of alignment and station locations (between 4% and 11% of total HST alignment in the region) would potentially result in medium property impacts. The higher numbers generally reflect inclusion of impacts along the Antelope Valley route (see Figure 3.7-12).

Environmental Justice

Modal Alternative: For the Modal Alternative, minority populations exist in the study area for the I-5 corridor from SR-14 to LAUS and along the SR-58/SR-14 corridor (with an average minority

Figure 3.7-11
Potential Property Impacts Bakersfield to Los Angeles
Modal Alternative

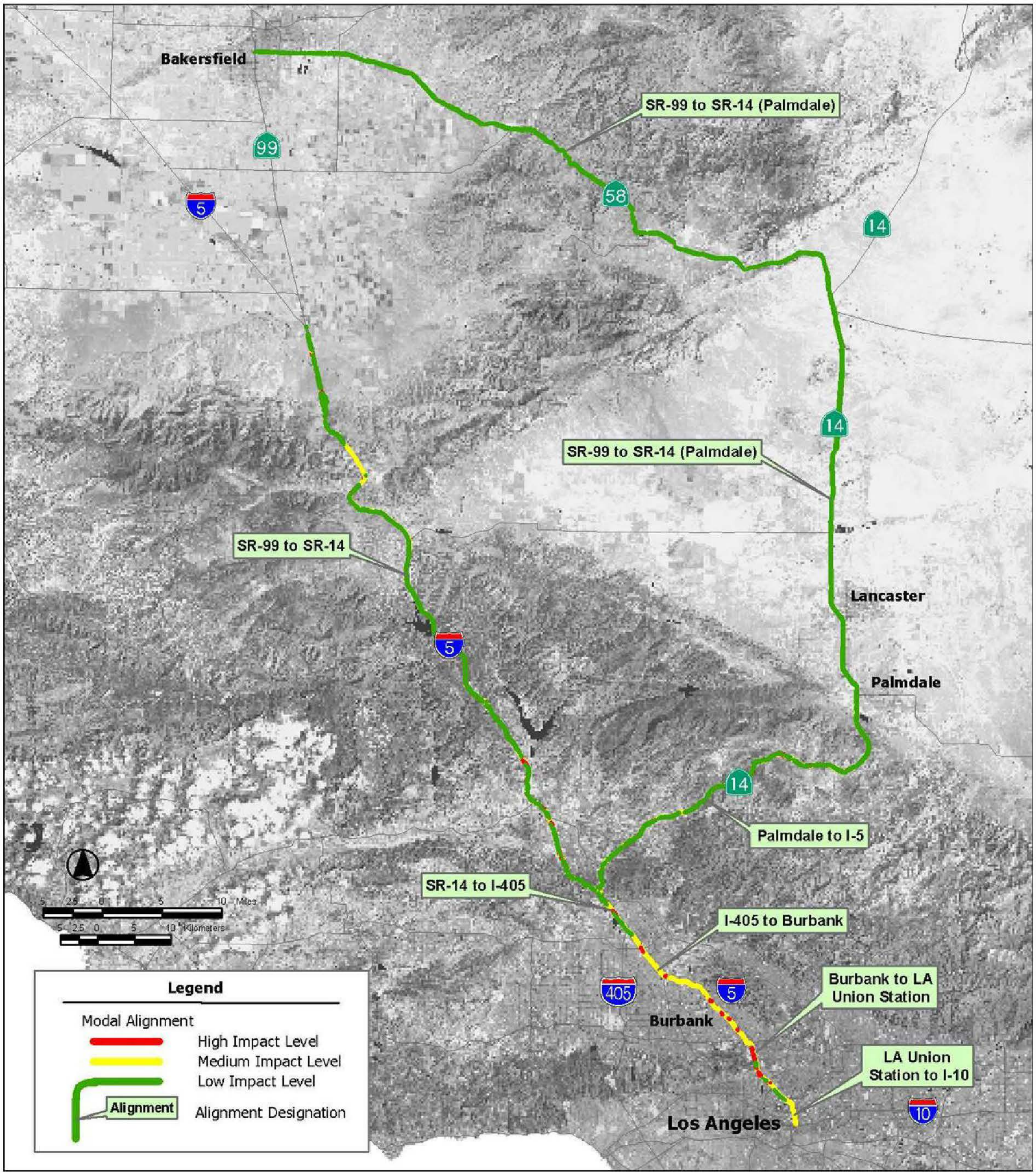
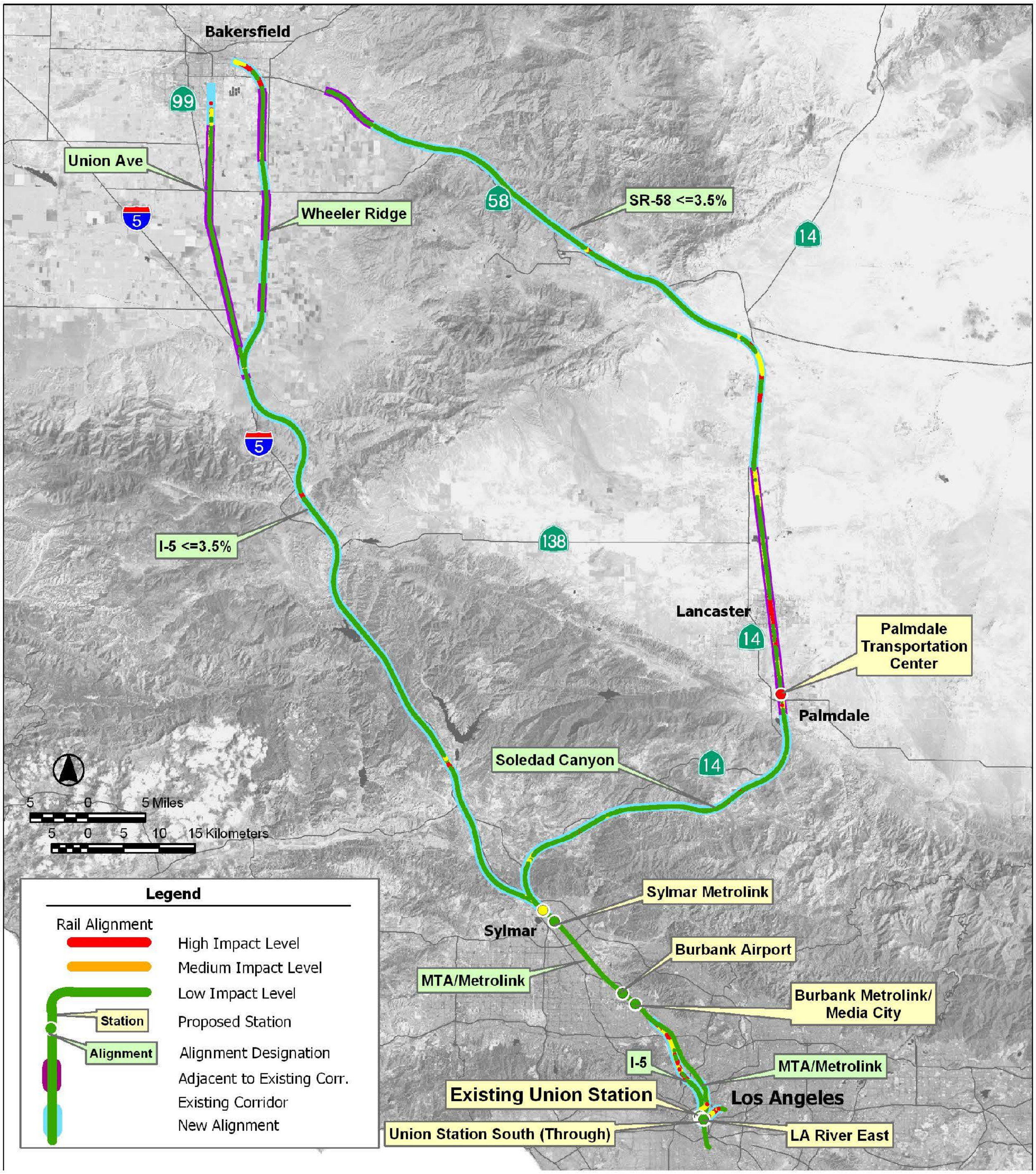


Figure 3.7-12
Potential Property Impacts Bakersfield to Los Angeles
HST Alternative



population percentage of 75%), and at other locations such as the I-5/SR-14 to I-405 and the SR-58/SR-14/SR-99 to Palmdale corridors. However, the highway improvements in these locations would be constructed within the existing right-of-way, which would reduce potential for adverse impacts. Potential for impacts would be greater where new right-of-way would be needed. The population of the study area around the Burbank-Glendale-Pasadena Airport comprises about 80% minorities. The need for additional right-of-way to expand the airport could result in potential impacts.

High-Speed Train Alternative: Minority populations are located in the study area at points along all of the alignment options. For example, the average percentage of minority population for the I-5 Tehachapi Mountain crossing (Wheeler Ridge and Union Ave), Palmdale Station location, and Soledad Canyon alignment is 73%. The potential for impacts would be greater for alignments that would be new transportation corridors. These segments include Wheeler Ridge corridor, SR-58 corridor, Palmdale Station, I-5 Burbank downtown station; I-5 Glendale, I-5 downtown Burbank to LAUS (aerial at Silver Lake), LAUS existing site, LAUS existing south, LAUS south, LAUS existing east, and the east connection.

Minority populations are present in the study areas for the proposed HST stations and the proposed Los Angeles maintenance yard site.

High-Speed Train Alignment Options Comparison

In the Bakersfield to Sylmar segment of the region, the proposed I-5 (Union Avenue and Wheeler Ridge) options would be potentially more compatible with existing land use than the SR-58 option because they would be either within tunnels or would not pass close to low-density residential uses or other sensitive uses, and they do not include proposed stations.

The Sylmar to Los Angeles segment includes two proposed alignment options: MTA/Metrolink or combined I-5/Metrolink. Most of the MTA/Metrolink option would be within an existing rail transportation corridor. Of the three stations proposed for this option, only Burbank Downtown Station would be located in an area with a low percentage of residential uses. Therefore, this alignment option would be moderately incompatible with existing land uses.

There are three proposed alignment options in the downtown Burbank to Los Angeles segment of the region. The I-5 Burbank downtown station option would have potentially high incompatibility because most of this option would not be within an existing transportation corridor and would be above ground as it cuts through low-density residential neighborhoods. However, the proposed I-5 downtown Burbank to LAUS (cut and cover at Silverlake) alignment would be potentially compatible because it would be constructed in tunnel. The proposed Metrolink/UPRR option would also have low incompatibility with existing land uses.

D. LOS ANGELES TO SAN DIEGO VIA INLAND EMPIRE

Land Use Compatibility

Modal Alternative: The Modal Alternative would include highway-widening improvements to I-10, I-15, I-215, I-15, and SR-163. Highway improvements in the LAUS to March ARB segment of the region would not be compatible with existing land use, which includes a high percentage of low-density residential development. Also, large portions of this segment are currently vacant and undeveloped. Expansion of the highway system would be expected to promote sprawl and low-density development and would not be compatible with local plans supporting high-density and transit-oriented development. Similarly, the segment between March ARB and Mira Mesa would also be incompatible with existing land use and future local plans. More than half of the study area in the Mira Mesa to San Diego segment consists of parklands or undeveloped land.

Therefore, the highway improvements in this segment would be incompatible with existing land use and future land use plans.

The Ontario International Airport is located in the LAUS to March ARB segment. Expansion of this airport would be incompatible with existing nearby residential neighborhoods.

High-Speed Train Alternative: Most of the proposed alignment options would be located within or adjacent to existing or planned highway or rail corridors. Two of the three proposed alignment options (UPRR Colton Line and UPRR Riverside/UPRR Colton) from Los Angeles would be located adjacent to the UPRR corridor in urbanized areas, which would be compatible with existing land use. The third option (the loop through San Bernardino) would traverse low-density residential neighborhoods and would be potentially incompatible with existing land uses. However, the San Bernardino Station would be located in a redevelopment area, and the HST Alternative would be compatible with future planned uses at this location.

This region includes one proposed alignment option to connect March ARB with Mira Mesa, and two proposed options for passing through the City of Escondido. The Escondido at SR-78/I-15 Station option would traverse mainly vacant and agricultural lands. This alignment would be located in the existing I-15 corridor and would be moderately compatible with existing land use. For the second option (Escondido Transit Center Station), the largest single land use in the corridor is single-family residential, followed by multifamily and commercial and office space. Although the large presence of residential uses is less compatible with HST, the potential for intra-city connectivity at the existing Escondido Transit Center makes this alignment moderately compatible.

For the third segment connecting Mira Mesa with San Diego, there are three proposed alignment options. The variety of land use along the options via Carroll Canyon and to Qualcomm Stadium via the I-15 corridor reflects the suburban nature of northern San Diego. Undeveloped land and parkland comprise a significant share of the land use along the alignments. All three options would follow existing transportation corridors and therefore would be moderately compatible with existing land use. The alignment option via Miramar Road would not include any stations. The majority of surrounding land use is institutional. Secondary uses are light industrial and undeveloped land. Although the alignment would also traverse the Miramar Memorial Golf Course, it would be located within an existing transportation corridor; therefore, the alignment would be moderately compatible with existing land use.

The two proposed station sites that would be potentially incompatible with surrounding land uses are South El Monte Station and City of Industry Station. This potential incompatibility is due to the more agricultural and residential nature of the areas surrounding the station locations. The proposed Escondido Transit Center Station site would be potentially incompatible with its location in an area of existing residential uses; however, the site would be compatible with local land use plans that support transit development in this area.

Communities and Neighborhoods

Modal Alternative: The Modal Alternative is not anticipated to result in any community cohesion impacts because all of the improvements would occur in existing transportation corridors.

High-Speed Train Alternative: The HST Alternative is not expected to result in any community cohesion impacts because the proposed alignments under consideration would be located in existing transportation corridors and in tunnels.

Property

Modal Alternative: The highest potential for medium to high property impacts would occur in the developed Los Angeles area from Los Angeles to San Bernardino (along I-10). The edge of this right-of-way is densely developed with commercial and residential uses. High to medium property impacts would also potentially occur along I-10, I-15, and I-215 alignments due to residential development. Much of the area in the southern section of this region is occupied by undeveloped and agricultural land. Potential property impacts on those land uses would be low. Overall, 44 mi (71 km) of highway alignment (37% of total Modal Alternative highway alignment in the region) would potentially result in high property impacts, and 44 mi (71 km) of alignment (37% of total Modal Alternative highway alignment in the region) would potentially result in medium property impacts. The Ontario Airport and Lindberg Field expansions would affect 445 ac (180 ha) of high-impact land uses and 142 ac (57 ha) of medium-impact land uses (see Figure 3.7-13).

The major land uses between LAUS and March ARB Station consist of low-density residential buffered from nearby rail corridors by commercial and industrial uses. Much of the alignment is also assumed to be adjacent to the existing highway corridor in this section and therefore is expected to result in mostly high and some medium property impacts. The area from March ARB Station to Mira Mesa Station primarily consists of open space; therefore, potential property impacts would be low. However, there are several areas located adjacent to existing corridors and new alignments that have a potential for medium to high property impacts. Between Mira Mesa Station, Downtown San Diego Station, and the Qualcomm Stadium Station, urban development increases as the alignments travel south, resulting in the potential for medium to high property impacts. There would be a medium potential for property impacts if the Qualcomm Stadium Station were located on the eastern side near multifamily residences.

Between 28 mi (45 km) and 37 mi (60 km) of rail alignment and station locations (between 19% and 22% of total HST alignment in the region) would result in potentially high property impacts, and between 35 mi (56 km) and 54 mi (87 km) of alignment and station locations (between 23% and 33% of total HST alignment in the region) would potentially result in medium property impacts (see Figure 3.7-14).

Environmental Justice

Modal Alternative: Minorities comprise 58% of the population in the study area from LAUS to March ARB. From March ARB to Mira Mesa, the minority population is 27%, and from Mira Mesa to San Diego it is 37%. Because the widening of highways would occur within the existing right-of-way, the potential for impacts would be low; however, for improvements that would need new alignment or required extensive additional right-of-way, the potential for impacts would be greater.

High-Speed Train Alternative: In this region, the HST Alternative would be located mostly within existing transportation corridors, which would limit potential the impacts on nearby communities, but potential for impacts would be greater where new right-of-way would be needed for an alignment option. Minority populations averaging 54% were identified along all of the proposed alignment options connecting Los Angeles to March ARB, including the Pomona (59%) and San Bernardino Station sites (59%), and the March ARB and Escondido Transit Center Station sites (68%) in the March ARB to Mira Mesa segment.

High-Speed Train Alignment Options Comparison

The UPRR Colton Line alignment option in the Los Angeles to March ARB segment and the I-15 alignment option in the March ARB to Mira Mesa segment would be moderately incompatible with existing land use. The Carroll Canyon alignment option in the Mira Mesa to San Diego segment also would be moderately incompatible with existing land use. However, these alignment options

Figure 3.7-13
Potential Property Impacts Los Angeles to San Diego Via Inland Empire
Modal Alternative

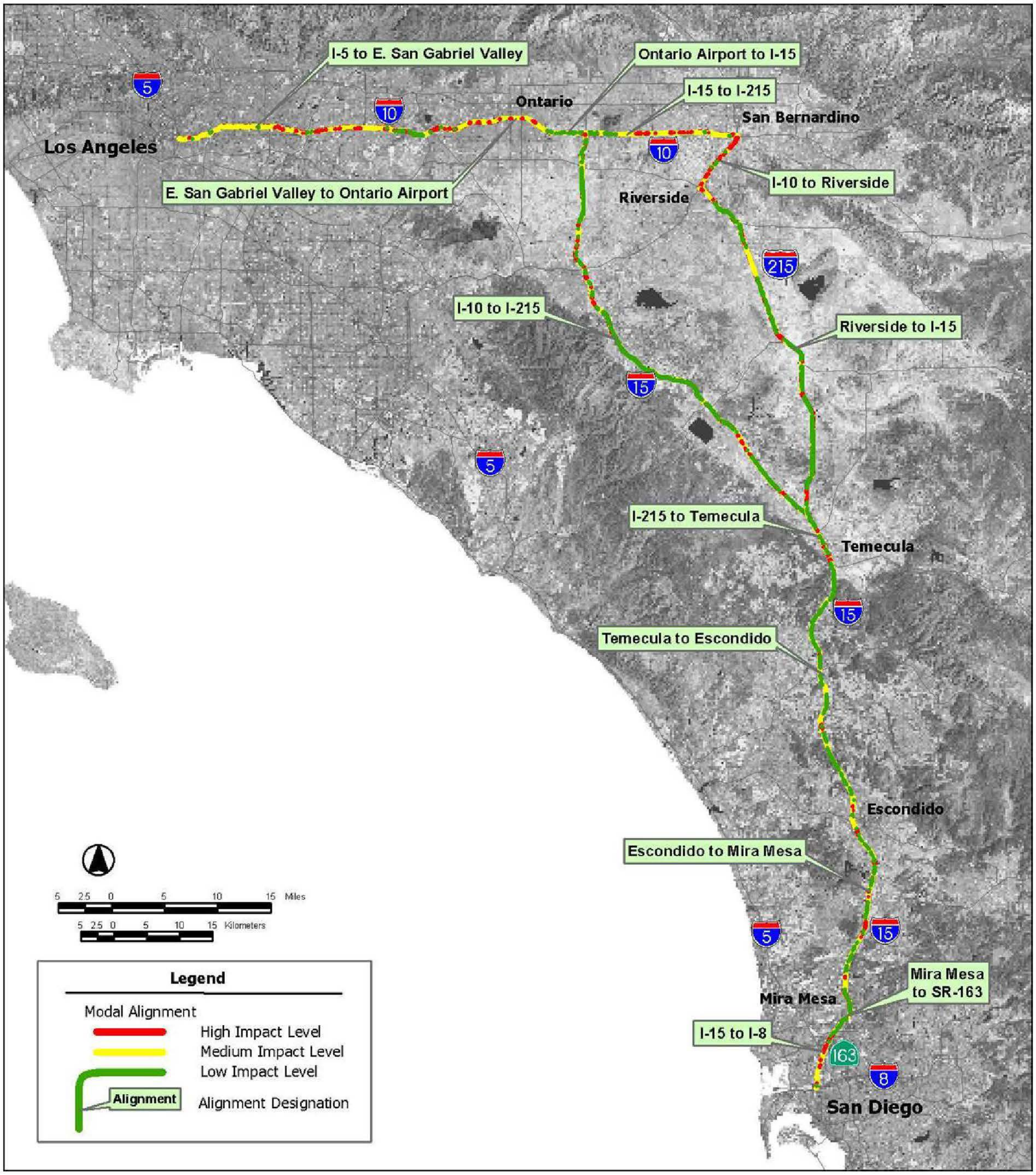
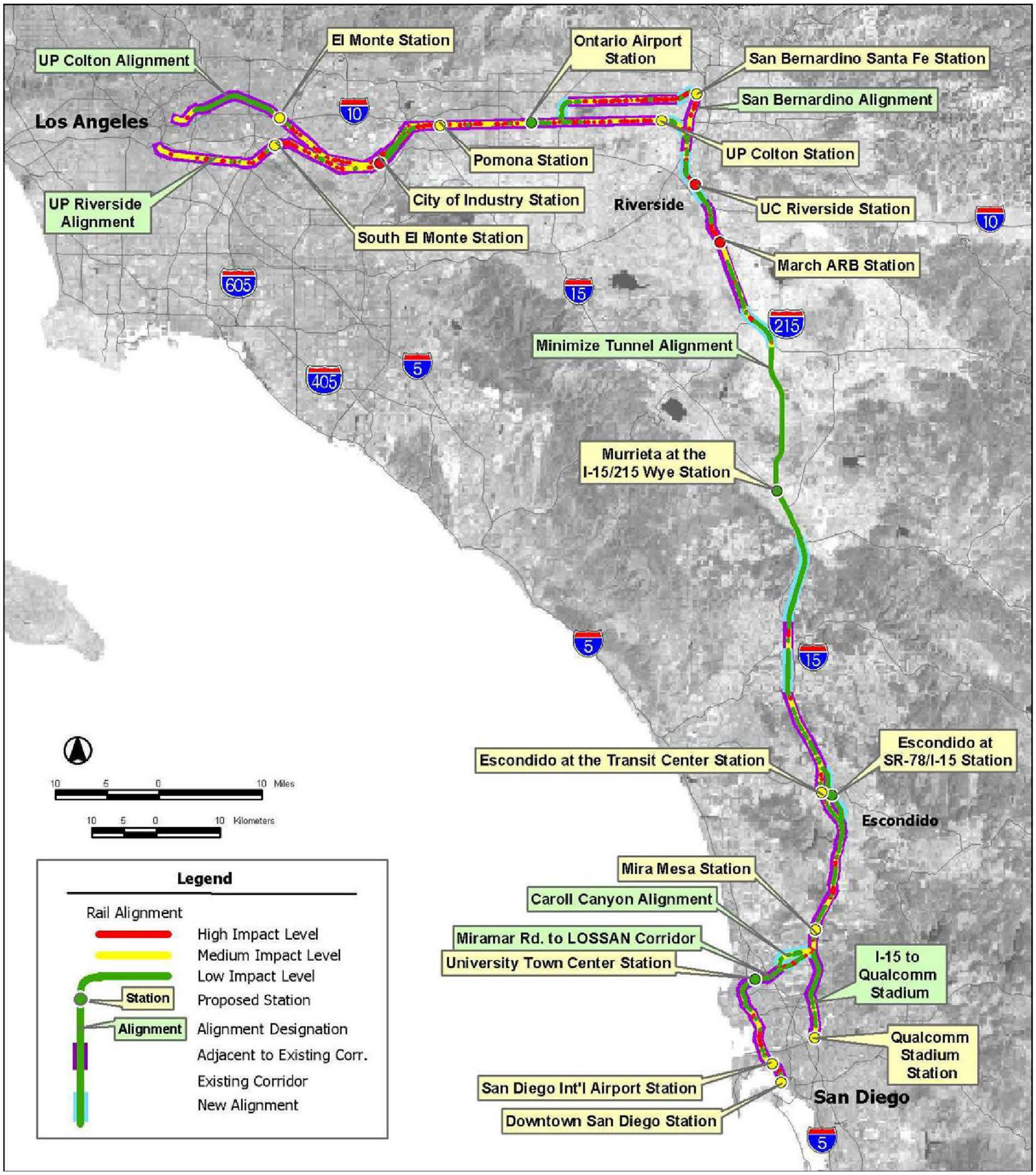


Figure 3.7-14
Potential Property Impacts Los Angeles to San Diego Via Inland Empire
HST Alternative



would be compatible with local plans. These alignments and station locations likely would provide better intercity to intra-city transit connections and would serve larger travel markets. Potential property impacts would be moderate in all of the Los Angeles to March ARB segments. In the Mira Mesa to San Diego corridor, the I-15-to coast via Carroll Canyon segment would have moderate potential property impacts, and the I-15 to coast via Miramar Road segment would have low potential property impacts.

E. LOS ANGELES TO SAN DIEGO VIA ORANGE COUNTY

Land Use Compatibility

Modal Alternative: The Modal Alternative would include the potential addition of nine gates at the Long Beach Airport and the widening of I-5 between Los Angeles and San Diego. The airport expansion would not impact surrounding land uses and would be compatible with existing and planned uses. The established I-5 corridor traverses urban and suburban mixed-use areas and crosses open space and coastal lagoons. The segments of I-5 under residential use are between Encinitas and Solana Beach, Oceanside and Carlsbad, Dana Point and San Clemente, and LAUS and Irvine. Because the highway corridor is established, it is considered compatible with existing land uses and with local plans that continue to recognize I-5 as a major transportation corridor throughout the region, and the improvements, which would be in the corridor, would also be compatible.

High-Speed Train Alternative: Proposed improvements to the LAUS to LAX segment would occur in an existing rail corridor. The existing land uses along this alignment are dominated by industrial and commercial development. Residential land uses in the study area are typically buffered from the rail by non-residential uses. Therefore, the proposed improvements would be compatible with existing and future land uses.

There are two alignment options that would travel south out of LAUS. The first option, connecting LAUS to Anaheim, would use the existing UPRR corridor, and the existing LOSSAN corridor, south of Anaheim to Irvine. Existing land uses along this alignment consist of a mixture of industrial, commercial, and residential. This alignment includes a station option in a commercial area of Norwalk with residential use and a community park located on the opposite side of the rail corridor. With the proximity of the park, the station option would have medium compatibility with land use. However, the alignment and station are generally compatible with existing land use, and they would be compatible with local land use policies to promote the enhancement of transit services and reduction of dependency on automobile use for visitors and residents.

The second alignment option traveling south out of LAUS would connect LAUS to Irvine and would be located adjacent to the existing LOSSAN corridor. Improvements would be made at the existing stations (Norwalk, Anaheim, and Irvine). Impacts on existing land uses along the alignment would be similar to those of conventional rail improvements along this section. The improvements proposed along the established rail route and around the existing stations appear to be compatible with existing and future land use.

Communities and Neighborhoods

Modal Alternative: The Modal Alternative would widen an existing transportation corridor around which neighborhoods and communities have been established. Since the corridor already exists, it is not expected that this alternative would divide any existing neighborhoods or otherwise substantially change the nature of the communities in the area. Improvements at the Long Beach Airport would have no impact on existing neighborhoods.

High-Speed Train Alternative: Under the HST Alternative, no new physical barrier to neighborhood interaction would be created. The existing residential areas along the alignment were developed with the railroad already in place, and the proposed HST system would not increase the barrier effect. Because the entire alignment would be grade separated, existing barriers at intersections with major cross streets would be eliminated, which would be a beneficial impact.

Property

Modal Alternative: The highest potential for property impacts due to Modal Alternative highway improvements would occur primarily in developed, urbanized areas. The LOSSAN region is primarily urbanized and consists of residential, commercial, and industrial land uses. High to medium property impacts are anticipated along I-5 from Los Angeles to San Juan Capistrano, and along I-5 from San Juan Capistrano to San Diego. The Camp Pendleton area along I-5 is undeveloped, and the alignment in this area would have a low property impact. There is potential for high property impacts along 59 mi (95 km) of highway alignment (28% of total highway alignment in the LOSSAN region) and potential for medium property impacts along 75 mi (121 km) of alignment (36% of total highway alignment distance in the LOSSAN region). The Lindberg Field expansion would affect 438 ac (177 ha) of high impact land uses and 10 ac (4 ha) of medium impact land uses (see Figure 3.7-15).

High-Speed Train Alternative: Under the proposed HST Alternative, no more than 2 mi (3 km) of rail alignment and station locations (1% or less of total alignment distance in the LOSSAN region) would have a high potential for property impact, and no more than 2 mi (3 km) of alignment and station locations (1% or less of alignment distance in the LOSSAN region) would have a medium potential for property impacts. The impacts would occur primarily in the vicinity of the LAX and , Anaheim sites. These impacts would be due to new alignments within this region (see Figure 3.7-16). However, because HST alignment options would use existing right-of-way, the overall potential for property impacts would be reduced.

Environmental Justice

Modal Alternative: A high percentage of minorities live within 0.25 mi (0.40 km) of I-5 in Los Angeles County. The minority population in this area is about 72%, slightly higher than the Los Angeles County average of 69%. The Modal Alternative would involve widening the existing established transportation corridor and would have low potential for impacts.

HST Alternative: The minority populations around the proposed Norwalk (UPRR corridor) and Anaheim Stations are approximately 81% and 59%, respectively. The Norwalk Station would be located along an existing rail corridor. The proposed new station at Anaheim would be underground. The potential for impacts at these stations would be low.

Minority populations were also identified in the study area along the proposed LAX to LAUS (99%) and LAUS to Irvine alignments (74%). However, the potential for impacts along these alignments would be expected to be low because the proposed alignments are along existing operating rail corridors, and because residential land uses located within 0.25 mi (0.40 km) of the rail corridor are typically buffered from the rail by non-residential uses.

Significant minority populations exist along the proposed LAUS to Irvine alignment (74%). However, the potential for impacts along these alignments would be expected to be low, because potential improvements would occur along an existing operating rail corridor, and because residential uses that are located within 0.25 mi (0.40 km) of the rail corridor are typically buffered from the rail by non-residential uses.

Figure 3.7-15
Potential Property Impacts Los Angeles to San Diego Via Orange County Modal Alternative

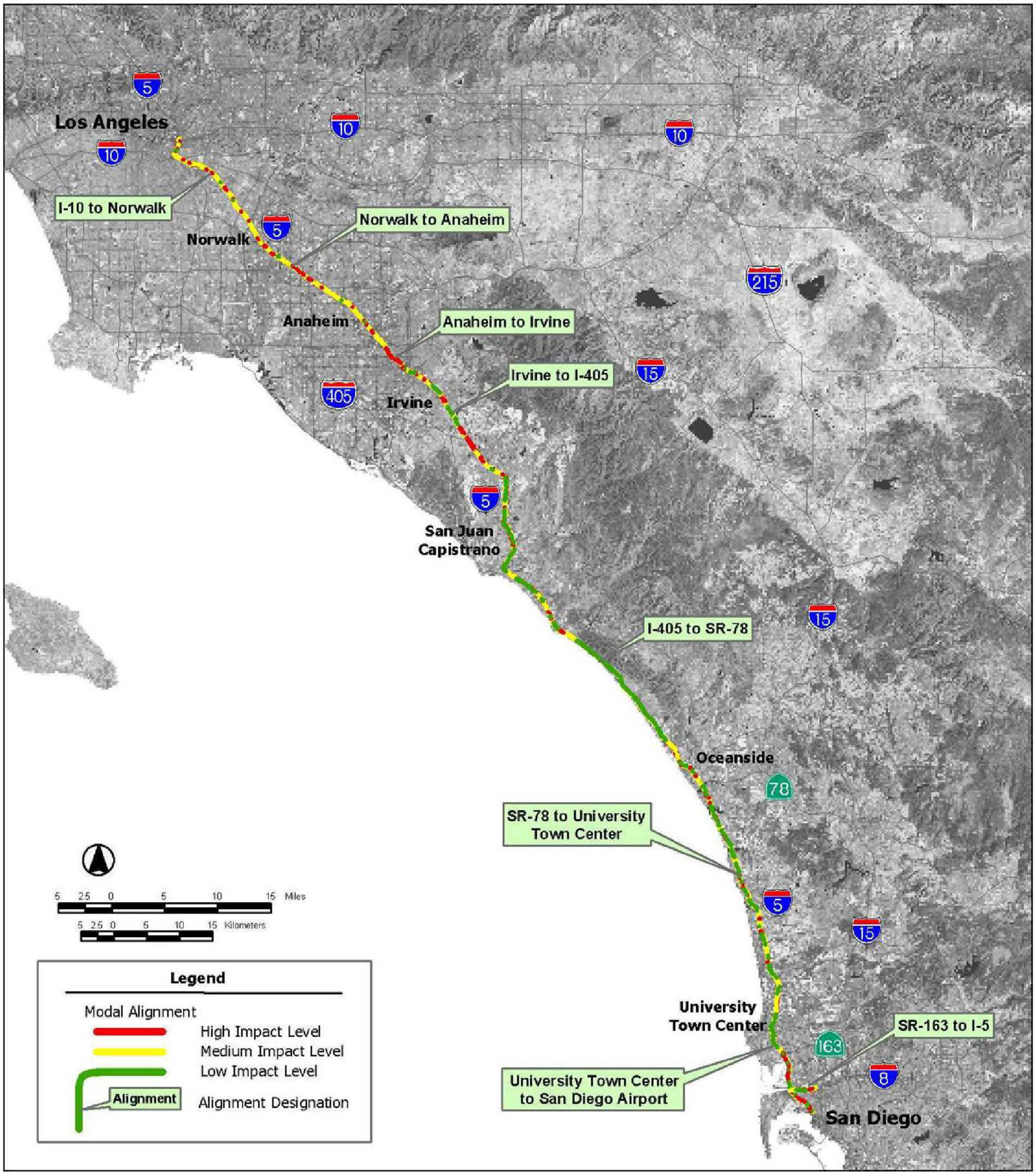
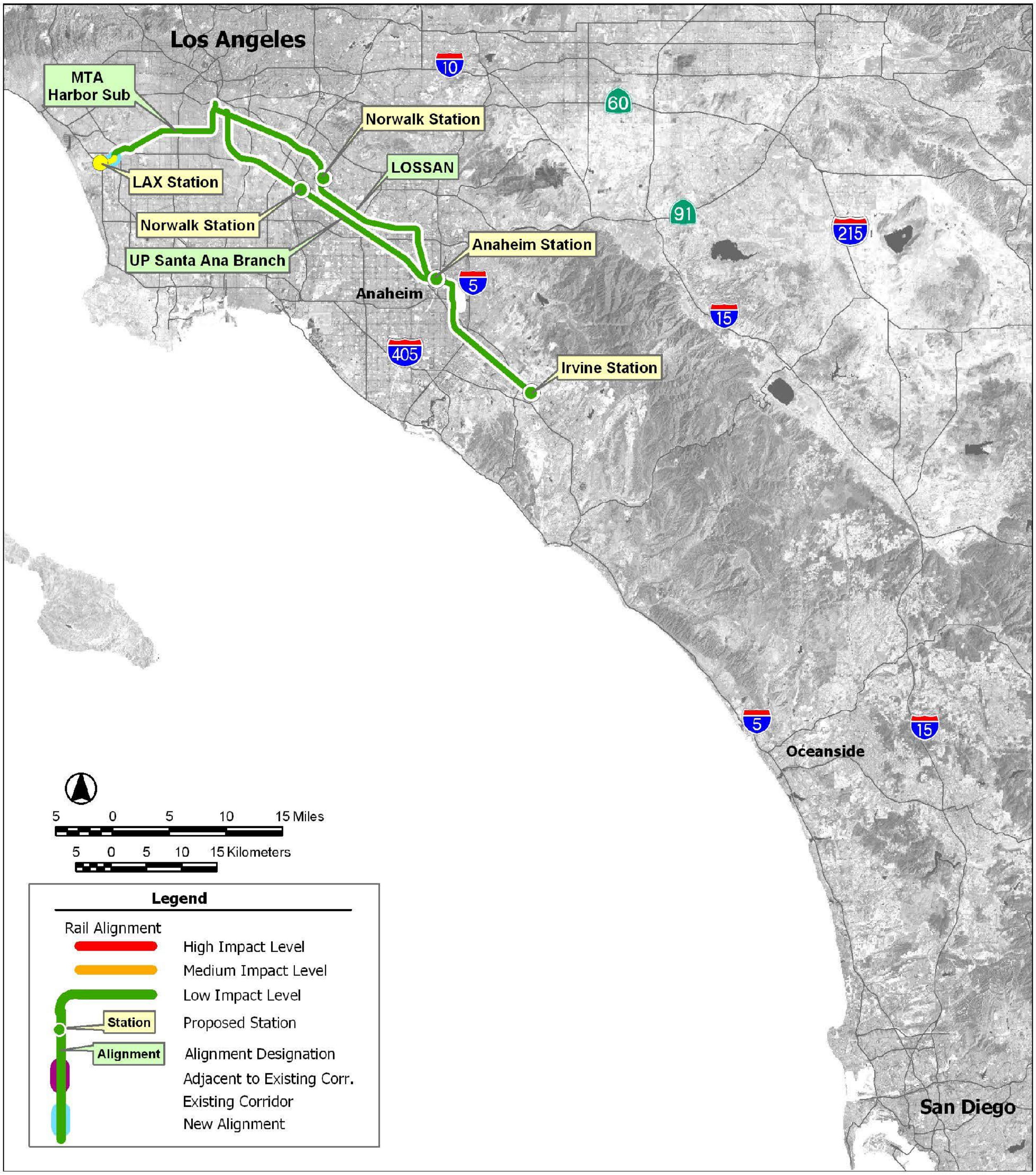


Figure 3.7-16
Potential Property Impacts Los Angeles to San Diego Via Orange County
HST Alternative



High-Speed Train Alignment Options Comparison

For the HST Alternative, the alternative routing options for high-speed rail between LAUS and Irvine present approximately the same potential for impacts related to land use. Because both options would occur within existing right-of-way, both options would have a low potential for impacts on existing land use. These impacts would be similar to those of conventional rail in this alignment. The LOSSAN corridor alignment would have higher potential connectivity and accessibility and compatibility with existing and planned development.

3.7.5 Design Practices

The Authority is committed to utilizing existing transportation corridors and rail lines in for the proposed high-speed rail system in order to minimize the need for additional rights -of -way and the associated potential property impacts. Nearly 70% percent of the adopted preferred HST alignments are either within or adjacent to a major existing transportation corridor (existing railroad or highway right-of-way). To a large extent, these existing transportation corridors already present barriers and impose other impacts on existing communities. Although the HST system would often introduce an additional (fenced) barrier, the HST systems would at least maintain and in many cases improve existing access conditions through the grade separation of existing services. Moreover, portions of the alignment would be on aerial structure or in tunnel, allowing for vehicular or pedestrian access across the alignment.

The Authority has also adopted strategies for HST stations that would incorporate transit oriented design and smart growth land use policies as described in Chapter 6B.

3.7.6 CEQA Significance Conclusions and Mitigation Strategies

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for land use and planning, the HST alternative would have a potentially significant impact on land use compatibility when viewed on a system-wide basis. While every effort has been made to incorporate alignment and station options that are compatible with existing local land use plans and ordinances to the extent feasible, in many cases local plans and ordinances do not address transportation options such as the high speed train system. In addition, many local land use plans and ordinances have not been updated for several years, and may be updated over time to acknowledge and support implementation of a high speed train system. The potential for land use incompatibility is considered significant at this programmatic level due to the uncertainties involved, however, such impacts may not be realized over the 20-year time horizon for implementing the high-speed train system. Regardless, mitigation strategies, as well as the design practices discussed in section 3.7.5, will be applied to reduce this impact, and the lead agencies will work closely with local government agencies in implementing these strategies.

The analysis in this Program EIR/EIS compares potential impacts from the alternatives and the HST alignment, station, and maintenance options. Potential impacts have been considered on a broad scale and on a system-wide basis. If a decision is made in the future to proceed with the proposed HST system, project-level review would analyze the potential for localized impacts.

A. LAND USE COMPATIBILITY

Local land use plans and ordinances would be further considered in the selection of alignments and station locations. Project-level review would consider consistency with existing and planned land use, neighborhood access needs, and multi-modal connectivity opportunities.

Potential mitigation strategies to alleviate or minimize land use related impacts associated with the HST Alternative might include, but are not limited to the following:

- Coordinate with the cities and counties in each region to ensure that project facilities would be consistent with land use planning processes and zoning ordinances.
- Establish requirements for station area plans and opportunities for transit oriented development. See Chapter 6B.

B. COMMUNITIES AND NEIGHBORHOODS

If a decision is made to go forward with the proposed HST system, alignments would be refined in consultation with local governments and planning agencies, with consideration given to minimizing barrier effects in order to maintain neighborhood integrity. Potential mitigation strategies to reduce the effects of any new barriers would be considered at the project-level environmental review and could include grade separating planned rail lines and streets, new pedestrian crossings, new cross-connection points, improved visual quality of project facilities, and traffic management plans to maintain access during and after construction.

In addition, mitigation measures would also be developed for temporary construction-related impacts on any nearby neighborhoods and communities. Potential mitigation strategies to alleviate or minimize community cohesion related impacts associated with the HST Alternative might include, but are not limited to the following:

- Provide opportunities for community involvement early in project level studies.
- Design workshops shall be held within each affected neighborhood to develop an understanding of key vehicle, bicycle, and pedestrian linkages across the rail corridor so that those linkages can be preserved, including the use of grade-separated crossings.
- Develop facility, landscape, and public art design standards for project corridors that reflect the character of adjacent affected neighborhoods.
- Ensure that connectivity (pedestrian/bicycle and vehicular crossings) across the rail corridor is maintained where necessary to maintain neighborhood integrity.
- Develop traffic management plan to reduce barrier effects during construction.
- To the extent feasible, maintain connectivity during construction.
- Maintain high level of visual quality of project facilities in neighborhood areas by implementing such measures as visual buffers, trees and other landscaping, architectural design and public artwork.

C. PROPERTY

Potential land use displacement and property acquisition (temporary use and/or permanent and non-residential property) are expected to be avoided to the extent feasible by considering further alignment adjustments and design changes in the future at the project level. In addition, analysis at the project level would consider relocation assistance in accordance with the Federal Uniform Relocation and Real Property Acquisition Policies Act of 1970. Design strategies would be developed for application at the project level to avoid or minimize the temporary or permanent acquisition of residential and non-residential property.

Access modifications including possible over or under crossings may be needed to mitigate impacts arising from partial property acquisitions that result in division of a farm or other land use.

D. ENVIRONMENTAL JUSTICE

On a system-wide basis, it is not expected that the proposed HST system would result in disproportionate adverse effects to minority or low-income populations. If a decision is made to pursue the development of the proposed HST system, additional consideration of environmental justice issues would occur during project-level review, which would include consideration of potential localized impacts and potential benefits to and enhancements for communities along potential HST alignments. Project-level review would include consideration of detailed mitigation measures, including mitigation for temporary construction-related impacts. Project-level review would also include outreach to potentially affected communities as part of the public review process.

Potential mitigation strategies to alleviate or minimize land use related impacts associated with the HST Alternative might include, but are not limited to the following:

EO 12898 requires federal agencies to ensure effective public participation and access to information. Consequently, a key component of compliance with EO 12898 is outreach to the potentially affected minority and/or low-income population to discover issues of importance that otherwise may not be apparent. Outreach to affected communities would be conducted as part of the decision-making process, and this outreach would be documented.

In addition to examining all impacts, specific attention would be given to the permanent impact categories that are commonly of concern for this type of project and to those that previously have been identified as being of concern. These include:

- Air quality
- Noise and vibration
- Public health
- Visual/aesthetics
- Parklands
- Relocation

The above mitigation strategies are expected to reduce the land use compatibility impacts of the HST alternative to a less-than-significant level. Additional environmental assessment will allow a more precise evaluation in the second-tier, project-level environmental analyses.

3.7.7 Subsequent Analysis

Should the HST Alternative be selected, the subsequent environmental evaluations and project-level review of proposed segments and facilities would address the need for the following studies.

- Land use studies for specific alignment and station areas potentially impacted, including evaluation of potential land use conversion, potential growth, and potential community benefits.
- Review of localized potential environmental justice issues.
- Relocation impact analysis for potentially displaced housing and businesses.
- Pedestrian and vehicular circulation studies.

3.8 AGRICULTURAL LANDS

Agricultural lands considered in this environmental document are those included in the State of California Department of Conservation's Farmland Mapping and Monitoring Program (FMMP). (Government Code § 65570) FMMP-listed agricultural resource categories include prime farmland, farmland of statewide importance, unique farmland, and farmland of local importance. This section generally describes the existing farmland locations and agricultural resources in the five project regions, and identifies potential impacts related to converting farmland to non-agricultural use for each alternative and high-speed train (HST) option. Severance of farmland, insofar as it is a potential impact on a working landscape, is also discussed in this section.

3.8.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY PROVISIONS

Many regulatory and non-regulatory strategies are used to discourage farmland conversion (i.e., the conversion of land in agricultural use to non-agricultural use). In addition, there are many non-regulatory strategies used to prevent farmland conversion. CEQA provides that significant effects on the environment of agricultural land conversions be considered in the environmental review process (P.R.C. § 21060.1 and CEQA Guideline § 21095[a]).

Farmland Mapping and Monitoring Program
FMMP is the only statewide land use inventory conducted on a regular basis. California Department of Conservation administers the FMMP, under which it maintains an automated map and database system to record changes in the use of agricultural lands. Farmland under the FMMP is listed by category—prime farmland, farmland of statewide importance, unique farmland, and farmland of local importance. Information regarding locations of farmland by category is readily available. Conversely, farmland sought to be protected by various other strategies, some of which are discussed below, can be more difficult to identify because they are listed and administered locally, and may use different criteria. Because of these considerations, this document uses only the FMMP-protected farmland categories for estimating potential impacts on farmland. The farmland categories listed under the FMMP are described below. The categories are defined pursuant to U.S. Department of Agriculture (USDA) land inventory and monitoring criteria, as modified for California.

- Prime Farmland. Prime farmland is land with the best combination of physical and chemical features to sustain long-term production of agricultural crops. These lands have the soil quality, growing season, and moisture supply necessary to produce sustained high yields. Soil must meet the physical and chemical criteria determined by the USDA's Natural Resources Conservation Service (NCRS). Prime farmland must have been used for production of irrigated crops at some time during the 4 years prior to the mapping date by the FMMP.
- Farmland of Statewide Importance. Farmland of statewide importance is similar to prime farmland but with minor differences, such as greater slopes or a lesser ability of the soil to store moisture. Farmland of statewide importance must have been used for production of irrigated crops at some time during the four years prior to the mapping date.
- Unique Farmland. Unique farmland is of lesser quality soils than prime farmland or farmland of statewide importance. Unique farmland is used for the production of the state's leading agricultural crops. These lands are usually irrigated but may include non-irrigated orchards or vineyards found in some climatic zones in California. Unique farmland must have been used for crops at some time during the four years prior to the mapping date.

- Farmland of Local Importance. Farmland of local importance is farmland that is important to the local agricultural community as determined by each county's board of supervisors and local advisory committees.

Federal Farmland Protection Policy Act

The USDA's NRCS oversees the Farmland Protection Policy Act (FPPA) (7 U.S.C. § 4201 et seq.; see also 7 C.F.R. part 658). The FPPA (a subtitle of the 1981 Farm Bill) is national legislation designed to protect farmland. The FPPA states its purpose is to "minimize the extent to which federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses." The FPPA applies to projects and programs that are sponsored or financed in whole or in part by the federal government. The FPPA does not apply to private construction projects subject to federal permitting and licensing, projects planned and completed without any assistance from a federal agency, federal projects related to national defense during a national emergency, or projects proposed on land already committed to urban development. The FPPA spells out requirements to ensure federal programs to the extent practical are compatible with state, local, and private programs and policies to protect farmland, and calls for the use of the Land Evaluation and Site Assessment (LESA) system to aid in analysis. Because the proposed HST Alternative may ultimately seek some federal funding, the FPPA is considered in this document.

Williamson Act

The California Land Conservation Act (Government Code §51200 et seq.) of 1965, commonly known as the Williamson Act, provides a tax incentive for the voluntary enrollment of agricultural and open space lands in contracts between local government and landowners. The contract enforceably restricts the land to agricultural and open space uses and compatible uses defined in state law and local ordinances. an agricultural preserve, which is established by local government, defines the boundary of an area within which a city or county will enter into contracts with landowners. Local governments calculate the property tax assessment based on the actual use of the land instead of the potential land value assuming full development.

Williamson Act contracts are for 10 years and longer. The contract is automatically renewed each year, maintaining a constant, ten-year contract, unless the landowner or local government files to initiate nonrenewal. Should that occur, the Williamson Act would terminate 10 years after the filing of a notice of nonrenewal. Only a landowner can petition for a contract cancellation. Tentative contract cancellations can only be approved after a local government makes specific findings and determines the cancellation fee to be paid by the landowner.

The State of California has the following policies regarding public acquisition and locating public improvements on lands in agricultural preserves and on lands under Williamson Act contracts (Government code §51290-51295).

- State policy to avoid location of any federal, state, or local public improvements and any improvements of public utilities, and the acquisition of land, in agricultural preserves.

- State policy to locate public improvements that are within agricultural preserves on land other than land under Williamson Act contract.

- State policy that any agency or entity proposing to locate such an improvement, in considering the relative costs of parcels of land and the development of improvements, give consideration to the value to the public of land, particularly prime agricultural land, within an agricultural preserve.

Conservation Easements

Conservation easements are voluntarily established restrictions that are permanently attached to property deeds, with the general purpose of retaining land in its natural, open-space, agricultural or other condition, while preventing uses that are deemed inconsistent with the specific conservation purposes expressed within the easements. Agricultural conservation easements define conservation purposes that are tied to keeping land available for continued use as farmland. Such farmlands remain in private ownership and the landowner retains all farmland use authority, but the farmland is restricted in its ability to be subdivided or used for non-agricultural purposes such as urban uses. The Division's California Farmland Conservancy Program (Public Resources Code §10200 et seq.) supports the voluntary granting of agricultural conservation easements from landowners to qualified non-profit organizations, such as land trusts, as well as local governments.

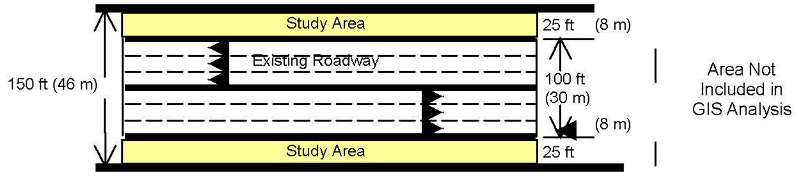
B. METHOD OF EVALUATION OF IMPACTS

Method of Determining Study Areas

Modal Alternative: It was assumed that all existing roadways potentially affected by the Modal Alternative have an average right-of-way width of 100 ft (30 m). This assumption was verified by aerial photographic analysis of the roadways that exist in agricultural areas that would be improved under the Modal Alternative. All roadway segments in the aerial photos that exceed the 100-ft (30-m) width assumption were observed to either have sufficient space to add lanes to the center portion of the roadway, or were not located near agricultural areas. The 100-ft existing roadway was excluded from geographic information systems (GIS) analysis under the assumption that no farmland impacts could occur within the right-of-way of an existing roadway.

The Modal Alternative, as defined in Chapter 2, would add one lane to each direction of travel to I-5, I-10, I-15, I-80, I-215, I-280, I-580, I-880, SR-14, SR-99, SR-152, and US-101. The Modal Alternative would also add two lanes to each direction of travel on I-5 through Los Angeles. A Caltrans standard lane width is 12 ft (3.65 m). Considering this, the study area was determined to extend from the edge of the existing right-of-way to 25 ft (8 m) on both sides of existing right-of-way. The 25-ft (8-m) distance is assumed to accommodate the added lanes with shoulders or other required additions. This approach is illustrated below in Figure 3.8-1.

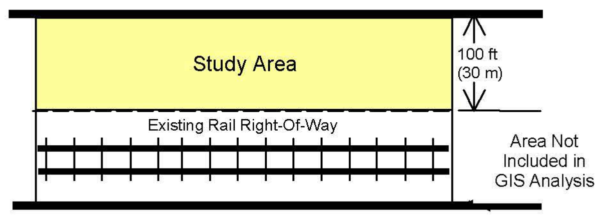
Figure 3.8-1
Modal Alternative Study Area (Highways)



Potential farmland impacts related to the Modal Alternative airport improvements were evaluated by applying the design footprint of the facility (e.g., runway) being improved over the FMMP GIS shapefiles and calculating the impacts on the FMMP-listed farmland. The study area for the region's airports included the land required to develop the proposed improvements to runways, taxiways, and terminals. This method assumed that the potential impact was limited to the geographic extent of area needed for the improvements only, with no extra area surrounding them.

High-Speed Train Alternative: The study area for the HST Alternative was developed to address two different potential improvement scenarios. The first scenario was for potential alignment options adjacent to existing rail corridors. In these cases, the study area extended 100 ft (30 m) from the rail right-of-way on the side that was selected for study by the California High Speed Rail Authority (Authority) and its regional study teams based on conceptual engineering studies. This allows the development of an estimate of the area that could be needed for a proposed HST system, and an estimate within that area of the land now in agricultural use that would potentially be affected. This approach is illustrated below in Figure 3.8-2.

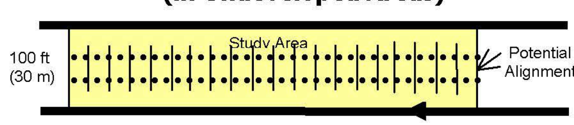
Figure 3.8-2
High-Speed Train Alternative Study Area
(in Existing Railway Areas)



This case represents a conservative approach to quantifying potential impacts, since it would be possible to fit the HST within a 50-ft (15-m) right-of-way in areas of high agricultural impact. Moreover, it may be possible to fit the entire HST line into existing rail corridors, given agreements with private rail operators. To the extent this could be done, it would reduce the potential impacts of the proposed HST Alternative to a nearly negligible level of impact on agricultural lands in existing railway areas.

The second scenario was developed for new alignments in undeveloped areas (i.e., areas outside the urban/metropolitan area that do not have existing rail rights-of-way) that are separate from existing rail corridors. In this scenario, the study area would extend 50 ft (15 m) on both sides of the proposed rail centerline, for a total width of 100 ft (30 m). This is a conservative approach because it would be possible to fit the HST line within a 50-ft (15-m) right-of-way in constrained areas. This approach is illustrated below in Figure 3.8-3.

Figure 3.8-3
High-Speed Train Alternative Study Area
(in Undeveloped Areas)



Analysis of Impacts
To ascertain the possible extent of potential farmland impacts, the Modal and HST Alternative study areas were overlain atop the FMMP farmland GIS shapefile. The GIS then calculated the acreage of farmland that would potentially be converted for the Modal Alternative improvements and the HST Alternative improvements in the study area for each of the FMMP categories. This analysis was performed for each region and used to calculate potential system-wide impacts on farmlands. This analysis accounts for proposed improvements that would expand existing transportation corridors, potential alignments that are adjacent to existing transportation corridors, and potential alignments that would traverse undeveloped areas. The station facilities

that would be included within the proposed HST Alternative are assumed to be located primarily within the study areas considered.

Improvements associated with the Modal Alternative would consist of lane additions to existing roadways, as well as additional runways, gates, and associated improvements at existing airports. Considering this, the Modal Alternative identifies improvements for specific routes as part of the overall system-wide improvement alternative. The HST Alternative represents an alternative with various alignment options within each region. While potential impacts were estimated for each alignment option, the analysis for the HST Alternative was developed to ascertain alignment combinations that would result in the least potential impacts on agricultural land per region (LPI) and alignment combinations that would result in the greatest potential impacts per region (GPI). Alignment combinations other than the LPI and GPI would be expected to have levels of impact between that of the LPI and GPI.

For purposes of this discussion, farmland severance is defined as the division of one farmland parcel into two or more areas of operation by the placement of a barrier (in this case rail line) through the parcel. Potential severance locations are discussed qualitatively, not quantitatively, in this program-level document. Parcel-specific information is also not considered in this program-level analysis. Project-level farmland conversion and severance impacts that are determined to be significant adverse impacts would be addressed in subsequent project-level documents.

3.8.2 Affected Environment

The locations of Modal Alternative and HST Alternative improvements in relation to the general locations of existing agricultural resources are shown in Figures 3.8-4A, 3.8-4B, 3.8-5A, and 3.8-5B.

A. STUDY AREA DEFINED

The study area for agricultural lands is defined above in Section 3.8.1 B.

B. GENERAL DISCUSSION OF AGRICULTURAL LANDS

California is the leading agricultural producer and exporter in the U.S. In 2001, California's agricultural production reached $27.6 billion, accounting for approximately 13% of the nation's gross cash receipts. The most recent statistics (2001) indicate that California has approximately 27.7 million acres (ac) (11.2 hectares [ha]) of land in farms, has approximately 88,000 farms (approximately 4% of the nation's total), and produces more than 350 different crop types. Although California has many areas of farmland production, its largest area of agricultural production is the Central Valley. Six out of the top ten California agricultural counties in 2001 were located in the Central Valley. (American Farmland Trust 2003, California Department of Food and Agriculture 2002.)

Urban growth frequently results in the conversion of agricultural land to non-agricultural uses. According to an estimate in a May 2001 report by the University of California Agricultural Issues Center, California lost approximately 497,000 ac (201,000 ha) of farmland by urbanization in the decade between 1988 and 1998, a loss rate of approximately 49,700 ac (20,100 ha) per year (Kuminoff, Sokolow, and Sumner 2001).

C. AGRICULTURAL LANDS BY REGION

<u>Bay Area to Merced</u>
This region includes central California from the San Francisco Bay Area (San Francisco and Oakland) south to the Santa Clara Valley and east across the Diablo Range to the Central Valley.

Figure 3.8-4A
Modal Alternative
North Portion of State

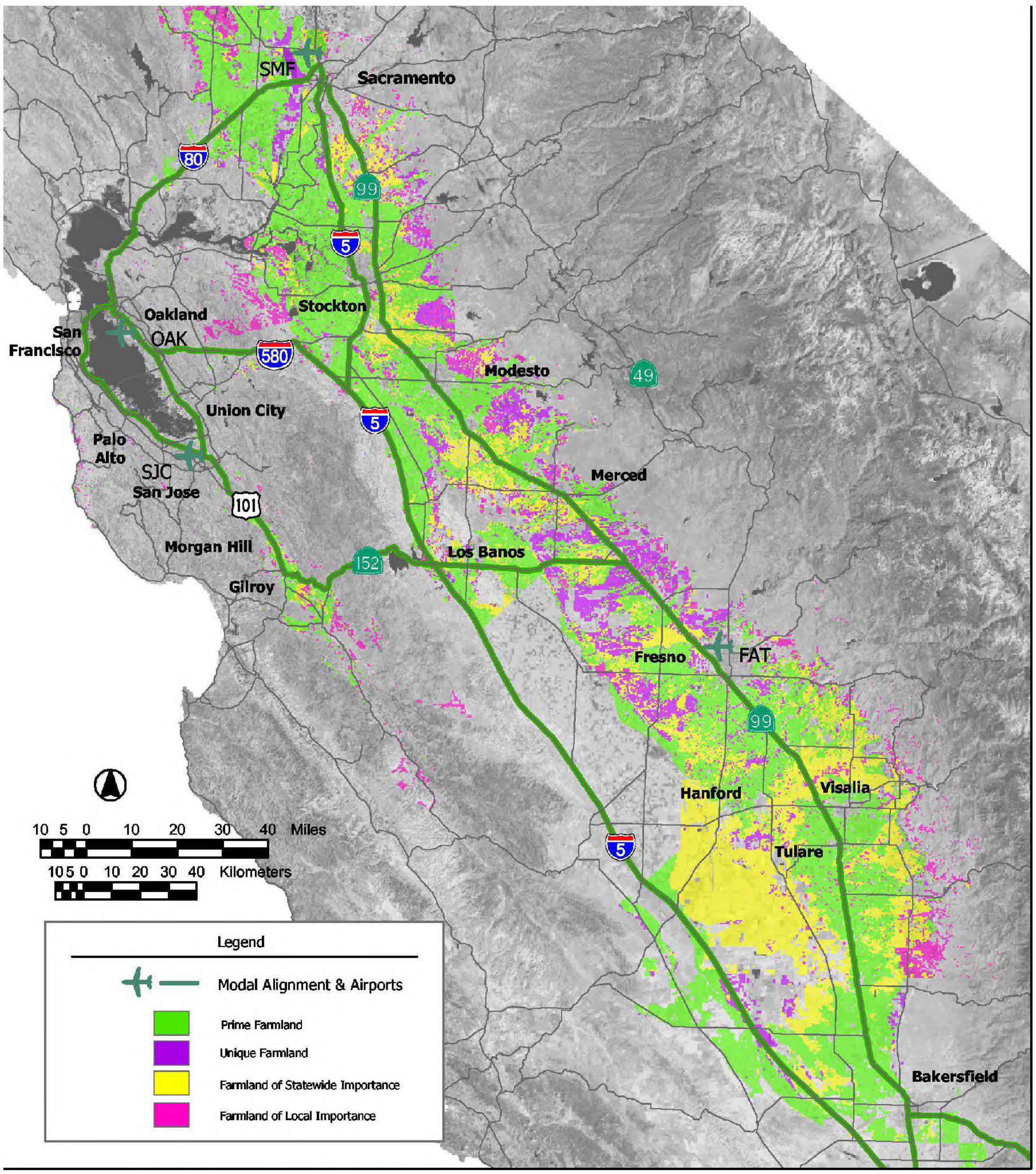


Figure 3.8-4B
Modal Alternative
South Portion of State

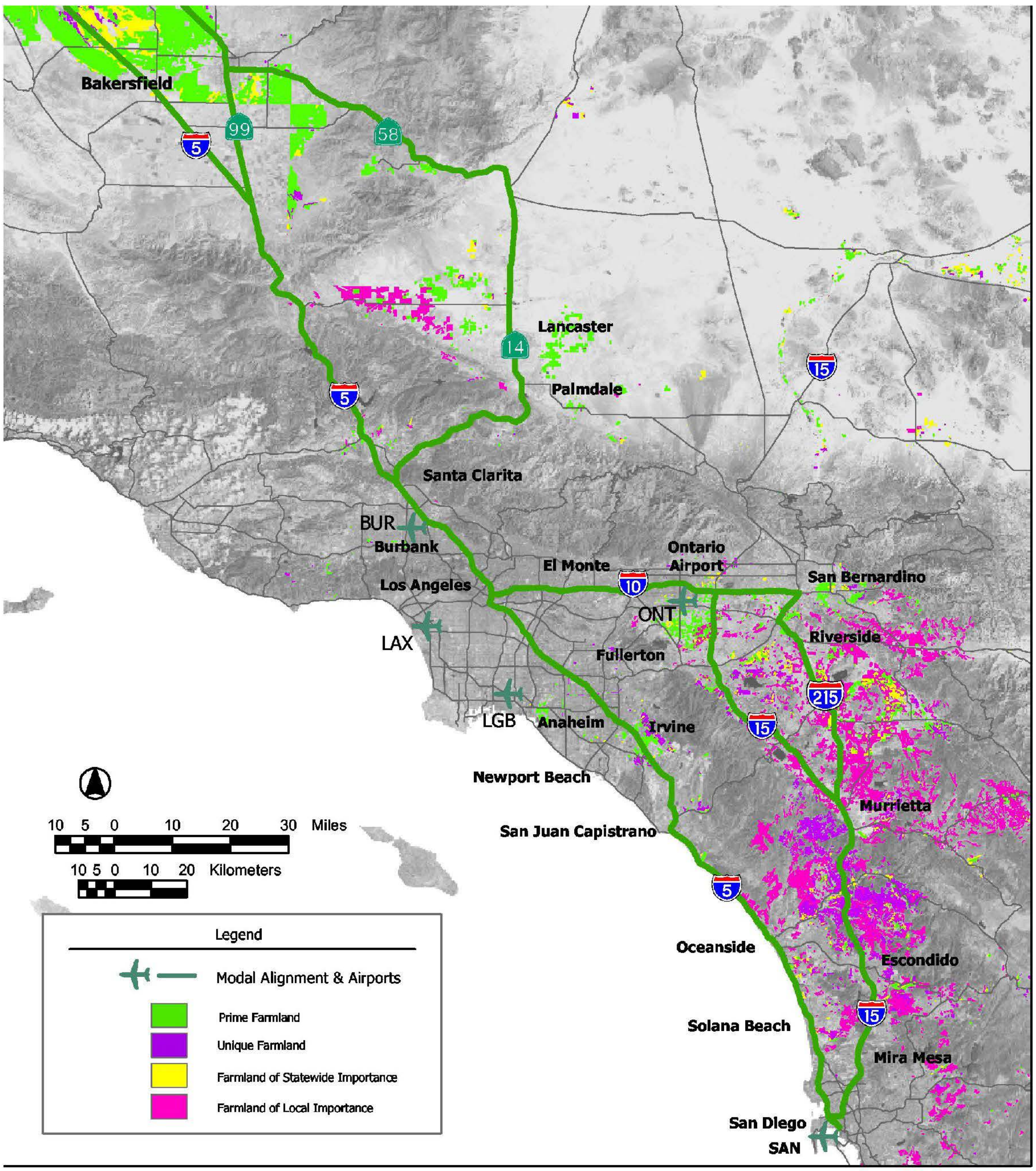


Figure 3.8-5A
High-Speed Train Alternative
North Portion of State

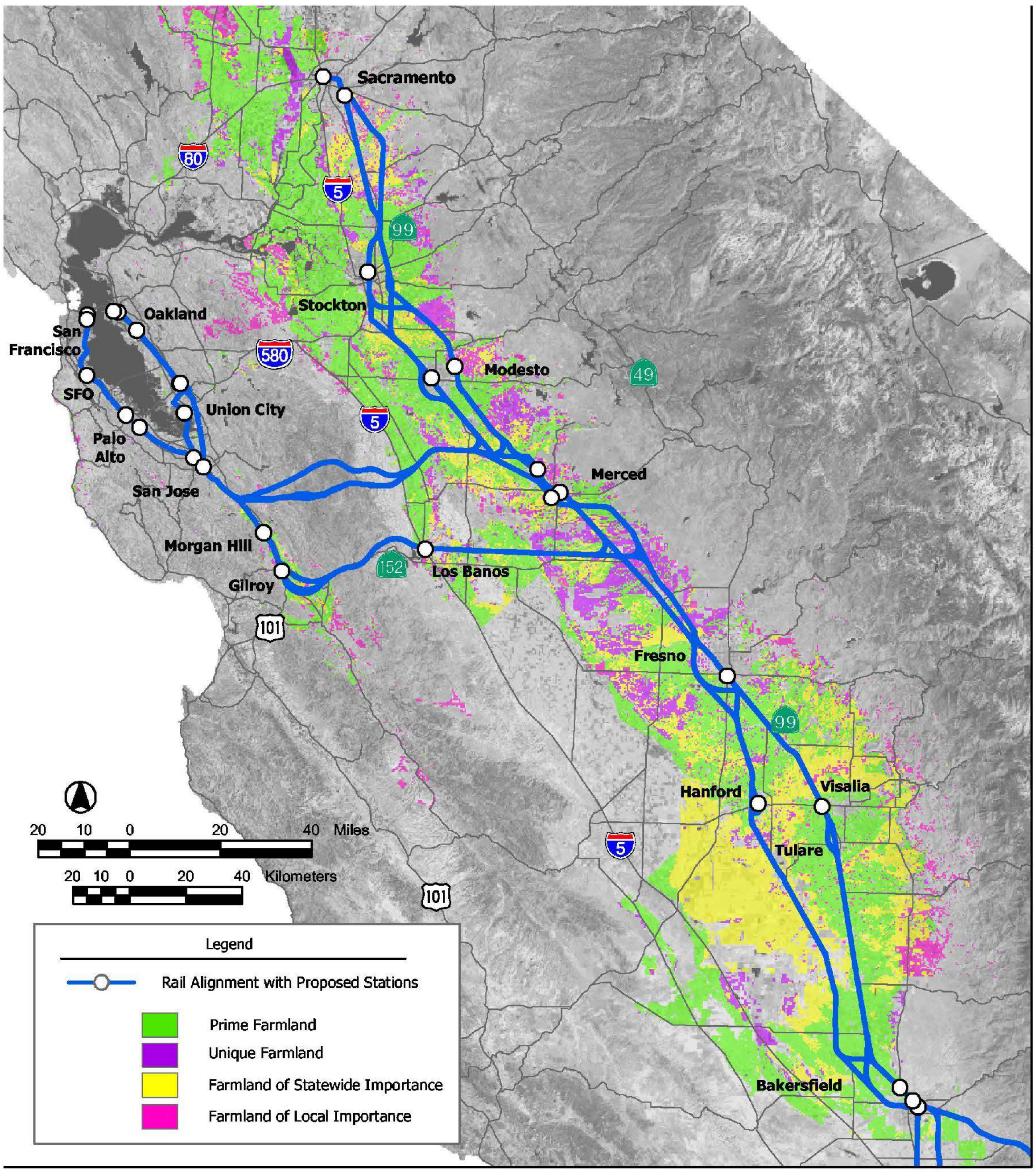
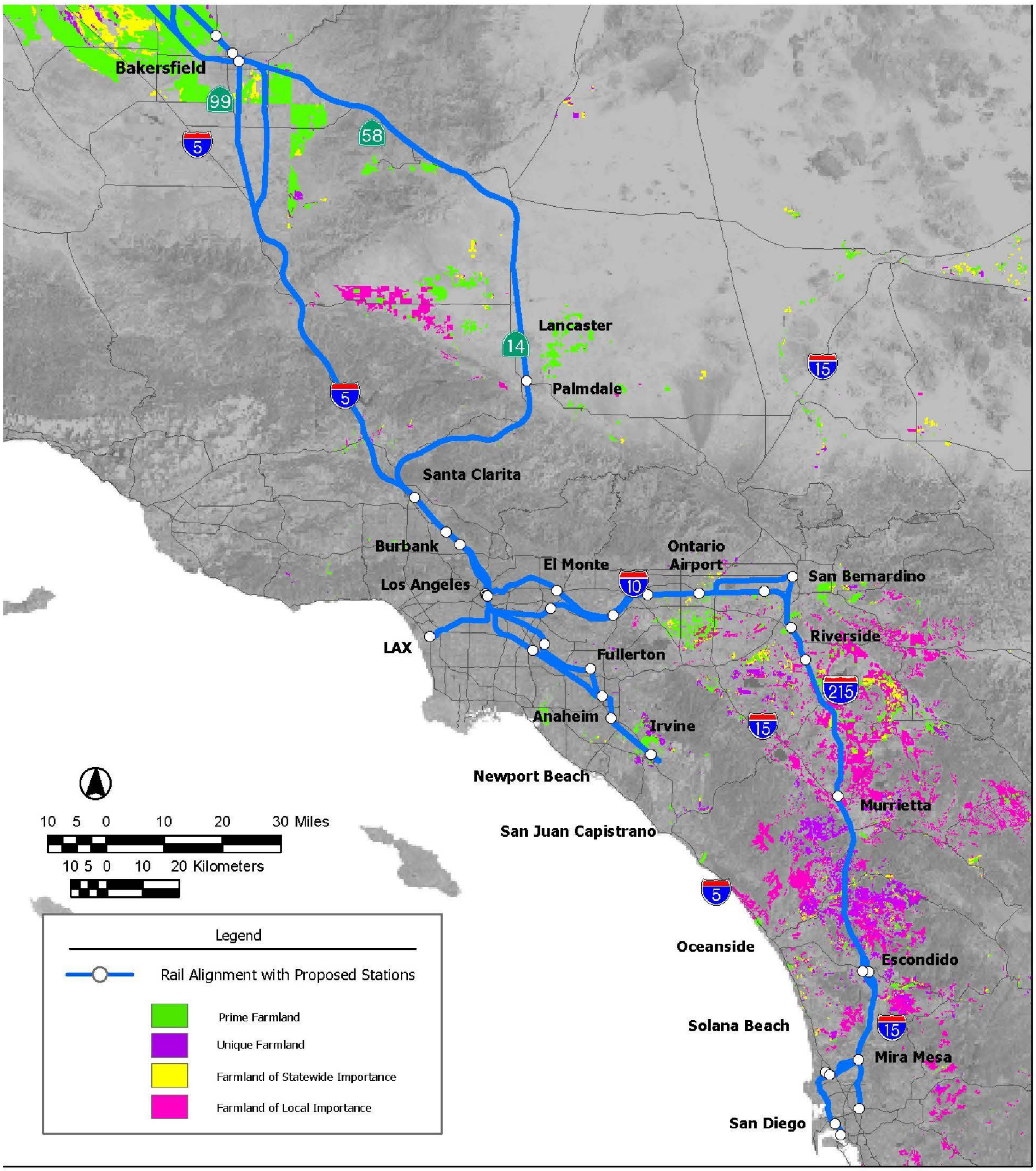


Figure 3.8-5B
High-Speed Train Alternative
South Portion of State



The majority of FMMP-listed farmland in the Bay Area to Merced region is located in the eastern portion of the region at the west side of the Central Valley. A smaller amount of FMMP-listed farmland is located in the Santa Clara Valley between San Jose and Gilroy. These areas are mostly prime farmland; smaller areas of farmland of statewide importance and farmland of local importance are also present.

Modal Alternative: The existing roadways relevant to the Modal Alternative in this region are I-80, I-580, I-880, US-101, and SR-152. I-80 travels through farmland areas in the northeastern portion of the Central Valley. I-580 (at its eastern end) travels through farmland areas in the northeastern portion of the Central Valley. I-880 travels through primarily urban areas in the eastern portion of the lower San Francisco Bay; agricultural uses are present but minimal along this roadway. US-101 travels through the agricultural areas in the southern portion of the Santa Clara Valley. SR-152 winds from the south portion of the Santa Clara Valley in an east-northeast direction to the Central Valley near the community of Los Banos. Agricultural lands along SR-152 are located in the southern portion of the Santa Clara Valley and on the eastern portion of the Central Valley.

High-Speed Train Alternative: HST Alternative alignment options in this region would begin at either San Francisco or Oakland, turn eastward at either San Jose (the Diablo Range direct alignment option) or Gilroy (the Pacheco Pass alignment option) and continue to Merced. There are negligible areas of farmland along these potential alignments between San Francisco and San Jose, and Oakland and San Jose. As indicated above, farmland in this region is primarily located in the eastern part of the region along the western areas of the Central Valley, and secondarily within the Santa Clara Valley south of San Jose. The mountainous topography along the Diablo Direct and Pacheco Pass alignment options between the Santa Clara and Central Valleys permits little agriculture besides grazing. However, grazing lands are not included in this program-level review. Grazing lands and other lands not included in the FMMP would be analyzed in the project-level review.

Sacramento to Bakersfield

This region of central California includes a large portion, approximately 75%, of the Central Valley (San Joaquin Valley) from Sacramento south to Bakersfield. The Central Valley is an active agricultural region. It contains some farmland in each of the FMMP-categories considered in this analysis. The largest FMMP farmland category represented in the Central Valley region is generally prime farmland, followed by farmland of statewide importance, then unique farmland, and, finally, farmland of local significance.

Modal Alternative: The existing roadways relevant to the Modal Alternative in this region are I-5, I-80, SR-99, and SR-152. Agricultural areas are located along the majority of the length of I-5 from Sacramento to Bakersfield. Although agricultural areas are apparent on aerial photos, the agricultural analysis is unable to ascertain agricultural impacts along I-5 in Fresno County because the FMMP has not recorded farmland for this area due to insufficient soils data. I-80 travels through the agricultural areas of the northeastern portion of the Central Valley. Like I-5, SR-99 runs through agricultural lands for the majority of its length, with minor exceptions near Fresno. SR-152 runs through areas of agriculture from I-5 to SR-99. However, agricultural uses along the Central Valley portion of SR-152 are somewhat interrupted in the area of Los Banos due to the presence of slough and pond areas. Under the Modal Alternative, the Sacramento to Bakersfield region would also include runway-related improvements to the Sacramento International Airport that would consist of lengthening Runways 1 and 2. These runways are adjacent to FMMP-listed farmland—primarily farmland of statewide importance—and some prime farmland.

High-Speed Train Alternative: Alignment options run primarily north-northwest to south-southeast adjacent to existing Union Pacific Railroad (UPRR) or Burlington Northern Santa Fe (BNSF) rail rights-of-way. There is more farmland along the BNSF corridor in this region than along the UPRR corridor. These corridors are compared below.

- Sacramento to Merced. The HST alignment options along the existing BNSF mainline corridor between Sacramento and Merced would be located within the existing Central California Traction (CCT) right-of-way from Sacramento to north of Stockton, on new alignment north of and through Stockton, and would be developed adjacent to the existing BNSF right-of-way between Stockton and Merced. The existing BNSF corridor along this length generally travels through farmland areas on exclusive right of way, circumventing the urban areas. The HST alignment options along the existing UPRR corridor are adjacent to the existing UPRR right-of-way, and would travel through more urban areas than the alignment options along the BNSF corridor. The potential alignment would include a downtown station site within Stockton. However, high-speed service through Stockton's urban area would not be feasible. The existing tracks through Stockton would need to be improved to serve stopping trains, and express tracks bypassing Stockton's urban areas would need to be developed to facilitate high-speed travel around the Stockton area. These express tracks would traverse farmland areas. The potential Modesto express loop/bypass on the UPRR mainline would run on a new alignment that would pass through farmland areas.
- Merced to Fresno. HST alignment options along the existing BNSF corridor between Merced and Fresno would travel through more agricultural areas than the alignment options along the UPRR mainline. One of the alignment options along the BNSF corridor would include new potential alignments connecting to the UPRR corridor through downtown Fresno, which corresponds to the current rail consolidation plans in this area. The new alignment of the Merced bypass, on the BNSF corridor, would travel through farmland. The Merced bypass would traverse more farmland than would the portion of the BNSF corridor that it would bypass. Options have been defined for the Merced Station on the BNSF corridor or the Merced loop/bypass. The HST potential alignment options along the existing UPRR corridor would traverse more urban areas than those on the BNSF corridor.
- Fresno to Bakersfield. HST alignment options along the existing BNSF corridor between Fresno and Bakersfield would run on new alignments in the areas around Fresno, Hanford, and just north of Bakersfield, but would be developed adjacent to existing right-of-way for the majority of the segments between these cities. An express loop/bypass along with the mainline alignment would be required around Hanford due to the existing tight curves in the area. HST alignments along the existing UPRR corridor would travel through roughly the same amount of farmland as those along the BNSF corridor. The Fresno bypass would require the development of a new alignment through farmland on the outskirts of Fresno and would run through more farmland than the existing BNSF and UPRR corridors. (The existing BNSF and UPRR corridors travel through the urban area in Fresno.)

Bakersfield to Los Angeles

This region of southern California encompasses the southern portion of the Central Valley south of Bakersfield, the mountainous areas between the Central Valley and the Los Angeles basin, and the northern portion of the Los Angeles basin from Sylmar to downtown Los Angeles. FMMP-listed agricultural land in the region is located mainly around the Bakersfield area and is largely prime farmland and farmland of statewide importance.

Modal Alternative: The existing roadways relevant to the Modal Alternative in this region are I-5, SR-99, and SR-58. I-5 travels through the agricultural areas at points south and west of Bakersfield. These areas are not included in the FMMP database and are thus not included within this agricultural analysis. South of Bakersfield, where SR-99 merges with I-5, lay the foothills of the mountains south of the Central Valley, with fewer agricultural uses. Similar to I-5, SR-99 runs through agricultural lands south of Bakersfield. SR-58 travels through the agricultural areas south and east of Bakersfield.

High-Speed Train Alternative: The Bakersfield to Los Angeles region represents the transition from high agricultural use areas to urban areas. There is less agricultural land acreage within this area than in the Sacramento to Bakersfield region. From Bakersfield south there are two potential alignment options entering the Los Angeles area. The westernmost alignment would traverse the eastern portion of the Tehachapi Mountains, but would encounter farmland areas south of Bakersfield. The easternmost alignment would progress into the Palmdale/Lancaster area and would encounter less farmland as it travels east out of Bakersfield. Within the Los Angeles area, these alignments would join in the Sylmar area.

Los Angeles to San Diego via Inland Empire

This region of southern California includes the eastern portion of the Los Angeles basin from downtown Los Angeles east to the Riverside and San Bernardino areas and south to San Diego generally along the I-215 and I-15 corridors. FMMP-listed farmland in the region is located mainly between Lake Elsinore and Escondido, and is largely farmland of local importance and, to a lesser extent, unique farmland.

Modal Alternative: The existing roadways relevant to the Modal Alternative in this region are I-15 and I-215. I-15 travels through the agricultural areas south of Lake Elsinore, continuing to Escondido. I-215 travels through fewer agricultural areas west of Lake Perris. Also under the Modal Alternative, the Los Angeles to San Diego inland region would include runway-related improvements to the Ontario International Airport that would consist of adding a third runway. The existing runways are adjacent to FMMP-listed prime farmland.

High-Speed Train Alternative: The proposed alignment and station options in this region would progress eastward out of Los Angeles to San Bernardino and would then continue south to San Diego, encountering most of the regional farmland areas between Lake Elsinore and Escondido.

Los Angeles to San Diego via Orange County

This region includes the western portion of the Los Angeles basin between downtown Los Angeles and Los Angeles International Airport (LAX) and the areas of southern California between Los Angeles and Irvine, generally following the existing Los Angeles to San Diego via Orange County I-5 highway corridor. There is relatively little FMMP-listed agricultural land in the coastal region, and it is located between Santa Ana and Irvine. The farmland between Santa Ana and Irvine is mostly prime farmland, with a smaller area of unique farmland.

Modal Alternative: The existing roadway relevant to the Modal Alternative in this region is I-5, which travels through the agricultural areas south of Santa Ana, continuing to San Diego. FMMP-listed agricultural land along the I-5 is limited and is located between Santa Ana and Irvine, and around Oceanside. The farmland along I-5 between Santa Ana and Irvine is mostly prime farmland, with a smaller area of unique farmland. The farmland along I-5 near Oceanside is entirely farmland of local importance.

High-Speed Train Alternative: Alignment options in the LOSSAN region would primarily run through the south portion of Los Angeles County and along the central areas of Orange County. An alignment would also run from the central Los Angeles area to LAX. Considering the high urbanization of Los Angeles County and the Southern California region, very limited areas of farmland are present. The agricultural areas along the Los Angeles to Orange County alignments are primarily between Santa Ana and Irvine.

3.8.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

The existing condition represents the No Project Alternative in the present and assumes the present transportation infrastructure is, and would continue to be, operational. As indicated earlier, California is presently losing farmland at a rate of 49,700 ac (20,100 ha) annually. This loss is primarily due to urban development fueled by a number of factors, including population growth, housing prices and economics, and commuting patterns (Kuminoff, Sokolow, and Sumner 2001). These circumstances suggest that there would be fewer farmland and agricultural resource areas in the future baseline case.

The No Project Alternative assumes that additional transportation improvements unrelated to this project would be programmed, funded, and expected to be operational by 2020. Some of the potential impacts on farmland from these projects would be mitigated. The trend of agricultural land conversion to accommodate urban development is likely to continue. Based on the present rate of farmland loss within the state, upon full implementation of the No Project Alternative by 2020, it is anticipated that the state would have lost nearly an additional 845,000 ac (342,000 ha) of farmland to urban development. This would represent a loss of approximately 3% of the state's 27 million ac (11 million ha) of farmland. The transportation improvements under the No Project Alternative would contribute to less than 1% of the 845,000-ac (342,000-ha) loss, but precise estimates are not possible.

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

The No Project Alternative primarily represents planned highway improvements, with relatively minor infrastructure development. Although some farmland acquisition and conversion would likely occur under the No Project Alternative, it would be less than under the Modal or HST Alternatives because projects included in the No Project Alternative are primarily programmatic and do not require use of farmland. Table 3.8-1 provides the quantified potential impact amounts per region for the Modal and HST Alternatives.

The Modal Alternative would not create additional alignments but would expand existing infrastructure. There are various alignment options for the HST Alternative in each region.

Table 3.8-1
Impacts on Potential System-wide Agricultural Land by Alternative[a,b,c]

Alternative	Region	Prime Farmland in ac (ha)	Unique Farmland in ac (ha)	Statewide Importance in ac (ha)	Local Importance in ac (ha)	Region Totals in ac (ha)
Modal Alternative	Bay Area to Merced	168 (68)	31 (13)	56 (23)	7 (3)	262 (106)
	Sacramento to Bakersfield	323 (131)	54 (22)	181 (73)	51 (21)	609 (246)
	Bakersfield to Los Angeles	1 (0.4)	0	1 (0.4)	0	2 (0.8)
	Los Angeles to San Diego via Inland Empire	106 (43)	1 (0.4)	3 (1)	107 (43)	217 (88)
	Los Angeles to San Diego via Orange County[1]	15 (6)	4 (2)	1 (0.4)	8 (3)	28 (11)
Modal Alternative System-Wide Totals		**613 (248)**	**90 (36)**	**242 (98)**	**173 (70)**	**1,118 (452)**
HST Alternative (SWLPI)[c]	Bay Area to Merced	244 (99)	46 (19)	248 (100)	11 (4)	549 (222)
	Sacramento to Bakersfield	1,132 (458)	110 (45)	524 (212)	106 (43)	1,872 (758)
	Bakersfield to Los Angeles	0	0	0	0	0
	Los Angeles to San Diego via Inland Empire	7 (3)	0	0	17 (7)	24 (10)
	Los Angeles to Orange County	0	0	0	0	0
HST Alternative (SWLPI)[c] Totals		**1,383 (560)**	**156 (63)**	**772 (312)**	**134 (54)**	**2,445 (989)**
HST Alternative (SWGPI)[c]	Bay Area to Merced	305 (123)	175 (71)	207 (84)	83 (34)	770 (312)
	Sacramento to Bakersfield	1,532 (620)	370 (150)	868 (351)	232 (94)	3,002 (1,215)
	Bakersfield to Los Angeles	62 (25)	0	1 (0.4)	0	63 (25)
	Los Angeles to San Diego via Inland Empire	8 (3)	0	1 (0.40)	16 (7)	25 (10)
	Los Angeles to Orange County	0	0	0	0	0
HST Alternative (SWGPI)[c] Totals		**1,907 (772)**	**545 (221)**	**1,077 (436)**	**331 (134)**	**3,860 (1,562)**

[1] Modal extends to San Diego along I-5 since majority of Los Angeles to San Diego auto travel would take this route as opposed to I-215/I-15.

[a] Alternative's system-wide totals for all agricultural categories shown in bold.

[b] The SWLPI and SWGPI potential impacts are based on the conservative assumption that the HST study area for agricultural lands would be 100 ft (30 m) wide in rural areas adjacent to existing rail rights-of-way. The 100-ft (30-m) width may be reduced to 50 ft (15 m) in areas of high agricultural impact, and may further be reduced to near negligible levels should right-of-way agreements be made with the existing rail operators.

[c] The HST Alternative system-wide alignment combinations with the lowest potential impact are denoted as SWLPI. The HST Alternative system-wide alignment combinations with the greatest potential impact are denoted as SWGPI. The amounts were determined by separately adding the impact amounts of the LPI and GPI alignment combinations per region for all five regions. This was done for each FMMP category.

The results of the comparative analysis, including each of the FMMP-listed farmland categories as well as the regional category totals for each of the alternatives, support the following conclusions.

- The Modal and HST Alternatives each would result in potentially greater impacts on farmland than the No Project Alternative, with the highest potential impacts being attributable to the proposed HST Alternative system-wide alignment combinations with the greatest potential impact (SWGPI).
- Compared to the Modal Alternative, the HST Alternative would result in potentially greater impacts on farmland in two out of five regions (Sacramento to Bakersfield and Bay Area to Merced), similar impacts in one region (Bakersfield to Los Angeles), and fewer impacts in two regions (Los Angeles to San Diego via Inland Empire and LOSSAN).
- The regions with the greatest potential impacts on farmland and agricultural lands are the Bay Area to Merced and Sacramento to Bakersfield regions.
- The HST Alternative system-wide alignment combinations with the lowest potential impacts on farmland (SWLPI) would exceed the potential impacts on farmland resulting from the No Project and Modal Alternatives by 2,445 ac and 1,327 ac (989 ha and 537 ha), respectively.
- The HST Alternative SWGPI would exceed the No Project and Modal Alternatives by 3,860 ac and 2,742 ac (1,562 ha and 1,110 ha), respectively.
- The HST Alternative SWLPI could generate fewer impacts than the Modal Alternative within the farmland of local importance FMMP category.
- The HST right-of-way width could potentially be reduced to 50 ft (15 m) in the areas of impact. This reduction would reduce the HST level of impact and reduce potential differences in impacts between the HST and Modal Alternatives. The HST alignment options could fit into existing rail rights-of-way in constrained areas if agreements could be reached with existing owners/operators. This approach would reduce the potential impacts of the HST Alternative on farmland in these areas to a nearly negligible level.
- Compared to the state's potential total or overall farmland loss of nearly 845,000 ac (342,000 ha) by 2020, the Modal, HST SWLPI, and HST SWGPI Alternatives would each represent less than 0.4% of the total potential farmland loss.
- For the HST Alternative, loops/bypasses and connections on new alignments would represent greater potential impacts on farmland due to severance than the alignment options within or adjacent to existing rail rights-of-way.

3.8.4 Comparison of Alternatives by Region

Table 3.8-1 above provides a synoptic comparison of the Modal and HST Alternatives, including range (LPI and GPI) of potential impact depending on the HST alignment combinations per region and system-wide. The key findings of the agricultural lands analysis by region for the Modal Alternative and HST

Alternative alignment options are summarized below. Appendix 3.8-A provides tables that illustrate the amount of potential impacts associated with each HST alignment option by region.

A. BAY AREA TO MERCED

This region has the second highest concentration of farmland of the regions being studied. The HST Alternative (LPI and GPI) would have potentially higher impacts in all FMMP categories than the Modal Alternative. The total FMMP category acreage potentially impacted in this region would be 262 ac (106 ha) for the Modal Alternative, 549 ac (222 ha) for the HST Alternative LPI, and 770 ac (312 ha) for the HST Alternative GPI, thus indicating that the HST Alternative (LPI and GPI) would exceed the potential impact of the Modal Alternative by 287 ac and 508 ac (116 ac and 206 ha), respectively. This would be added to impacts that may result from the No Project Alternative by 2020. Figures 3.8-6 and 3.8-7 show the locations of the Modal Alternative improvements and HST Alternative in the region.

Modal Alternative

Nearly all of the improvements under the Modal Alternative would be in areas containing existing roadway rights-of-way and runways. The agricultural impacts analysis included a review of existing roadways that could accommodate the development of one lane each way in the center median. The ability to add lanes to the center median reduces the requirement to acquire farmland for outside lane expansion, and thus reduces potential farmland impacts. The Modal Alternative improvements would be implemented on existing roadways in this region; no farmland parcels would be severed.

The roadways relevant to the Modal Alternative in this region are I-80, I-580, I-880, US-101, and SR-152. Considering the location of FMMP-listed farmland in this region and the ability to develop lanes in the center medians of the above-mentioned roadways, the areas of greatest potential impact would be primarily along SR-152 east of I-5, and secondarily along US-101 in the Santa Clara Valley. Possible roadway improvements in these areas could result in farmland impacts because they would require the acquisition of farmland adjacent to the roadway due to their apparent inability to accommodate the development of inside lanes.

The amount of farmland potentially impacted in the Bay Area to Merced region for the Modal Alternative would be 168 ac (68 ha) of prime farmland, 31 ac (13 ha) of unique farmland, 56 ac (23 ha) of farmland of statewide importance, and 7 ac (3 ha) of farmland of local importance. The Modal Alternative would potentially impact a total of 262 ac (106 ha) of farmland in this region.

High-Speed Train Alternative

This region includes potential alignment options that could extend southward from either San Francisco or Oakland to San Jose or Gilroy, and on to Merced. Farmland in this region is primarily in the east along the west margin of the Central Valley, and secondarily between San Jose and Gilroy. Farmlands are sparsely located in the San Francisco and Oakland urban areas.

The HST Alternative may benefit from being able to use existing rail rights-of-way. Configuration options of the HST Alternative, as indicated in the methodology subsection, include developing the HST alignment options within or adjacent to existing rail rights-of-way, or on new alignments. The development of the HST alignment options within or adjacent to existing rail rights-of-way would reduce the potential for farmland impacts from conversion, and significantly reduce severance-related farmland impacts. Both the Modal and HST Alternatives have this potential to reduce impacts on farmland.

Figure 3.8-6
Modal Alternative Improvement Locations
Bay Area to Merced

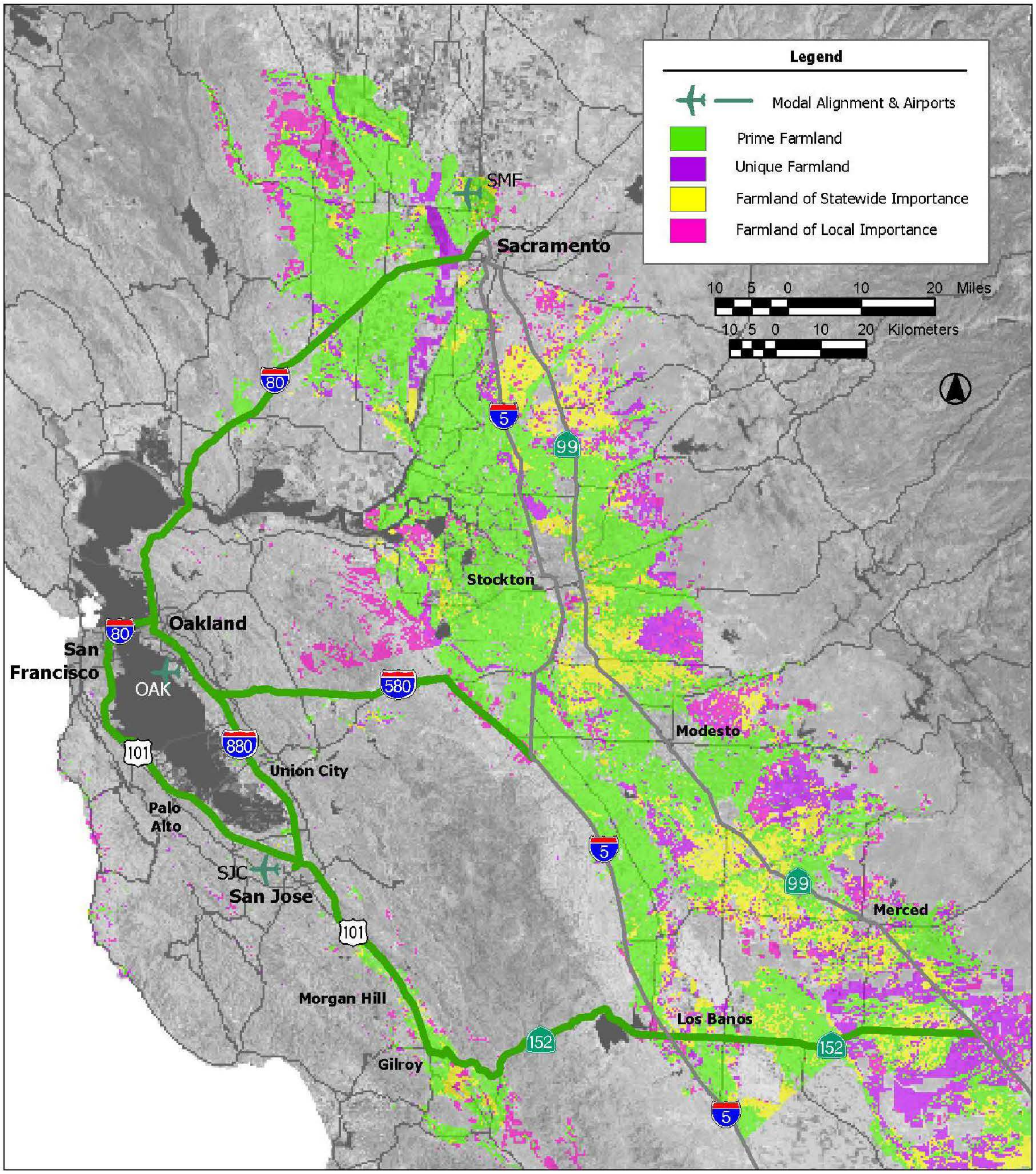
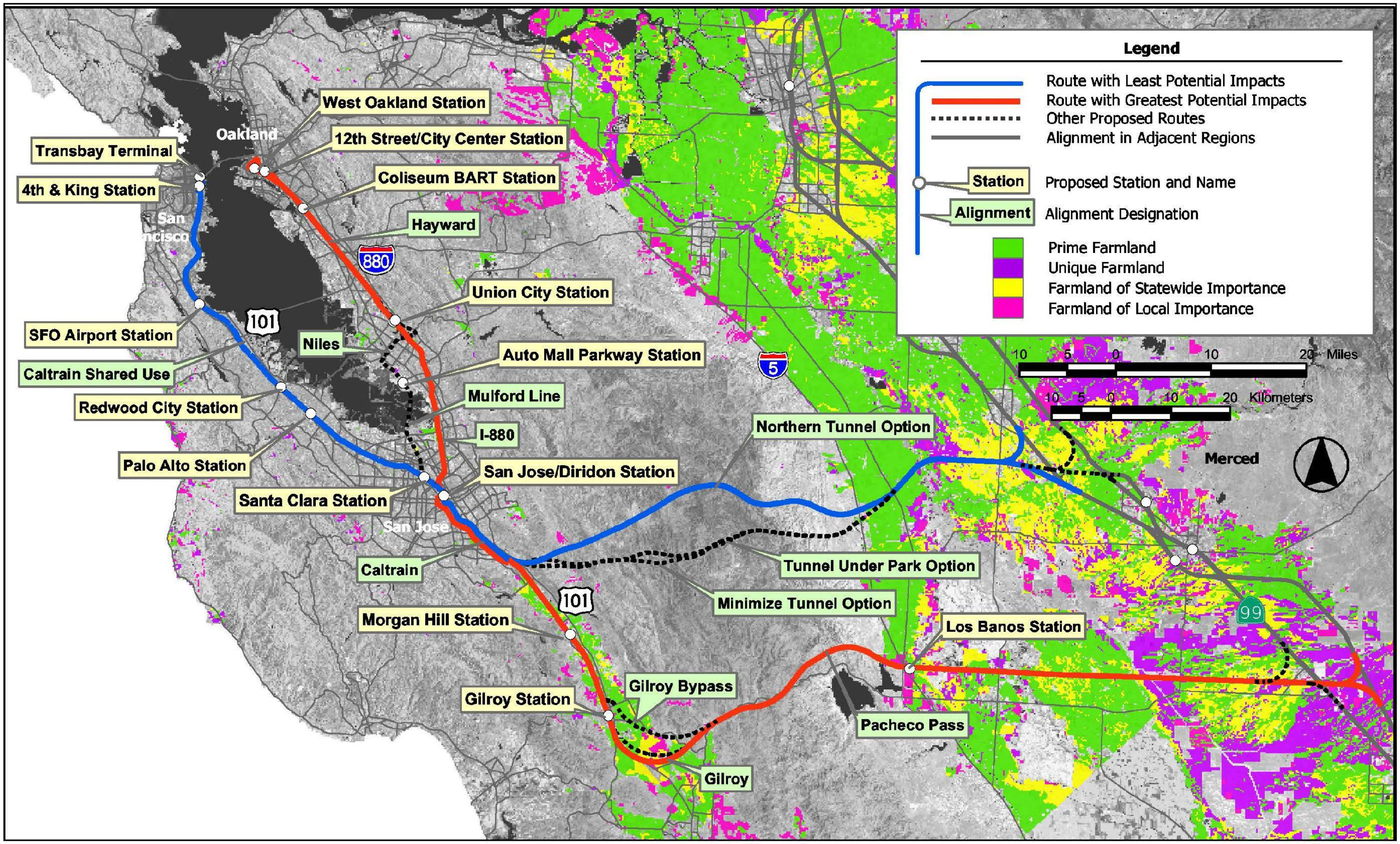


Figure 3.8-7
Alignments with Least Potential Impacts and Greatest Potential Impacts
Bay Area to Merced



High-Speed Train Alignment Option Comparison

Very little farmland is found in the San Francisco and Oakland urban areas. The Diablo Range direct and Pacheco Pass alignment options would connect the Bay Area to the Merced area. The Diablo Range direct alignment option would result in less potential for farmland impacts because it would travel through urban and mountainous areas and would not extend as far east into the Central Valley farmland areas as the Pacheco Pass.

There are two options for the potential Pacheco Pass alignment through the Gilroy area: through downtown Gilroy (Caltrain/Gilroy/Pacheco Pass) and bypassing Gilroy to the north (Morgan Hill/Caltrain/Pacheco Pass). The Morgan Hill/Caltrain/Pacheco Pass alignment option would result in potential impacts on 26 ac (11 ha) of farmland more than the Gilroy/Caltrain/Pacheco Pass alignment option. This greater impact would be due primarily to the Gilroy/Caltrain/Pacheco Pass option being closer to suburban areas with fewer adjacent agricultural uses than the more agricultural areas of the Morgan Hill/Caltrain/Pacheco Pass. The LPI alignment combination in this region would use the Caltrain alignment from San Francisco to San Jose and the Diablo Range direct Northern Tunnel option from San Jose to Merced, potentially impacting a total of 549 ac (222 ha) of farmland. All of the 549 ac (222 ha) impacted would be located in the western part of the Central Valley at the east end of this alignment.

The GPI alignment combination in this region would use the Hayward/I-880 alignment from Oakland to San Jose and the Morgan Hill/Caltrain/Pacheco Pass alignment from San Jose to Merced. This alignment combination would potentially result in impacts on 770 ac (312 ha) of total farmland, which is approximately 221 ac (89 ha) more than the LPI alignment combination. Approximately 629 of the 770 ac (255 of the 312 ha) would be attributable to the farmland located in the western part of the Central Valley at the east end of this alignment which is mostly an agricultural area. See Appendix 3.8-A for potential impacts associated with each HST alignment option in all regions.

B. SACRAMENTO TO BAKERSFIELD

The Central Valley represents the most active agricultural region in California. Potential improvements to highways and airports, as well as new HST alignments and stations in the Sacramento to Bakersfield region, would generate the greatest potential for impacts on farmland of the regions analyzed. The HST Alternative (LPI and GPI) would have higher impacts in all FMMP categories than the Modal Alternative. The total FMMP category acreage potentially impacted in this region would be 609 ac (246 ha) for the Modal Alternative, 1,872 ac (758 ha) for the HST Alternative LPI, and 3,002 ac (1,215 ha) for the HST Alternative GPI, thus indicating that the HST Alternative LPI and GPI would exceed the potential impact of the Modal Alternative by 1,263 ac and 2,393 ac (511 ha and 968 ha), respectively. Figures 3.8-8A and 3.8-8B and 3.8-9A and 3.8-9B show the locations of the Modal Alternative and HST Alternative improvements in the region.

Modal Alternative

As with the Bay Area to Merced region, areas along existing roadways in the Sacramento to Bakersfield region that can accommodate an additional lane in each direction within the center median were assumed not to generate farmland impacts because acquisition and conversion of adjacent agricultural lands would not be required. Under this assumption, the number of acres of farmland impacted by roadway right-of-way acquisition for the Modal Alternative would be 287 ac (116 ha) of prime farmland, 43 ac (17 ha) of unique farmland, 124 ac (50 ha) of farmland of statewide importance, and 48 ac (19 ha) of farmland of local importance. Total roadway-related impacts on farmland under the Modal Alternative would be 502 ac (203 ha).

Airport-related improvements under this alternative would include the lengthening of Runways 1 and 2 at the Sacramento International Airport. These improvements would potentially impact

Figure 3.8-8A
Modal Alternative Improvement Locations
Sacrament to Bakersfield, North Portion

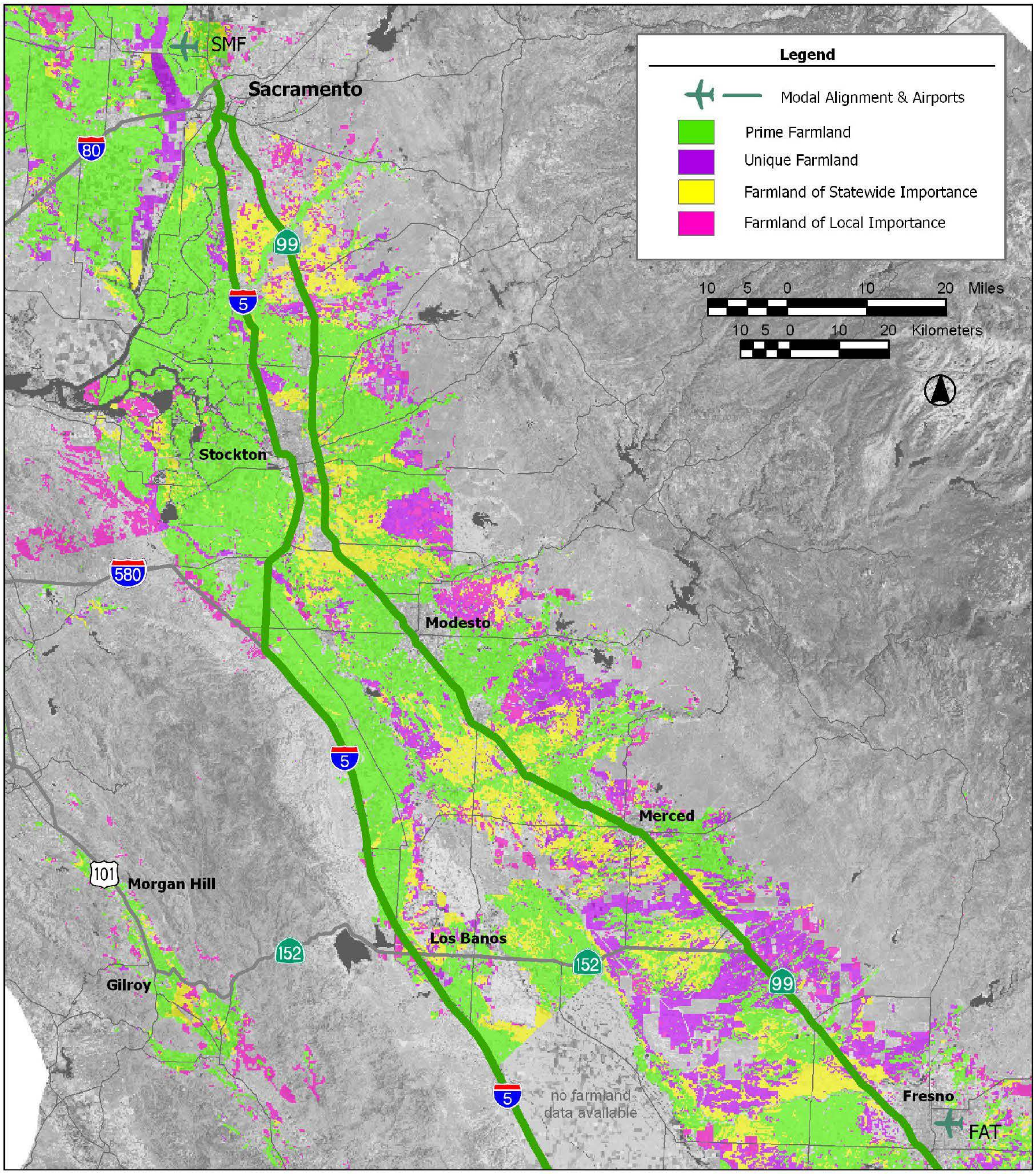


Figure 3.8-8B
Modal Alternative Improvement Locations
Sacramento to Bakersfield, South Portion

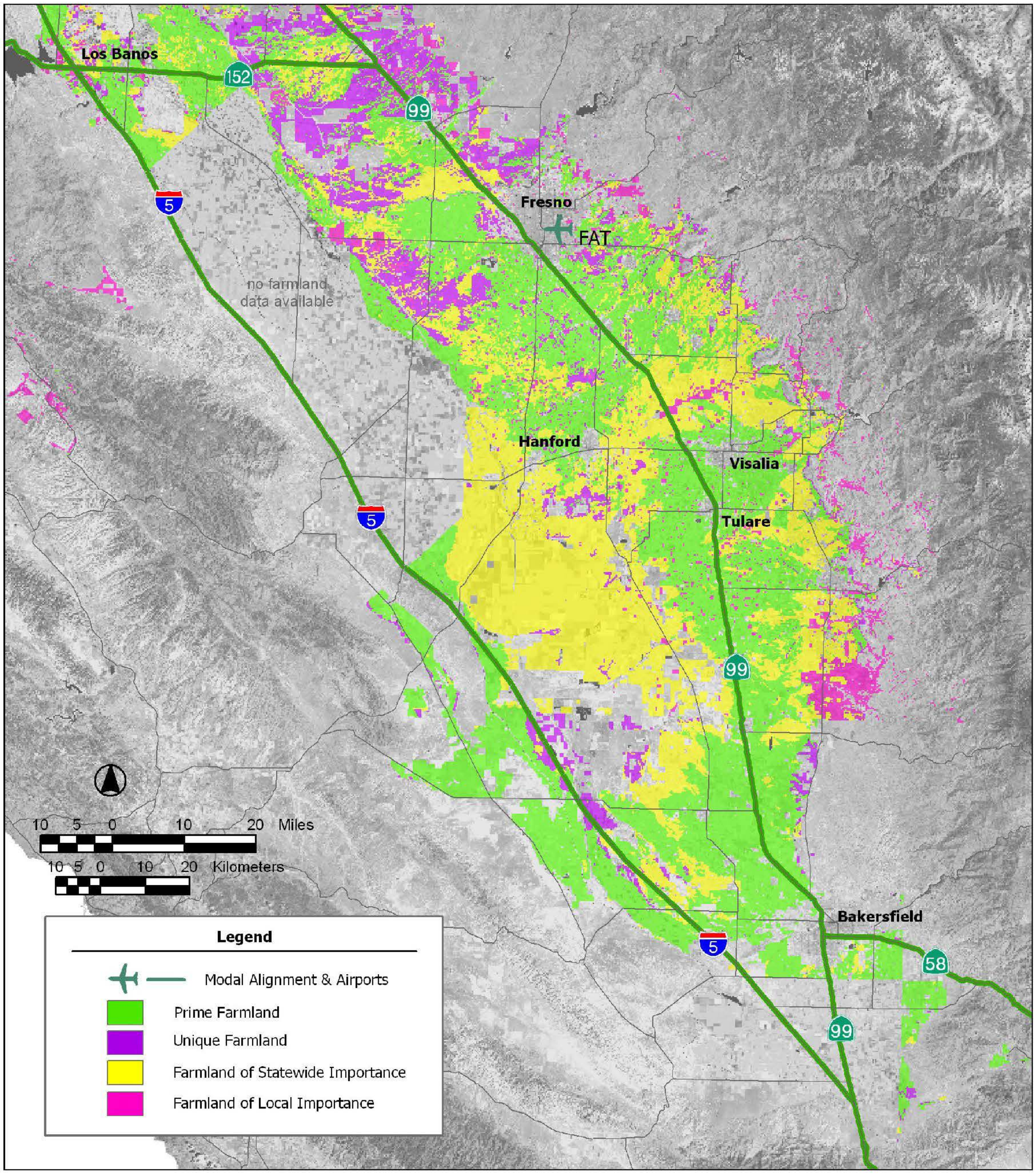


Figure 3.8-9A
Alignments with Least Potential Impacts and Greatest Potential Impacts
Sacramento to Bakersfield
North Portion

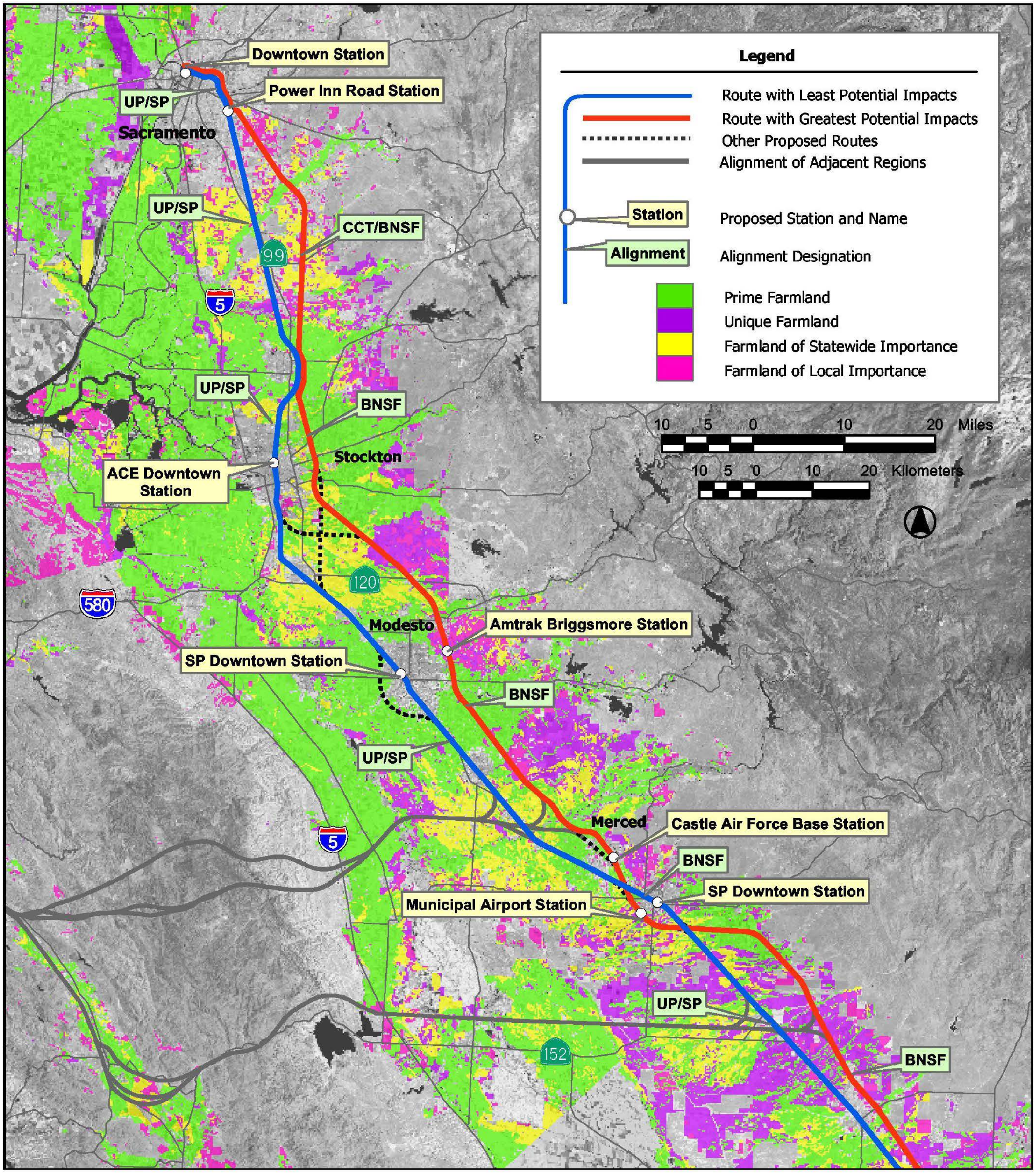
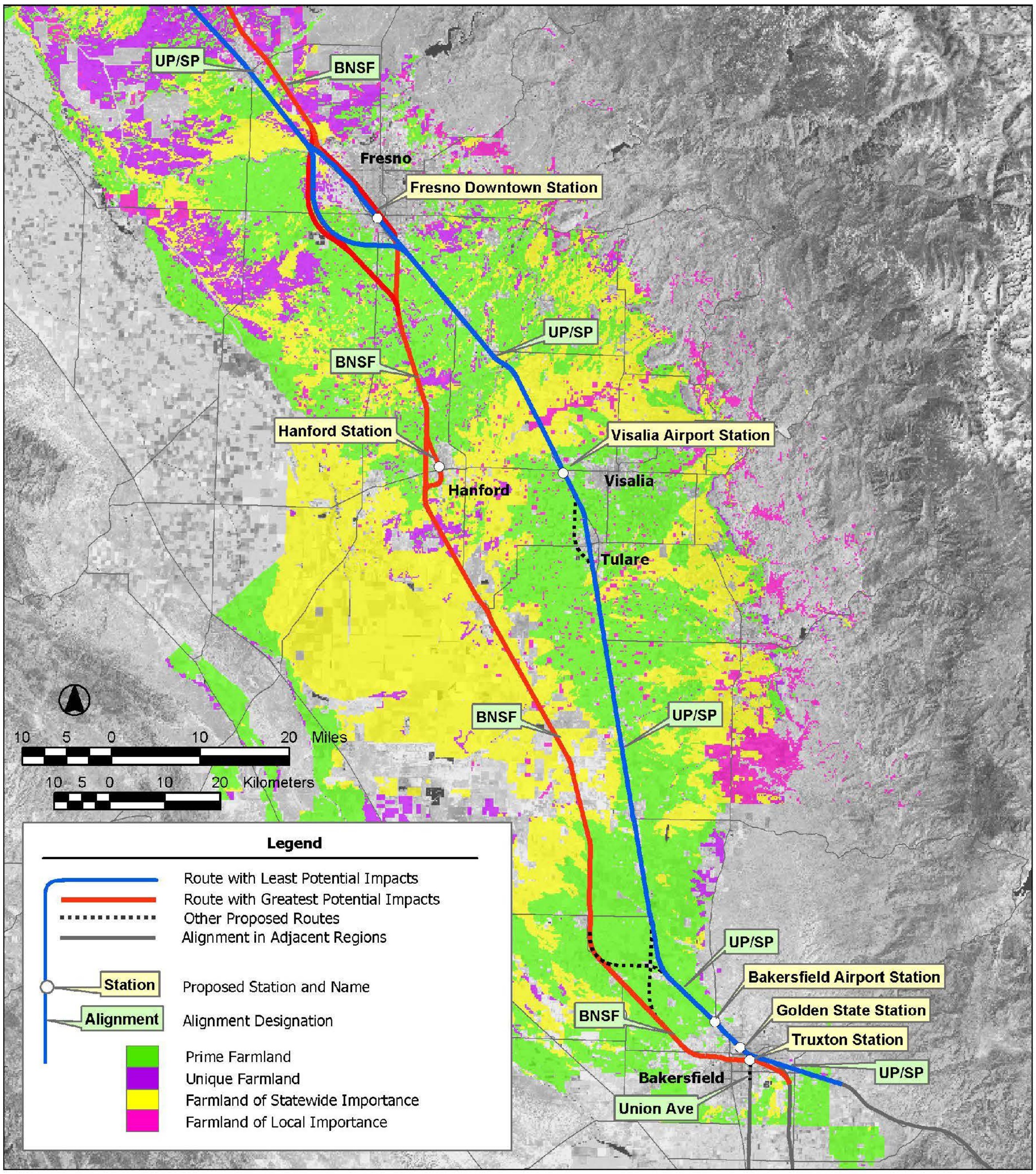


Figure 3.8-9B
Alignments with Least Potential Impacts and Greatest Potential Impacts
Sacramento to Bakersfield Region
South Portion



36 ac (15 ha) of prime farmland, 11 ac (4 ha) of unique farmland, 57 ac (23 ha) of farmland of statewide importance, and 3 ac (1 ha) of farmland of local importance. Total potential airport-related impacts on farmland under the Modal Alternative would be 107 ac (43 ha).

Collectively, the Modal Alternative improvements, roadway and airport, would potentially impact 323 ac (131 ha) of prime farmland, 54 ac (22 ha) of unique farmland, 181 ac (73 ha) of farmland of statewide importance, and 51 ac (21 ha) of farmland of local importance. The Modal Alternative would potentially impact a total of 609 ac (246 ha) of farmland in this region.

High-Speed Train Alternative

It is generally assumed that potential HST alignments in the Sacramento to Bakersfield region would be developed adjacent to existing UPRR or BNSF rail rights-of-way. In some segments, however, the alignment options are assumed to be within existing rights-of-way (e.g., CCT from Sacramento to Stockton). The GIS analyses accounted for these alignment areas. Some alignment options within the Sacramento to Bakersfield region, particularly the express loops/bypasses and connections between existing corridors would require new alignments separate from existing rail corridors.

Farmland severance impacts (i.e., impacts from dividing parcels currently in agricultural use) would potentially result, in addition to farmland conversion. While the precise amount of farmland potentially severed by the HST alignment options cannot be ascertained at this level of study, the HST alignment options on new alignments traversing farmland areas would have the potential to sever the vast majority of parcels traversed due to the curving nature of the alignments.[2]

High-Speed Train Alternative Alignment Option Comparison

The area of highest potential impact in this region would be Stockton, followed by Fresno and the north portion of Bakersfield. Although there could potentially be alignments on new corridors in the Merced area, these alignments would not occur in farmland areas. The Sacramento to Bakersfield region also has several potential express loops/bypasses under consideration that are intended to circumvent the more congested urban areas, reduce costs, and reduce potential urban impacts such as noise. They are generally routed through the agricultural areas surrounding the urban areas, resulting in greater farmland conversion and severance-related impacts.

As shown below in Table 3.8-2, seven of the eight potential express loops in the region would have higher potential farmland impacts than the mainline alignments that they would bypass. Although express loops are shown separately, some areas may require the development of an express loop and mainline alignment. Such instances have been accounted for in this report's LPI and GPI alignment combinations analysis.

[2] Severance issues may arise in the Sacramento to Bakersfield region where the HST alignment options would bypass urban areas on new corridors traveling primarily north-northwest to south-southeast, and result in diagonally dividing a number of north-south oriented farmland parcels.

Table 3.8-2
Potential Farmland Impacts: Express Loops Compared to Mainlines

Alignment	Express Loop	Prime Farmland in ac (ha)	Unique Farmland in ac (ha)	Statewide Importance in ac (ha)	Local Importance in ac (ha)	Total Farmland in ac (ha)
Stockton to Modesto	Modesto loop	141 (57)	0	0	0	141 (57)
	Mainline	49 (20)	0	0	0	49 (20)
Modesto to Merced	Atwater Station loop	79 (32)	0	2 (0.8)	3 (1)	84 (34)
	Mainline	52 (21)	0	2 (0.8)	23 (9)	77 (31)
	Merced loop (BNSF)	45 (18)	9 (4)	72 (29)	5 (2)	131 (53)
	Mainline	35 (14)	1 (0.4)	23 (9)	7 (3)	66 (27)
	Merced loop (UPRR)	40 (16)	10 (4)	72 (29)	5 (2)	127 (51)
	Mainline	48 (19)	3 (1)	20 (8)	6 (2)	77 (31)
Merced to Fresno	Fresno loop (BNSF)	149 (60)	76 (31)	63 (26)	5 (2)	293 (119)
	Mainline	70 (28)	23 (9)	32 (13)	9 (4)	134 (54)
	Fresno loop (UPRR)	131 (53)	44 (18)	42 (17)	7 (3)	224 (91)
	Mainline	3 (1)	0	11 (5)	1 (0.4)	15 (6)
Fresno to Tulare	Hanford Station loop	46 (19)	0	15 (6)	0	61 (25)
	Mainline	74 (30)	0	13 (5)	0	87 (35)
Tulare to Bakersfield	Tulare loop	103 (42)	3 (1)	12 (5)	1 (0.4)	119 (48)
	Mainline	60 (24)	2 (1)	13 (5)	0	75 (30)

Although more potential farmland conversion-related impacts would occur along the alignments of the proposed express loops than along the urban areas they would bypass, there would be the potential for severance-related impacts. These impacts are likely to occur as a result of the curvilinear nature and diagonal directions of travel of the express loops as compared to the more north-south orientation of the farmland parcels. For instance, a curved alignment through farmland has more potential to sever farmland than a straight alignment located along a road section or other linear feature.

Based on GIS analysis included in the related System-Wide Agricultural Resources and Farmlands Report (Parsons Brinkerhoff 2003), there would be consistently less agricultural land potentially impacted by the alignment options adjacent to the UPRR corridor than the BNSF corridor. Map observations and review of aerial photography reveal that the UPRR corridor runs parallel to SR-99. Much of the urban growth in the last 50 years in the Central Valley appears to have been around SR-99 (California Department of Transportation 2003). The nearby UPRR corridor would be in urban areas with correspondingly fewer agricultural severances or conversions. Potential HST alignment options adjacent to these corridors or sharing them would generate similar impacts on farmland. See Appendix 3.8-A for potential impacts associated with each HST alignment option in all regions.

C. BAKERSFIELD TO LOS ANGELES

The Bakersfield to Los Angeles region represents the transition from agricultural areas in the Central Valley to urbanized areas of Los Angeles. For the HST Alternative, the HST Alternative GPI would have the highest potential impacts in all FMMP categories (63 ac [25 ha]); the Modal Alternative and the HST Alternative LPI would have similar levels of impact, 2 ac (0.8) and 0 ac, respectively. Figures 3.8-10 and 3.8-11 show the locations of the Modal Alternative and HST Alternative improvements for the region.

Modal Alternative

Little farmland would be traversed by the potential Modal Alternative improvements in this region. The portions of the existing roadways that are able to accommodate an additional lane in each direction in the center median were assumed not to generate additional/new farmland impacts. The amount of farmland potentially impacted by the Modal Alternative in the region would be 1 ac (0.4 ha) of prime farmland and 1 ac (0.4 ha) of farmland of statewide importance. Based on these assumptions, the Modal Alternative would potentially impact a total of 2 ac (1 ha) of farmland in this region.

High-Speed Train Alternative

The FMMP database indicates that land uses along the Sylmar to Los Angeles alignment are all considered urban. Most of the farmland and agricultural resources in the region are south and east of the outskirts of Bakersfield. Little farmland would be traversed by the proposed HST Alternative alignment options in this region; there is virtually no farmland in the FMMP categories in the region.

High-Speed Train Alternative Alignment Option Comparison

The I-5 Union Avenue and Wheeler Ridge Road alignment options would traverse more farmland and thus would have the greatest potential impacts (63 ac [25 ha]) among the proposed HST alignment options. The LPI alignment combination would be the SR-58/Soledad Canyon alignment along the Bakersfield to Sylmar segment, and either the MTA/Metrolink or combined I-5/Metrolink portion along the Sylmar to Los Angeles segment. With implementation of this alignment combination, no farmland impacts would occur. The GPI alignment combination would be the Wheeler Ridge to I-5 alignment along the Bakersfield to Sylmar segment, and either the MTA/Metrolink or combined I-5/Metroliink portions along the Sylmar to Los Angeles segment. With implementation of this alignment combination, impacts on 63 ac (25 ha) of farmland would occur. See Appendix 3.8-A for potential impacts associated with each HST alignment option in all regions.

D. LOS ANGELES TO SAN DIEGO VIA INLAND EMPIRE

The Los Angeles to San Diego via Inland Empire region includes farmland areas located mainly along I-15 between Riverside and south of Escondido. The Modal Alternative would have more potential impacts in all FMMP categories than the HST Alternative LPI and GPI. The total FMMP category acreage potentially impacted in this region would be 217 ac (88 ha) for the Modal Alternative, 24 ac (10 ha) for the HST Alternative LPI, and 25 ac (10 ha) for the HST Alternative GPI, thus indicating that the Modal Alternative would exceed the potential impact of the HST Alternative LPI and GPI by 193 ac and 192 ac (78 ha), respectively. Figures 3.8-12 and 3.8-13 show the potential impacts of the Modal Alternative and HST Alternative in this region.

Modal Alternative

There is not space available to add lanes to the center medians of I-15 and I-215; thus additional right-of-way would be required in this region. The amount of farmland impacted by possible Modal Alternative roadway right-of-way acquisition would be 25 ac (10 ha) of prime farmland, 1 ac (0.4 ha) of unique farmland, 3 ac (1 ha) of farmland of statewide importance, and 107 ac (43 ha) of farmland of local importance. Total potential roadway-related impacts on farmland under the Modal Alternative would be 136 ac (55 ha).

Figure 3.8-10
Modal Alternative Improvement Locations
Bakersfield to Los Angeles

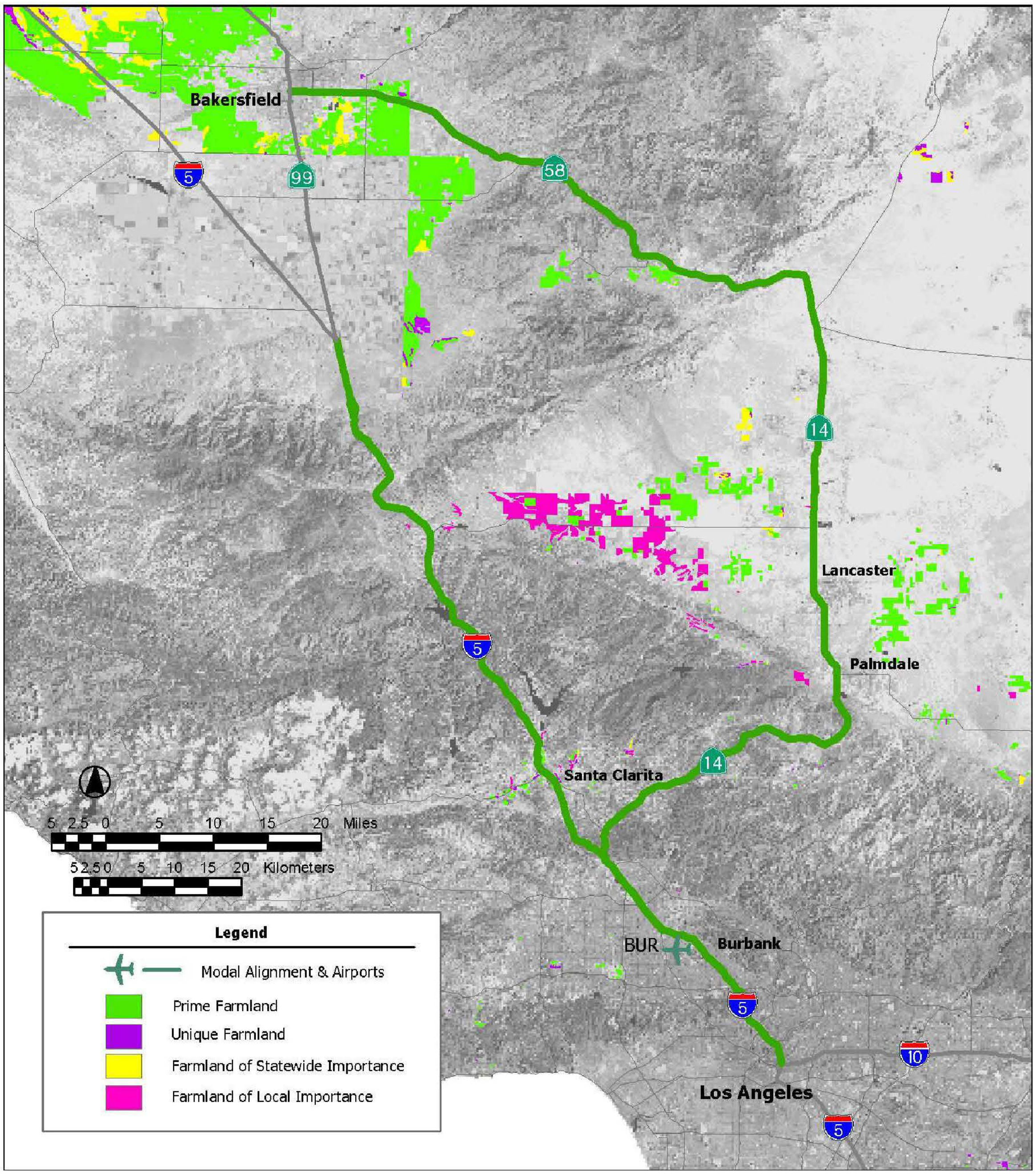


Figure 3.8-11

Alignments with Least Potential Impacts and Greatest Potential Impacts

Bakersfield to Los Angeles

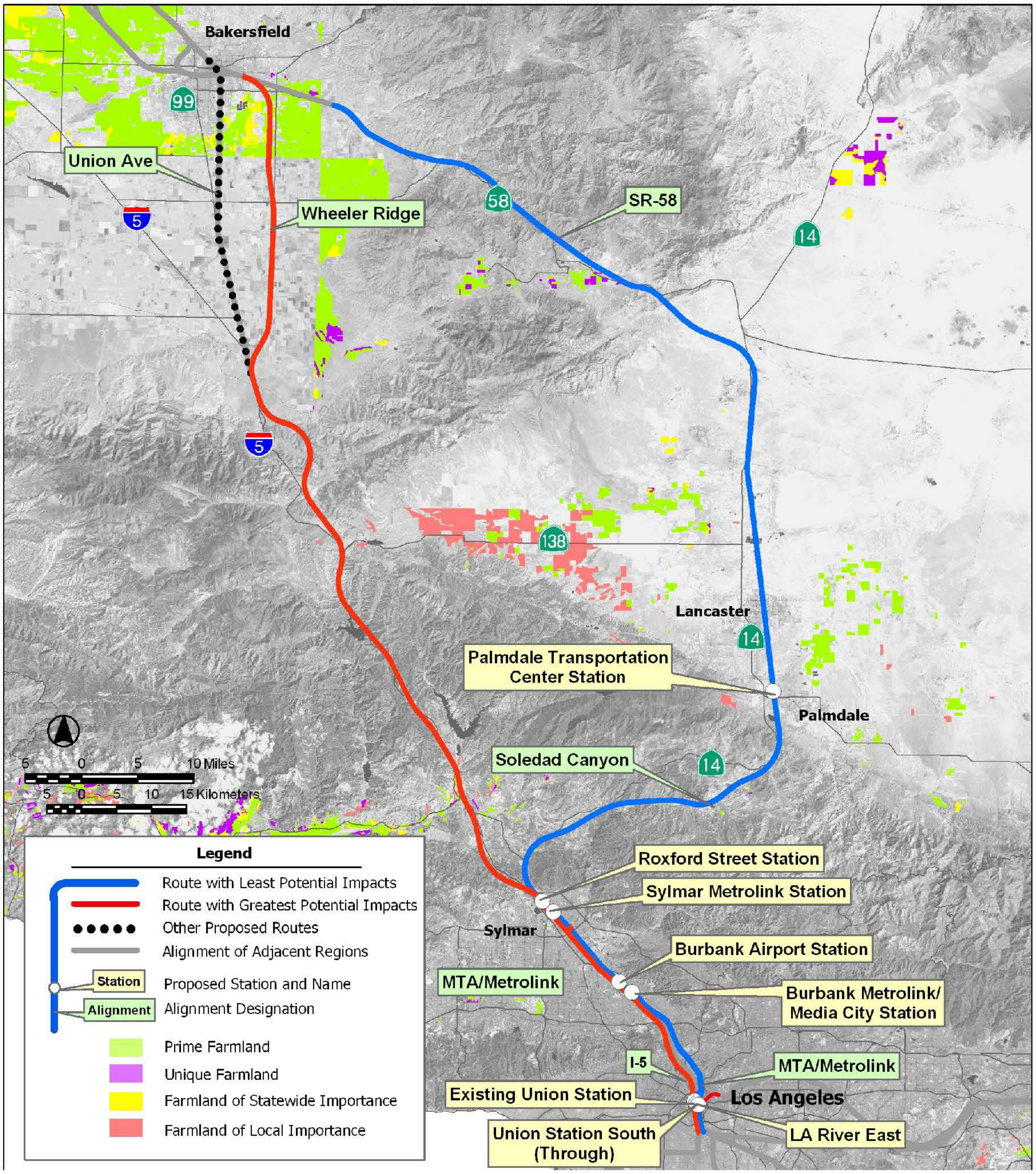


Figure 3.8-12
Modal Alternative Improvement Locations
Los Angeles to San Diego via Inland Empire

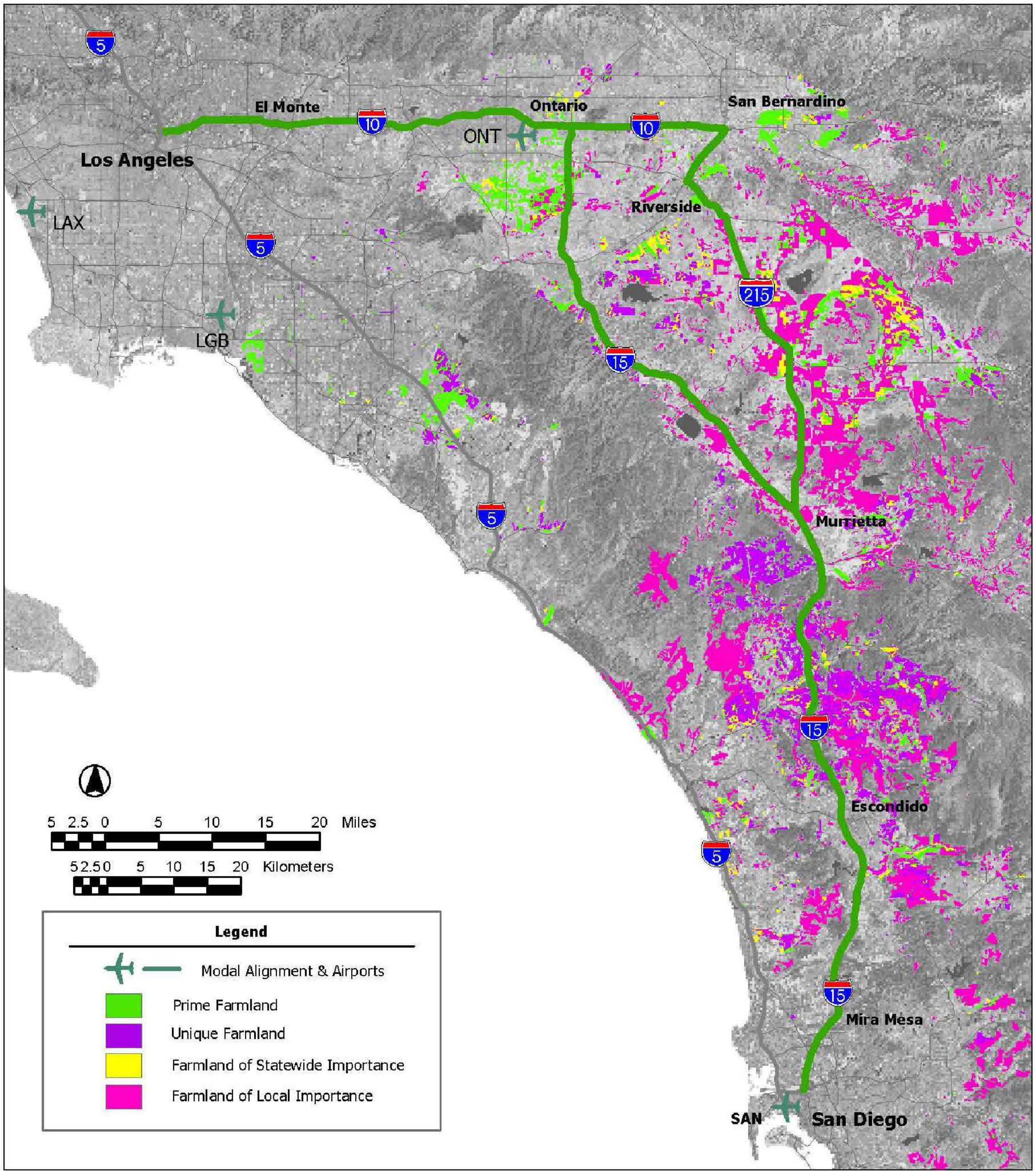
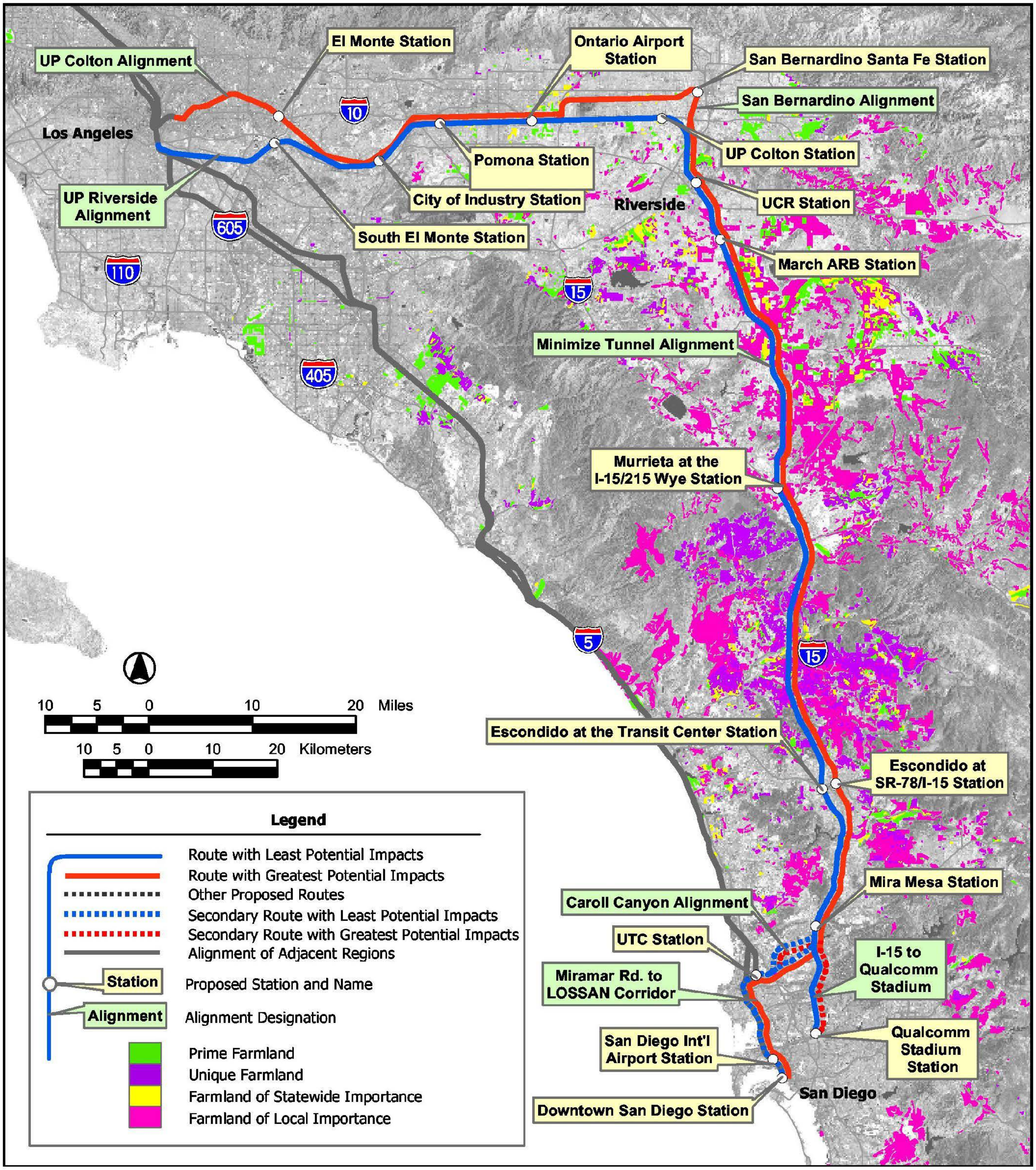


Figure 3.8-13
Alignments with the Least Potential Impacts and Greatest Potential Impacts
Los Angeles to San Diego via Inland Empire



Airport-related improvements under this alternative would include the addition of a third runway at the Ontario International Airport. Total potential airport-related impacts on farmland under the Modal Alternative would be 81 ac (33 ha), all of which would be prime farmland.

Collectively, the Modal Alternative improvements would potentially impact 106 ac (43 ha) of prime farmland, 1 ac (0.4 ha) of unique farmland, 3 ac (1 ha) of farmland of statewide importance, and 107 ac (43 ha) of farmland of local importance. The Modal Alternative would potentially impact a total of 217 ac (88 ha) of farmland in this region.

High-Speed Train Alternative

The Los Angeles to San Diego via Inland Empire region would travel eastward out of Los Angeles to San Bernardino and would then continue south from San Bernardino to San Diego. Most of the region's farmland and agricultural resource areas are located between Lake Elsinore and Escondido, and portions of the farmland would potentially be impacted by the HST alignment options.

The LPI alignment combination would be the UPRR Colton Line alignment or UPRR Riverside/UPRR Colton Line alignment from the Los Angeles to March Air Reserve Base (ARB) segment to the San Jacinto to I-15 alignment, from the March ARB to Mira Mesa segment to any of the alignments in the Mira Mesa to San Diego segment. With implementation of this alignment combination, impacts on 24 ac (10 ha) of farmland would occur.

The GPI alignment combination would be the UPRR Colton Line to San Bernardino alignment from the Los Angeles to March ARB segment to the San Jacinto to I-15 Alignment, from the March Air Force Base to Mira Mesa segment to any of the alignments in the Mira Mesa to San Diego segment. With implementation of this alignment combination, impacts on 25 ac (10 ha) of farmland would occur. See Appendix 3.8-A for potential impacts associated with each HST alignment option in all regions.

E. LOS ANGELES TO SAN DIEGO VIA ORANGE COUNTY

The Los Angeles to San Diego via Orange County region includes only limited farmland areas located between Santa Ana and Irvine and near Oceanside for the Modal Alternative. The Modal Alternative would have greater potential impacts in all FMMP categories than the HST Alternative LPI and GPI in this region. The total FMMP category acreage potentially impacted in this region would be 28 ac (11 ha) for the Modal Alternative, 0 ac for the HST Alternative LPI, and 0 ac for the HST Alternative GPI. Thus, the Modal Alternative would exceed the potential impact of the HST Alternative LPI and GPI by 28 ac (11 ha). Figures 3.8-14 and 3.8-15 show the locations of the Modal Alternative and HST Alternative improvements for the region.

Modal Alternative

FMMP-listed agricultural land in the coastal region, located between Santa Ana and Irvine and around Oceanside, is sparse. The farmland between Santa Ana and Irvine is mostly prime farmland, with a smaller area of unique farmland. The farmland around Oceanside is entirely farmland of local importance. Under the Modal Alternative, one northbound and one southbound lane would be added to I-5. However, I-5 in this region lacks sufficient width for additional lanes in the center median. Right-of-way would need to be acquired to develop added outside lanes. The amount of farmland the Modal Alternative would potentially impact in the LOSSAN region would be 15 ac (6 ha) of prime farmland, 4 ac (2 ha) of unique farmland, 1 ac (0.4 ha) of farmland of statewide importance, and 8 ac (3 ha) of farmland of local importance. The Modal Alternative would impact a total of 28 ac (11 ha) of farmland in this region.

Figure 3.8-14
Modal Alternative Improvement Locations
Los Angeles to San Diego via Orange County

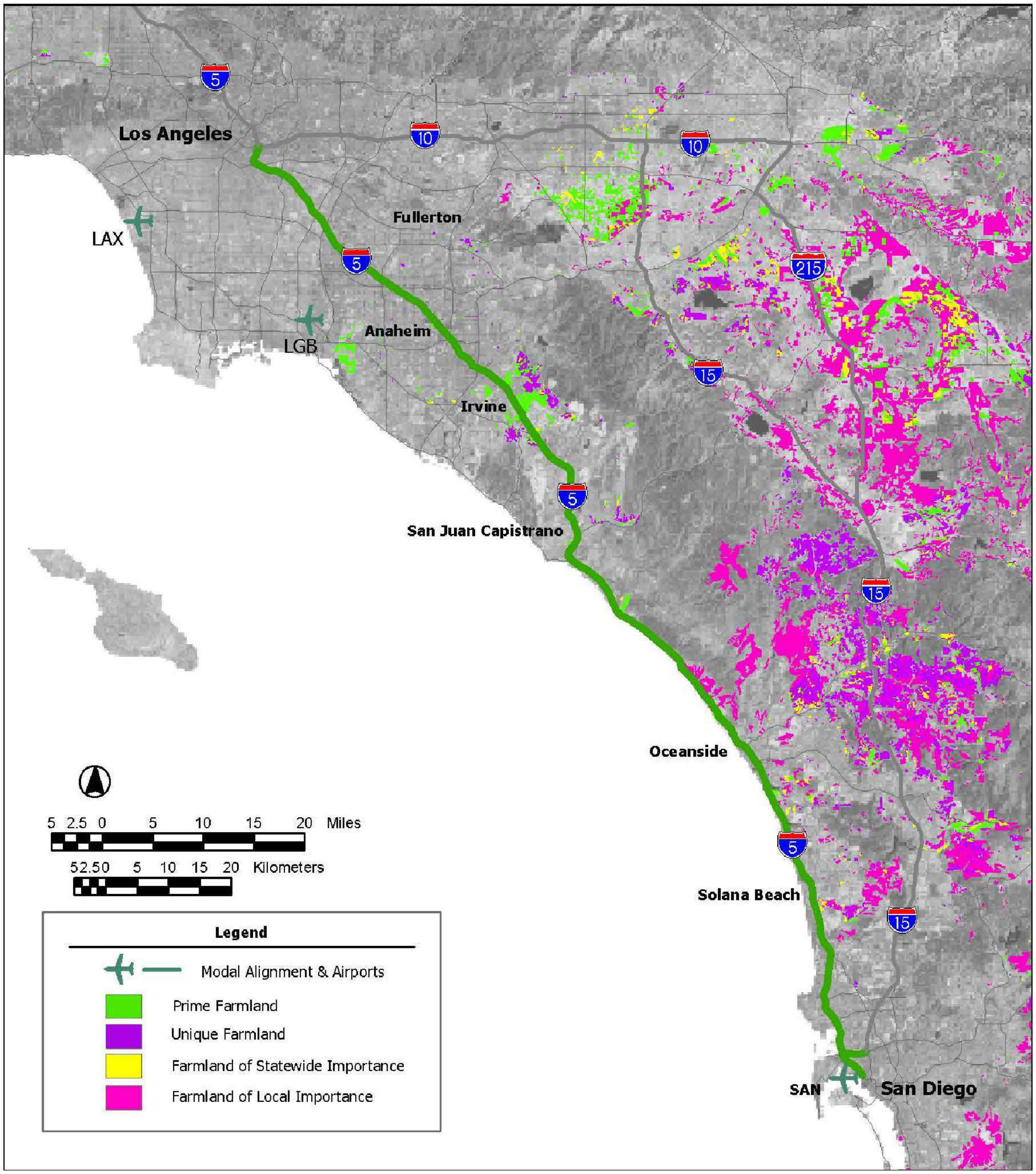
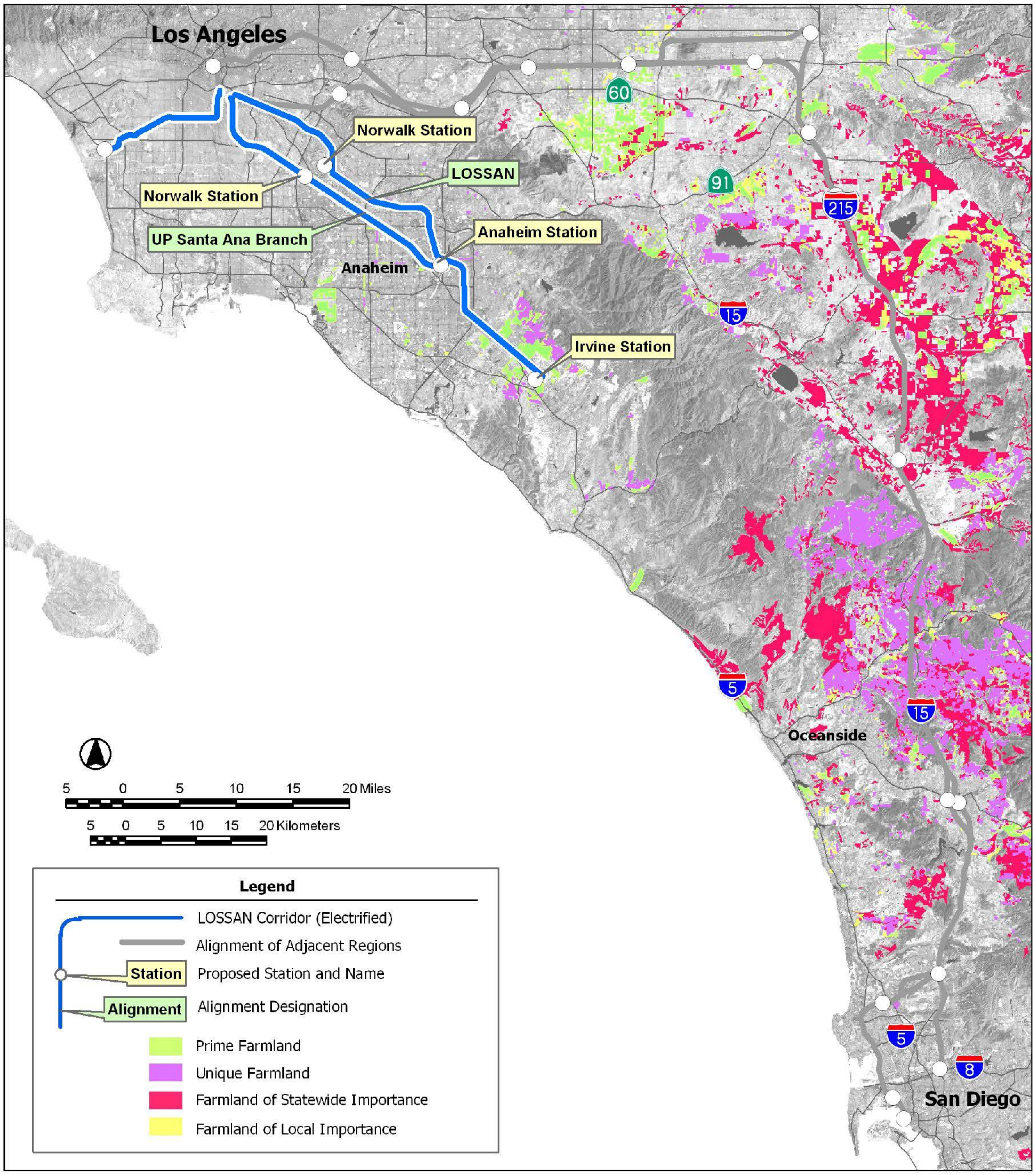


Figure 3.8-15

Alignment Options

Los Angeles to San Diego via Orange County (LOSSAN)



High-Speed Train Alternative
The Los Angeles to Orange County coastal region runs primarily along the southern California coastal areas through Los Angeles and Orange County. This region includes alignment options from central Los Angeles to LAX, and from the central Los Angeles area to Irvine. The existing UPRR Santa Ana Branch would be an HST alignment option. The existing LOSSAN alignment from Los Angeles to Irvine is being considered for shared HST and conventional passenger train service. The HST alignment options that would be developed primarily within the existing LOSSAN corridor right-of-way and no farmland resources would be impacted.

High-Speed Train Alternative Alignment Option Comparison
The HST alignment options that would be developed in the existing LOSSAN corridor right-of-way would only require development of bypasses; no farmland resources would be impacted. See Appendix 3.8-A for potential impacts associated with each HST alignment option in all regions.

3.8.5 Design Practices

The Authority is committed to utilizing existing transportation corridors and rail lines in the proposed high-speed rail system in order to minimize the need to encroach onto additional agricultural lands. Nearly 70% percent of the preferred HST Alternative is either within or adjacent to a major existing transportation corridor (existing railroad or highway right-of-way). These existing transportation corridors, along which the HST system would be placed, have already divided properties and agricultural lands. Moreover, portions of the alignment would be on aerial structure or in tunnel, allowing for vehicular or pedestrian access across the alignment. Only 24% percent of the preferred HST overall preferred alignment would be in new at-grade rail corridors (not on aerial structure and not in tunnel) and not within or adjacent to an existing transportation right-of way), where there would be the potential to divide or sever properties. For the HST system, underpasses or overpasses would be constructed at reasonable intervals to provide property access, and/or appropriate severance payments would be made to the property owners whose land is severed. The Authority would work directly with land owners during the final design of the system regarding the location(s) for access passages (overpasses or underpasses) to enable adequate property access.

To minimize the potential impact to agricultural lands, the HST right-of-way width could potentially be reduced to 50 ft (15 m) in constrained areas. In addition, the Authority is committed to pursuing agreements with existing owners/rail operators to place the HST alignment within existing rail rights-of-way, which would avoid and /or minimize potential impacts to agricultural resources.

3.8.6 CEQA Significance Conclusions and Mitigation Strategies

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for agricultural lands, the HST alternative would have a significant impact to agricultural lands when viewed on a system-wide basis. Some direct conversion of agricultural lands to other non-agricultural uses would be expected. The HST alternative may also result in changes such as the severance of agricultural parcels that could indirectly contribute to agricultural land conversion. At this programmatic level of analysis it is not possible to know precisely the location, extent, and particular characteristics of agricultural lands that would be involved, or the precise impacts on those lands. The impact is therefore considered significant. Mitigation strategies, as well as the design practices discussed in section 3.8.5, will be applied to reduce this impact.

Mitigation of potentially major impacts on farmland (i.e., by conversion to other uses) would be based first on avoidance. The strategy followed beginning early in the conceptual design stage of the project was to avoid farmland wherever feasible. Throughout the initial screening of alternatives, a number of potential alignment options were eliminated due to the high potential for farmland impacts as well as other impacts (i.e., potential new alignments in the foothills of the Central Valley). Where potential impacts on farmland would occur, the effort would focus on reducing the potential impact. Potential system-wide impacts have been reduced by sharing existing rail rights-of-way wherever feasible or by alignment immediately adjacent to them.

Site-specific impacts would need to be assessed and evaluated in project-level environmental review, and specific farmland mitigation measures would be considered, such as access modifications. Potential mitigation strategies would focus on securing easements, participation in mitigation banks, and local planning measures to increase the permanent protection of farmlands, open space and habitat lands.

The Authority would coordinate these efforts with other mitigation initiatives such as the California Farmland Conservancy Program (California Public Resources Code section 10222 et seq.), which is managed by the California Department of Conservation. This program provides grant funding for the purchase of agricultural easements and grants for farmland policy and planning projects. The Authority would review what this program is doing and the areas in which it has identified needs for farmland preservation. During project-level review where the co-lead agencies determine that farmland mitigation is required to address site-specific impacts from the HST system, one strategy may be to support easements that further this existing conservation program.

The Authority would coordinate with private agricultural land trusts, local programs, mitigation banks, and other agricultural stewardship programs to help identify needs for farmland protection.

The Authority would also coordinate with Resource Conservation Districts to identify additional measures to limit impacts to or otherwise to protect farmlands.

The feasibility of any mitigation strategy would have to be evaluated at the project-specific level and would depend on such factors as an assessment of the land under the state LESA model or other significance criteria, the number of voluntary participants in local or regional programs, and the cost of acquiring easements. Possible mitigation strategies for severance impacts could include alternative access, HST realignment, or over-crossings at select locations.

The Authority has established policies regarding the use of smart growth and transit oriented development strategies for station areas (see Chapter 6B), which will help to avoid secondary growth impacts on agricultural lands.

The above mitigation strategies are expected to substantially lessen or avoid impacts to agricultural lands in many circumstances. Sufficient information is not available at this programmatic level, however, to conclude with certainty that the above mitigation strategies will reduce impacts to agricultural lands to a less than significant level in all circumstances. This document therefore concludes that impacts to agricultural lands would remain significant, even with the application of mitigation strategies. Additional environmental assessment will allow a more precise evaluation in the second-tier project-level analysis.

3.8.7 Subsequent Analysis

As indicated earlier, the above analysis does not provide a parcel-specific potential impact analysis for farmland. Subsequent project-level analysis would address local issues once the potential alignments are defined in more detail, assuming a decision is made to proceed with the HST Alternative. Subsequent project-level environmental documentation would include more detailed information on potential severance impacts insofar as it potentially impacts a working landscape, and on potential impacts on FMMP-listed farmland, farmland under Williamson Act contracts, and farmland easements.

3.9 AESTHETICS AND VISUAL RESOURCES

Visual resources are the natural and human-made features of a landscape that characterize its form, line, texture, and color. This section describes the existing landscape in the five regions and identifies potential impacts on visual resources for each alternative related to the proposed addition of infrastructure in, or removal of infrastructure from, the existing landscape. Infrastructure may include roadway expansion, airport improvements, high-speed train (HST) improvements/construction, tunnels, fences, noise walls, elevated guideways, catenaries,[1] and stations. This assessment evaluates the potential changes to existing scenic landscapes for each alternative and HST alignment station option during construction (addition of construction staging areas, site work, construction equipment, temporary barriers, fences, and temporary power poles) and operation.

3.9.1 Regulatory Requirements and Methods of Evaluation

A. REGULATORY PROVISIONS

There are no specific regulatory requirements or federal or state standards for aesthetics and visual resources. However, there is a requirement in both federal and state environmental guidelines to address topics related to the visual environment. The most explicit guidance is in CEQA environmental checklist, which requires that a project proponent identify whether a project would have a substantial adverse effect on a scenic vista; substantially damage scenic resources, including trees, rock outcroppings, and historical buildings within a state scenic highway; substantially degrade the existing visual character or quality of the site and its surroundings; or create a new source of substantial light or glare that would adversely affect day or nighttime views in the area (CEQA Appendix G Environmental Checklist Form 2001). The Federal Rail Authority (FRA) Procedures for Considering Environmental Impacts (FRA Docket No EP-1, Notice 5, May 26, 1999), under the topic of aesthetic environmental and scenic resources, states: "The EIS should identify any significant changes likely to occur in the natural landscape and in the developed environment. The EIS should also discuss the consideration given to design quality, art, and architecture in project planning and development as required by DOT Order 5610.4." Consideration of local community design guidelines would be part of a subsequent phase of analysis for project-specific environmental review when more detailed engineering and architectural information would be developed for proposed alternatives. California Department of Transportation (Caltrans) design standards would apply to state highway improvements under the No Project and Modal Alternatives.

B. METHOD OF EVALUATION OF IMPACTS

The analysis of aesthetic and visual resources for this Program EIR/EIS focuses on a broad comparison of potential impacts on visual resources (particularly scenic resources, areas of historic interest, and natural open space areas and significant ecological areas [SEAs]) along proposed Modal and HST Alternative corridors and around HST stations. The potential impacts for each of these alternatives are evaluated against the existing conditions, as described in Section 3.9.2, Affected Environment.

Photo simulations have been prepared to illustrate the conceptual design of the facilities associated with the Modal and HST Alternatives for a set of typologies (or general descriptions) selected from each of the regions and representative of highly scenic landscapes most subject to potential significant visual impacts. These simulations have been used to evaluate how the distinguishable (dominant) visual features (color, line, texture, form) that characterize the existing landscape would change if the alternative were implemented. Of particular interest are locations where plans and profiles show elevated structures (guideways or overpasses), and tunnel portals or extensive cut or

[1] Catenaries are the wires and support-pole system that deliver the power supply to the proposed HST system.

fill. Also addressed in the evaluation is the potential shadow effect of elevated structures and the light and glare effects of the proposed alternatives. For the HST Alternative, the linear feature of the overhead electric wires and poles to supply power to the train, and the fenced track and potential noise barriers are considered in the evaluation.

Potential changes to the dominant landscape features, or potential visual impacts, are described and ranked as high, medium, or low according to the potential extent of change to existing visual resources. Visual contrast rankings, or impact rankings, are defined as follows.

- High visual impacts would be sustained if features of the alternative were obvious and began to dominate the landscape and detract from the existing landscape characteristics or scenic qualities.
- Medium visual impacts would be sustained if features of the alternative were readily discernable but did not dominate the landscape or detract from existing dominant features.
- Low visual impacts would be sustained if features of the alternative were consistent with the existing line, form, texture, and color of other elements in the landscape and did not stand out.
- Shadow impact ranking would be high if the new (not existing) elevated structure were within 75 feet (ft) (23 meters [m]) of residential or open space, natural areas, or parkland.
- Beneficial visual impact would result if the alternative eliminated a dominant feature in the landscape that currently detracts from scenic qualities or blocks vistas.

3.9.2 Affected Environment

A. STUDY AREA DEFINED

The study area for aesthetics and visual resources is defined as 0.25 mi (0.40 km) from the centerline of proposed alternative corridors and around stations and airports. However, where there are scenic viewing points or overlooks within 1 mi (2 km) of the alternative, these scenic viewing points have been included in the study area. The distance range of up to 0.25 mi (0.40 km) from proposed corridors and stations and up to 1 mi (2 km) from proposed alternative corridors and facilities for scenic viewing points is considered the area where a change in landscape features would be most noticeable to viewers, and where newly introduced features could begin to dominate the visual character of the landscape.

B. GENERAL DISCUSSION OF AESTHETICS AND VISUAL RESOURCES

Each of the five regions includes a number of distinct types of landscapes spread over a large geographic area, many of which are common among the regions. A typology of typical landscapes is used to describe the aesthetic and visual resources in the study area. The typologies provide the baseline or existing conditions against which the analysis of potential change or visual impact for each of the proposed alternatives is evaluated. Photographs of highly scenic and typical landscapes within each of the five regions are provided to illustrate the dominant line, form, color, and texture for that landscape typology.

The landscape typologies discussed are urban mixed use, urban suburban, traditional small urban community, industrial use, rural agriculture, rural desert, and natural open space and parks.

<u>Urban Mixed Use</u>

High-density urban mixed-use landscapes consist of multifamily housing, high-rise office buildings, at-grade and elevated transportation systems (Caltrain, BART, Metrolink, San Diego Trolley), street grids, and limited vegetation. This landscape characterizes the major metropolitan areas in the study area: San Francisco, Los Angeles, Sacramento, San Jose, and San Diego.

Urban Suburban
This typology consists of suburban areas of low-density development—modern single-family houses, yards set back, trees and ornamental landscaping—located around more densely developed metropolitan areas. This typology also includes commercial, retail, office structures, and infrastructure such as roads, highways, overpasses, underpasses, rail lines, and utilities. Examples include South San Jose, Irvine to Oceanside, San Bernardino, Riverside, and Merced.

Traditional Small Urban Community
This typology is characterized by long-established rural communities—older buildings and historic architecture two to three stories high, with mature street trees—along existing highways or rail corridors. This typology comprises historic or early post-World War II residential neighborhoods characterized by small- to mid-size houses on small lots with narrow streets, and retail, commercial, and institutional mixed uses along arterial streets. Examples include Morgan Hill, Gilroy, Visalia, Tulare, and Santa Clarita.

Industrial Use
This landscape typology features industrial complexes with structures and warehouses of widely varied areas, sizes, and scales, and includes freight tracks and rail yards, transmission towers, substations, and utility lines. This typology typically is found along existing rail corridors or major highways.

Rural Agricultural
Broad, open agricultural fields with or without fences, along with barns, silos, and other farm structures, farm equipment, isolated farm houses, and low-density rural commercial strips typify this typology. The horizontal topography is characterized by crop fields, farm roads, fence and pole lines, and wind breaks, punctuated by barns, houses, sheds, water towers, and other agriculture-related structures. This landscape is typical of the Central Valley region.

Rural Desert
In this typology, open, flat, barren land is dotted with desert plants and shrubs, and residential and commercial structures. This landscape typology is found south of Bakersfield in the Bakersfield to Los Angeles region, and in the Inland Empire region.

Natural Open Space and Parks
Undeveloped natural areas such as coastal lagoons, forested mountains, mountain lakes and streams, rolling hills with woodlands and grasslands, or forested ridges and valleys with lush vegetation form the dominant visual features of these landscapes. These landscapes are typically scenic with high aesthetic qualities. Examples include the Pacheco Pass/Diablo Range, Tehachapi Mountains, and coastal area from San Clemente to San Diego.

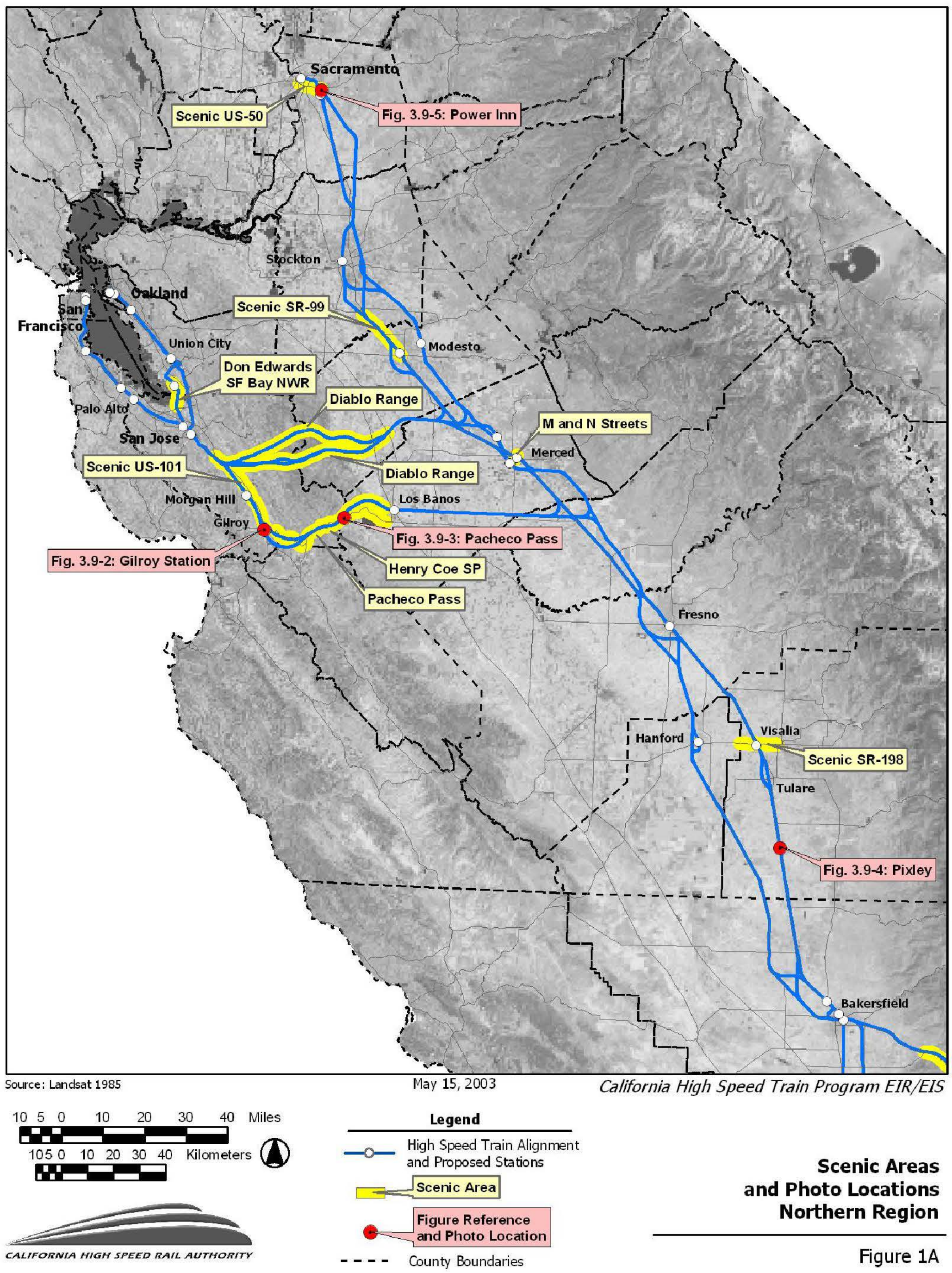
C. AESTHETICS AND VISUAL RESOURCES BY REGION

A geographic information systems (GIS) map showing the location of the scenic corridors (identified in regional and local planning documents as "corridors with landscapes of high scenic qualities and scenic vistas") and scenic or sensitive landscapes in the northern region is shown in Figure 3.9-1A and in Figure 3.9-1B for the southern region. For both the No Project and Modal Alternatives, the affected environment is divided into typologies along both sides of existing highway and rail corridors. Several of the HST alignment options being evaluated are either within or adjacent to

Figure 3.9-1A

Northern Region

GIS Visually Sensitive Landscapes with Modal Alternative and HST Alignments



Scenic Areas and Photo Locations Northern Region

Figure 1A

Figure 3.9-1B
Southern Region
GIS Visually Sensitive Landscapes with Modal Alternative and HST Alignments

Source: Landsat 1985

May 15, 2003

California High Speed Train Program EIR/EIS

10 5 0 10 20 30 Miles

10 5 0 10 20 30 Kilometers

Legend

High Speed Train Alignment and Proposed Stations

Scenic Area

Figure Reference and Photo Location

County Boundaries

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Scenic Areas and Photo Locations Southern Region

Figure 1B

these existing highway or rail corridors and therefore would potentially affect many of the same landscapes.

Bay Area to Merced

This region includes central California from the San Francisco Bay Area (San Francisco and Oakland) south to the Santa Clara Valley and east across the Diablo Range to the Central Valley. Landscape types vary substantially in this region, from primarily urban mixed use or urban industrial in the northern part of the Bay Area, to more rural and natural open space landscape in the southern part of the region. From San Jose to Gilroy, the study area includes about 20 mi (32 km) of scenic corridor along US-101. From Gilroy through the Diablo Mountain Range or through the Pacheco Pass (along SR-152) for about 35 mi (56 km), the study area consists of a mix of highly scenic agricultural, wetland, and natural open space landscapes, and the Henry W. Coe State Park backed by mountains (Mount Hamilton) and rolling hills with mixed oak woodlands and grasslands.

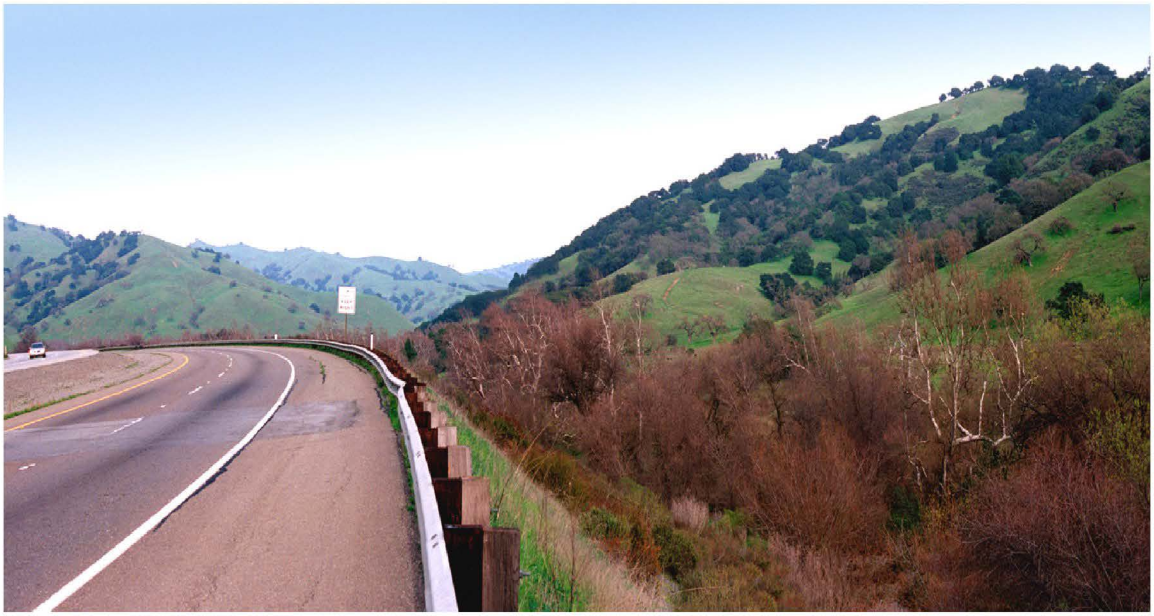
Starting from the northern part of the region, the landscapes along the Caltrain corridor and US-101 and I-880 between San Francisco and San Jose and along the Union Pacific Railroad (UPRR) corridor between Oakland and San Jose are typically urban mixed use or industrial, with stretches of urban suburban residential and commercial landscapes between the metropolitan destinations of San Francisco, Oakland, and San Jose. On the Oakland side of the Bay, the existing UPRR Line splits off to the Hayward Line and the Mulford Line. The Mulford Line traverses the eastern edge of the Don Edwards San Francisco Bay National Wildlife Refuge and transitions to the Niles Line that goes through the historic town of Niles near the mouth of the scenic Niles Canyon. The existing non-electric rail tracks and stations along the Caltrain corridor on the west side of the Bay and the UPRR tracks and elevated BART guideway on the east side of the Bay are dominant linear features in the landscape between Oakland/San Francisco and San Jose. Views of the Bay are part of the aesthetic landscape experience along the UPRR in the East Bay and also along some segments of Caltrain near the San Francisco International Airport (SFO). Views of the skyline of San Francisco are visible from the Caltrain alignment approaching the city. Views of the Caltrain tracks are visible from several local parks and from San Bruno Mountain hiking trails; however, the tracks are not a dominant visual feature in these landscapes (the multiple-lane freeways and bridges are dominant). The San Jose Diridon Station is a designated historic property listed on the National Register of Historic Places. The station dates to 1935, with architectural features characteristic of that period.

The traditional small urban community landscapes south of the highly urbanized San Jose area and through the small rural towns of Morgan Hill and Gilroy are characterized by mixed residential, commercial, and institutional uses in early to mid-20th-century contiguous buildings, average heights of two to three stories, minimal setbacks from streets, mature landscaping, and pedestrian-oriented streetscapes. Dominant visual features are historic architecture, mature street trees, and the surrounding distant mountainous ridgelines. Figure 3.9-2, Gilroy Station, shows traditional small urban community typology with historic rural community character.

The natural open space landscapes along SR-152 in Pacheco Creek Valley east of Gilroy are characterized by coastal mountains and mountain valley topography typified by rolling to steep-sloped grassland with shrubs, clusters of oaks and other native tree species, and wooded bottomland. Much of this area is part of the Henry Coe State Park and Mount Hamilton Project Area of The Nature Conservancy (described in Section 3.15, Biological Resources and Wetlands) that is designed to preserve the rich natural habitats in a 780-sq-mi (1255-sq-km) area of the Diablo Range. Small farms or ranches (in bottomlands), isolated roadside businesses, and widely dispersed small communities (e.g., Casa de Fruta) characterize the landscape. Figure 3.9-3, Pacheco Pass, illustrates a rural agricultural and natural open space landscape typology.

Figure 3.9-2
Gilroy Station

Figure 3.9-3
Pacheco Pass



The coastal valley landscape consists of flat or rolling landscapes ringed with low hills and mountains in the background. Dominant visual elements are vistas of agricultural bottomland and wetlands framed by background views of green hills, ridges, and mountains. East of the community of San Felipe, the coastal valley landscape transitions into the rural agricultural landscape typical of the Central Valley.

Sacramento to Bakersfield

This region of central California includes a large portion of the Central Valley (San Joaquin Valley) from Sacramento south to Bakersfield. At the northern end of the region in the Sacramento area, the typology is urban mixed-use landscape. The Central Valley from Sacramento to Bakersfield consists primarily of rural agricultural landscapes and traditional small urban community landscapes. Agriculture dominates the majority of the region with uniform topography of tilled fields, orchards, or undeveloped land. Agricultural areas also include highly visible utility poles and lines arranged along the major roadways (e.g., SR-99 and I-5) that form a dominant linear visual element in the landscape.

Locally designated scenic routes in the study area in this region include US-50 in Sacramento, Austin Road and East River Road in San Joaquin County, M and N Streets in Merced, and SR-198 in Visalia. Much of the proposed HST Alternative in this region would be adjacent to existing rail or highway corridors and thus would share the same affected environment.

The traditional small urban communities in the region range from clustered residential subdivisions outside Pixley (Figure 3.9-4) to the mixed commercial and residential uses of towns and cities like Visalia and Madera. For the Sacramento to Bakersfield region, urban settings are exemplified by the traditional downtown areas of Sacramento, Stockton, Modesto, Merced, Hanford, Fresno, and Bakersfield. Views of the Sacramento River are intermittently part of the landscape from along the I-5 corridor south of Sacramento.

Along each alignment option for the proposed alternative corridors in the region, views are generally sweeping vistas of rural agricultural landscapes and small urban communities. The proposed HST Alternative station sites range from undeveloped or agricultural sites (e.g., the Power Inn Road station site in Sacramento), to older station sites that are either in active use (e.g., Hanford) or underutilized (e.g., Fresno), to new or refurbished station sites that are pedestrian-scale (e.g., Truxtun Amtrak) or grand (e.g., downtown Sacramento Valley station).

For the Sacramento to Bakersfield region, the industrial settings include existing station sites as well as groupings of industrial buildings along the existing rail corridors. Figure 3.9-5, Sacramento Power Inn Road, looks south from Polk Street (and Power Inn Road) in Sacramento, illustrating a rural landscape with light industrial uses.

Bakersfield to Los Angeles

This region of southern California encompasses the southern portion of the Central Valley south of Bakersfield, the mountainous areas between the Central Valley and the Los Angeles basin, and the northern portion of the Los Angeles basin from Sylmar to downtown Los Angeles. Landscapes in this region transition from rural agricultural and traditional small urban communities south of Bakersfield, to highly scenic mountain range (natural open space) through the Tehachapi Mountains and Angeles National Forest, and finally into highly urban mixed-use landscapes in northern Los Angeles County.

State- and locally designated scenic routes in the region include 2.5 mi (4.0 km) along I-5, 2.2 mi (3.5 km) along Riverside Drive near Burbank, and 1.1 mi (1.8 km) along the Sierra Highway in Palmdale. Other scenic overlooks or viewing points along the I-5 Tehachapi corridor in the

Figure 3.9-4
Pixley

Figure 3.9-5
Sacramento Power Inn

region include those in the Pyramid Lake Recreational Area in the Angeles National Forest north of the Santa Clarita Valley; views from the Golden State Highway, also in the Angeles National Forest south of Pyramid Lake; trails in the Towsley Canyon part of the Santa Clarita Woodlands Park, which is managed by the Santa Monica Mountains Conservancy; and trails near the Pacific Crest Trail south of Soledad Canyon Road in the Angeles National Forest.

Rural agricultural landscape characterizes the north part of the study area in the Central Valley between Bakersfield and the edge of the Tehachapi Mountains to the south. Urban/suburban landscapes characterize the greater Los Angeles metropolitan area, generally from the City of Santa Clarita south through the study area in the City of Los Angeles, with development density generally increasing from north to south. Rural desert landscape characterizes the Antelope Valley from the base of the Tehachapi Mountains to the town of Rosamond.

The area from Bakersfield to Sylmar includes the highly scenic natural open space landscapes described below along both the Tehachapi and Antelope Valley corridors.

- Pyramid Lake Recreation Area is in the Angeles National Forest north of the Santa Clarita Valley. Pyramid Lake, owned and operated by the California Department of Water Resources (DWR), is a reservoir of the State Water Project that provides boating, fishing, and swimming opportunities for visitors. The Vista Del Lago Visitors Center operated by DWR provides interactive exhibits on California's water and has balconies with telescopes for viewing the lake, as illustrated in Figure 3.9-6. I-5 is visible on the left of the view in the middle ground.
- The Angeles National Forest is considered a visually scenic resource because of the camping and other recreation opportunities it provides, and the largely undeveloped views it affords to visitors, as illustrated in Figure 3.9-7. The landscape shown in the figure is typical of similar mountain landscape views from within the Angeles National Forest from viewing points near I-5. Vehicles are visible on I-5, and high-voltage electrical towers are visible on the hills in the background.
- The Santa Clarita Woodlands Park, which is managed by the Santa Monica Mountains Conservancy, provides picnic facilities and trails for hiking, mountain biking, and equestrian uses. This park is considered a scenic resource because it is available to recreation users to enjoy a predominantly undeveloped setting that includes a variety of native plants and animals.
- The Tehachapi Pass south of SR-58 and east of the town of Keene includes scenic viewing points and landscapes considered scenic. The Tehachapi Pass Railroad Line, of which this loop along SR-58 is a part, is a national Historic Civil Engineering Landmark. This rail line, constructed between 1874 and 1876, averages a gradient of 2.2% along its 28-mi (45-km) length. The line is in constant use today, essentially unchanged 126 years after its completion.
- The Sierra Highway-Antelope Valley area is considered a scenic resource because Sierra Highway from Avenue S south to the City of Palmdale boundary is designated in the City of Palmdale general plan as a scenic highway. Una Lake can be seen from Sierra Highway. The Lake Palmdale dam is also visible.
- The Santa Clarita Floodplain portion of the Santa Clarita River floodplain is considered a scenic resource because it is designated an SEA by the County of Los Angeles. The primary purpose of SEAs, as described in Section 3.15, Biological Resources and Wetlands, is to preserve biological diversity in Los Angeles County. The county recognizes, however, that the natural open space in SEAs functions also as a visual amenity.
- The north wall of Soledad Canyon, illustrated in Figure 3.9-8, is considered a scenic resource because it is largely undeveloped and is visible to hikers on the Pacific Crest Trail and other

Figure 3.9-6
Pyramid Lake

Figure 3.9-7
Angeles National Forest

Figure 3.9-8
Soledad Canyon

Figure 3.9-9
Santa Clarita from Dockweiler Drive

trails, as well as to motorists using unpaved roads in this area of the forest. This figure shows a landscape that is typical of views from the forest looking north in Soledad Canyon.

- Figure 3.9-9 illustrates Santa Clarita from Dockweiler Drive. The area south of SR-14 is considered a scenic resource because the predominantly undeveloped area beyond SR-14 is Los Angeles County-designated SEA. The undeveloped area beyond SR-14 comprises green curvilinear hills, ridges, and mountains covered with predominantly evergreen shrubs and trees with scattered grassland areas.
- Views of the Los Angeles Union Station (LAUS) area are considered scenic because LAUS is an important historic building listed in the National Register of Historic Places, as discussed in Section 3.12, Cultural and Paleontolgical Resources.

<u>Los Angeles to San Diego via Inland Empire</u>
This region of southern California includes the eastern portion of the Los Angeles basin from downtown Los Angeles east to the Riverside and San Bernardino areas and south to San Diego generally along the I-215 and I-15 highway corridors. The region extends approximately 150 mi (241 km) through a series of diverse, and in some cases, highly developed and populated landscapes. From LAUS east and south to March Air Reserve Base (ARB), the I-10 and I-215 highway and the HST study area travel through several large, intensively urbanized, interior valleys (urban mixed-use and urban suburban landscape typologies). From the area south of March ARB through the northern reaches of San Diego County, I-15 and the HST study area pass through valley and upland areas that are under active development pressure but that presently retain a relatively undeveloped and, in places, more rural appearance than the more developed urban areas of San Diego. From Escondido south to Mira Mesa, the upland areas through which the study area passes have a generally suburban appearance. South of Mira Mesa, the various alternative options would pass through a series of coastal valleys and then along the coastal plain.

In the areas along and in the immediate vicinity of the highway and HST corridors being considered in this analysis, there are no roadways officially designated state scenic routes. None of the alternatives in the region would pass within 0.25 mi (0.40 km) of a designated scenic corridor.

For much of the distance between LAUS and the northern fringes of Riverside, the HST alignment options being considered consist of existing rail corridors, along which the adjoining areas have been developed with industrial uses. To the east south of LAUS, the long-established industrial areas are characterized by a dense pattern of development. In the area around LAUS and around the historic centers of communities in the San Gabriel Valley and in Pomona, Ontario, and San Bernardino, the rail corridors pass through or adjacent to areas of urban mixed use that extend up to the railroad right-of-way with little or no buffer of industrial development.

The central area of Escondido and the southern end of the San Diego central business district have a traditional urban character, with a regular block and lot pattern, creating a grid of urban streets. These streets are lined with buildings of varying ages housing a variety of commercial, governmental, and institutional uses. In many cases, such areas include the long-established community centers and therefore contain older structures. Often these buildings have some architectural merit or symbolic importance. Although these areas are generally highly developed, there is often vegetation consisting of street trees, and in some cases small landscaped areas on lawns or in public open spaces. In some landscapes, there are historically and architecturally important structures and/or distant views of significant natural features. Pomona is one example. At several points along the rail corridor—particularly in Los Angeles, the older portions of the San Gabriel Valley, and central San Diego—there are areas of high-density urban mixed-use landscapes with housing close to the railroad rights-of-way.

For many miles along the alternative corridors in this region, the study area passes through or is adjacent to lower-density suburban neighborhoods of single-family homes. The residential scale of the structures and the presence of landscaping, fences, and other small-scale features characterize the landscape.

Approaching San Diego, several of the HST alignment options are located either immediately adjacent to or down the middle of existing freeways, (I-215, I-15, and I-5) as illustrated in Figure 3.9-10, I-15 in San Diego. The freeway landscape has a highly developed, large-scale, and highly linear appearance. Figure 3.9-11 illustrates a view from the eastern edge of Mission Bay Park.

<u>Los Angeles to San Diego via Orange County</u>

This region includes the western portion of the Los Angeles basin between downtown Los Angeles and Los Angeles International Airport (LAX), and the coastal areas of southern California between Los Angeles and San Diego, generally following the existing Los Angeles to San Diego via Orange County I-5 highway corridor. The existing local visual setting in the region ranges from highly urbanized landscapes to undeveloped areas. Much of the existing highway system in the southern part of the region parallels the coastline of the Pacific Ocean. I-5 (evaluated in this study under the Modal Alternative) provides only one or two isolated views of the ocean.

There are no local- or state-designated scenic corridors in the study area for visual resources in this region, though some highways (e.g., SR-1 along the coast) are considered eligible for designation as California State Scenic Routes and are located near the existing rail corridor. These routes do not offer continuous views of the ocean within the study area.

Landscapes and visual settings in the region include urban mixed-use and industrial landscapes. The majority of the existing rail corridor currently traverses dense development that includes warehouses, commercial and industrial buildings, and residential housing (areas in Los Angeles County and northern/central Orange County, for example). Limited landscaping and native vegetation exist in these industrial areas that are dominated by typically large, box buildings. There are areas of high-density housing (multifamily and single-family dwelling units) along the railroad right-of-way. Residential, commercial, and industrial building structures blend with the surrounding environment with neutral colors, tones, and textures. The historic areas typically include older structures, often with architectural importance, that vary in texture, size, and color. The area of a proposed rail station along the existing UPRR Santa Ana Line in Norwalk is highly developed with a mixture of commercial and industrial uses along with surrounding residential areas.

There are a number of suburban and traditional small urban community landscapes in the region that are located close to commuter and transportation hubs and surrounded by retail, business, and residential land uses. The city center and neighborhoods in these communities, such as Santa Ana, are separated by transportation corridors and/or undeveloped land.

The region is characterized by coastal towns and urban areas, historic districts, parks, and wildlife preserves. Calafia Park in San Clemente, Camp Pendleton, area beaches, and a number of lagoons are examples of parks and open space areas along the existing I-5 highway corridor. The Camp Pendleton area is undeveloped land with some large overhead transmission lines, industrial facilities (e.g., San Onofre Power Plant), and the I-5 corridor. .

Figure 3.9-10
I-15 in San Diego

Figure 3.9-11
Mission Bay

3.9.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

The existing conditions in 2003, or existing landscapes, are used as the baseline and are assumed to be representative for the analysis of potential visual impacts for the Modal Alternative and the HST Alternative. Though it is likely that the existing landscape character will change in each of the regions by the year 2020 due to development and urban growth, these changes are not possible to characterize at this time with precision. To base comparisons of alternatives on current conditions is to take a conservative approach. The extent of change to some of the landscapes (particularly the rural and open space landscapes) reported in this section may not be as pronounced as they appear in this impact evaluation.

The highway projects approved and funded for construction by 2020 and included in the No Project Alternative are described in Chapter 2, Alternatives. In most of the regions, these improvements or changes to the existing highways and airports are generally expansions or reconfigurations of existing facilities that would not result in substantial visual contrasts or changes to the dominant line, form, color, or texture characterizing the existing landscape condition. No significant visual impacts, shadow, or glare impacts have been identified for the changes between the existing conditions and No Project Alternative for this program-level analysis. As these projects advance, the project sponsors (not the California High Speed Rail Authority [Authority]) may identify and address some localized visual impacts in separate environmental documentation.

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

The comparison of potential aesthetic and visual resource impacts for the Modal and HST alternatives is a broad overview of potential differences between alternatives for the construction (short-term) and operation (long-term), direct and indirect, and cumulative impacts.

<u>Modal Alternative</u>
Under this alternative, the potentially feasible highway improvements would represent about 2,970 lane mi (4,345 lane km) of new highway construction. Several intercity highways would be widened to a total of 12 lanes. Adding outside lanes to existing highways would involve vegetation clearing, cut and fill in areas where the topography is uneven, relocation of existing noise walls or construction of new noise barriers, reconstruction of existing ramps and bridges, and property acquisition along some constrained corridors. Construction-related activities and changes (equipment operation and movement of materials in adjacent staging areas, construction signage, jersey barriers [concrete bars about 3 ft high], temporary lane closures, and night lighting) would be highly visible to motorists and adjacent residents and businesses over a period of about 2 to 5 years in any one location and up to 17 years across the state, detracting from scenic landscape features along the highway corridors. The Modal Alternative would potentially contribute to temporary cumulative visual impacts during the construction period when added to the existing No Project Alternative.

The Modal Alternative would also result in potential long-term visual impacts from additional pavement, wider highway structures (interchanges, ramps, bridges), noise barriers, retaining walls, and open cuts in steep terrain, thus changing the dominant landscape characteristics in the study area along vast stretches of highway that traverse a variety of landscape types. Lanes added to bridges and elevated portions of the highway (two lanes would add approximately 24 ft [7 m]), and new stretches of noise barrier walls would cast additional shadows on landscapes below the structure and adjacent to the structure. Widened highways would also result in light and glare being closer to adjacent properties.

Though individually these landscape changes may not be considered significant because they would consist of additions to existing infrastructure, this alternative could contribute to substantial cumulative visual impacts during the next 17 years. Expanded paved surface would result in potential impacts on visual resources. Widening a two-lane or four-lane highway through the natural open space and rural landscapes of the state would result in both direct and cumulative visual impacts because the line, form, texture, and color of the highway would begin to dominate the landscape. Widening highways in suburban and urban areas of the state would contribute to cumulative visual impacts and shadow effects from elevated portions of highway and additional noise walls. The width of 12-lane highways would be approximately 185 ft (56 m), the width of eight lanes would be approximately 125 ft (38 m), and the width of six lanes would be approximately 100 ft (31 m). These pavement widths, together with the need for cut and fill to conform to grade changes and the elevated portions of bridges and ramps required by the Modal Alternative, would result in visual impacts similar to or greater than the HST Alternative along scenic corridors and through natural open space areas. Examples of such areas include the mountain passes (e.g., Diablo Mountain Range, Pacheco Pass, Tehachapi Mountains, Angeles Forest, and Soledad Canyon) and open rural agricultural lands south of San Jose and in the Central Valley. Figures 3.9-14 and 3.9-15 illustrate the potential impacts on SR-152 (Pacheco Pass) of the Modal and HST Alternatives.

In the Los Angeles to San Diego region, the difference between the No Project and Modal Alternatives would be substantial. The Modal Alternative would require the acquisition of approximately 1,100 ac (445 ha) of new right-of-way between Los Angeles and San Diego, 370 ac (150 ha) of which would be paved, to accommodate the highway and interchange widening proposed under this alternative.[2] The additional right-of-way would displace residential, commercial, and industrial land uses that have been established adjacent to the existing highway, as well as some areas of natural vegetation and rock slopes. Bridges and overpasses would be widened in urban, suburban, coastal, and open space environments, increasing the footprint of the highway as well as the width or extent of the shadow effects beneath the infrastructure.

The airport improvements would add runways and gates to existing airports, and these features would blend with existing landscape features. Therefore, no visual impacts have been identified for the airport part of the Modal Alternative.

<u>High-Speed Train Alternative</u>

A typical double-track HST, at grade, would have a 50- to 100-ft (15- to 31-m) fenced right-of-way, and an elevated guideway would have a 50-ft (15-m) right-of-way. The 100-ft width would be comparable to a six-lane highway. Catenary supports 26 ft (8 m) in height would be located every 30 ft (9 m) along both sides of the track to support the electric wires that supply power to the trains. The proposed HST alternative would include using existing rail tracks or parallel tracks or highways where feasible, and tunneling through the scenic mountainous area. (See Chapter 2, Alternatives, for full description of proposed HST alignment options.). About 194 mi (312 km) of tunnel has been identified for this conceptual stage of design.

The proposed HST Alternative would be built in phases. Construction of the system would have short-term impacts on visual resources similar to those described for highway construction above in the discussion of the Modal Alternative. Construction equipment, staging areas with construction materials, signage, and night lighting would be visible from adjacent properties and roadways during the construction period.

[2] Acres of right-of-way for the Modal Alternative are estimated based on the need for a minimum of 25 ft (8 m) of additional pavement width, and 50 ft (16 m) of unpaved width for drainage, cut and fill, and other unpaved area, for the length of I-5 between Los Angeles and San Diego.

Figure 3.9-14

Photo simulation of Modal Alternative SR-152 (Pacheco Pass) with two added lanes

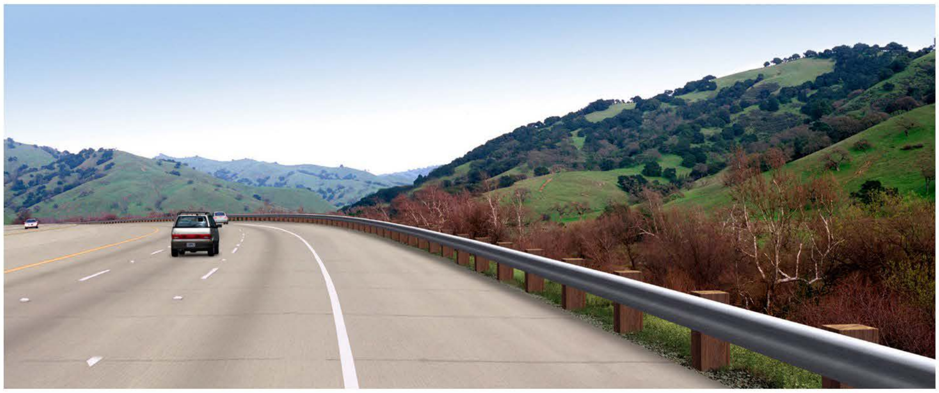


Figure 3.9-15

Photo simulation HST Alternative SR-152 (Pacheco Pass)

Long-term visual changes would result from the introduction of a new transportation system that would be visible along many major highways and rail corridors connecting the metropolitan areas of the state. The track, catenary, fencing, 12-ft (4-m) to 16-ft- (5-m) high soundwalls (where proposed), approximately 220 mi (354 km) of elevated guideway (where proposed), and the trains themselves would introduce a linear element into the landscape that would have potential cumulative visual impacts when considered with the strong linear element of the existing highway and rail facilities that the HST would parallel. The significance of the visual change would depend on the sensitivity of the landscape and the compatibility with existing landscape features of the typologies along each of the alignment options described in the affected environment section. The landscape typologies considered scenic and therefore most subject to high-contrast visual changes—where the HST would begin to dominate the landscape and detract from the existing features—are the natural open space and park typology and the traditional small urban community typology.

At this program level of analysis, there are no potentially high aesthetic or visual impacts that could not be reduced or mitigated through design treatments (e.g., architectural treatment at historic stations, tunneling, or minimizing the cut and fill through mountainous terrain and in natural areas). Similar construction-related and long-term visual changes would occur under both the Modal and HST Alternatives, particularly in highly scenic areas of the state. Both alternatives would contribute to cumulative visual impacts from construction and shadow effects of elevated structures.

3.9.4 Comparison of Alternatives by Region

Table 3.9-1 summarizes the key findings for each of the alternatives by region. The table identifies the highways in the proposed Modal Alternative and the proposed HST alignment options and stations in each of the five regions that would have potential significant visual impacts (high visual contrasts).

Table 3.9-1
Potential Visual Impacts by Region

Alignment and Station Options	Scenic Highway	Scenic Viewing Point/Landscape	High Contrast/Impact	Shadow Impact	Light/Glare
Bay Area to Merced					
Modal Alternative					
SR-152/US-101 to I-5	35 mi (56 km) designated scenic highway	10–20 viewing points Pacheco Creek Valley, scenic natural open space	High contrast in color, line, and form from enlarged cut/fill, expanded two lanes of pavement, removal of vegetation	High—widened bridges, ramps	Lights from increased auto use at night
High-Speed Train Alternative					
Hayward/Niles/ Mulford alignment	6 mi (10 km) (Niles Creek)	4 viewing points historic town of Niles	High contrast of elevated guideway with historic town and scenic canyon	Moderate	Low
Pacheco Pass options	30 mi (48 km)	10-20 viewing points Pacheco Creek Valley, scenic natural open space	High contrast in line and color from elevated guideway over hwy. and catenary and tunnel portal	Moderate—elevated guideway	Low—glare from locomotive lights
Diablo Range Direct options		Natural open space, Henry Coe State Park Orestimba Valley, I-5	Aerial guideway, cut/fill, catenary, tunnel portal	Moderate—elevated guideway	Locomotive lights
Sacramento to Bakersfield					
Modal Alternative			Low visual contrasts		
High-Speed Train Alternative					
UPRR options	0–6.3 mi (0–10.1 km)	0 viewing points	Low visual contrasts	Low—at grade	Low
BNSF options	0.8–6.7 mi (1.28–10.8 km)	0 viewing points	Low visual contrasts	Low—at grade	Low
Stations at Power Inn Road, Stockton ACE, Modesto, Merced, Castle Air Force Base, Visalia, Bakersfield Airport	None	None	Moderate to high visual contrasts with traditional rural community historic architecture in highly visible landscapes	None	Low to moderate light and glare around stations

Alignment and Station Options	Scenic Highway	Scenic Viewing Point/Landscape	High Contrast/Impact	Shadow Impact	Light/Glare
Bakersfield to Los Angeles					
Modal Alternative					
I-5: SR-99 to SR-14; and SR-14: Palmdale to I-5		Pyramid Lake scenic viewing from Visitors Center and Castic Lake Viewing Point from visitor rest area	Moderate contrasts from cut required along hillside, removal of vegetation	No shadow impacts	Increased lights from auto use
I-5: SR-14 to I-405	2.5 mi (4 km) of scenic corridor along I-5		Moderate contrast from double-decking of four lanes for about 4 mi (6 km) over I-5, contrast with scale of urban features	No shadow impacts, existing double-deck sections	Increased lights from auto use
High-Speed Train Alternative					
I-5: Tehachapi corridor	None	2 viewing points: Pyramid Lake scenic viewing point (412 ft [126 m]) and Castic Lake scenic viewing points 0.4 mi (0.6 km) and 0.7 mi (1.1 km)	High-contrast impacts from elevated structure and catenary at edge of Pyramid Lake adjacent to I-5; and cut/fill and tunnel portals in hillside of Santa Clarita Woodlands Park. Moderate contrast from cut and fill for 7.5 mi (12 km) where alignment is close to I-5. Moderate contrast across valley in front of Castic Lake.	Shadow impacts on Pyramid Lake and recreational users within 75 ft (23 m) of elevated structure	
SR-58 corridor	None	Tehachapi Loop Marker 0.7 mi (1 km) from alignment	Contrast with historic Tehachapi Pass Rail, and moderate contrast from cut/fill in hillside for about 12 mi (19 km)	None	
Soledad Canyon corridor	Sierra Highway in City of Palmdale	None within 0.25 mi (0.40 km) of alignment	The elevated guideway and catenary across the scenic Sierra Hwy. and adjacent to Santa Clarita River SEA would contrast with the existing landscape features. Cut/fill, tunnel portals would be visible against natural open space hillsides, and ridges in Angeles National Forest.	Shadow impacts of elevated guideway	

Alignment and Station Options	Scenic Highway	Scenic Viewing Point/Landscape	High Contrast/Impact	Shadow Impact	Light/Glare
			Los Angeles to San Diego via Inland Empire		
Modal Alternative			Low visual contrasts for all Modal (highway and airport improvements) in landscapes previously modified	Low	Light and glare from increased traffic
High-Speed Train Alternative					
UPRR Colton Line to March ARB	None	Viewing points are from residential streets.	High visual contrast in urban suburban landscape where alignment is in center of arterial street through residential neighborhood east of the UC Riverside campus	High shadow impacts	
UPRR Colton Line to San Bernardino	None	Viewing points are from residential streets.	High visual contrast in urban suburban landscape where alignment is through established residential neighborhood in Rialto and San Bernardino	High shadow impacts	Low to moderate light and glare at station
San Jacinto to I-5	None	Viewing points are from residential streets.	High visual contrast from long segments of elevated structures in median of highway	High shadow impacts	
Downtown San Diego	None		Elevated guideway in urban mixed use landscape would block views of Bay	High shadow impacts	
			Los Angeles to San Diego via Orange County		
Modal Alternative					
I-5 San Juan Capistrano to Del Mar	None	Coastal communities with high aesthetic qualities, limited views of the ocean	Moderate visual contrasts from extensive cut and fill of natural hillsides (removal of vegetation) and rock slopes, and widened sections of elevated highway and bridges; medium impacts in scenic lagoon areas	Shadow impacts of elevated sections of widened highway, medium impacts at lagoons and open space areas	Light and glare from increased auto use
High-Speed Train Alternative					
Los Angeles to Irvine	None		Low visual contrasts	Low at-grade	Low to moderate light and glare at stations

of recorded vertebrate fossil sites, has produced vertebrate fossil remains within the study area and/or vicinity, and is likely to yield additional remains within the study area.

- Low: The rock unit contains no or very low density of recorded resource localities, has produced little or no fossil remains within the study area and/or vicinity, and is not likely to yield any remains within the study area.
- Undetermined: The rock unit has had limited exposure(s) in the study area and has been little studied, and there are no known recorded paleontological resource localities. However, in other areas, the same or a similar rock unit contains sufficient paleontological resource localities to suggest that exposures to disturbance of the unit within the right-of-way have potential to yield fossil remains.

The number of rock units (formations) having high paleontologic sensitivity and the number of paleontological resource localities recorded within each study area were assessed to provide an accurate interpretation of the overall ranking of high, low, or undetermined potential to impact significant nonrenewable paleontological resources. This evaluation was reached using both the numbers of formations and localities and incorporating professional assessments regarding the significance of recovered resources from exposed rock units and the likelihood of these rock units to contain additional paleontological resources.

3.12.2 Affected Environment

A. STUDY AREA DEFINED: AREA OF POTENTIAL EFFECT

The study area for cultural resources is the APE that was defined in consultation with the SHPO, as noted above in Section 3.21.1.B. The APE for cultural resources at this program level of analysis was developed based on review of the records searches from the CHRIS Information Centers, as well as the cultural resource specialists' knowledge and experience in regional history and prehistory. It is important to note that the APE was specifically designed to aid in the program level analysis, which provides a general comparison of the alternatives without new identification surveys. The size and width of the APE was selected to predict the existence and relative sensitivity of cultural resources in and near the proposed program route alternatives, including prehistoric archaeological sites, historic archaeological sites, traditional cultural properties, and historic buildings, structures, objects, districts, and cultural landscapes. The APE for cultural resources for the proposed HST Alternative is as follows:

- 500 ft (152 m) on each side of the centerline of proposed new rail routes where additional right-of-way could be needed.
- 100 ft (30 m) on each side of the centerline for routes along existing highways and railroads where very little additional right-of-way would be needed.
- 100 ft (30 m) around station locations.

Locations of easements and construction-related facilities, such as equipment staging areas, borrow and disposal areas, access roads, and utilities, have not yet been identified. Locations for these will be identified as part of the construction design program for the alternatives selected for more detailed analysis in the next phase of the project. Thus, these items are not considered in the program Level Tier 1 analysis, but this information will be available for Tier 2 site-specific EIR/EIS's. The APE will be modified to include these items as part of the Tier 2 analysis.

Under the Modal Alternative, the APE for freeway routes and around airports is 100 ft (30 m) beyond the existing freeway right-of-way and 100 ft (30 m) beyond the existing airport property boundary.

The study area for paleontological resources under the HSR Alternative is 100 ft (30 m) on each side of the centerline of proposed rail routes (including station locations), in both nonurban and urban areas. The paleontological APE under the Modal Alternative for freeway routes and around airports is 100 ft (30 m) beyond the existing freeway right-of-way and 100 ft (30 m) beyond the existing airport property boundary. The study area for paleontological resources is limited to the area that would potentially be disturbed by earthwork construction activities.

B. CULTURAL RESOURCE CATEGORIES

The following topics are covered in this section.

- Prehistoric archaeological sites.
- Historic archaeological sites.
- Historic-era properties and historical resources.
- Traditional cultural properties.
- Paleontological resources.

Following are brief descriptions of each cultural resource category.

Prehistoric Archaeological Sites

Prehistoric archaeological sites in California are places where Native Americans lived or carried out activities during the prehistoric period before 1769 AD. Prehistoric sites contain artifacts and subsistence remains, and they may contain human burials. Artifacts are objects made by people and include tools (projectile points, scrapers, and grinding implements, for example), waste products from making flaked stone tools (debitage), and nonutilitarian artifacts (beads, ornaments, ceremonial items, and rock art). Subsistence remains include the inedible portions of foods, such as animal bone and shell, and edible parts that were lost and not consumed, such as charred seeds.

Historic Archaeological Sites

Historic archaeological sites in California are places where human activities were carried out during the historic period between 1769 AD and 50 years ago. Some of these sites may be the result of Native American activities during the historic period, but most are the result of Spanish, Mexican, Asian, African-American or Anglo-American activities. Most historic archaeological sites are places where houses formerly existed and contain ceramic, metal, and glass refuse resulting from the transport, preparation, and consumption of food. Such sites can also contain house foundations and structural remnants, such as windowpane glass, lumber, and nails. Historical archaeological sites can also be nonresidential, resulting from ranching, farming, industrial, and other activities.

Historic-era Properties / Historical Resources

Historic-era properties (NRHP) and historical resources (CRHR) are historically significant elements of the built environment that are listed in, or eligible for the NRHP and/or the CRHR. These elements reflect important aspects of local, state, and/or national history and can be buildings, structures, objects, sites, districts, and/or historic cultural landscapes. Examples of the types of historic-era properties or historical resources that are located in and near the APE for the HST program include dwellings, industrial buildings, commercial buildings, downtown districts, farms, canals, rural landscapes, dams, bridges, roads, and other facilities that were built, operated, and previously gained historical significance.

Traditional Cultural Properties

Traditional cultural properties are places associated with the cultural practices or beliefs of a living community that are rooted in that community's history and are important in maintaining the continuing cultural identity of the community. Examples include locations "associated with the traditional beliefs of a Native American group about its origins, its cultural history, or the nature of the world" and locations "where Native American religious practitioners have historically gone, and are known or thought to go today, to perform ceremonial activities in accordance with traditional cultural rules of practice" (Parker and King 1990). Traditional cultural properties are identified by consulting with Native American groups that have a history of using an area, as well as the Native American Heritage Commission, the Sacred Lands File, and tribal representatives.

Paleontological Resources

Paleontological resources are the fossilized remains of animals and plants. They are typically found in sedimentary rock units, and they provide information about the evolution of life on earth over the past 500 million years or more.

C. CULTURAL RESOURCES BY REGION

Archaeological Resources by Region

As described above, information on the numbers, kinds, and locations of archaeological sites for this Program EIR/EIS was obtained from CHRIS Information Centers. For the most part, the data from CHRIS Information Centers provide archaeological site information only for areas that have been previously surveyed by archaeologists. No archaeological field surveys were conducted for this Program EIR/EIS. However, surveys would be a part of the next stage of environmental review in the project-level EIR/EIS (see Section 3.12-6).

Bay Area to Merced: This region includes central California from the San Francisco Bay Area (San Francisco and Oakland) south to the Santa Clara Valley and east across the Diablo Range to the Central Valley. Archaeological evidence places prehistoric people in California as early as 8,000 to 12,000 years ago; however, in the Bay Area to Merced region, the last 2,000 to 4,000 years are best documented. The regional chronological sequence of time periods (PaleoIndian; Early, Middle, and Late Archaic; and Protohistoric) reflects changes in land use that were influenced by population growth (e.g., shift from small camps to village sites), technological innovation (e.g., shift from use of the spear to bow and arrow), and resource intensification (e.g., the intensive use of mortars and pestles and bedrock milling features for acorn processing). Change also resulted from population movements and displacements, and from outside influences such as climate change and rise in sea level.

The records search for the project APE in the Bay Area to Merced region identified 109 archaeological sites: 95 prehistoric sites, 13 historic sites, and one site with both prehistoric and historic archaeological components. Half of the prehistoric sites are habitation sites, variously referred to as shell mounds, shell middens, and large flaked and ground stone scatters[3] with midden[4] accumulations, but also including sites where house pits were noted. Many of these habitation sites (the shell mounds around San Francisco Bay in particular) contain Native American burials. Burials are noted on the site records for more than 15% of the sites within the APE. Other types of sites identified in the APE include bedrock mortars, lithic scatters,[5] ground

[3] Ground stone scatter refers to a site containing milling equipment, including handstones, mortars, and pestles.

[4] Midden refers to a mound or deposit containing shells, animal bones, and other refuse that indicates the site of a human settlement.

[5] Lithic scatter refers to a site containing general utility implements such as projectile points, bifaces, expedient flake tools, and debitage.

stone scatters, and fire-affected rock scatters.[6] The 13 historic archaeological sites identified within the APE include debris and features associated with nineteenth and early twentieth-century housing developments, farm complexes, and post–World War II trash dumps. The third location of Mission Santa Clara de Asís, near the Santa Clara train station, is the site identified above where both prehistoric and historic components are present.

Sacramento to Bakersfield: This region of central California includes a large portion of the Central Valley (San Joaquin Valley) from Sacramento south to Bakersfield. Archaeological investigations conducted in the southern San Joaquin Valley generally document human occupation of the region since about 12,000 years ago. Population density was low at that time, with the few settlements concentrated around the shores of ancient water sources such as Tulare and Buena Vista Lakes. Because of the rapid accumulation of sediment on the valley floor, older archaeological material tends to be deeply buried. Material from a site near Buena Vista Lake is estimated to be 7,500 to 11,500 years old. Most other archaeological material found in the southern valley appears to be a result of the presence of the Yokuts in the San Joaquin Valley throughout the last 2,000 years.

The Sacramento to Bakersfield portion of the project APE passes through the traditional lands of four Native American groups: the Nissenan, Plains Miwok, Northern Valley Yokuts, and Southern Valley Yokuts. However, the northern San Joaquin Valley is one large area in California for which very little ethnographic information is available. The dearth of information about the early inhabitants of the region is thought to be due in part to their rapid depopulation as a result of European diseases in the early nineteenth century and invasion of their territory by gold miners and others in the mid-nineteenth century. Most of what is known about the early inhabitants comes from the writings of explorers and other early travelers in the region. By piecing together these scraps of information, it has been determined that by the time of the first European visitors, the primary inhabitants of the area were the Northern Valley Yokuts.

Prehistoric archaeological sites in the region consist of habitation sites, many of which represent village locations, and lithic scatters, which may represent camps and activity areas away from villages. Cemeteries and isolated burials are also present. Most prehistoric sites in this region are found between Sacramento and Stockton, where many rivers and streams that originate in the Sierras to the east cross the Modal Alternative and the HST Alternative routes, and between Tulare and Bakersfield near Tulare and Buena Vista Lakes. (See Section 3.14, Hydrology and Water Resources, for maps of rivers and streams). Proximity to water was common for habitation sites because the rivers and streams were a source of food and water.

San Joaquin Valley archaeological sites containing material from the historic period include sites with structural remains (usually foundations) and associated refuse, and sites consisting only of refuse.

Bakersfield to Los Angeles: This region of southern California encompasses the southern portion of the Central Valley south of Bakersfield, the mountainous areas between the Central Valley and the Los Angeles basin, and the northern portion of the Los Angeles basin from Sylmar to downtown Los Angeles. The prehistory of the Mojave Desert has been divided into several periods spanning the time from 10,000 BC (approximately 12,000 years ago) to the time of Euro-American contact in the early nineteenth century. Each period has characteristic artifacts and subsistence systems. The earliest occupation of the Mojave Desert for which widely accepted data are available began about 10,000 BC, or 12,000 years ago. The period from 10,000 BC to 5,000 BC (12,000 years ago to 7,000 years ago) is known as the Lake Mojave Period. This period was followed by the Pinto Period (5000 to 2000 BC, or 7,000 to 4,000 years ago); the

[6] Rock scatter refers to dispersed pieces of rock.

Gypsum Period (2000 BC to 500 AD, or 4,000 years ago to 1,500 years ago); the Saratoga Springs Period (500 AD to 1200); and the Shoshonean Period (began 1200 AD).

The Milling Stone Period along the southern California coast (about 5000 BC to 1000 BC, or from 7,000 to 3,000 years ago) was characterized by smaller, more mobile groups compared to later periods. The period from 1000 BC to 750 AD (3,000 years ago to 1,350 years ago) is known archaeologically as the Intermediate Period. More specifically, in the Los Angeles basin, perhaps the earliest evidence of human occupation was recovered from the tar pits of Rancho La Brea. In 1914, the partial skeleton of a young woman was discovered in association with a stone used for grinding by hand, called a mano. In the 1970s, a collagen sample from the skeleton was dated at circa 9,000 years old. In addition, projectile points similar to those found in the desert dating from 7,000 to 10,000 years ago, as well as crescent-shaped flaked tools, called crescentics, have been recovered from bluffs near Ballona Lagoon. The presence of these point types along the coast suggests connections between what is now the Los Angeles area and the cultures of the southeastern California desert regions present during this early period.

A different nomenclature is used to organize the prehistoric record in southern California coastal contexts. The Milling Stone Period manifest primarily along the coast (about 5000 BC to 1000 BC, or from 7,000 to 3,000 years ago) was characterized by smaller, more mobile groups compared to later periods. The period from 1000 BC to AD 750 (3,000 years ago to 1,350 years ago) is known archaeologically as the Intermediate Period. More specifically, in the Los Angeles basin, perhaps the earliest evidence of human occupation was recovered from the tar pits of Rancho La Brea. In 1914, the partial skeleton of a young woman was discovered in association with a stone used for grinding by hand, called a mano. In the 1970s, a collagen sample from the skeleton was dated at circa 9,000 years old. In addition, projectile points similar to those found in the desert dating from 7,000 to 10,000 years ago, as well as crescent-shaped flaked tools, called crescentics, have been recovered from bluffs near Ballona Lagoon. The presence of these point types along the coast suggests connections between what is now the Los Angeles area and the cultures of the southeastern California desert regions present during this early period.

The Los Angeles basin was part of territory occupied by the Tongva Native American groups (renamed Gabrieliños by early explorers, missionaries, and settlers) when the Spanish arrived in 1769 AD. Tongva settlement and subsistence systems may extend back in time to the beginning of the Late Prehistoric Period, about 750 AD.

Prehistoric archaeological sites types commonly found along the APE for the HST and Modal Alternative alignments in the Bakersfield to Los Angeles region include lithic scatters, milling stations, and quarries. Less common are habitation sites, which can include midden, rock features and, in some cases, human burials. One rock art site, a petroglyph, is also known to exist within the APE.

<u>Los Angeles to San Diego via Inland Empire</u>: This region of southern California includes the eastern portion of the Los Angeles basin from downtown Los Angeles east to the Riverside and San Bernardino areas and south to San Diego generally along the I-215 and I-15 corridors. This region includes a portion of the Los Angeles basin. The prehistory and ethnography of this area were discussed above in the Bakersfield to Los Angeles section. The rest of the region consists of the area east of the Santa Ana Mountains in Riverside County and east of the coastal hills in San Diego County.

The 241 known archeological sites within the study area for this region reflect the full range of cultures and periods, from chronologically ancient prehistoric Native American, to historic European (Spanish/Mexican) settlements, to historic Euro-American settlements and more recent periods through World War II urban and industrial growth. There are 130 prehistoric sites and

101 sites from the historic period. The majority of the prehistoric sites (80) are in San Diego County, and 48 of the 101 historic sites are in San Bernardino County.

The San Dieguito Complex[7] was originally thought to represent big-game hunters who moved to the San Diego County coastal area from the Great Basin during Early Holocene time (8,000 to 10,000 years before present [BP], or 10,000–5,000 BC). This movement occurred when warmer, drier conditions resulted in desiccation of the pluvial lakes in the Great Basin. Although it was thought that big-game hunting continued after these people arrived on the coast during Early Holocene time, more recent investigations at Early Holocene sites closer to the coast have shown that a wide range of plant foods, along with small- and medium- sized terrestrial mammals, fish, and shellfish, were also being exploited in these sites. Population size was likely low, with relatively little competition for resources. Therefore, small groups probably migrated throughout the coastal area and the area inland of the coastal hills and mountains to wherever the best resources were available at the time.

The Pauma Complex characterized inland San Diego County and southwestern Riverside County during the period from 3,000 to 8,000 years ago. However, there are few sites that date to the period from 1,300 to 3,000 BP in northern San Diego County and western Riverside County.

A larger population, a more sedentary settlement system, and a more intensive use of available resources characterize the Late Period (100 to 1,300 BP in this area). The large villages, occupied almost year-round, that were present when the Spanish explored this area in 1769 AD developed during this period.

Los Angeles to San Diego via Orange County: This region includes the western portion of the Los Angeles basin between downtown Los Angeles and Los Angeles International Airport (LAX) and the coastal areas of southern California between Los Angeles and San Diego, generally following the existing Los Angeles to San Diego via Orange County (LOSSAN) rail corridor. The prehistory and ethnography of the Los Angeles basin portion of the region was discussed above in the Bakersfield to Los Angeles section.

The prehistory of coastal San Diego County begins with the San Dieguito Complex, as discussed above in the Los Angeles to San Diego via Inland Empire section. Archaeological sites occupied between 3,000 and 8,000 years ago on the San Diego County coast belong to the La Jolla Complex. Most La Jolla Complex sites are located around the coastal lagoons, which began filling with seawater at the beginning of this period because of a rise in the sea level, as the ice caps melted at the end of the last ice age. Most sites around lagoons on the San Diego County coast were abandoned about 3,000 years ago. However, sites around Peñasquitos Lagoon and San Diego Bay continued to be occupied because these two southern bay/estuary systems did not fill with sediment. Still, in general, there are few sites in the coastal region that date to the period between 1,300 and 3,000 BP. Little is known about settlement and subsistence during this period of San Diego County prehistory.

The Late Period (200 to 1,300 BP in this area) is characterized by a more sedentary settlement system and a more intensive use of available resources. The large villages, occupied almost year-round, that were observed by the Spanish in 1769 AD developed during this period.

Historic-era Properties and Historical Resources by Region

Historic buildings, structures, objects, sites, districts and cultural landscapes in and near the program route alternatives date from the eighteenth century to the mid-1900s, although the vast

[7] Complex refers to a group or association of artifacts and subsistence remains that are characteristic of a specific period of time and geographic area.

majority date to the twentieth century. These properties/resources were constructed during the major historic periods of California history, including the exploration and settlement of the Spanish and Mexican eras; the US-Mexican War, the Gold Rush, and statehood in the mid nineteenth century; and subsequent settlement and development of California through the mid twentieth century. The property types also vary widely, but most are dwellings, commercial buildings, or industrial facilities that date to the 1890s and after. Properties/resources dating to before 1890 largely consist of a few remaining adobe structures and sites dating to the Mexican period prior to 1848, and wood-frame dwellings and commercial buildings from the period between 1849 and 1890.

The oldest standing elements of the built environment in California date to the eighteenth century, during the period when California was a Spanish colony. Spanish exploration and settlement began in 1769 with the Portola Expedition and continued with the establishment of 21 missions and several presidios (forts) and pueblos (towns) near the coast between San Diego and Sonoma. Three of the missions, San Gabriel, San Juan Capistrano, and Santa Clara, are located near proposed project alignments. The San Gabriel Mission is located along the proposed HST Alternative alignment in the Los Angeles to San Diego via Inland Empire region. The San Juan Capistrano Mission is located near all of the proposed HST and Modal Alternative routes through San Juan Capistrano in the LOSSAN region. The third location of Mission Santa Clara de Asís, near the extant, historic Santa Clara train station is an archaeological site with both prehistoric and historic components. It lies within the HST alignment in the Bay Area to Merced region. (See Chapter 2, Alternatives, for maps of the routes).

The Spanish made land grants to retired soldiers and other Spanish citizens interested in settling the area. The Mexican government continued the land grant system after gaining independence from Spain in 1821 and dissolving the mission system in 1834. The presidios and pueblos founded during the Spanish/Mexican period, including San Francisco, San Jose, Los Angeles, and San Diego, grew slowly during the 1830s and 1840s and relatively few properties/resources are predicted for the HST and modal routes that pass through these cities.

The United States acquired California upon the ratification of the Treaty of Guadalupe-Hidalgo at the close of the Mexican War in 1848. The subsequent gold rush of 1849 lured immigrants to the west coast from across the United States and around the world. California became a state in 1850 and it continued to grow in population as completion of the transcontinental railroad in 1869 brought more settlers. Southern California remained a sparsely settled cattle ranching area until the arrival of the Southern Pacific Railroad in the 1870s and the Atchison, Topeka, and Santa Fe Railroad in the 1880s. New towns developed across the state in the nineteenth century, but were especially clustered along the state's railroad routes. Some of these properties / historical resources (such as dwellings, businesses, factories and other buildings and structures from the Victorian era) remain along the various segments of the proposed HSR routes and modal alternatives.

The early twentieth century saw continued urban expansion in both northern and southern California, especially in conjunction with the first widespread use of automobiles. Popular residential architectural styles during this period included the Craftsman bungalow, as well as the Spanish Colonial Revival and other revival styles. Increasing use of automobiles also led to construction of linear commercial strips and other roadside development along arterials, although industry and major shipping facilities largely remained clustered along rail lines and maritime ports. By the late 1930s and during World War II, dwellings, commercial, industrial, and public buildings were often designed in the Art Deco Style (or the related Art, Zigzag, or Streamline Moderne styles). The construction boom of the post-war period brought residences in the Ranch style with an open plan and attached garage, often laid out in expansive suburbs of builders' tract homes. Regional malls and shopping centers developed on the outskirts of communities, while the industrial and shipping facilities of the post-war period became more inter-modal as trucking competed with rail and sea transportation. The areas along the HST routes and modal alternatives contain properties/resources of each of these types and from each decade of the twentieth century.

Bay Area to Merced: By far the largest concentrations of historic buildings, structures, objects, sties, districts, and cultural landscapes (or potential historic properties/historical resources) in this region are in the urban centers of San Jose, San Francisco, and Oakland, but resources of all types appear throughout the Bay Area to Merced region. A certain number of properties/resources appear in other towns, and to a lesser extent, in the rural countryside of the Santa Clara and Central valleys. Towns that were important local trade centers in the late nineteenth century, like Morgan Hill and Gilroy, exhibit concentrations of historical resources along the project corridors. Diridon (Cahill) Station and Santa Clara Station in San Jose are listed on the National Register of Historic Places (NRHP) and California Register of Historical Resources (CRHR). Diridon Station is a NRHP historic district, and the Santa Clara Station is a multi-component listed historic property and is a historical resource for the purposes of CEQA.

Other historic districts in the region include the Redwood City Historic District along the Caltrain alignment, the Downtown Oakland Historic District, the Oakland Waterfront Warehouse District along the Oakland to San Jose via I-880 route, and the Alviso Historic District and Agnews Insane Asylum Historic District along the Oakland to San Jose via Milford route. There is also one historic district, the U.S. Naval Air Station Sunnyvale Historic District, in the San Francisco to San Jose segment, as well as two bridges listed in the NRHP, Carquinez Bridge and the Oakland–San Francisco Bay Bridge, on the Modal Alternative alignment. Rural historic properties and historical resources that appear long the HST routes include farm and ranch complexes, as well as infrastructure elements (such as water conveyance systems, bridges, industrial complexes, and rail stations).

Sacramento to Bakersfield: Buildings from the historic period along the alternative corridors in the Sacramento to Bakersfield region consist of residential and commercial structures located mostly in the towns and cities that developed along the Southern Pacific Railroad (now the Union Pacific Railroad [UPRR]) and Central Pacific Railroad routes in the 1870s.[8] Some of the region's railroad bridges and stations are also historic, along with some roads, highway bridges, and cemeteries. Construction of agricultural irrigation projects in the San Joaquin Valley began in the late 19th century and continued into the 20th century. There are many canal and levee systems in this region, some of which may be historic.

Because the UPRR tracks were initially constructed in the Central Valley in the mid- to late nineteenth century, the towns along the HST alignments that use the UPRR corridor have a high potential to contain nineteenth-century buildings. For example, one of the towns that developed during the nineteenth century along the UPRR corridor between Sacramento and Stockton is Elk Grove, a part of which is now a National Register Historic District. Alignments that use the Burlington Northern Santa Fe (BNSF) corridors established in the early twentieth century avoid many of the smaller towns and pass through far fewer historically sensitive areas.

Bakersfield to Los Angeles: Historic structures along the project corridors in the Bakersfield to Los Angeles region are primarily twentieth-century residential, commercial, and industrial structures located within cities. Large tracts of residential houses are most common, with industrial and commercial structures largely confined to existing railroad rights-of-way and station areas in Los Angeles.

[8] The Central Pacific was later purchased by the AT&SF Railroad (now the BNSF Railroad).

Structures dating to before 1900 are rare. In many parts of the region, such as the Antelope Valley, structures from this time period were sparse and were built in perishable vernacular styles (e.g., wooden barns and other structures). In the largest cities of the region, Los Angeles and Bakersfield, large sections of houses and commercial structures built originally before 1900 have been replaced by subsequent development.

Los Angeles to San Diego via Inland Empire: Before 1900, the region's small towns had developed small-scale residential neighborhoods surrounding their central blocks. In the region's rural areas, the pre-1900 built environment consisted mostly of farm/ranch homes and related outbuildings, small bridges, dirt roads, and railroads and railroad-related terminals and warehouses. The small towns consisted mostly of residential and commercial buildings and offered better-established roads. Railroad stations in these smaller towns often served as the commercial hub for the surrounding areas.

By 1900, Los Angeles, Riverside, San Diego, and the central blocks of the smaller outlying towns had developed commercial/industrial buildings and were surrounded by more residential land uses. Between 1900 and 1929, the built environment changed markedly, with the advent of the automobile age. Not only did the region experience population growth, but major improved road networks were also constructed to accommodate increased numbers of automobiles and trucks. During this timeframe, new types of specialized structures appeared in the built environment, including gas stations, parking garages, and auto/truck sales and repair/maintenance facilities. Urbanized areas continued to grow, and use of streetcars and interurban passenger rail services peaked at this time. In the years following World War I, Southern California experienced growth in military bases and training facilities. Important industrial facilities expanded in the Riverside and San Bernardino vicinities with Kaiser steelworks in Fontana being a notable example.

Very few pre-1900 structures remain near the proposed project alignments. A notable exception is the San Gabriel Mission (founded in 1771), located immediately adjacent to the former Southern Pacific Railroad (now UPRR) route through San Gabriel. There is the potential for a few pre-1900 buildings, including rail stations, along this railroad route in Pomona, Ontario, Guasti, San Bernardino, and Temecula. Los Angeles Union Station (LAUS) passenger terminal is listed in the NRHP.

Los Angeles to San Diego via Orange County: Historic structures in the LOSSAN region are primarily twentieth-century (1900 to 1929 and 1930 to 1958) residential, commercial, and industrial structures located within cities. Large tracts of residential houses are most common, with industrial and commercial structures largely confined to existing railroad rights-of-way in the Los Angeles and San Diego areas. However, many of the medium-sized cities of the region, such as Anaheim, Fullerton, and San Clemente, began as small towns in the late nineteenth or early twentieth century. The historic core areas of cities in this region commonly preserve some buildings from this time period.

Structures dating to the period before 1900 are rare. As in other parts of southern California, structures from this time period were sparse in much of this region and were built in perishable vernacular (wood frame) styles. However, there are notable exceptions, especially the Spanish and Mexican Period development in downtown San Juan Capistrano (1769 to 1848) around Mission San Juan Capistrano (founded in 1776) and the Hispanic to American Transition Period (1848 to 1870) development along the waterfront of San Diego, and Old Town San Diego. In the largest cities of the region, Los Angeles and San Diego, large sections of houses and commercial structures built before 1900 have been replaced by subsequent development.

Traditional Cultural Properties

Information regarding traditional cultural properties was derived from the NAHC's review of the Sacred Land files, the Native American Outreach Workshops, from presentations at public hearings, and in formal comments received on the draft EIR/EIS.

Based on their review of the Sacred Lands file, the NAHC identified one traditional cultural property near the project's APE. Within the Bakersfield to Los Angeles region, the property is described as a sacred power area and a worship and ritual site. It is, however, located well north of SR 58 and the High-Speed Train Alignment, and so lies outside of the project APE. The NAHC did not identify any other traditional cultural property within the APE of the other four regions (Bay Area to Merced; Sacramento to Bakersfield; Los Angeles to San Diego via Inland Empire; Los Angeles to San Diego via Orange County).

Letters were distributed to Native American potential contacts provided by the NAHC. No direct reply to the contact letters was received from Native Americans, that identified traditional cultural properties that could be affected by the project.

At each of the three Native American Outreach Workshops, attendees provided information concerning potentially sensitive resources and concerns. At the Frazier Park workshop, concerns were raised about potential impacts on sensitive cultural resources along the HST alignment options through the I-5 corridor between Bakersfield and Los Angeles, in particular for the northern portion of the Tehachapi range area between Grapevine and Frazier Park. At the San Luis Recreation Area workshop, concerns were raised about potential impacts on sensitive cultural resources along the HST Pacheco Pass alignment options, both through the mountains and in the Santa Clara Valley between Gilroy and Morgan Hill. During this meeting it was also noted by those attending that the Altamont Pass corridor, would have considerably more potential impacts on Native American traditional cultural properties than either the Diablo Range direct or Pacheco Pass corridors that are being considered for further HST evaluation. At the Temecula workshop, concerns were raised about potential impacts on sensitive cultural resources along the HST alignment options through the Soledad Canyon between Antelope Valley and Los Angeles, and in regards to potential alignment and tunneling impacts through the mountain range just south of Temecula along the I-215/I-15 HST alignment.

At public hearings, two individuals representing two different tribes presented statements. Two statements have also been submitted as written comments representing tribal concerns. At the April 28, 2004 hearing in Fresno, Mr. Val Lopez, Chair of the Amah Mutsun Tribal Band, spoke in general support of the HST project, requesting continued involvement and consultation on subsequent planning and construction of the project, and provided perspective on traditional tribal territories for the Amah Mutsun and Yokuts. In the spring of 2004, the Authority received public comments from Robert Gomez, Tubatulabal, concerning continued consultation with Native Americans, natural and cultural resources preservation, and disposition of archaeological collections. On June 23, 2004, representatives of the Pechanga Band of Luiseno Indians in Temecula requested continued involvement and consultation throughout subsequent phases of the project, including government-to-government consultation, and inclusion in the development of agreement documents concerning cultural resources. Subsequent to that public statement, the Pechanga Band submitted written comments stating their concerns with potential project impacts on significant cultural resources, sacred sites, and Native American human remains. Among their specific requests, the Pechanga Band asks that the Authority meet with tribal representatives in-person regarding confidential information concerning sensitive locations, in the interest of avoiding impacting such locations.

Paleontological Resources By Region

California's rich geologic record and complex geologic history has resulted in exposure of many rock units with high paleontologic sensitivity at the surface. The fossil record in California is exceptionally prolific; abundant fossils representing a diverse range of organisms have been recovered from rocks as old as 1 billion years to as recent as 11,000 years. These fossils have provided key data for charting the course of the evolution and extinction of various types of life on the planet, both locally and globally, as well as for determining paleoenvironmental conditions, sequences and timing of sedimentary deposition, and other details of geologic history.

The following paragraphs summarize key paleontological resources by region. More detailed information is given in the regional technical reports on cultural and paleontological resources.

Bay Area to Merced: The major fossil-bearing units in the Bay Area to Merced region include the Irvington Gravels, Livermore Gravels, Merced Formation, Santa Clara Formation, Tulare Formation, Tehama Formation, Pinole Tuff, San Pablo Formation, Orinda Formation and Siesta Formation (Contra Costa Group), Briones Formation (San Pablo Group), Markley Sandstone, Nortonville Shale, Martinez Formation, Panoche Formation, Quinto Formation, Chico Formation, and Franciscan Formation. Pleistocene alluvial units also contain important paleontological resources.

Of the 237 vertebrate fossil localities identified within the study area, 93 (nearly 40%) are in materials of Pleistocene age, including the Los Banos alluvium, Riverbank Formation, Irvington Gravels, and Tulare Formation. Other units with a high sensitivity include the Pinole Tuff, the Contra Costa Group, and the San Pablo Group, all of which are of Miocene age. The Pleistocene and Miocene age geologic units are units with a high potential for containing vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils.

Sacramento to Bakersfield: The most important paleontological resources in the Sacramento to Bakersfield region are contained in the Modesto-Riverbank Formations, the Turlock Lake-Laguna Formations, and the Franciscan Formation.

The Modesto-Riverbank Formations are largely unconsolidated Middle to Late Pleistocene units composed of interbedded poorly sorted brownish sandstone and siltstone with lesser amounts of pebble to cobble conglomerate. They are primarily fluvial (stream) deposits, and have yielded a wide range of fossils including clams, fish, turtles, frogs, snakes, birds, bison, mammoths, mastodons, ground sloths, camels, horses, deer, dire wolves, coyotes, rabbits, rodents, and land plant remains, including wood, leaves, and seeds.

The Turlock Lake-Laguna Formations are Pliocene in age and are composed of interbedded poorly sorted, reddish-brown siltstone and sandstone with lenses of pebble to cobble conglomerate. They are primarily fluvial deposits, but lacustrine (lake) beds are not uncommon. The Turlock Lake-Laguna Formations have yielded fossil remains at many sites, including petrified wood and the bones and teeth of a diversity of extinct land mammals.

The Franciscan Formation ranges in age from Jurassic through Cretaceous. The formation consists mainly of sandstone and shale or mudstone, but contains lesser amounts of chert, serpentinite, and greenstone. Coherent sedimentary units in the Franciscan primarily record deep marine deposition. Fossil vertebrates are rare; molluscan fossils and freshwater gastropods and pelecypods have been reported.

The Modesto-Riverbank and Turlock Lake-Laguna Formations occur in all segments of the Modal Alternative alignment except between Sacramento and Stockton. Along the HST Alternative route, they occur between Sacramento and Stockton in the Central California Traction (CCT) alignments and in all the alignments between Modesto and Merced. The Franciscan Formation occurs only on the Modal Alternative route between Merced and Fresno.

Bakersfield to Los Angeles: Sixteen different formations occur along both the Modal and HST Alternative corridors in this region. In the Bakersfield to Los Angeles region, the following formations have the potential to yield fossils.

- The Tecuya Formation along I-5 from SR-99 to SR-14 and the I-5 Tehachapi crossing, with oreodont artiodactyl and amphicyonid carnivore fossils.
- The Tick Canyon Formation along the SR-14 corridor, with horse, camel, carnivore, and oreodont artiodactyl fossils.
- The Kinnock Formation along the SR-58 corridor, with canid fossils.
- The Monterey Formation along I-405 between LAUS and Burbank, with fish and marine mammal fossils.
- The Towsley Formation along I-405 to Burbank, and along I-5 from SR-99 to SR-14 and in the Soledad Canyon and Tehachapi crossing, with whale fossils.
- The Castaic Formation along SR-14 and I-5 in Soledad Canyon and the Tehachapi crossing, with fish, mollusk, sea cow, sea turtle, and tapir fossils.
- The Mint Canyon Formation along SR-14 and in Soledad Canyon, with horse, camel, peccary, and rodent fossils.
- The Peace Valley Formation along I-5 between SR-99 and SR-14 and in the Tehachapi crossing, with cypriniodont, plant, and killifish fossils.
- The Ridge Route Formation along I-5 from SR-99 to SR-14 and in the Tehachapi crossing, with rhinoceros, horse, ground sloth, mollusk, lizard, snake, gopher, bony fish, and plant fossils.
- The Horned Toad Formation along SR-58, with gomphothere fossils.
- The Walker Formation along SR-58, with shark, ray, bony fish, whale, and marine bird fossils.
- The Pico Formation along SR-14 and I-5 and in Soledad Canyon, with shark, whale, and clam fossils.
- The Harold Formation along SR-14 and in the Antelope Valley area, with mammals and birds fossils.
- The Saugus Formation along SR-14 and I-5 between SR-99 and SR-14, and in Soledad Canyon and the Tehachapi crossing, with camel, horse, tapir, deer, lizard, gopher, canid, shark, ray, and bony fish fossil.
- The Kern River Formation along SR-58, with mustelid carnivore, peccary, mouse, and vulture fossils.
- Older Quaternary alluvium along I-405 to Burbank; along SR-14, SR-58, and I-5 between SR-99 and SR-14; and in Soledad Canyon, Antelope Valley, and the Tehachapi crossing, with large mammal and small nonmammalian vertebrate fossils.

Los Angeles to San Diego via Inland Empire: The following formations that occur along proposed alignments of the Modal and HST Alternatives in the Los Angeles to San Diego via Inland Empire region have the potential to yield fossils.

- The Silverado Formation from March Air Reserve Base (ARB) to Mira Mesa, with mollusk fossils.

- The Ardath Shale from Mira Mesa to downtown San Diego, with shark, ray, bony fish, and marine microorganism and macroinvertebrate fossils.
- The Scripps Formation from Mira Mesa to downtown San Diego, with shark, ray, bony fish, marine invertebrate, rhinoceros, artiodactyl, brontothere, uintathere, crocodile, turtle, as well as wood fossils.
- The Friars Formation between Escondido and San Diego, with artiodactyl, perissodactyl, primate, opossum, insectivore, and rodent fossils.
- The Stadium Conglomerate Formation from Mira Mesa to San Diego and Mira Mesa to Qualcomm Stadium, with artiodactyl, perissodactyl, primate, opossum, insectivore, rodent, carnivore, and rhinoceros fossils.
- The Mission Valley Formation between Mira Mesa and San Diego, with shark, ray, bony fish, marine microorganism and macroinvertebrate, artiodactyl, perissodactyl, primate, opossum, insectivore, and rodent fossils.
- The Puente Formation from Los Angeles to March ARB and Mira Mesa, and from LAUS to Pomona via El Monte and South El Monte, with marine and terrestrial vertebrate, invertebrate, and plant fossils.
- The Sespe Formation from March ARB to Mira Mesa, with camel, rhinoceros, oreodont, carnivore, insectivore, primate, and rodent fossils.
- The Vaqueros Formation from March ARB to Mira Mesa, with shark, ray, crab, and clam fossils.
- The Fernando Formation from Los Angeles to March ARB and from LAUS to Pomona via El Monte, with shark, ray, bony fish, bivalve, snail, whale, bird, camel, and tapir fossils.
- An unnamed sandstone unit from March ARB to Escondido, with large mammal, small vertebrate and invertebrate, and giant teratorn fossils.
- The Lindavista Formation from Mira Mesa to San Diego and Escondido to Mira Mesa and Qualcomm Stadium, with shark, whale, and marine invertebrate fossils.
- The Pauba Formation from March ARB to Mira Mesa, with large and small vertebrate fossils.
- The Bay Point Formation from Mira Mesa to San Diego, with shark, ray, bony fish, and mollusk fossils.
- Quaternary terrace deposits from Mira Mesa to the Transit Center, with small and large mammal and bird fossils.
- Older Quaternary alluvium from March ARB to San Diego, with large mammal and plant fossils.

<u>Los Angeles to San Diego via Orange County</u>: The following formations in the LOSSAN region have the potential to yield fossils.

- The Ardath Shale and Scripps Formation along SR-52 to San Diego, with shark, ray, bony fish, marine microorganism and macroinvertebrate, rhinoceros, artiodactyl, brontothere, uintathere, crocodile, turtle, as well as wood fossils.
- The Delmar Formation in Del Mar and along I-5/I-805 at the SR-52 split, with estuarine vertebrate and invertebrate, aquatic reptile, and rhinoceros fossils.
- The Torrey Sandstone from Encinitas to Solana Beach and Del Mar, with plant and marine invertebrate fossils.

- The San Mateo Formation at Camp Pendleton, with horse, camel, peccary, llama, sea cow, fur seal, walrus, sea otter, sea bird, whale, dolphin, shark, ray, bony fish, and marine invertebrate fossils.
- The Capistrano Formation from Irvine to San Juan Capistrano, Dana Point, San Clemente, Camp Pendleton, Oceanside, and Carlsbad, with whale, walrus, sea cow, fur seal, sea bird, shark, ray, bony fish, and kelp fossils.
- The Niguel Formation from Irvine to San Juan Capistrano, with marine mollusk and marine vertebrate fossils.
- The San Diego Formation along SR-52 to San Diego, with shark, ray, bony fish, marine invertebrate, sea bird, walrus, fur seal, cow, whale, dolphin, terrestrial mammal, wood, and leaf fossils.
- The Lindavista Formation along I-5/I-805, with marine invertebrate, shark, and whale fossils.
- The Bay Point Formation along SR-52 to San Diego, with shark, ray, bony fish, and mollusk fossils.
- Unnamed marine terrace deposits from Camp Pendleton through Encinitas and Solana Beach to the Santa Fe Depot in San Diego, with marine invertebrate, shark, ray, bony fish, and terrestrial mammal fossils.

3.12.3 Environmental Consequences

A. EXISTING CONDITIONS COMPARED TO NO PROJECT ALTERNATIVE

The No Project Alternative is composed of transportation projects other than the proposed HST system that are projected to be completed between the time of this Program EIR/EIS and 2020, including local, state, and interstate transportation system improvements designated in existing plans and programs. No additional impacts on cultural resources would occur under No Project beyond those addressed in environmental documents for those projects.

Because it was not realistically feasible for this Program EIR/EIS to identify or quantify all the statewide impacts on or mitigation activities for cultural resources associated with all of the projects considered as part of the No Project Alternative, it is assumed that the existing condition is representative of No Project conditions. It is possible that other transportation projects (not including the Modal or HST Alternatives) may impact some existing cultural resources by 2020, and that these changes to the baseline would be described and quantified in subsequent environmental analysis and reflected in future database information. This Program EIR/EIS addresses the general potential for the proposed project to affect or impact cultural resources as they exist at present and uses this information to compare the potential for impacts from the alternatives evaluated.

B. NO PROJECT ALTERNATIVE COMPARED TO MODAL AND HIGH-SPEED TRAIN ALTERNATIVES

This section compares the predicted sensitivity or potential for the alternatives to cause adverse effects or impacts to archaeological, historic, and/or paleontological properties/resources, and which would require mitigation. No new inventory or evaluation surveys of properties/resources were conducted for this Program EIR/EIS because that identification and evaluation work would be conducted as part of the next stage of environmental review in the project-level EIR/EIS (see Section 3.12.6).

The Modal Alternative would potentially affect or impact cultural resources (archaeological and historic properties/resources) as a result of expanding freeway rights-of-way to add lanes and as a result of airport expansion (new runways). Systemwide, the Modal Alternative is ranked as medium in terms of its potential impact on cultural resources Cumulative effects and impacts are likely because the combined effects and impacts from the Modal Alternative, No Project, and other community residential and commercial development projects would be greater than from the Modal Alternative alone. The Modal Alternative is ranked as high in terms of its potential effect or impact on paleontological resources from expansion of highways and airports. This ranking is a result of the estimated 2,970 lane mi (4,780 km) of expansion statewide and the number of formations identified as sensitive for paleontological resources that would be crossed by highways.

The HST Alternative would potentially affect or impact cultural resources as a result of its construction, including grading, cutting, tunneling, and erecting pylons for elevated track, as well as station construction. Systemwide, the HST Alternative is ranked as medium to high in terms of its potential effect or impact on archaeological, historic, and or paleontological properties/resources. The HST Alternative's potential effect or impact on historic properties/resources is generally higher on a systemwide basis compared to No Project or the Modal Alternative because the HST Alternative would use existing rail corridors at many locations. These existing rail corridors developed during the historic period and therefore the rail lines tend run through the oldest parts of cities and towns and are surrounded by historic properties/resources. Cumulative effects or impacts are likely because the combined effects and impacts from the HST Alternative, projects anticipated or planned for under No Project, and other residential and commercial development projects in the study area can be expected to be greater than from the HST Alternative alone. Potential effects or impacts on historic properties during operation of the HST Alternative related to noise or visual impacts are discussed in Sections 3.4 and 3.9, respectively, of this Program EIR/EIS.

The Modal and HST Alternatives would have greater potential effect and impact on cultural resources than No Project. Although many of the potential effects or impacts could be avoided or minimized through design refinements or alignment changes in a linear facility such as a highway or rail corridor, it is not always feasible to avoid effects or impacts to cultural resources, and mitigation measures would need to be identified and evaluated to address these situations for specific projects.

Table 3.12-1 summarizes the comparison of potential effects and impacts on cultural and paleontological resources for each of the alternatives. The table depicts relative sensitivity, or the potential for the alternatives to cause adverse effects or impacts to cultural resources. This table does not identify specific adverse effects or impacts at this programmatic level of review.

Table 3.12-1
Summary Rating Table—Potential Impacts on Cultural and Paleontological Resources

	Archaeological Resources	Historic Structures	Paleontological Resources
Bay Area to Merced			
No Project	Medium	Medium	Low
Modal	Medium	Medium	High
HST	Medium	High	Medium
Sacramento to Bakersfield			
No Project	Low	Low	Low
Modal	Medium	Medium	High
HST	Medium	High	Medium

	Archaeological Resources	Historic Structures	Paleontological Resources
Bakersfield to Los Angeles			
No Project	Low	Low	Low
Modal	Medium	Medium	High
HST	High	High	Medium
Los Angeles to San Diego via Inland Empire			
No Project	Low	Low	Low
Modal	Medium	Medium	High
HST	Medium	Medium	High
Los Angeles to San Diego via Orange County			
No Project	Low	Low	Low
Modal	Medium	Medium	High
HST	High	High	High

3.12.4 Comparison of Alternatives by Region

This section compares the potential effects or impacts to cultural and paleontological resources predicted for the program alternative options in each of the five regions, based on available information. At this level of analysis, the extent and types of effects or impacts on specific cultural and paleontological resources are not known, instead this comparison presents the likelihood for these alternatives to cause effects or impacts that would meet criteria for significance under NEPA/NHPA and CEQA.

A. BAY AREA TO MERCED

Modal Alternative

The total number of archaeological sites that could be potentially impacted by the Modal Alternative in this region is 47. The northern portion of the Modal Alternative route from San Francisco/Oakland to San Jose has a medium ranking for archaeological sensitivity, while the southern portion from San Jose to Merced is ranked as low.

Sixty percent of the areas along the Modal Alternative route in this region developed during the historic period are within the potentially affected area resulting in an overall rank of medium sensitivity for historic properties/resources. The greatest number of historic buildings in or near the APE for the Modal Alternative is found between San Francisco/Oakland and San Jose, where 100% of this area was developed during the historic period, however, the ranking for the Modal Alternative in the entire Bay Area to Merced region is medium.

The Modal Alternative has the potential to affect an estimated 81 to 93 mi (130 to 150 km) of highly sensitive geologic units within the study area. As such, this receives a high sensitivity rank concerning paleontological resources.

High-Speed Train Alternative

The total number of archaeological sites for the HST Alternative ranges from 16 (for the Oakland to San Jose via Hayward Line and the Diablo Range Direct corridors) to 35 (for the San Francisco to San Jose and Diablo Range Direct corridors). For archaeological resources, the No Project, Modal, and HST Alternatives are all ranked as medium, although the HST Alternative has a somewhat greater potential for impacts.

One hundred percent of both the Oakland to San Jose study area and the San Francisco to San Jose study area developed during the historic period and these segments of the HST alternative in the Bay Area to Merced region have a high ranking for adverse effects or impacts. This high potential for adverse effect or impact could be reduced to medium if HST construction could be confined to the existing rail corridor and grade-separation impacts were minimized, particularly in the areas of the downtown Oakland Historic District, the Oakland Waterfront Warehouse District, the Redwood City Historic District, the Agnews Insane Asylum Historic District, the Santa Clara Station Historic District, and the Cahill (Diridon) Station Historic District in San Jose. The outlying segments of the HST alternatives in the Bay Area to Merced region are ranked medium for historic properties/resources, as are the No Project and Modal Alternatives.

An estimated 28 mi (45 km) of geologic units identified as highly sensitive for paleontological resources have been identified for the HST Alternative. For opaleontological resources, this correlates to a medium sensitivity.

High-Speed Train Alignment Options Comparison

All segments of the HST Alternative in this region, except the two Pacheco Pass alignment options, have a medium sensitivity for archaeological resources. The two Pacheco Pass options are ranked as low. For the San Jose to Merced portion of the study area, there is a slight difference between the Pacheco Pass routes (14%) and the Diablo Range direct routes (9%). The greatest numbers of archaeological sites occur along the two Diablo Range tunnel alignments (more than 20 each).

Both alignment options from San Jose to Merced via Pacheco Pass are ranked high for potential impacts on historic structures, whereas the alignment options using the three Diablo Range direct alignments area ranked low. Selection of the Diablo Range direct options would reduce potential impacts on historic structures.

For the HST alignment options, the key differences for paleontological resources are between the Pacheco Pass options, which would cross about 11 mi (18 km) of high-sensitivity rock units and 13 mi (21 km) of moderate-sensitivity units, compared to the Diablo Range Direct options, which would cross about 2 mi (3 km) of high-sensitivity rock units and 14 mi (23 km) of moderate-sensitivity units.

B. SACRAMENTO TO BAKERSFIELD

Modal Alternative

There are 85 archaeological sites in the study area for the Modal Alternative (50 prehistoric sites and 31 historic sites). Most sites are in the Sacramento to Stockton corridor (27) and the Tulare to Bakersfield corridor (30). Under the Modal Alternative, most sites are along SR-99, with relatively few sites along I-5. The SR-99 alignment under the Modal Alternative has the highest potential to impact archaeological resources, while the I-5 corridor is ranked low, with the lowest number of sites. The overall archaeological sensitivity ranking for the Modal Alternative is medium.

More than 50% of the length of the SR-99 Sacramento to Stockton, Modesto to Merced, and Merced to Madera segments was developed during the historic period. As a result, the Modal Alternative has a medium potential to impact historic structures.

The Modal Alternative has a high potential to impact paleontological resources.

High-Speed Train Alternative

The number of archaeological sites potentially affected by the HST Alternative varies greatly, ranging from 55 to 225, depending on which alignments are chosen. In general, the HST alignments that have fewer archaeological sites are those that bypass the urban cores to the extent possible and follow the BNSF corridor. The APEs for the UPRR alignments that go through the urban cores have the most archaeological sites. For example, between Modesto and Merced, the alignments that follow the UPRR corridor and go to the Merced Downtown Station each have the potential to affect more than 100 sites. The alignments that follow the BNSF corridor to the Merced Municipal Airport each have the potential to affect only one site. The minimum and maximum number of sites for the other corridors are not as high or low; they range from 17 to 32 for Sacramento to Stockton, 18 to 19 for Stockton to Modesto, three to 14 for Merced to Fresno, and 12 to 40 for Tulare to Bakersfield. Overall, the HST has a medium potential to impact archaeological resources.

Though the degree to which the areas along the HST alignment options developed during historic periods varies greatly, the HST Alternative has a high potential to effect or impact historic properties/resources because all routes pass through station locations in historic urban cores, although there are lower-ranked alternatives for most of the alignments between stations. Examples include historic properties/resources in the area of the downtown Sacramento Valley Station, which is the oldest area of the city, and the segment from Sacramento to Stockton with five known historic sites, two preservation areas, and one State Historic Landmark. The percentage of the route length with the potential to contain historic structures ranges from 20% to 37%. In urban cores, however, the route percentages of historic properties/resources would be nearly 100%. Thus, the UPRR alignments that traverse the urban cores would potentially cause the greatest number of impacts to historic properties/resources. For example, the area around the following stations are almost entirely of historic age: the Downtown Sacramento Valley Station, Stockton ACE Downtown Station, Modesto Downtown Station, Fresno Downtown Station, Hanford Station, and Truxtun Station in Bakersfield. The UPRR route would go through Elk Grove and Galt, two towns established in the mid-1800s.

The HST Alternative has a medium potential to impact paleontological resources.

High-Speed Train Alignment Options Comparison

The potential impact of the HST Alternative on archaeological resources varies greatly, depending on the alignments chosen. The segments between Modesto and Merced have a high potential to affect archaeological resources, with about two-thirds of the more than 150 recorded historical sites that lie along the corridor concentrated in two areas: along a portion of the UPRR Line between Keyes and Atwater, and at the former Castle Air Force Base. The potential for effects or impacts to historic properties is somewhat greater along the UPRR route because of the towns dating to the 1870s. Similarly, from Fresno to Tulare, the UPRR corridor would have the greatest number of historic structures per mile, over the BNSF alignment options. In general, the alignments that would have fewer historic structures are those that follow the BNSF corridor and bypass urban cores.

C. BAKERSFIELD TO LOS ANGELES

Modal Alternative

Overall, the Modal Alternative for this region has a medium potential for impacting archaeological sites, with 49 archaeological sites recorded along this alignment. Most sites are in the I-5 corridor between SR-99 and SR-14 (18 sites) and in the SR-14 corridor between Palmdale and I-5 (30 sites). There is a high potential for as-yet-unidentified buried sites from the historic period (which may also be of concern to Native Americans) in the Tejon area south of the Grapevine along I-5 between SR-99 and SR-14. In this area, the Sebastian (Tejon) Indian Reservation is

California Historical Landmark #133 and the Rose Stage Station is California Historical Landmark #300. In addition, Fort Tejon State Historic Park and the Tejon Ranch headquarters are located in this area.

For the Modal Alternative, the route following I-5 between Bakersfield and Santa Clarita has a medium potential to impact archaeological sites, while the route through the Antelope Valley (SR-58/SR-14) has a low potential impact on archaeological sites. The remainder of the I-5 corridor from Santa Clarita to LAUS has a high potential for impacts on archaeological sites.

Half of the Modal Alternative segments are in areas that developed in the historic period, (prior to 1958). These include I-5 from I-405 to Burbank, I-5 from Burbank to LAUS, and SR-58 and SR-14 between Bakersfield and Palmdale. The area around Burbank Airport was almost completely developed during the historic period. The Modal Alternative has a low to medium ranking for potential to effect or impact historic properties/resources in this region. Though sensitivity varies greatly within this study area, the overall level of potential impacts is considered medium.

The Modal Alternative would also impact paleontological resources because existing highways traverse 30 formations with high paleontologic sensitivity, resulting in an overall high-sensitivity ranking.

<u>High-Speed Train Alternative</u>

The HST Alternative for this region receives a high-sensitivity rank for potential effects to archaeological resources and historic-era structures (Table 3.12.1). The sensitivity of subsegments, however, differs considerably. For the HST Alternative, there are two corridors under consideration between Bakersfield and Sylmar in the northern San Fernando Valley: the I-5 corridor and the SR-58–Antelope Valley–Soledad Canyon corridor. There are 17 recorded archaeological sites in the study area for the I-5 corridor using the Union Avenue corridor from Bakersfield to I-5 and 16 sites using the Wheeler Ridge corridor from Bakersfield to I-5. One prehistoric site reported to contain human burials is recorded within the Union Avenue study area. The Tehachapi Crossing portion of the I-5 corridor passes through the Tejon area discussed under the Modal Alternative.

The HST corridor that passes through the Antelope Valley has the potential to affect 68 recorded archaeological sites. The majority of the sites in the SR-58 corridor and the Soledad Canyon corridor are prehistoric. A burial was reported at one of the sites in the Soledad Canyon corridor. Most sites in the Antelope Valley corridor are historic trash scatters along the railroad.

The HST alignments between Sylmar and LAUS have no known archaeological sites because most of this area was not surveyed prior to development. The area developed prior to 1971 before systematic archaeological surveys began to be required. However, impacts are likely. There is a high potential for buried prehistoric sites in this area, especially along the Los Angeles River. There is also a high potential for buried historic sites in the vicinity of LAUS, located in the historic core of Los Angeles, because archaeological material from the nineteenth-century occupation of the area by Hispanic Americans, Chinese Americans, and Anglo Americans has been recovered.

More than 70% of the following HST Alternative alignments had begun development by 1958: Burbank Airport to downtown Burbank, the Burbank Airport Station and Downtown Burbank Station, the MTA/Metrolink route from downtown Burbank to LAUS, and the I-5 route from downtown Burbank to LAUS (cut and cover at Silverlake option). LAUS is listed in the NRHP.

High-Speed Train Alignment Options Comparison
The HST alignment from Bakersfield to Sylmar via the I-5/Grapevine has a low potential to impact archaeological sites, while the Antelope Valley alignment option has a high potential to impact archaeological sites, including recorded trash scatters from historic period along rail corridors.

For the HST Alternative, the alignment options from Bakersfield to Sylmar via the Grapevine have a medium to high potential for effects or impacts on historic properties/resources, whereas the Antelope Valley alignment option has a low to medium potential for such impacts. Both alignment options leading into the LAUS have a high potential to affect or impact historic properties/resources because of the historic area surrounding the station.

The HST alignment options with the lowest potential impact on paleontological resources would be the I-5/Grapevine south of Bakersfield, using the Union Avenue corridor, and the Metrolink/I-5 aerial alignment option into LAUS. The I-5/Grapevine south of Bakersfield, using the Wheeler Ridge alignment and or the SR-58 and SR-14 corridors through the Antelope Valley with an at-grade cut would have greater potential impacts on paleontological resources.

D. LOS ANGELES TO SAN DIEGO VIA INLAND EMPIRE

Modal Alternative
The Modal Alternative has the potential to affect 85 recorded sites in this region; 44 of these are in the March ARB to Mira Mesa corridor. From March ARB to Mira Mesa, all alignments and corridors are ranked as having high potential impacts. From Mira Mesa to San Diego, the Modal Alternative is ranked as having medium potential impacts.

There are many commercial and residential properties/resources that date to the periods between1900 to 1929 and 1930 to 1958 along the rail routes between Los Angeles and Ontario. There are relatively few historic properties/resources along the rest of the Modal Alternative alignment; only 16% of the study area developed during the historic period. The overall potential impact ranking concerning historic structures for this region is medium.

The mountainous terrain just south of Temecula is considered to contain important traditional tribal cultural areas. The Pechanga Band of Luiseno Indians has expressed particular concern that the project not effect traditional cultural properties in the vicinity of Temecula.

For peleontological resources within this region, the potential level of effects is high for the Modal Alternative.

High-Speed Train Alternative
The HST Alternative for this region receives a medium rank for potential effects to archaeological resources, having the potential to affect between 125 and 136 recorded archaeological sites, depending on the alignments used and excluding the spur from Mira Mesa to Qualcomm Stadium. For the corridor from LAUS to March ARB, there are between 18 and 25 recorded sites. For the corridor from March ARB to Mira Mesa, there are either 60 or 62 recorded sites, depending on which route through Escondido is used. From Mira Mesa to San Diego, there are 47 or 49 recorded sites, depending on which alignment between Mira Mesa and the Transit Center is used. There are five recorded sites in the corridor from Mira Mesa to Qualcomm Stadium.

The average historically developed area along the HST alignments between LAUS and March ARB is 27.5%, with the highest being the UPRR Colton Line via San Bernardino (33%), and the lowest the UPRR Riverside Line–UPRR Colton Line (21%). The average historically developed area along the HST alignments between March ARB and Mira Mesa is 0.3% due to the rural characteristics of this area. For Mira Mesa to San Diego, the two alignments each average about 21% of the study area built during the historic period. None of the spur from I-15 to Qualcomm Stadium developed during the historic period. Over 95% of the area around the San Diego Station at the Santa Fe Depot was developed during the historic period, and the station structure is listed in the NRHP. The overall potential impact to historic structures for this region is considered medium-ranked.

The mountainous terrain just south of Temecula is considered to contain important traditional tribal cultural areas. The Pechanga Band of Luiseno Indians has expressed particular concern that the project not affect traditional cultural properties in the vicinity of Temecula.

While both the Modal and HST Alternatives potential impacts on historic structures is calculated as medium, the HST alignment is nearly twice the length as the Modal Alternative.

For paleontological resources in this region, the HST Alternative, like the Modal Alternative, would have similar potential impacts on Pliocene-Pleistocene nonmarine sedimentary rock units and Quatenary Dune Sand.

<u>High-Speed Train Alignment Options Comparison</u>

The segment between March ARB and Mira Mesa has the highest potential to impact archaeological resources. The segment from LAUS to El Monte passes directly adjacent to San Gabriel Mission, where there are recorded archaeological sites dating to the late eitheenth and nineteenth centuries and high potential for encountering additional buried archaeological material from the historic period. The two HST alignment options (I-15 to Coast via Miramar Road and I-15 to Coast via Carroll Canyon) are ranked as having high potential impacts.

For this region, the UPRR Colton Line via San Bernardino would have the highest potential to impact historic properties.

E. LOS ANGELES TO SAN DIEGO VIA ORANGE COUNTY

<u>Modal Alternative</u>

The Modal Alternative would have potential impacts on 108 recorded archaeological sites in this region, resulting in a medium sensitivity ranking. However, all of the recorded sites are south of Irvine Station. This is due to lack of archaeological surveys north of Irvine Station prior to development of the area; as mentioned above, there were few systematic archaeological surveys until the passage of CEQA in 1971. More than 70% of the portion of the Modal Alternative between LAUS and Irvine and between SR-52 and Santa Fe Depot developed during the historic period, prior to 1958.More than 70% of the portion of the Modal Alternative between LAUS and Irvine and between SR-52 and Santa Fe Depot developed during the historic period. This Alternative, therefore, has a high ranking for potential to effect or impact historic properties/resources and known historic properties/resources are located within the APE.

<u>High-Speed Train Alternative</u>

There are three recorded archaeological sites between LAUS and Anaheim (UPRR corridor) and 21 sites between LAUS and Irvine following the LOSSAN (BNSF) corridor. The spur from LAUS to LAX has seven recorded sites.

The HST alignment option from LAUS to Anaheim via the UPRR ranks low for recorded archaeological sites.

For the HST alignments, 52% of the area between LAUS and Anaheim (UPRR corridor) and 78% of the area between LAUS and Irvine following the LOSSAN (BNSF) corridor developed during the historic period. Fifty-eight percent of the area along the spur from LAUS to LAX developed historically. The HST Alternative between LAUS and Irvine has a high potential to result in effects and impacts on historic properties/resources because much of the area developed during the historic period and historic properties/resources remain along the corridor.

Over 95% of the area around the San Diego Station at the Santa Fe Depot was developed during the historic period, and the building is listed in the NRHP.

3.12.5 Design Practices

The Authority and FRA are committed to avoiding potential impacts to cultural resources through careful alignment design and selection. The Authority is committed to avoiding impacts to Native American resources to the extent feasible and practical.

The Authority will develop procedures for fieldwork, identification, evaluation, and determination of potential effects to cultural resources in consultation with SHP and Native American Tribes. On-site monitoring is often incorporated in the fieldwork when sites are known or suspected of containing native American human remains. The procedures need to comply with federal and state statutes concerning burials.

3.12.6 Mitigation Strategies and CEQA Significance Conclusions

Based on the analysis above, and considering the CEQA Appendix G thresholds of significance for cultural and historic resources, the proposed HST system alternative would have a potentially significant effect on cultural and historic resources when viewed on a systemwide basis. Although placing the conceptual corridors for the HST system alternative within or along existing transportation corridors reduces the potential for adverse effects to many resources, providing HST service to and locating potential stations sites in metropolitan centers increases the potential for adverse impacts to cultural and historic resources. Additional avoidance and mitigation strategies will be applied in the second-tier, project-level analyses. However, some cultural and historic resources will be adversely affected should a decision be made to proceed with the development of the HST system. At the programmatic level of analysis, it is not possible to know precisely the location, extent and particular characteristics of impacts to these resources. Because of this uncertainty, at the programmatic level of analysis the impact is considered significant. Mitigation strategies, as well as the design practices discussed in section 3.12.7, will be applied to reduce these impacts.

General mitigation strategies are discussed in this section as part of this programmatic evaluation. Should the HST Alternative be carried forward, the Authority and FRA would consult with SHPO to define and describe general procedures to be applied in the future for fieldwork, methods of analysis, and the development of specific mitigation measures to address effect and impacts on cultural resources, which could be reflected in a programmatic agreement between the Authority, FRA and SHPO. The Authority and FRA would also continue to consult with Native American tribes concerning the proposed undertaking, as required by federal and state laws concerning the management of historic properties (federal)/historical resources (state). Mitigation measures would be required for adverse effects (significant under CEQA) on cultural resources that are listed, determined eligible for, or that appear to be eligible for listing in the NRHP or CRHR. The mitigation measures ultimately selected for this undertaking will meet the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716-44740), as well as standards and guidelines for historic preservation activities established by the California SHPO.

At the conclusion of the programmatic environmental review process, the Authority and the FRA, in consultation with the SHPO, would develop a programmatic memorandum of agreement (PA) to describe expectations for the next phase of fieldwork, eligibility determination, and documentation under Section 106 of NHPA and pursuant to CEQA. The PA may specify procedures for the identification and evaluation of impacts for future projects and the site-specific work that would be required during project-level environmental review.

These potential measures provide two levels of mitigation and are organized by resource type. One level of mitigation are those that, when implemented as conditions of project approval, would enable the project to avoid an adverse effect or impact. The other level of mitigation includes measures that would lessen the degree of adverse effect/impact. No one measure presented in this section would mitigate all adverse effects or impacts, however, some combination of these measures and others negotiated during the project phases of the program will emerge as the agreed upon mitigation for this project.

In general, there is a wide range of actions that can qualify as mitigation, depending on the type of project, the type of property, and impacts the project may have on cultural resources. The following list presents some of the principles that generally guide mitigation development in historic preservation practice.[9]

- Mitigation measures should correspond or be related directly with the resource being affected, rather than in a compensatory fashion that does not relate to the affected resource;
- Mitigation should be consistent with the significance of the historic property and correspond to the severity of project effects on the historic property;
- Mitigation must be relevant to the goals of historic preservation, rather than as an enhancement of the project to which it is related or as enhancement to amenities unrelated to the affected properties;
- Mitigation measures that are chosen should be a worthwhile use of public funds and provide a high degree of public benefit relative to the cost;
- Mitigation measures should benefit the greatest number of people, particularly those members of the interested public rather than only those of a specialized audience or particular group;
- Historic properties that will be demolished or greatly altered should be documented in permanent forms.

A. ARCHAEOLOGICAL RESOURCES

The following are potential mitigation measures for eligible or listed archaeological sites:

- Consider avoidance of impact, and when avoidance cannot be accommodated, consider minimizing the scale of impact..
- Incorporate the site into parks or open space (P.R.C. § 21083.2).
- Cap or cover the site before construction.
- Provide data recovery.
- Develop procedures for fieldwork, identification, evaluation, and determination of potential effects to cultural resources in consultation with SHPO and Native American tribes. On-site monitoring is often incorporated in the fieldwork when sites are known or suspected of containing Native American human remains. The procedures need to comply with federal and state statutes concerning burials.

[9] These factors are based on those presented in: Caltrans, "San Francisco-Oakland Bay Bridge East Span Seismic Safety Project, Consideration of Proposed Mitigation Measures," September 1999.

Avoidance is preferred, but if adjustments to the alignment plan or profile are not feasible, data recovery may be provided. When impacts will destroy or affect the data potential of a property (NRHP Criterion D/CRHR Criterion 4), data recovery may consist of archaeological excavation of an adequate sample of site contents so that the research questions applicable to the site can be addressed. Recovery of important information from the site mitigates the information loss that would result from site destruction. If only part of a site were impacted by the project, data recovery would only be necessary for that portion of the site. Data recovery would not be required if the agency determines prior testing and studies had adequately recovered the scientifically consequential information from the resources (CEQA Guidelines, 14 C.C.R. § 15126.4[b]).

When other NRHP or CRHR criteria are relevant (e.g., Criterion A/1; Criterion B/2; Criterion C/3) or when a Traditional Cultural Property is involved, it is often necessary to consider more diverse mitigation measures.

B. HISTORIC PROPERTIES/RESOURCES

Measures to avoid adverse effects would include steps taken in both the design and construction phases of the project. Avoidance has occurred and would occur during the design phase by not including components that could possibly effect or impact historic properties/resources. Avoidance would also occur by conducting construction activities to actively evade historic properties/resources.

The following are potential mitigation measures for historic properties/resources Measures to avoid Adverse Effects:

Stabilization/Monitoring During Construction. The lead agency would prepare a treatment plan that would present a detailed methodology for the protection of historic properties/resources, such as buildings, structures, objects, and sites, and cultural landscape elements that are in close proximity to construction activities. This treatment plan would describe methods for the preservation, stabilization, shoring / underpinning, and monitoring of buildings, structures, and objects. The treatment plan would also include provisions that high vibration construction techniques would be avoided in sensitive areas. Underpinning and/or other stabilization methods could be used at buildings located near project construction areas and that may be susceptible to damage or inadvertent destruction.

Measures to Lessen Adverse Effects. Measures to minimize project impacts to historic properties/resources would occur in pre-construction, construction, and post-construction phases. Many of these mitigation measures would require careful agency review and may require stipulations in the contracts of the construction contractors to ensure appropriate preservation of cultural resources.

Recordation. The lead agency would ensure that cultural resources adversely affected by the project would be recorded and documented to the standards of the Historic American Building Survey (HABS) or Historic American Engineering Record (HAER). This would require coordination with the NPS HABS / HAER program to determine the appropriate level of recordation. This coordination would also address the adequacy of recordation previously conducted for historic properties/resources that may be adversely affected.

Design Guidelines. The lead agency would ensure that design guidelines would be developed to ensure sympathetic, compatible, and appropriate designs for new construction. Aesthetic details can be considered mitigation, but there may be a limit to the amount of change possible in the design once important engineering and environmental considerations have been taken into account. It is most likely that the design guidelines mitigation would apply to the visual appearance of the project, rather than specifics of alignment, overall depth / width, or placement of supports. Design guidelines could be informed by the documentation prepared under HABS/HAER standards. It would be necessary for an architectural historian or a historical architect to advise the structural designers on appropriate architectural treatments that could serve as mitigation. SHPO and other agencies would review draft design guidelines and provide comment on the guidelines as well as on proposed design changes.

Interpretive / Educational Materials and Popular Report. The lead agency could prepare interpretive and/or educational materials and programs regarding the affected historic properties/resources. The focus of this mitigation would be the historic themes related to these resources. Such materials and/or programs could include: a popular report; documentary videos, booklets, interpretive signage, additional interpretive information made available to state and local agencies. These materials could also include salvage items, historic drawings, interpretive drawings, current and historic photographs, models, and oral histories. Assistance could also be provided for archiving or digitizing the documentation of cultural resources affected, as well as for the dissemination of the material to appropriate repositories.

Relocation. Historic properties/resources that would be otherwise demolished because of the project could be relocated and rehabilitated. The lead agency would ensure that these buildings or structures were recorded to HABS standards prior to their removal and in consultation with NPS. The lead agency / project proponent would prepare a removal plan, including site plans for the new locations and placing them on new foundations and to conditions consistent with those that existed prior to the move.

Monitoring (Architectural / Cultural Landscape). The project construction documents and new construction would be monitored to ensure they conform to the design guidelines and any other treatment procedures agreed to by the consulting parties. A professional architectural historian and a professional historical landscape architect, who meet the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738-9), would monitor construction to identify conditions that could conflict with the mitigation measures. The lead agency would take steps to correct these conflicts.

Minor Repairs and Reconstruction. The lead agency would ensure that inadvertent damage to historic properties/resources would be repaired in accordance with the Secretary of the Interior's Standards for Treatment of Historic Properties.

Salvage. The lead agency would ensure that selected decorative or architectural elements of the adversely affect historic properties/resources would be reviewed for feasibility of salvage in order to mitigate their loss or destruction. Where possible, these elements would be retained and incorporated into the new construction. Where re-use was not possible, selected salvaged elements could be made available for use in interpretive displays either near the affected resources or at an appropriate museum, for example.

C. PALEONTOLOGICAL RESOURCES

Mitigation measures for paleontological resources would be developed and implemented at the project level. The following measures may be included.

- Educate workers.
- Recover fossils identified during the field reconnaissance.
- Monitor construction.
- Develop protocols for handling fossils discovered during construction, likely including temporary diversion of construction equipment so that the fossils could be recovered; identified; and

prepared for dating, interpreting, and preserving at an established, permanent, accredited research facility.

The above mitigation strategies, including implementation of a programmatic agreement addressing historic resources and continued consultation and coordination with tribal representatives, are expected to substantially lessen or avoid impacts to cultural and historic resources in most circumstances. At the second-tier, project-level review it is expected that for proposed HST alignments which would result in impacts to cultural and historic resources, most of the impacts will be mitigated to a less-than-significant level, but it is possible that for some impacts will be significant. Sufficient information is not available at the program level to conclude with certainty that the above mitigation strategies will reduce impacts to affected resources to a less than significant effect in all circumstances. Therefore, potential impacts to cultural and historic resources are considered significant at the program level even with the application of mitigation strategies. Additional environmental assessment will allow more precise evaluation in the second-tier, project-level environmental analyses.

3.12.7 Subsequent Analysis

The following paragraphs describe the procedures that would be necessary at the next stage of environmental review (a Tier-2 study) to determine appropriate and feasible mitigation measures in consultation with the SHPO, if a decision is ultimately made to go forward with the proposed HST system. These procedures would satisfy the NHPA and also satisfy CEQA requirements.

As allowed under 36 C.F.R. § 800.4(b)(2), a phased approach to identification of historic properties can be used when the proposed undertaking involves corridors. As indicated by the results of this study, FRA and the Authority have determined that historic properties likely exist in various corridor segments, through background research, consultation, and abbreviated field reconnaissance. Once alternatives have been refined, full identification efforts may proceed. Under NHPA Section 106 and implementing regulations (36 C.F.R. § 800), the procedures would include identifying resources with the potential to be affected; evaluating their significance under NRHP and CEQA; and identifying any substantial adverse effects, and then evaluating potential mitigation.

In the interest of identifying archaeological sites within the APE, a field survey of the APE should be completed which will identify those sites evident on the surface, geomorphological maps and studies should be reviewed to assess the potential for corridor segments to contain significant buried sites, and historic maps and an historic overview or context should be developed in the interest of identifying potential historical archaeology sites within the APE.

Additional efforts must also be made to consult with appropriate Tribes and individuals knowledgeable about the nature and locations of potential traditional cultural properties.

Identifying potentially affected archaeological and historical properties/resources would require identification and evaluation within a more specifically defined APE that would include the area where direct and indirect impacts from construction could occur (including locations of easements and construction-related facilities, such as equipment staging areas, borrow and disposal areas, access roads, and utilities) and the area(s) where the settings of any eligible historic buildings and structures, or the buildings and structures themselves, could be materially or significantly altered.

All identified resources would then be evaluated using NRHP and CRHR eligibility criteria. Evaluating archaeological sites may require preparing test plans for archaeological resources that contain regionally relevant research questions. The Authority and the FRA would consult with the SHPO on any test plans and determinations of eligibility for evaluated resources. The impacts of a proposed specific project on resources determined eligible would be analyzed. An impact analysis report may then be reviewed with the SHPO. Mitigation measures needed to address impacts on specific resources could then be developed and incorporated in an MOA between the SHPO, the Advisory Council on Historic Preservation, the FRA, and the Authority during the preparation of project-specific environmental evaluation. The mitigation measures in the MOA would then be incorporated into project-specific environmental documentation and project approvals.

A paleontological resource assessment program would also be completed as part of the subsequent analysis for a project-level EIR/EIS. The assessment program would include field reconnaissance to identify exposed paleontological resources and more precisely determine potential paleontologic sensitivity for the project. A paleontological resources treatment plan would be prepared by a qualified paleontologist. The plan would be included in project approval and would address the treatment of paleontological resources discovered prior to and during construction.

Further consultation would also occur at the project level with the Native American Heritage Commission as necessary, and with Native American groups when traditional territories may be close to APEs for the project. Additionally, more specific information related to traditional cultural sites of concern would be obtained as necessary.