CALIFORNIA HIGH-SPEED TRAIN

Program Environmental Impact Report/Environmental Impact Statement

Los Angeles to San Diego via Inland Empire

NOISE & VIBRATION TECHNICAL EVALUATION

January 2004

Prepared for:

California High-Speed Rail Authority

U.S. Department of Transportation
Federal Railroad Administration

CALIFORNIA HIGH SPEED RAIL AUTHORITY

U.S. Department of Transportation
Federal Railroad Administration

CALIFORNIA HIGH-SPEED TRAIN PROGRAM EIR/EIS

Inland Empire
Noise & Vibration
Technical Evaluation

Prepared by:

Wilson, Ihrig & Associates, Inc.

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ACRONYMS

AUTHORITY	CALIFORNIA HIGH-SPEED RAIL
CEQA	CALIFORNIA ENVIRONMENTAL QUALITY ACT
COG	COUNCIL OF GOVERNMENTS
EIR	ENVIRONMENTAL IMPACT REPORT
EIS	ENVIRONMENTAL IMPACT STATEMENT
EPA	ENVIRONMENTAL PROTECTION AGENCY
FAA	FEDERAL AVIATION ADMINISTRATION
FHWA	FEDERAL HIGHWAY ADMINISTRATION
FRA	FEDERAL RAILROAD ADMINISTRATION
FTA	FEDERAL TRANSIT ADMINISTRATION
GIS	GEOGRAPHIC INFORMATION SYSTEM
HSR	HIGH SPEED RAIL
HST	HIGH SPEED TRAINS
HUD	DEPARTMENT OF HOUSING & URBAN DEVELOPMENT
IM	IMPACT METRIC
IR	IMPACT RATING
MTA	METROPOLITAN TRANSPORTATION AUTHORITY
MU	MIXED USE (COMMERCIAL AND RESIDENTIAL LAND USE)
NEPA	NATIONAL ENVIRONMENTAL POLICY ACT
RTP	REGIONAL TRANSPORTATION PLAN
TNM	TRAFFIC NOISE MODEL
USACE	U.S. CORPS OF ENGINEERS
USFWS	U.S. FISH AND WILDLIFE SERVICE

1.0 INTRODUCTION

The California High-Speed Rail Authority (Authority) was created by the Legislature in 1996 to develop a plan for the construction, operation, and financing of a statewide, intercity high-speed passenger train system.[1] After completing a number of initial studies over the past six years to assess the feasibility of a high-speed train system in California and to evaluate the potential ridership for a variety of alternative corridors and station areas, the Authority recommended the evaluation of a proposed high-speed train system as the logical next step in the development of California's transportation infrastructure. The Authority does not have responsibility for other intercity transportation systems or facilities, such as expanded highways, or improvements to airports or passenger rail or transit used for intercity trips.

The Authority adopted a *Final Business Plan* in June 2000, which reviewed the economic feasibility of a 1,127-kilometer-long (700-mile-long) high-speed train system. This system would be capable of speeds in excess of 321.8 kilometers per hour (200 miles per hour [mph]) on a dedicated, fully grade-separated track with state-of-the-art safety, signaling, and automated train control systems. The system described would connect and serve the major metropolitan areas of California, extending from Sacramento and the San Francisco Bay Area, through the Central Valley, to Los Angeles and San Diego. The high-speed train system is projected to carry a minimum of 42 million passengers annually (32 million intercity trips and 10 million commuter trips) by the year 2020.

Following the adoption of the Business Plan, the appropriate next step for the Authority to take in the pursuit of a high-speed train system is to satisfy the environmental review process required by federal and state laws which will in turn enable public agencies to select and approve a high speed rail system, define mitigation strategies, obtain necessary approvals, and obtain financial assistance necessary to implement a high speed rail system. For example, the Federal Railroad Administration (FRA) may be requested by the Authority to issue a *Rule of Particular Applicability*, which establishes safety standards for the high-speed train system for speeds over 200 mph, and for the potential shared use of rail corridors.

The Authority is both the project sponsor and the lead agency for purposes of the California Environmental Quality Act (CEQA) requirements. The Authority has determined that a Program Environmental Impact Report (EIR) is the appropriate CEQA document for the project at this conceptual stage of planning and decision-making, which would include selecting a preferred corridor and station locations for future right-of-way preservation and identifying potential phasing options. No permits are being sought for this phase of environmental review. Later stages of project development would include project-specific detailed environmental documents to assess the impacts of the alternative alignments and stations in those segments of the system that are ready for implementation.

The decisions of federal agencies, particularly the Federal Railroad Administration (FRA) related to high-speed train systems, would constitute major federal actions regarding environmental review under the National Environmental Policy Act (NEPA). NEPA requires federal agencies to prepare an Environmental Impact Statement (EIS) if the proposed action has the potential to cause significant environmental impacts. The proposed action in California warrants the preparation of a Tier 1 Program-level EIS under NEPA, due to the nature and scope of the comprehensive high-speed train system proposed by the Authority, the need to narrow the range of alternatives, and the need to protect/preserve right-of-way in the future. FRA is the federal lead agency for the preparation of the Program EIS, and the Federal Highway Administration (FHWA), the U.S. Environmental Protection Agency (EPA), the U.S. Corps of Engineers (USACE), the Federal Aviation Administration (FAA), the U.S. Fish and Wildlife Service (USFWS), and the Federal Transit Administration (FTA) are cooperating federal agencies for the EIS.

[1] Chapter 796 of the Statutes of 1996; SB 1420, Kopp and Costa

A combined Program EIR/EIS is to be prepared under the supervision and direction of the FRA and the Authority in conjunction with the federal cooperating agencies. It is intended that other federal, state, regional, and local agencies will use the Program EIR/EIS in reviewing the proposed program and developing feasible and practicable programmatic mitigation strategies and analysis expectations for the Tier 2 detailed environmental review process which would be expected to follow any approval of a high speed train system.

The statewide high-speed train system has been divided into five regions for study: Bay Area-Merced, Sacramento-Bakersfield, Bakersfield-Los Angeles, Los Angeles-San Diego via the Inland Empire, and Los Angeles-Orange County-San Diego. This Noise and Vibration Technical Evaluation for the Inland Empire Corridor is one of five such reports being prepared for each of the regions on the topic, and it is one of fifteen technical reports for this region. This report will be summarized in the Program EIR/EIS and it will be part of the administrative record supporting the environmental review of alternatives.

1.1 ALTERNATIVES

1.1.1. No-Project Alternative

The No-Project Alternative serves as the baseline for comparison of the Modal and High-Speed Train Alternatives. The No-Project Alternative represents the state's transportation system (highway, air, and conventional rail) as it existed in 1999-2000, and as it would be after completion of programs or projects currently programmed for implementation and projects with funding expected by 2020 (Figure 1). The No-Project Alternative addresses the geographic area serving the same intercity travel market as the proposed high-speed train (generally from Sacramento and the San Francisco Bay Area, through the Central Valley, to Los Angeles and San Diego). The No-Project Alternative satisfies the statutory requirements under CEQA and NEPA for an alternative that does not include any new action or project beyond what is already committed.

The No-Project Alternative defines the existing and future statewide intercity transportation system based on programmed and funded (already in funded programs/financially constrained plans) improvements to the intercity transportation system through 2020, according to the following sources of information:

- State Transportation Improvement Program (STIP)
- Regional Transportation Plans (RTPs) for all modes of travel
- Airport plans
- Intercity passenger rail plans (California Rail Plan 2001-2010, Amtrak Five- and Twenty-year Plans)

As with all of the alternatives, the No-Project Alternative will be assessed against the purpose and need topics/objectives for congestion, safety, air pollution, reliability, and travel times.

Figure 1
No-Project Alternative – California Transportation System (Present to 2020)

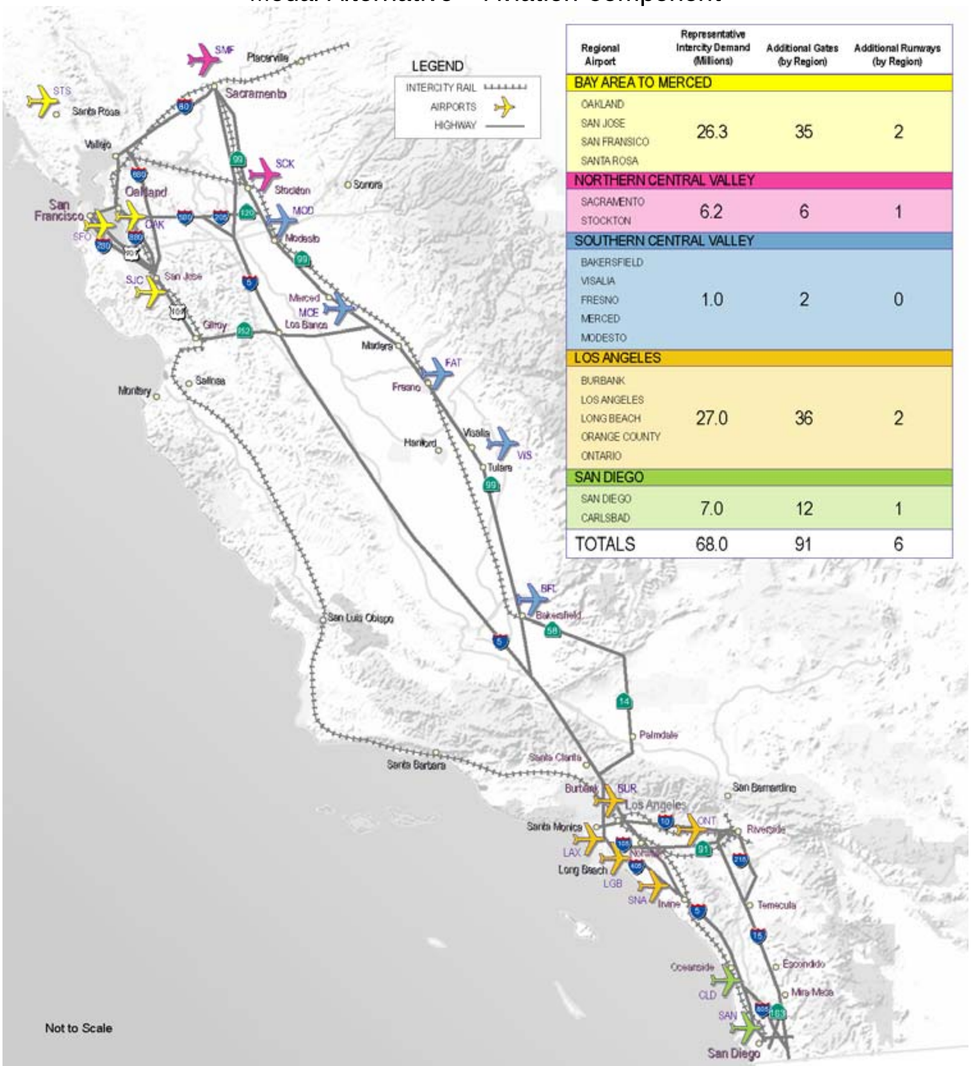
1.1.2 Modal Alternative

There are currently only three main options for intercity travel between the major urban areas of San Diego, Los Angeles, the Central Valley, San Jose, Oakland/San Francisco, and Sacramento: vehicles on the interstate highway system and state highways, commercial airlines serving airports between San Diego and Sacramento and the Bay Area, and conventional passenger trains (Amtrak, etc.) on freight and/or commuter rail tracks. The Modal Alternative consists of expansion of highways (Figure 2), airports (Figure 3), and intercity and commuter rail systems serving the markets identified for the High-Speed

Train Alternative. The Modal Alternative uses the same inter-city travel demand (not capacity) assumed under the high-end sensitivity analysis completed for the high-speed train ridership in 2020. This same travel demand is assigned to the highways and airports and passenger rail described under the No-Project Alternative, and the additional improvements or expansion of facilities is assumed to meet the demand, regardless of funding potential and without high-speed train service as part of the system.

Figure 2
Modal Alternative – Highway Component

Figure 3
Modal Alternative – Aviation Component



Regional Airport	Representative Intercity Demand (Millions)	Additional Gates (by Region)	Additional Runways (by Region)
BAY AREA TO MERCED			
OAKLAND SAN JOSE SAN FRANSICO SANTA ROSA	26.3	35	2
NORTHERN CENTRAL VALLEY			
SACRAMENTO STOCKTON	6.2	6	1
SOUTHERN CENTRAL VALLEY			
BAKERSFIELD VISALIA FRESNO MERCED MODESTO	1.0	2	0
LOS ANGELES			
BURBANK LOS ANGELES LONG BEACH ORANGE COUNTY ONTARIO	27.0	36	2
SAN DIEGO			
SAN DIEGO CARLSBAD	7.0	12	1
TOTALS	68.0	91	6

1.1.3 High-Speed Train Alternative

The Authority has defined a statewide high-speed train system capable of speeds in excess of 200 miles per hour (mph) (320 kilometers per hour [km/h]) on dedicated, fully grade-separated tracks, with state-of-the-art safety, signaling, and automated train control systems. State of the art high-speed steel-wheel-on-steel-rail technology is being considered for the system that would serve the major metropolitan centers of California, extending from Sacramento and the San Francisco Bay Area, through the Central Valley, to Los Angeles and San Diego (Figure 4).

The High-Speed Train Alternative includes several corridor and station options. A steel-wheel on steel-rail, electrified train, primarily on exclusive right-of-way with small portions of the route on shared track with other rail is planned. Conventional "non-electric" improvements are also being considered along the existing LOSSAN rail corridor from Los Angeles to San Diego. The train track would be either at-grade, in an open trench or tunnel, or on an elevated guideway, depending on terrain and physical constraints.

For purposes of comparative analysis the HST corridors will be described from station-to-station within each region, except where a by-pass option is considered when the point of departure from the corridor will define the end of the corridor segment. Segment and subsegment labels and civil station numbers taken from the project plans and data are also used to identify corridor locations.

Figure 4
High-Speed Train Alternative – Overview and Areas Served

2.0 BASELINE/AFFECTED ENVIRONMENT

2.1 STUDY AREA

The Study Area for noise and vibration assessment is defined by the screening distances established by FRA and FTA for rail and highway corridors. In all cases, the areas are confined to within 1000 feet from the center of the proposed corridor. For airport noise, the area is confined to within the Ldn 65 noise contour established for the particular airport. This is the extent of area where a change in noise would be most noticeable to receivers, and new projects could begin to dominate the noise environment.

2.2 GENERAL DESCRIPTION OF REGIONAL NOISE & VIBRATION ENVIRONMENTS

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.

Noise contours for major road and rail corridors are required by the State of California to be part of community (city and county) General Plan documents. Contours for road and rail corridors can also be estimated using Table 5-7 of the FTA *Transit Noise and Vibration Impact Assessment* Manual. In this study, existing noise contours for the No-Project Alternative and Representative Cases (typologies) were estimated according to the FTA procedures because of the high number of communities involved. The FTA procedures also allow noise contour estimation based on the local population density, and this method was also used in this study, particularly for Representative Cases at portions of the HST Alternative that would be new corridors.

Near airports, regional noise environments will be dominated by aircraft operations. Major civil and military airports are required to produce noise contour maps to assist local agencies with land development and zoning. Operational growth at a particular airport may also be studied from a noise basis using noise contour maps. The 65 Ldn contour is typically considered to be the transition between aviation and vehicle traffic dominated noise environments, although aircraft flyovers can remain a measurable part of the local noise environment outside of the 65 Ldn airport noise contour.

2.3 SENSITIVE NOISE & VIBRATION LAND USE LOCATIONS

The screening study includes residential, institutional, and park areas as noise and vibration sensitive land uses. All residential zones within the screening distances defined for highways and HST corridors were included in the study. Institutional locations for the study included schools, hospitals, and historic structures within the screening distances. All sensitive land use locations were determined from GIS data and project plans for the region.

2.4 REPRESENTATIVE NOISE & VIBRATION TYPOLOGIES IN REGION

Representative land use typologies for the region were selected from residential, institutional, and park uses within the study screening areas for the HST Alternative. For the Inland Empire region, the land use typologies selected for individual study are as follows:

Table 2.4.1 Representative Typology Cases for Region – Inland Empire

Alignment Segment	Description	City/County	Distance(ft)*	Land Use Type	Community
Seg.1B	W. Roosevelt Avenue	Montebello	400	Residential	Montebello
Seg.1A	E. Lansdale Street	El Monte	150	Residential	El Monte
Seg.1C	Bonnie View Dr.	Rialto	50	Residential	Rialto
Seg.1A	Campus View Dr.	Riverside	100	Residential	Riverside
Seg.2A	Encanto Dr.	Sun City	300	Residential	Sun City
Seg.2A	Los Padres Dr.	Rainbow	600	Residential	Rainbow
Seg.2B	Woodglen Place	Escondido	50	Residential	Escondido
Seg.3B	Jade Coast Lane	San Diego	450	Residential	San Diego
Seg.3B	W. Ivy Dr. at India St.	San Diego	410	Residential	San Diego
Seg.1A	Alhambra Health Center	Alhambra	200	Hospital	Alhambra
Seg.1B	Rowland School	Industry	260	School	Industry
Seg.2A	Antelope School	Riverside	50	School	River. Co.
Seg.1C	Nunez Park	San Bernardino	50	Park	San Bernardino
Seg.2A	Rancho Bernardo Park	San Diego	80	Park	San Diego
Seg.3B	Old Town	San Diego	50	Park	San Diego

* Distance from the alignment centerline

The geographic locations for the representative cases indicated in Table 2.4.1 are shown in Figure 5.

Development is dense along the northern and southern portions of the Inland Empire region. Between Los Angeles and Riverside, the alignment travels through heavily built-up land uses that include residential, commercial, and industrial. From Escondido to San Diego, the alignment passes by mostly residential land uses of varying density, with commercial and industrial uses concentrated most near downtown San Diego and Miramar Air Base. However, commercial and industrial land uses are located near most city centers along the alignment.

Between Riverside and Escondido, development is less dense, with scattered residential zones along the alignment outside of the city centers, and most commercial and industrial uses near the city centers. March Air Reserve Base is the largest single facility in this portion of the Inland Empire region.

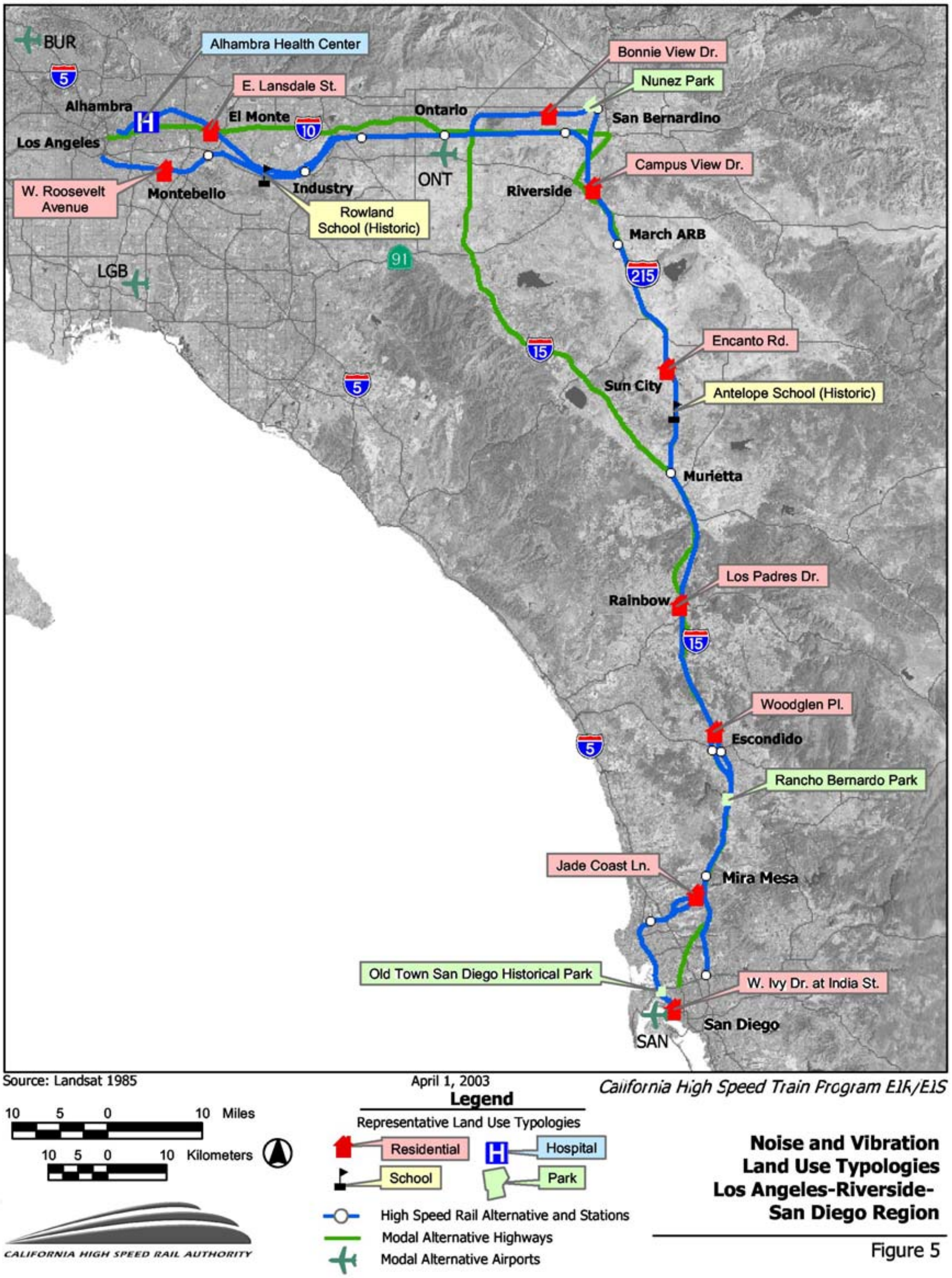
Typical residential land use typologies have been selected from each of these areas using the GIS data from which were chosen representative cases within the noise screening distances. Representative cases of hospitals, schools and parkland which might be impacted by the HST alternative of the project have also been selected, using GIS data within the screening distances.

Ambient noise in the Inland Empire region has been estimated in part by using data in Noise Elements from the General Plans of cities and counties in the region, but predominantly by using general methods provided by FRA and FTA for estimating noise.

Between Los Angeles and Riverside, the ambient noise environment along the alignment is dominated by a combination of noise from freeways, major roads, and existing railroads. Also, the generally urban setting of this portion of the region brings with it a noise environment that is typically dominated by motor vehicle traffic. Close proximity to a freeway or existing commuter, Amtrak, or freight rail line will typically cause that particular source to dominate the local noise environment. Ambient noise in these areas ranges from L_{dn} 58 to 68.

Along portions of the alignment between Riverside and Escondido, which follow Highway 15 and existing freight rail lines, freeway noise is the dominant component of the existing ambient noise. Although the development in this portion of the region is fairly rural, ambient noise near the existing rail lines and Highway 15 will be quite high. The most rural area of this portion is mountainous, where the alignment will be tunnel. Ambient noise in this portion ranges from L_{dn} 54 to 65.

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


BUR
Alhambra Health Center
E. Lansdale St.
Bonnie View Dr.
Nunez Park
Alhambra
El Monte
Ontario
San Bernardino
Los Angeles
ONT
Campus View Dr.
W. Roosevelt Avenue
Montebello
Industry
Riverside
Rowland School (Historic)
March ARB
LGB
Encanto Rd.
Sun City
Antelope School (Historic)
Murietta
Los Padres Dr.
Rainbow
Woodglen Pl.
Escondido
Rancho Bernardo Park
Jade Coast Ln.
Mira Mesa
Old Town San Diego Historical Park
W. Ivy Dr. at India St.
San Diego
SAN
Source: Landsat 1985
April 1, 2003
California High Speed Train Program EIR/EIS
10 5 0 10 Miles
10 5 0 10 Kilometers
Legend
Representative Land Use Typologies
Residential
Hospital
School
Park
High Speed Rail Alternative and Stations
Modal Alternative Highways
Modal Alternative Airports
CALIFORNIA HIGH SPEED RAIL AUTHORITY
Noise and Vibration Land Use Typologies Los Angeles-Riverside-San Diego Region
Figure 5

3.0 EVALUATION METHODOLOGY FOR NOISE & VIBRATION

3.1 CHARACTERISTICS OF HST NOISE & VIBRATION

High-speed trains have similar noise and vibration characteristics to conventional trains with some unique features resulting from the higher speed of travel. The HST is expected to be a steel-wheel, steel-rail electrically-powered train operating on its own tracks in an exclusive right-of-way. Because there will be no highway grade crossings, the annoying sounds of the train horn and warning bells will be eliminated. The use of electrical power cars eliminates the rumble associated with diesel-powered locomotives. All of the above factors allow HST to generate lower noise levels than conventional trains at speeds with which most people are familiar. At higher speeds, however, HST shows a noise increase over conventional trains due to aerodynamic effects. A mitigating factor is that the high speeds enable HST noise to occur for a relatively short duration (a few seconds at the highest speeds).

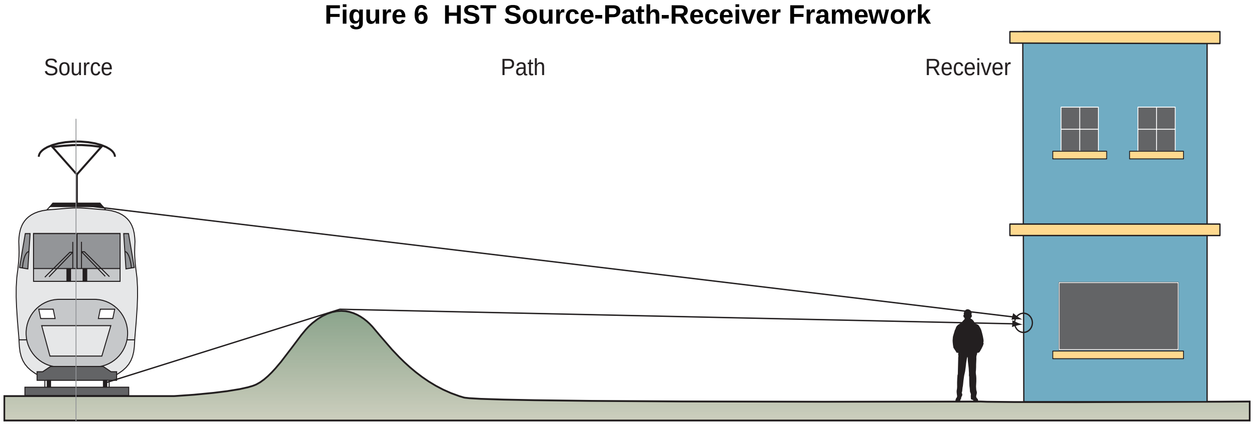
Vibration of the ground caused by the pass-by of the HST is similar to that caused by conventional steel wheel/steel rail trains. The same speed-dependent vibration generation mechanisms are present in each type of train. Holding down the vibration levels associated with the HST are the new track construction and smooth track and wheel surfaces resulting from high maintenance standards required for high speed operation.

This section provides a description of the noise and vibration effects associated with HST.

3.1.1 Elements of Noise Environment Associated with HST

Noise from HST is expressed in terms of a Source-Path-Receiver framework as illustrated in Figure 6. The source of noise is the train moving on its tracks. The path describes the intervening course between the source and the receiver wherein the noise levels are reduced by distance, topographical and man-made obstacles, atmospheric effects and other factors. Finally, at each receiver, the noise from all sources combines and is the noise environment at that location.

Figure 6 HST Source-Path-Receiver Framework



3.1.2 Noise Sources on HST and Conventional Trains.

The total noise generated by a train consists of 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 7. These noise sources can be grouped into three categories according to the speed of the train.

Noise Sources at Low Speeds. For low speeds, below about 40 mph, noise emissions are dominated by the propulsion units, cooling fans, and undercar and top-of-car auxiliary equipment such as compressors and air conditioning units. HST will be electrically powered whereas conventional trains are usually diesel powered, a major difference in noise emission levels at low speed. Cooling fan noise is similar on all trains, but missing from the HST will be the low-frequency noise generated by the diesel exhaust that people associate with freight and commuter trains. Sources of HST noise occur both low and high on the body of the train. For example cooling fans and auxiliary systems can be located both on top and underneath the coaches and power cars. Traction motors on the power cars are low down near the wheels. Below 40 mph, noise levels increase only slightly with speed increases, typically following a relationship of 10 times the logarithm of the train speed.

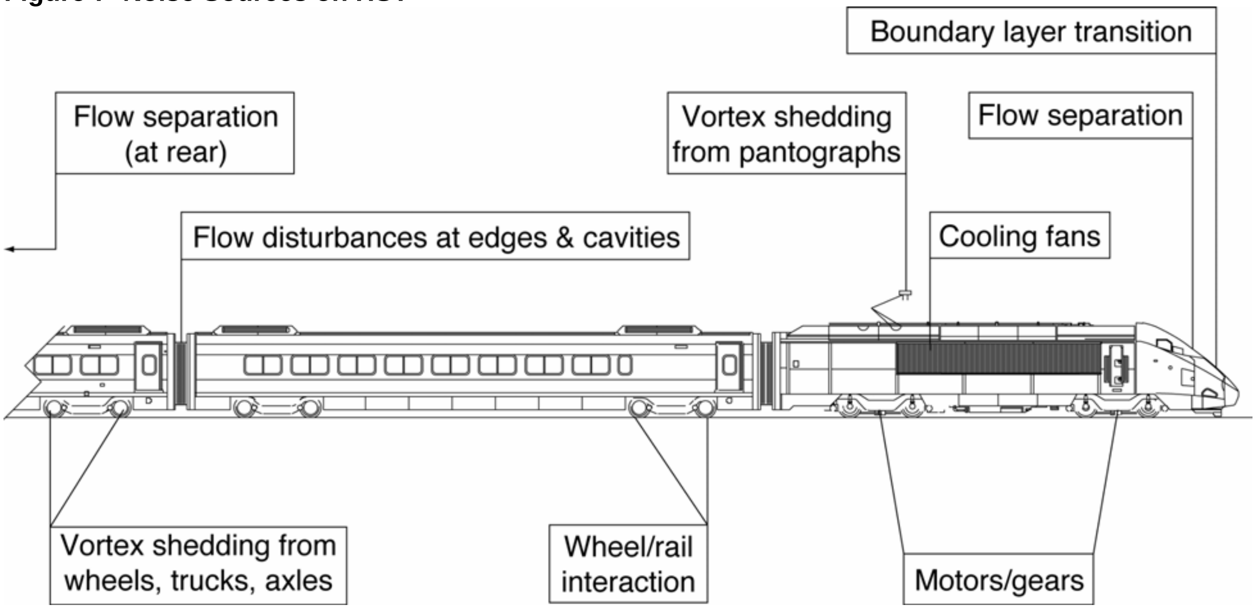
Noise Sources at Medium Speeds. In the speed range from 60 mph to about 150 mph, mechanical noise resulting from wheel/rail interactions and structural vibrations dominate the noise emission from trains. Conventional trains seldom exceed 125 mph, so this speed range which represents a medium range for HST actually represents the top end of noise characteristics for trains with which most people are familiar. Wheel/rail interaction is the source of the rolling noise radiated by steel wheels and rails on both HST and conventional trains. Rolling noise is caused by roughness and unevenness in the running surfaces and emanates from just above the track level. Consequently, this source is low to the ground and easy to shield with noise barriers for at-grade operations. When a train runs on a bridge or an elevated structure, the noise becomes a combination of wheel/rail noise and structure-borne noise. Structure-borne noise comes from many elements of the structure, but is generally concentrated on the area near the point of wheel/rail contact. Speed has a strong influence on noise in the medium speed range, usually about 30 times the logarithm of train speed.

Noise Sources at High Speeds. Above approximately 170 mph, aerodynamic noise sources tend to dominate the radiated noise from HST. Conventional trains are not capable of attaining such speeds. Aerodynamic noise is generated from solid elements of the train body moving rapidly through the air. The motion causes air to flow around components and separate from the train in an unsteady way, especially in the areas around the wheels, the gaps between coaches, and the pantograph (the telescopic structure that picks up electrical current from the overhead wires). Unsteady flow causes aerodynamic noise which increases very rapidly with speed, typically 60 to 70 times the logarithm of speed.

HST noise in the transition speeds between each of the three foregoing ranges is a combination of the sources in each range, with no clear dominant source.

Sources at all Speeds: Horns and Bells. Horns are an example of a train noise source that is meant to be the dominant noise source at any speed. Audible warnings at grade crossings, including train horns and warning bells, are a common feature of conventional trains. These noise sources often prove to be a source of annoyance to people living in the vicinity of railroad tracks. In the case of HST, however, these sources are absent except in the case of emergencies because grade crossings are eliminated for reasons of safety. Elimination of horns and bells at grade crossings is a clear noise benefit associated with the implementation of HST.

Figure 7 Noise Sources on HST



3.1.3 Noise Propagation from Trains

Sound from a train reduces in level in its path to nearby receivers due to a number of natural and environmental factors, including:

Divergence – Sound reduces by spreading in all directions.

Absorption – Sound gets absorbed by the air and the ground.

Refraction – Wind and temperature gradients change the direction of sound waves.

Natural Shielding – Topographical features (hills) interfere with sound waves.

Man-made Shielding -- Noise barriers and buildings interfere with sound waves.

Most of these effects occur in nature and provide a gradual and predictable reduction of noise with distance in open areas. A typical natural reduction would be 5 to 6 dB per doubling of distance starting from about 100 feet from the tracks. In contrast, for built-up areas and locations where mitigation is applied, the man-made shielding by buildings and noise barriers provides significant reductions of noise in a short distance. A typical reduction by man-made shielding is 5 to 10 dB in the shadow of the structure. Specially designed noise barriers for HST can achieve somewhat greater noise reductions.

3.1.4 Noise Perception at the Receiver

When train noise reaches the receiver, whether it be a person outdoors in the garden or someone indoors sleeping, it combines with other sounds in the environment and may or may not stand out in comparison. The distant sources may include traffic, aircraft, industrial activities, animal sounds or wind in the trees. These distant sources create a background noise in which no particular source is identifiable, 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 passby of a train, the overflight of an airplane, 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 responsible for annoyance.

The highest noise level reached during a single event is called the "maximum level" (Lmax). Lmax is used to provide information on how loud is the noise from a train passby, for example. Some typical Lmax's are shown in Figure 8.

Despite the usefulness of the Lmax in describing a single event, there are better measures for assessing the noise environment containing many such events of varying duration in a fluctuating noise environment. The primary descriptor used for HST environmental assessment is Day-Night Sound Level (Ldn), which describes a receiver's cumulative noise exposure from all noise events that occur in a 24-hour period, with events between 10 pm and 7 am increased by 10 decibels to account for greater nighttime sensitivity to noise. The Ldn is used to describe the general noise environment in a location – the so-called "noise climate." The descriptor is a computed number, not one to be read moment to moment on a meter. Its magnitude is related to the general noisiness of an area. The U.S. Environmental Protection Agency (EPA) developed the Ldn descriptor and now most Federal agencies, including the FRA and Federal Transit Administration (FTA), use it to evaluate noise impacts.

Along highway and rail corridors where the noise sources run for 24-hours a day and 7 days a week, the Ldn is considered the best descriptor of the noise environment. Freeway noise tends to be continuous, with sources extending out in the distance in both directions. This type of source is characterized as a "line source," a term that defines the way the sound propagates away from the highway. HST and railroad noise is a bit different in character. Rather than a continuous line source like highway traffic, rail traffic is described as a "truncated line source," where trains pass by only periodically. The sound propagation from a rail line differs from that of the highway.

A comparison of Ldn associated with surface transportation sources at various distances is shown in Figure 9. The example is based on rural areas adjacent to a typical 4-lane freeway[2], a moderately busy freight railroad[3], and the HST at 180 mph in a segment between Merced and Sacramento[4]. In general, the HST noise falls off more rapidly with respect to distance than that from a busy freeway.

The way people react to noise in their environment has been studied extensively by researchers throughout the world. As a result of these studies, noise impact criteria have been adopted by FRA and other federal agencies based on the contribution of the noise from a source like HST to the existing environment. FRA bases noise impact criteria on the increase in Ldn (for buildings with nighttime occupancy) or increase in Leq (for institutional) buildings caused by the project. Criteria are discussed in Section 3.2.

[2] Freeway, 4 lanes, 1885 vehicles/hour/lane, 65 mph, 2% medium trucks, 3% heavy trucks.

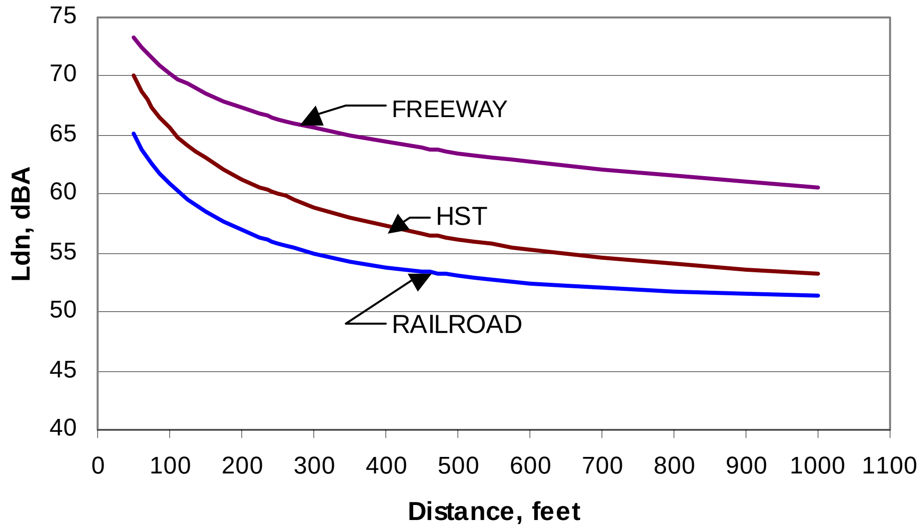
[3] Freight trains with 2 locomotives, 40 cars, 60 mph, 10 daytime, 3 nighttime.

[4] HST, 180 mph, 67 daytime, 5 nighttime.

Figure 8 Typical Lmax Values

Noise Level dBA	Extremes	Home Appliances 3ft	Speech at 3 ft	Motor Vehicles at 50 ft	Trains at 100 ft
120	Jet aircraft at 500 ft.				
110					
100		Chain saw			Horns
90		Power Lawn mower		Diesel Truck (not muffled)	HST, 200 mph
80		Shop tools	Shout	Diesel Truck (muffled)	HST, 150 mph Locomotives, 50 mph
70		Blender	Loud voice	Automobile, 70 mph	Passenger Train, 50 mph
60		Dishwasher	Normal voice	Automobile, 40 mph	Freight Cars, 50 mph
50		Air conditioner	Normal voice (back to listener)	Automobile, 20 mph	
40		Refrigerator			
30					
20					
10					
0	Threshold of hearing				

Figure 9 Example of Noise Exposure vs. Distance for Transportation Modes



3.1.5 Vibration from HST

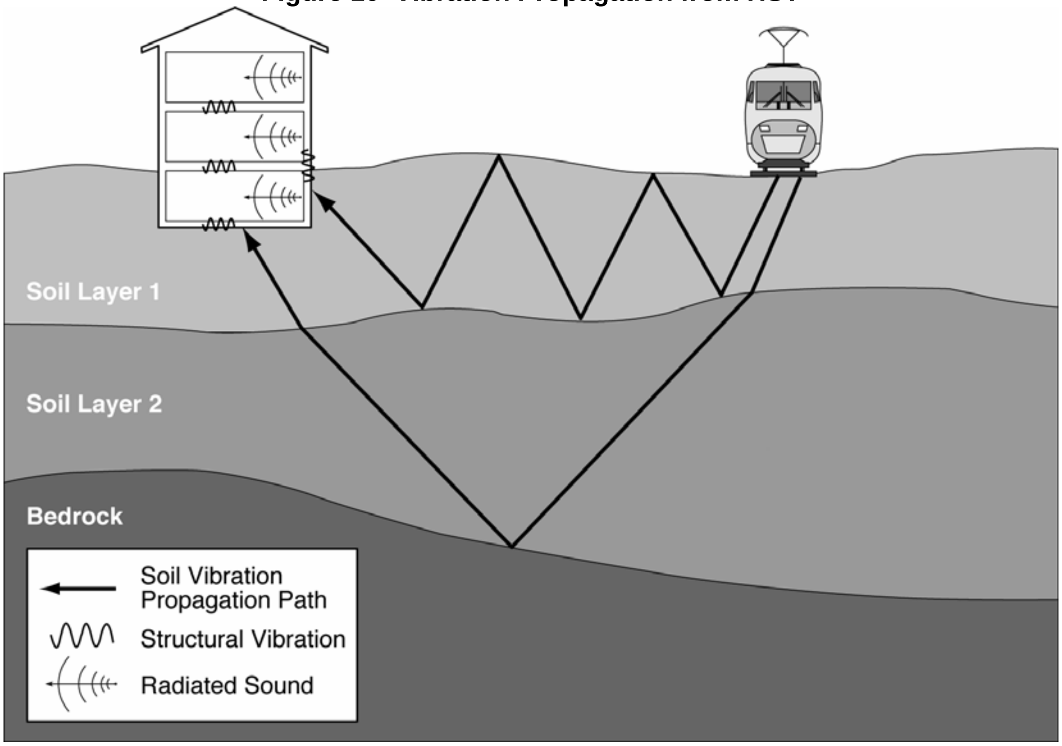
Ground-borne vibration from trains refers to the fluctuating motion experienced by people on the ground and in buildings near railroad tracks. In general, people are not exposed to vibration levels from outside sources that they can feel in their everyday lives. They slam their doors and a wall may shake, or drop something heavy and feel the floor shake, but when an outside source like a train causes their homes to shake, they become concerned. The effects of ground-borne vibration in a building close to a source of vibration may 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 per day.

As is the case with noise, ground-borne vibration can be considered to follow a Source-Path-Receiver Framework, as shown in Figure 10. The Source of vibration is the train wheels rolling on the rails. They create vibration energy that gets transmitted through the track support system into the trackbed or track structure. The amount of energy that is transmitted into the track structure depends strongly on factors such as how smooth the wheels and rails are and the details of the vehicles and tracks. Vibration levels from conventional trains and from HST have been measured and documented by FRA in the guidance manual. As in the case of noise, speed makes a difference: vibration levels increase according to a 20 times the logarithm of speed relationship.

The Path of vibration involves the ground between the source and a nearby building. The vibration of the track or structure excites the adjacent ground, creating vibration waves that propagate through the various soil and rock strata to the foundations of nearby buildings. Ground-borne vibration propagation characteristics vary considerably among the different ground types found in a region. FRA's guidance manual provides a generic method for estimating propagation effects for Tier 1 and a more detailed method for Tier 2 assessments.

The Receiver of vibration is the building. Vibrations propagate from the foundation throughout the building structure, causing floors, walls and other building elements to vibrate. Vibration impact criteria have been adopted by FRA based on people's annoyance from repeated exposure to ground-borne vibrations from trains. These criteria are discussed in Section 3.2.

Figure 10 Vibration Propagation from HST



3.2 CRITERIA FOR NOISE & VIBRATION IMPACT

Criteria for HST noise and vibration impact assessment have been established by the FRA based on activity interference and annoyance ratings developed by the US Environmental Protection Agency. These criteria provide the basis for the screening procedures used in the programmatic assessment.[5]

HST Noise. FRA's noise criteria are ambient-based such that a project's noise is compared with existing conditions to provide an assessment of the effect of the potential change in noise environment on various land uses in the transportation corridor. They incorporate elements of both "relative" and "absolute" limits in assessment of project noise levels. Relative criteria are based on expected annoyance due to the change in the noise environment caused by the HST. Absolute criteria are based on activity interference caused by the HST alone.

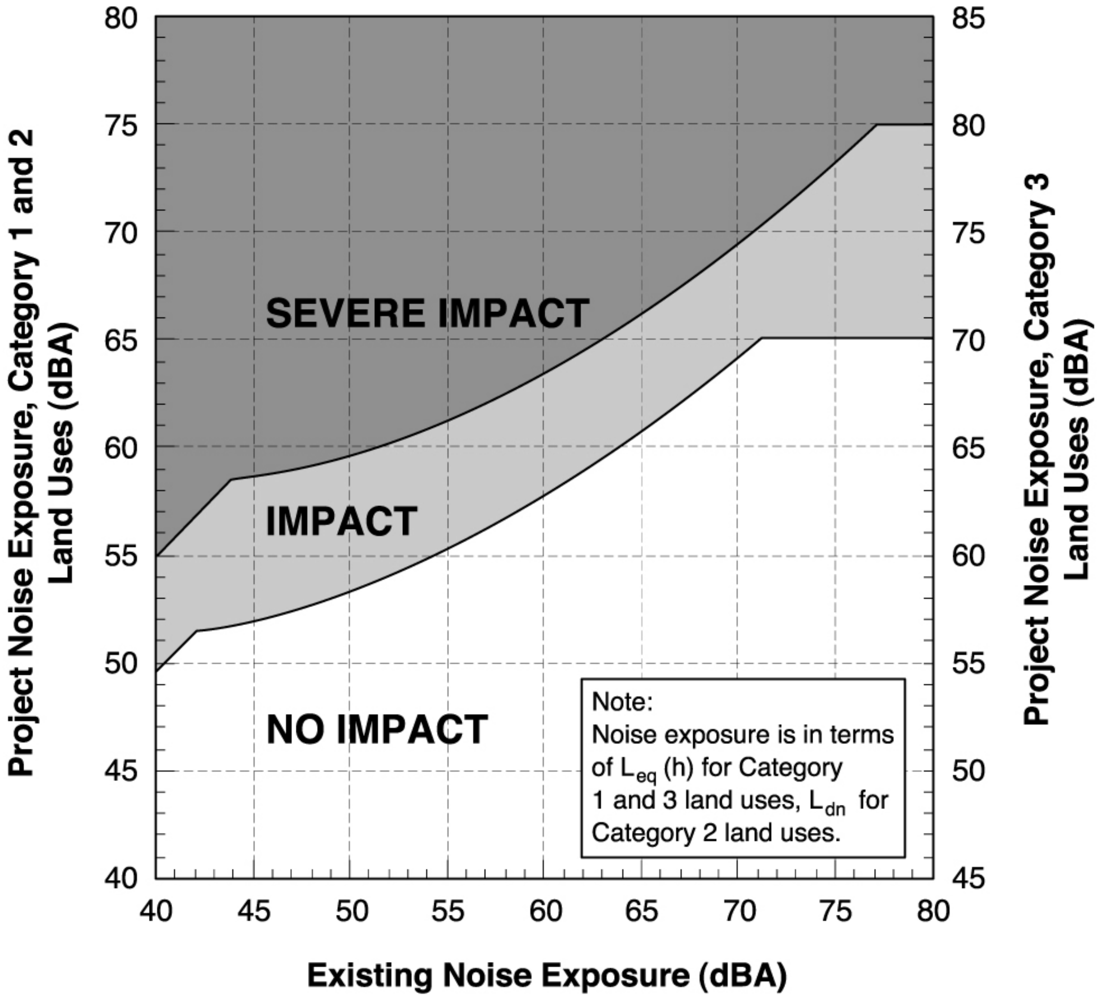
The metric used for noise impact assessment is the day-night sound level (Ldn) in dBA for residential land uses, Land Use Category 1, including buildings where people sleep (hospitals, hotels, motels). The hourly equivalent sound level (Leq) in dBA is applied during hours of active use in parks (Land Use Category 2) and institutional uses (Land Use Category 3 -- churches, libraries, schools).

Changes in noise over existing conditions are categorized into three levels of effect by FRA: No Impact, Impact and Severe Impact, as shown in Figure 11. The project noise level is compared to the existing ambient noise level prior to the introduction of the project. The intersection of the two levels on the graph is an indicator of the degree of impact. Below the threshold of Impact the project is considered to have no noise impact since, on the average, the introduction of the project will result in an insignificant

[5] U.S. Department of Transportation, Federal Railroad Administration. "High Speed Ground Transportation Noise and Vibration Impact Assessment," (see FRA website).

increase in the number of people highly annoyed by the new noise source. For Severe Impact, a significant percentage of the people exposed to the noise would be highly annoyed by the new noise source. Impact is assessed when the HST's noise level would be noticeable but would not be sufficient to cause strong, adverse reactions from the community. Upper limits are imposed in the FRA criteria to account for high noise levels judged to interfere with human activities.

Figure 11 Noise Impact Criteria for High Speed Rail Projects



HST Vibration. FRA's vibration criteria are based on research documenting people's reactions to various levels of building vibrations induced by rail systems. The research, combined with national and international standards related to human exposure to vibration provides the foundation for predicting annoyance from ground-borne vibration in residential areas that would be caused by the HST. The criteria shown in Table 3.2.1 are based on the expected maximum vibration level caused by an average passby of the HST at site-specific locations.

The metric used for vibration impact assessment is the one-second average root-mean-square velocity level (Lv) in VdB. For frequent events, e.g., more than 70 HST passbys per day, the criterion for residential land use is 72 VdB.

Table 3.2.1 Ground-Borne Vibration Impact Criteria

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re 1 micro inch/sec)	
	Frequent Events[1]	Infrequent Events[2]
Category 1: Buildings where low ambient vibration is essential for interior operations.	65[3]	65[3]
Category 2: Residences and buildings where people normally sleep	72	80
Category 3: Institutional land uses with primarily daytime use.	75	83

Notes:
1. "Frequent Events" are defined as more then 70 vibration events per day. Most rapid transit projects fall into this category.
2. "Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems
3. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration sensitive manufacturing or research will require detailed evaluation to define acceptable vibrations levels. Ensuring lower vibration levels in a building often requires special design of the HVAC (heating/air conditioning) systems and stiffened floors.

Modal and No-Project Alternative Noise and Vibration Criteria. The alternatives to HST include railroad, highway, and aviation components, each of which has criteria established by the corresponding transportation departments concerned with those modes.. Railroad noise and vibration criteria have been established by FTA for commuter trains and can be applied to the speeds attained by usual intercity operations; highway noise criteria have been established by FHWA; and aviation noise criteria have been established by FAA. It is to be noted that neither of the latter agencies have vibration criteria. Although each agency has a different approach, it is possible to link the noise impact assessments obtained from the various methods by a commonality of annoyance relationships quantified by the US EPA and noise standards adopted by the US HUD.

Railroad noise and vibration criteria developed by FTA are actually the original criteria adopted by FRA. Since they are identical to those used for HST, these criteria will be used for all rail operations in the Modal and No-Project Alternatives.

Aviation noise can be assessed using the Ldn metric, and noise impact occurs where Ldn exceeds 65 dBA, according to FAA. Noise contours around airports are routinely developed to identify the area exposed to noise levels in excess of the impact threshold. Some airports have noise contours for future planned airport operations. However, noise contours are not available for the Modal Alternative and consequently could not be used to assess the potential impacts of the aviation mode in the Modal Alternative. It was not possible to obtain noise contours for the No-Project Alternative. Consequently the potential noise impacts associated with the aviation component of these two alternatives is not included. Vibration is assumed not to be an issue with aviation.

Highway noise metrics used by FHWA are slightly different from the other modes. Highway noise impact is based on the traffic equivalent noise level (Leq) during one hour of the day -- the hour with the worst impact on a regular basis. For adding to the impacts of other modes and subsequent comparison with

HST, the hourly Leq can be used to develop an estimate of Ldn in communities along the highway corridors.

3.3 SCREENING PROCEDURE FOR PROGRAMMATIC ASSESSMENT

Noise Screening for HST Alternative. FRA has developed a screening method for application early in the HST development, before many details of the system have been defined. Distances from the center of the corridor are provided to encompass all potentially impacted locations. The purpose is to provide an indication whether any noise-sensitive receivers are close enough to the proposed alignments for noise impact to be possible, and it identifies locations where the HST has little possibility of noise impact. The method is used for making a general comparison of potential impacts for different corridors. It is also a key element in the identification of locations for subsequent analysis in Tier 2 where the greater refinement in the detailed analysis is used to focus in on the actual impacts. Correspondingly, screening identifies locations where no additional noise studies need be conducted.

The FRA screening procedure takes account of the noise impact criteria, the type of corridor, and the ambient noise conditions in typical communities. Distances are developed from detailed noise models based on noise emissions of typical steel-wheel/steel-rail high-speed trains, expected maximum operation levels and speeds, along with the noise-sensitivity of residential land use. The FRA screening procedure is considered to be appropriate for HST speeds from 125 mph to 210 mph. FRA's screening method is not intended for use at speeds less than 125 mph, or for areas near stations. However, FTA has developed a screening method that is consistent with the FRA method, and will be used for these conditions.

The screening distances differentiate among areas 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 Ldn. Similarly, "Quiet Suburban" and "Rural" areas are grouped as areas where ambient noise levels are less than 55 Ldn. For developed land with Ldn between 55 and 60, the classification is dependant on other factors such as proximity of major transportation facilities and density of population.

Table 3.3.1 Noise Screening Distances for HST Alternative

Speed (mph)	Type of Corridor	Land Use - Ambient	Distance† (ft)
≥ 125	Existing Rail	Urban/Noisy Suburban	450
		Quiet Suburban/Rural	900
	Existing Highway	Urban/Noisy Suburban	450
		Quiet Suburban/Rural	700
	New Rail	Urban/Noisy Suburban	450
		Quiet Suburban/Rural	900
< 125	Any	Urban/Noisy Suburban	375
		Quiet Suburban/Rural	750
Station§	Any	Urban/Noisy Suburban	225
		Quiet Suburban/Rural	450

† Measured from centerline of track
§ For a distance of 1/4 mile in either direction from center of station

Vibration Screening for HST Alternative. FRA also provides a screening method for HST vibration levels. The method is similar to that for noise, except it assumes typical ground propagation conditions. Vibration propagation is site-specific depending on the soil conditions. Although it is not possible to account for this in a Tier 1 analysis, this has been addressed in the typology analyses. The FRA screening distances are shown below:

Table 3.3.2 Vibration Screening Distances for HST Alternative

Speed (mph)	Receptor Type	Distance† (ft)
≥ 125	Special Facilities (e.g. concert halls, research)	750
	Residential	220
	Institutional (e.g., schools, public buildings)	160
< 125	Category 1 (e.g., concert halls, research)	600
	Category 2 (e.g., residences, theaters, auditoria)	200
	Category 3 (e.g., schools, public buildings)	120

† Measured from centerline of track

Modal and No-Project Alternatives. The railroad noise component of the alternatives is screened according to the FRA/FTA methods described above. Areas considered for impact by aviation noise are based on the published noise contour maps for each airport showing the location of the 65 Ldn noise contour. Screening distances for highways are calculated for various roadway types according to the number of lanes, using the authorized FHWA traffic noise model to determine the distance to where the 65 Leq noise contour is reached. Highway noise screening distances are shown below:

Table 3.3.3 Noise Screening Distances for Highways

Number of Lanes	Distance† (ft)
2	242
4	335
6	390
8	455
10	510
12	580
14	640
16	715

† Measured from centerline of highway

3.4 SUBSEQUENT ANALYSIS IN TIER 2

Locations identified as potentially impacted by noise and vibration in the screening procedure will be revisited with a more detailed assessment in Tier 2 analysis. FRA provides procedures for a general assessment to refine the noise impact areas, followed by a detailed analysis to develop mitigation for impacted areas.

3.5 PARAMETERS FOR COMPARING ALTERNATIVES

The screening procedures described above are designed to provide distances from the center of a corridor, or area enclosed by contours. However, noise and vibration impacts relate to the number of people who are likely to be annoyed by activity interference. The areas defined by the screening distances along the alignments, together with available population density information in GIS format, provide a measure of the number of people potentially impacted by HST and the other alternatives. Consequently, people impacted will be the base parameter for comparing the alternatives.

Rating the severity of impacts by "High," "Medium," or "Low" requires an assessment of how many people are exposed to impact-level noise and vibration. Consequently, a metric describing the relative magnitude of impact has been developed. For this screening study, an Impact Metric (IM) and Impact Rating (IR) have been defined as follows:

Impact Metric (IM) = (#Res. Population Impacts/Mile) + 0.3 x (#MU Population Impacts/Mile) + (l00 x # Hospitals)/Mile + (250 x # Schools)/Mile

Noise Rating Scheme (IR): High (H) = IM > 200; Medium (M) = 80 < IM <200; Low (L) = IM < 80

Vibration Rating Scheme (IR): High (H) = IM >100; Medium (M) = 40 < IM < 100; Low (L) = IM < 40

Implications of the Rating Scheme for noise as defined in this manner are that a moderate impact of only Low (L) with IM less than 80 corresponds to a residential impact of 4 people per house and 20 houses per mile (520 feet between houses for development on both sides of the alignment), and no institutional impacts (hospitals, schools). Institutional impacts, because of their higher occupancy add substantially to the severity of impact.

4.0 NOISE IMPACTS

4.1 NO-PROJECT ALTERNATIVE

The No-Project Alternative, potential noise impacts associated with existing highways only were obtained from the screening analysis. Because of limited or nonexistent information, impacts for expected future (2020) rail and aviation conditions were not included in the impact tabulations. Therefore the comparison between the No-Project Alternative and the HST Alternative is somewhat conservative in that the No-Project Alternative impacts are underestimated.

4.2 MODAL ALTERNATIVE

Potential noise impacts for the Modal Alternative associated with highway expansions and airport improvements were obtained from screening analyses. These impacts can be used to compare with the overall results of the No-Project Alternative potential highway impacts and potential HST impacts. Complete aviation data for the Modal Alternative is not available for this study, but where data were available an assessment of impact was made. The aviation component will increase the number people impacted and the degree of impact for the Modal Alternative. From the data available, it would appear that the number of people impacted by the aviation component is small in comparison with the highway component. However, where available the potential airport impacts were combined with the potential highway component for comparison between the Modal Alternative and the HST Alternative.

4.3 HIGH-SPEED TRAIN ALTERNATIVE

HST noise typologies were analyzed using the General Assessment method provided by the FRA. Representative Cases were chosen to show, in more detail than is possible with the screening analysis, a range of impact levels that are likely to be encountered in the Tier 2 impact evaluation. Potential impacts for the entire HST Alternative were obtained from the screening analysis. The results of the screening analysis can be used to compare potential impacts between regional alignment options and between the potential highway impacts of the Modal Alternative and No-Project Alternative. Residential, park, and institutional noise impact summaries are based upon the GIS land use and location data made available for the screening study and the corresponding screening distances used for each alignment segment.

4.4 NOISE TYPOLOGIES FOR HST

The results of the HST Representative Case noise typology studies are shown in Table 4.4.1 and 4.4.2 below. Table 4.4.1 includes residences and hospitals where there is occupancy both night and day and people generally sleep. Table 4.4.2 includes schools and parks with primarily daytime usage. The Representative Cases shown illustrate the typologies that exist throughout the Inland Empire portion of this Rail Alternative. The FRA criteria, as described in Section 3.2, define three levels of noise impact: “no impact” (NI), “impact” (I), and “severe impact” (SI). Severe impact is normally associated with a Significant Impact as defined by CEQA, whereas an “impact” is usually not considered a significant impact, but worthy of consideration for mitigation based on a detailed cost/benefit analysis.

Reviewing Table 4.4.1, it can be seen that, in the southern corridor option between Los Angeles and Industry, the potential HST noise impact to the residences analyzed is SI before applying noise reduction for standard mitigation as provided in the FRA manual. Standard noise reduction for this receptor is sufficient to reduce the impact to a level I. For the Rowland School in Industry, the impact level, as indicated in Table 4.4.2, is NI without mitigation, due primarily to the lower speed and distance this receptor is from the alignment. In the northern corridor option between Los Angeles and Industry, the HST noise impact to the residences in El Monte on Lansdale Street is SI before mitigation. Standard noise mitigation reduces this impact to a level of I. The Alhambra Health Center is not impacted by noise, and noise mitigation would not be necessary in this case.

In the northern corridor option between Ontario and San Bernardino, the HST noise impact to the residences in Rialto on Bonnie View Drive is SI before mitigation. Standard noise mitigation reduces this impact to a level of I, as indicated in Table 4.4.1. The noise impact to Nunez Park in San Bernardino is a level SI before mitigation. This can be reduced to an impact level of NI with a standard noise wall.

Along the HST corridor south from San Bernardino to Murietta, the residences in Riverside on Campus View Drive and the residences in Sun City on Encanto Drive are shown as being impacted at a level of SI before mitigation. Typical noise mitigation can reduce the impact to both these residences to a level NI The noise impact level for the Antelope School in Riverside County is indicated to be SI before mitigation. Typical noise mitigation is sufficient to reduce these impacts to a level of NI for these receptors.

South of Murietta, in the I-15 corridor, of the residences analyzed for noise, those in Rainbow on Los Padres Drive are indicated to have an impact level of I before mitigation, and the ones in Escondido on Woodglen Place to have an impact level of SI. For these residences the standard noise mitigation reduces the level of impact to NI in the case of the residences in Rainbow and I in the case of the residences in Escondido.

Continuing in the I-15 corridor south of Escondido, the Typology analysis indicates that the residences in San Diego on Jade Coast Lane to be impacted at a level of I before mitigation. With a standard noise wall this would be reduced no impact. In San Diego, the Rancho Bernardo Park is shown to have a noise impact at a level of I, as indicated in Table 4.4.2 and with standard noise mitigation this can be reduced to NI.

In San Diego, the Old Town Historic Park, adjacent to I-5, is indicated as having an impact level of I for noise, due to its close proximity to the rail alignment. With standard noise mitigation, this is reduced to a level of NI. For the residences on W. Ivy Drive in San Diego, the impact to this residential receptor is level I before mitigation and can be reduced to NI with a standard noise wall.

Table 4.4.1 Typology Analysis Table – Potential Residential and Hospital Noise Impacts
Inland Empire

ALIGNMENT SEGMENT	DESCRIPTION	COMMUNITY	CORRIDOR TYPE	DISTANCE (ft)***	SPEED (mph)	EXISTING Ldn	PROJECT Ldn*	IMPACT TYPE**	IMPACT TYPE AFTER MITIG.
Seg.1B	W. Roosevelt Avenue	Montebello	Exist. Rail	400	149	60	65	SI	NI
Seg.1A	E. Lansdale Street	El Monte	Hwy/Rail	150	180	66	69	SI	I
Seg.1C	Bonnie View Drive	Rialto	Exist. Rail	50	145	68	74	SI	I
Seg.1A	Campus View Drive	Riverside	Exist. Rail	100	90	58	70	SI	NI
Seg.2A	Encanto Drive	Sun City	New/Hwy	300	160	57	63	SI	NI
Seg.2A	Los Padres Drive	Rainbow	Highway	600	173	54	60	I	NI
Seg.2B	Woodglen Place	Escondido	Highway	50	121	65	73	SI	I
Seg.3B	Jade Coast Lane	San Diego	New	450	113	55	58	I	NI
Seg.3B	W. Ivy Dr. at India Street	San Diego	Exist. Rail	410	127	63	63	I	NI
Seg.1A	Alhambra Health Center	Alhambra	Exist. Rail	200	140	60	50	NI	----

*Project Ldn includes energy summation of noise levels from high speed rail alone.
** NI = No Impact, I = Impact, SI = Severe Impact
*** Measured from centerline of alignment

Table 4.4.2 Typology Analysis Table – Potential Institutional Noise Impacts
Inland Empire

ALIGNMENT SEGMENT	DESCRIPTION	COMMUNITY	CORRIDOR TYPE	DISTANCE (ft)*	SPEED (mph)	EXISTING Leq	PROJECT Leq	IMPACT TYPE**	IMPACT TYPE AFTER MITIG.
Seg.1B	Rowland School	Industry	Exist. Rail	260	95	60	58	NI	----
Seg.2A	Antelope School	Riverside	Highway	50	145	65	72	SI	NI
Seg.1C	Nunez Park	San Bernardino	New	50	155	60	77	SI	NI
Seg.2A	Rancho Bernardo Park	San Diego	Highway	80	122	67	68	I	NI
Seg.3B	Old Town	San Diego	Exist. Rail	50	93	68	73	I	NI

* Measured from centerline of alignment
** NI = No Impact, I = Impact, SI = Severe Impact

4.5 NOISE SCREENING ANALYSIS

The screening analyses were performed for the No-Project, the Modal and the HST Alternatives. The analyses were accomplished using available GIS data for land use and alignment geometry. The land use along rail and highway alignments were “buffered” using the screening distances presented in Section 3.3. For airports, the screening distance is the distance to the existing CNEL 65 noise contour. The screening analyses for airports determined the number of people currently impacted. The number of people potentially impacted by the Modal Alternative was determined using an “area equivalent” method approved by the FAA. The area equivalent method estimates that for every 1 dBA increase, the population impacted increases by 17%. The increase in noise level was estimated by the growth in demand forecast for each airport. The number of people potentially impacted within the noise buffers was determined using GIS census data.

There are two types of residential land use in the GIS database: strictly residential and mixed use (MU). The former is referred to as Anderson Land Use category 11, and the latter as Anderson Land Use category 16. Anderson Land Use category 16 applies to mixed use land (e.g., commercial and high density residential) where the residential component is typically 30% of the total. This latter fact was used in determining the impact metric (IM) described in Section 3.3.

The impact rating (IR) for each segment is indicated as being either L, M or H. The IR designates the degree of impact based on the number of people impacted per mile of alignment based on the metric thresholds presented in Section 3.3. Figure 12 indicates the results of the screening analysis for the No-Project and Modal Alternatives with the highway alignments color coded to show whether the rating is H, M, or L. Similar results of the HST screening analysis are indicated in Figure 13. The highest impact ratings for all three Alternatives are seen to coincide with the more densely populated areas such as found along the corridor to San Bernardino.

Table 4.5.1 presents the detailed results of the screening analyses for the three project alternatives. In addition to potential residential land use impact, impacts to schools, hospitals and parks are also included. For hospitals and schools, the number of potentially impacted locations is indicated. Where parks are potentially impacted, the amount of acreage within the screening distances is indicated.

Under the No-Project Alternative (see Figure 12), the IR for the various highway segments ranges from L to H. The area of H impact is in the I-10 corridor downtown Los Angeles to San Bernardino and south to Riverside. These same trends are also seen for the Modal Alternative. This result is not unexpected considering the close proximity of residential land along these alignment segments. What is different between the two alternatives is that the number of people impacted increases with the Modal Alternative and consequently the IM, although not enough to change the IR.

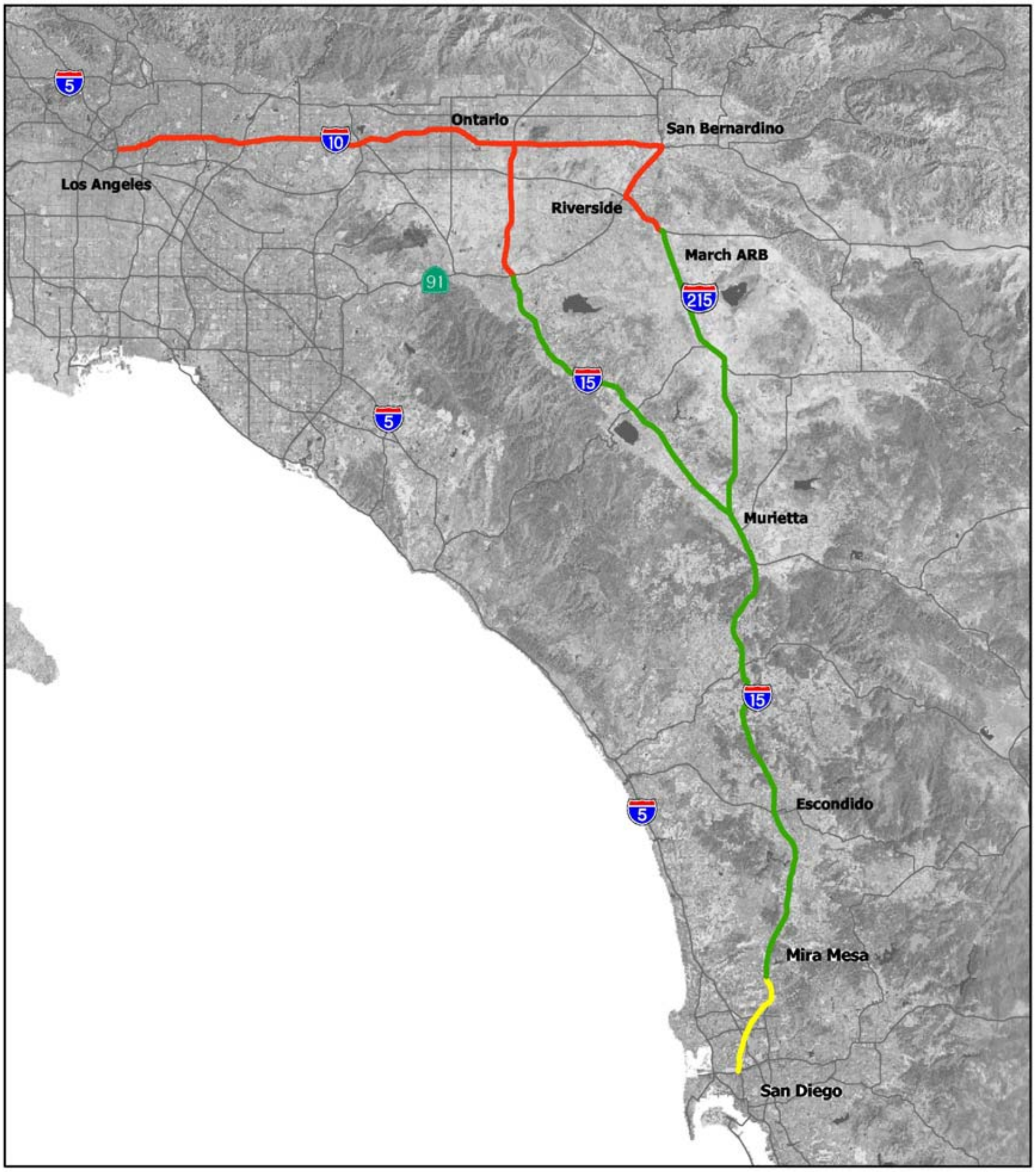
The HST Alternative (see Figure 13) is indicated to have potential impacts, which are H along the northern corridor between Los Angels and Industry. as would be expected considering the close proximity of residential land use along most of this route. This continues to San Bernardino and South to March AFB. The southern corridor option between Los Angels and Industry is seen to have an M noise impact.

East of Industry, the two alignment options pass through areas with residential population. Of these two options, one has an H impact the other an M impact up to March AFB. South of March AFB, the HST impacts are indicated to be L until Mira Mesa. From Mira Mesa to San Diego, there are two alignment options. The western option has H impact, whereas the eastern option, which is through less populated areas has an L impact.

Overall the HST Alternative has IRs which range from L to H depending primarily on the proximity and density of residential population, but also on the speed of the train. The noise Typology study results are seen to reflect the same general trend as the screening analysis results. Where population is dense and close to the alignment, potential impacts are higher and more substantial and conversely where the alignment passes through less densely populated areas such as in the southern and eastern portion of the region, the impacts are less and not as substantial.

Figure 14 indicates the two combinations of HST segments which produce the least and the greatest impacts based on the results of the screening analysis. The primary factor used to select the segments for each combination was the number of people potentially impacted. In most cases the HST segment with the greatest impact would be the longest segment with the highest IR and conversely the segment with the least impact would be the shortest segment with the lowest IR. In most cases this is true, but because the IR represents a range of values of the IM, cases arise where, because of the density of population, a shorter segment can have a greater potential impact than a longer segment.

The HST alignment with the least potential noise impacts consists of the UP Riverside Line – UP/Colton Line, with the San Jacinto to I-15 Alignment via Escondido Transit Center, in conjunction with the I-15 to Qualcomm Stadium option. The HST alignment with the greatest potential for noise impact consists of the UP/Colton Line via San Bernardino, and the San Jacinto to I-15 Alignment via Escondido with the I-15 to Coast via Carroll Canyon option.



Source: Landsat 1985

April 7, 2003

California High Speed Train Program EIR/EIS

10 5 0 10 Miles

10 5 0 10 Kilometers

Legend

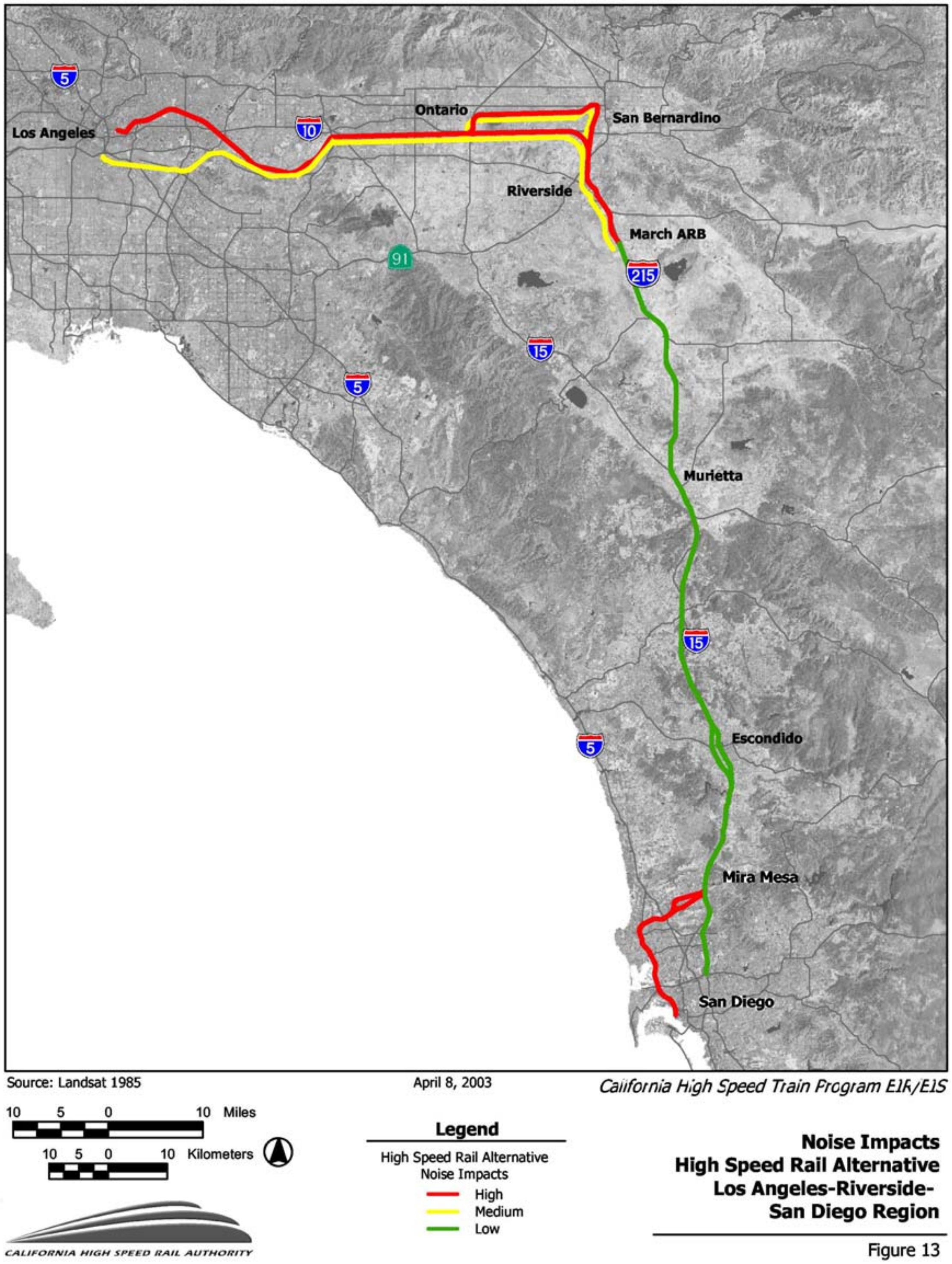
No-Build and Modal Alternatives
Highways - Noise Impacts

- High
- Medium
- Low

Noise Impacts
No-Build and Modal Alternatives
Los Angeles-Riverside-
San Diego Region

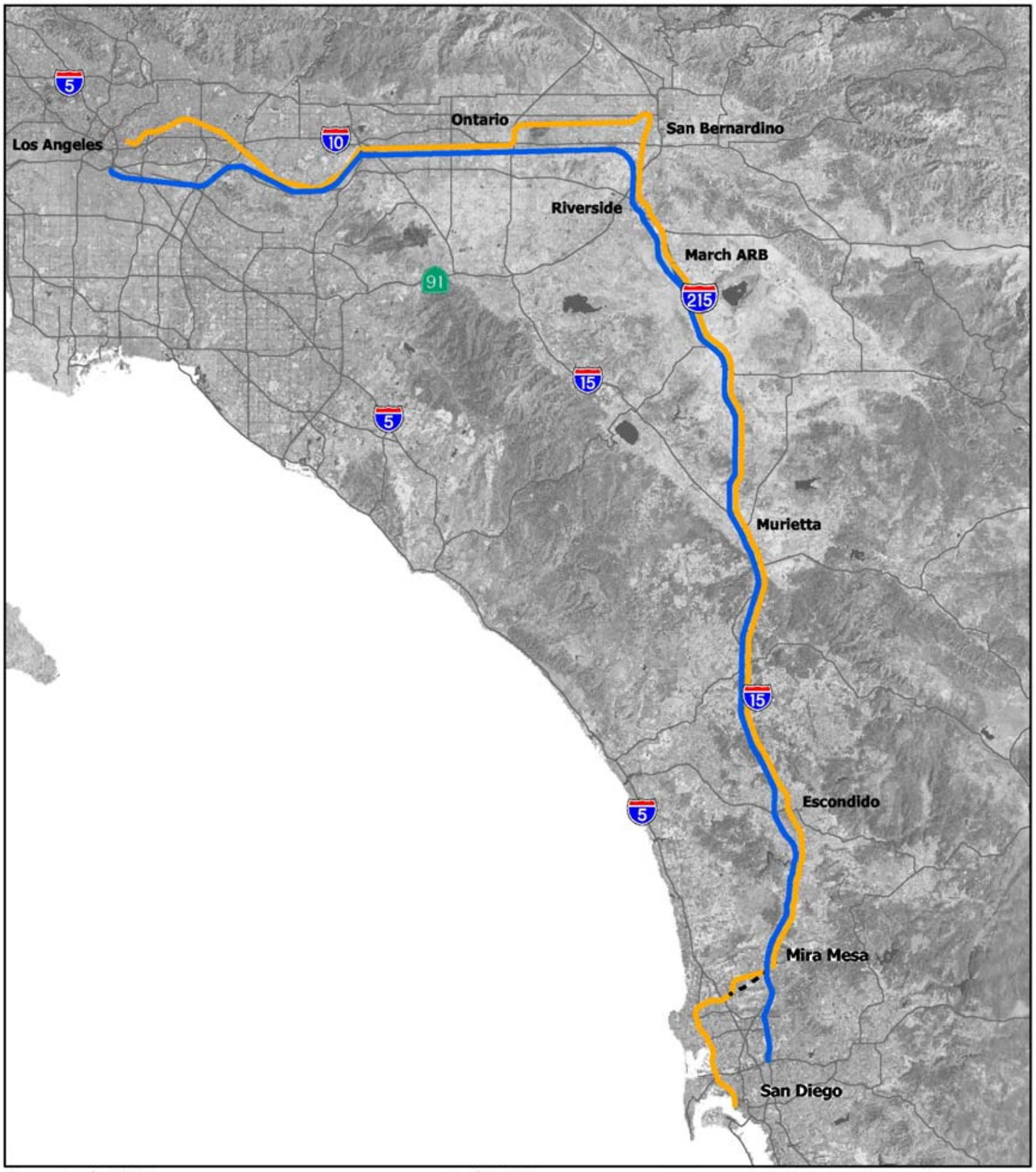
Figure 12

CALIFORNIA HIGH SPEED RAIL AUTHORITY



Noise Impacts
High Speed Rail Alternative
Los Angeles-Riverside-
San Diego Region

Figure 13



Source: Landsat 1985

April 8, 2003

California High Speed Train Program EIR/EIS

10 5 0 10 Miles

10 5 0 10 Kilometers

Legend

High Speed Rail Alternative
Potential Noise Impacts
Least
Greatest
Other Routes

CALIFORNIA HIGH SPEED RAIL AUTHORITY

Routes with Least and Greatest Potential Noise Impacts High Speed Rail Alternative Inland Empire Region

Figure 14

Table 4.5.1 Analysis/Comparison Table – Potential Noise Impacts – Segment Options Inland Empire

	Residential	MU	Parkland	Institution		Impact Rating
	(no. of people)	(no. of people)	(acres)	Schools	Hospitals	(H,M,L)
No-Project Alternative						
Union Station to March Air Reserve Base	34988		58	6	1	H
March Air Reserve Base to Mira Mesa	4658		87			L
Mira Mesa to San Diego	2000		17			M
Modal Alternative						
Union Station to March Air Reserve Base	46803	49	79	8	1	H
March Air Reserve Base to Mira Mesa	5782		87		1	L
Mira Mesa to San Diego	2330		17		1	M
High-Speed Train Alternative						
Union Station to March Air Reserve Base						
Alignments						
UP/Colton Line (Subsegments 1A1, 1A2, 1A3, 1A4)	12909	47	36	4	1	H
UP/Colton Line via San Bernardino (Subsegments 1A1, 1A2, 1C1, 1A4)	18482	47	62	4	1	H
UP/Riverside Line - UP/Colton Line (Subsegments 1B1, 1A2, 1A3, 1A4)	6901		19	4		M
UP/Riverside - UP/Colton Line via San Bernardino Subsegments 1B1, 1A2, 1C1, 1A4)	12474		45	4		M
March Air Reserve Base to Mira Mesa						
Alignments						
San Jacinto to I-15 Alignment via Escondido (Subsegments 2A1, 2A2, 2A3)	3436		66	2		L
San Jacinto to I-15 Alignment via Escondido Transit Center (Subsegments 2A1, 2B1, 2A3)	2774		63	2		L
Mira Mesa to San Diego						
Alignments						
I-15 to Coast via Miramar Road (Subsegments 3C1, 3B2)	3786	6	157			H
I-15 to Coast via Carroll Canyon (Subsegments 3B1, 3B2)	3858		157			H
I-15 to Qualcomm Stadium (Subsegment 3A1)	378					L

5.0 VIBRATION IMPACTS

5.1 NO-PROJECT ALTERNATIVE

Vibration impacts are assumed to be non-existent for highway and airport modes.

5.2 MODAL ALTERNATIVE

Vibration impacts are assumed to be non-existent for highway and airport modes

5.3 HIGH-SPEED TRAIN ALTERNATIVE

HST Alternative entries in the Analysis/Comparison Table above can be used to compare potential impacts between regional alignment options. Residential, park, and institutional impact summaries in the Analysis/Comparison Table are based upon the GIS land use and location data made available for the screening study and the corresponding screening distances used in each alignment portion. Please see the Appendix for a list of the individual screening distances used, and the length of alignment to which each screening distance applies.

5.4 VIBRATION TYPOLOGIES

The results of the Representative Case land use typology vibration studies are shown in the Typology Analysis Table below. The Representative Cases shown illustrate the typologies that exist throughout the LABAK portion of the HST Alternative. Representative Cases were chosen to show a range of the levels that are likely to be encountered in Tier 2 analyses.

The results of the typology analyses using the FRA criteria for assessing vibration impacts are indicated in Table 5.4.1. Of the thirteen cases analyzed, five of them are indicated as being possibly impacted by groundborne vibration. The closer the building is to the alignment, the greater the likelihood of impact. At 50 feet from the alignment, as in the case of the residence in Rialto on Donnie View Drive, the projected vibration level is 80 dBV or 8 dBV greater than the criterion. In a similar situation, the residence in Escondido on Woodglen Place, is also impacted, but at a slightly lower level (78 VdB), due to a slightly lower speed.

Speed of the train can also be seen to play an important factor in the level of vibration. In the case of the Old Town Historic Park buildings in San Diego, at 50 feet away the vibration is less because of a lower speed of 93 mph compared with 200 to 207 throughout much of the region. The distance vibration impact can occur extends out to greater distances with increasing speed, as in the case of residence in El Monte on Landsdale Street at 150 feet away, where the train speed is 207mph. In this instance the projected vibration is over the criterion by 4 dBV. The residence in Sun City on Encanto Drive is indicated as being not impacted by vibration at 300 feet away even for a train sped of 207mph.

The typology vibration analyses would seem to indicate that beyond about 200 feet from the alignment vibration would be low enough not to result in impact to residences. This is consistent with the screening distance of 200 feet used for most of the Inland Empire alignment segments. For schools, the distance beyond which impact ceases appears to be 150 feet. However, groundborne vibration is very site-specific, and actual vibration levels from HST will be determined and evaluated in more detail in the Tier 2 analysis. These future investigations would measure the local response of the soil strata along the alignment(s) chosen for further impact assessment. Specific HST technology would be evaluated and the characteristics of such systems would be directly taken into account in the analyses.

Mitigation of groundborne vibration can be achieved using special systems that reduce vibration transmitted into the ground below the tracks. Available technology for reducing HST groundborne vibration relies on special track support systems, which are discussed in more detail in Section 6 under mitigation strategies. Specific mitigation for portions of the HST alignment which are indicated as requiring groundborne vibration mitigation will be developed in the Engineering Phase of the project.

Table 5.4.1 Typology Analysis Table – Potential Vibration Impacts Inland Empire

ALIGNMENT SEGMENT	LAND USE/ DESCRIPTION	COMMUNITY	CORRIDOR TYPE	DISTANCE (ft)*	SPEED (mph)	MAX. ALLOWED (dBV)	PROJECT (dBV)	IMPACT? (YES/no)
Seg.1B	W. Roosevelt Ave	Montebello	Exist. Rail	400	198	72	66	NO
Seg.1A	E. Lansdale St	El Monte	Hwy/Rail	150	207	72	76	YES
Seg.1C	Bonnie View Dr	Rialto	Exist. Rail	50	200	72	80	YES
Seg.1A	Campus View Dr	Riverside	Exist. Rail	100	148	72	73	YES
Seg.2A	Encanto Dr	Sun City	New/Hwy	300	207	72	69	NO
Seg.2A	Los Padres Dr	Rainbow	Highway	600	207	72	61	NO
Seg.2B	Woodglen Place	Escondido	Highway	50	207	72	78	YES
Seg.3B	Jade Coast Lane	San Diego	New	450	207	72	62	NO
Seg.3B	W. Ivy Dr. at India St	San Diego	Exist. Rail	410	207	72	64	NO
Seg.1A	Alhambra Health Center	Alhambra	Exist. Rail	200	207	72	71	NO
Seg.1B	Rowland School	Industry	Exist. Rail	260	207	75	66	NO
Seg.2A	Antelope School	River. Co.	Highway	50	207	75	80	YES
Seg.3B	Old Town	San Diego	Exist. Rail	50	93	75	76	YES

* Measured from centerline of alignment

5.5 VIBRATION SCREENING ANALYSIS

The vibration screening analysis was performed only for the HST, because the No-Project and Modal Alternatives are assumed to have no associated vibration impacts. Table 5.5.1 presents the detailed results of the vibration screening analysis for the HST Alternative. All alignment options are indicated as having IRs of M or L. In areas with greater density, more of the population is within the screening distance. Of the Union Station to March AFB, the UP/Riverside Line – UP/Colton Line option has an L impact due to lower population within the screening distance along this alignment. The first two options in this segment also are indicated as possibly impacting hospitals. However, as indicated by the typology impact analysis the Alhambra Health Center is not impacted by vibration, being at a distance of 200 feet. The Rowland School, which is within the noise screening distance, but outside of the vibration screening distance, is seen as not impacted by vibration in the typology analysis. Whereas, the Antelope School is within the vibration screening distance, in fact quite close at 50 feet, and is indicated as being impacted by vibration.

Table 5.5.1 Analysis/Comparison Table – Potential Vibration Impacts – Segment Options Inland Empire

	Residential	MU	Institution		Severity of Impact
	(no. of people)	(no. of people)	Schools	Hospitals	(H,M,L)
No-Project Alternative*					
Modal Alternative*					
High-Speed Train Alternative					
Union Station to March Air Reserve Base					
Alignments					
UP/Colton Line (Subsegments 1A1, 1A2, 1A3, 1A4)	4182	30		1	M
UP/Colton Line via San Bernardino (Subsegments 1A1, 1A2, 1C1, 1A4)	6703	30		1	M
UP/Riverside Line - UP/Colton Line (Subsegments 1B1, 1A2, 1A3, 1A4)	2130				L
UP/Riverside - UP/Colton Line via San Bernardino Subsegments 1B1, 1A2, 1C1, 1A4)	4651				M
March Air Reserve Base to Mira Mesa					
Alignments					
San Jacinto to I-15 Alignment via Escondido (Subsegments 2A1, 2A2, 2A3)	1304		1		L
San Jacinto to I-15 Alignment via Escondido Transit Center (Subsegments 2A1, 2B1, 2A3)	2372		1		L
Mira Mesa to San Diego					
Alignments					
I-15 to Coast via Miramar Road (Subsegments 3C1, 3B2)	1120				M
I-15 to Coast via Carroll Canyon (Subsegments 3B1, 3B2)	1098				M
I-15 to Qualcomm Stadium (Subsegment 3A1)	210				L

* Vibration impacts are assumed to be non-existent for highway and airport modes.

6.0 REFERENCES

PUBLICATIONS

Federal Aviation Administration Noise Standards, Tital 14, Code of Federal Regulation, Chap. 1, Part 36, 34 fed Reg. 1864, November 1969

Federal Highway Administration, *FHWA Highway Traffic Noise Model (Version 2.0 Addendum)*, May 2002

Federal Highway Administration, *FHWA Highway Traffic Noise Prediction* Model, FHWA-RD-77-108, December 1978

Federal Railroad Administration, *High-Speed Ground Transportation Noise and Vibration Impact Assessment: Final Draft*, Report No. 293630-1, December 1998.

Federal Transit Administration, *Transit Noise and Vibration Impact* Assessment, Report No. PB96-1721135. April 1995.

GIS DATA

Land Use, CAHSR Alignment, Highway Alignment – Provided by regional team

Parks, Population Density, Schools, Hospitals – ESRI Data & Maps Media Kits 2002, ESRI, 380 New York Street, Redlands, CA

OTHER MATERIALS

Aerial Photos, Plan & Profile Drawings, and Alignment Sections – Provided by regional team

7.0 PREPARERS

WILSON, IHRIG & ASSOCIATES, INC.

Richard A. Carman
Principal
Wilson, Ihrig & Associates, Inc.

Ph.D., M.S., B.S., Mechanical Engineering, University of California at Berkeley. Registered Professional Mechanical Engineer in the State of California. Member of Acoustical Society of America, High Speed Ground Transportation Association, Association of Environmental Professionals, and The American Railway Engineering and Maintenance-of-Way Association. 22 years experience managing and consulting on transportation projects, including noise and vibration control, and complying with NEPA, CEQA, and other governmental regulations.

- Project Manager – Noise and Vibration

Steven L. Wolfe
Principal
Wilson, Ihrig & Associates, Inc.

M.S., Mechanical Engineering, University of California, Berkeley. B.S., Engineering, Harvey Mudd College, Claremont. Over 30 years experience managing and consulting on transportation projects.

- Project Reviewer

William A. Pritchard
Associate
Wilson, Ihrig & Associates, Inc.

B.S., Mechanical Engineering, University of California, Berkeley. Three years experience in transportation noise and vibration control.

- Project Engineer

APPENDIX A1

Analysis/Comparison Table – Potential Noise Impacts – Segment Options Inland Empire

	Residential (no. of people)	MU (no. of people)	Parkland (acres)	Institution		Impact Rating (H,M,L)
				Schools	Hospitals	
NO-PROJECT						
East San Gabriel Valley to Ontario Airport	3,809		43			H
Escondido to Mira Mesa	2,939		47			M
I-10 to I-215	1,114		39			L
I-10 to Riverside	876					M
I-15 to I-215	604					L
I-15 to I-8	-					L
I-215 to Temecula	146		1			L
I-5 to East San Gabriel Valley	25,327		9	6	1	H
Mira Mesa to SR-163	489					M
Ontario Airport to I-15	3,820					H
Riverside to I-15	983	19	6	1		L
SR-163 to I-5	1,510		17			H
Temecula to Escondido	27					L
MODAL						
East San Gabriel Valley to Ontario Airport	4,417		43			H
Escondido to Mira Mesa	3,657		47			H
I-10 to I-215	1,335		39			L
I-10 to Riverside	1,056					M
I-15 to I-215	704					L
I-15 to I-8	-					L
I-215 to Temecula	193		1			L
I-5 to East San Gabriel Valley	35,516		15	8	1	H
Mira Mesa to SR-163	525					M
Ontario Airport to I-15	4,421					H
Riverside to I-15	1,253	49	21		1	L
SR-163 to I-5	1,806		17		1	H
Temecula to Escondido	33					L
HST CORRIDOR & STATION OPTIONS						
LOS ANGELES UNION STATION TO MARCH ARB						
Segment 1A						
1A1 – Union Station to	10217	47	17	2	1	H

	Residential (no. of people)	MU (no. of people)	Parkland (acres)	Institution		Impact Rating (H,M,L)
				Schools	Hospitals	
Pomona						
1A2 – Pomona to beginning of Segment 1C	860		1	0	0	L
1A3 – Beginning of 1C to End of 1C, but on the 1A Segment	483		0	0	0	L
1A4 – End of 1C to March ARB	1349		18	2	0	H
Segment 1B						
1B1 – Union Station to Pomona	4209		0	2	0	M
Segment 1C						
1C1 – Beginning of 1C to End of 1C	6056		26	0	0	H
MARCH ARB TO MIRA MESA						
Segment 2A						
2A1 – March ARB to Beginning of Segment 2B	667		20	2	0	L
2A2 – Beginning of 2B to End of 2B	1031		3	0	0	M
2A3 – End of 2B to Mira Mesa	1738		43	0	0	M
Segment 2B						
2B1 – Beginning of 2B to End of 2B	369		0	0	0	L
MIRA MESA TO SAN DIEGO						
Segment 3A						
3A1 – Mira Mesa to Qualcomm Stadium	378		0	0	0	L
Segment 3B						
3B1 – Mira Mesa to End of Segment 3C	960		0	0	0	M
3B2 – End of 3C to Downtown San Diego	2898		157	0	0	H
Segment 3C						
3C1 – Mira Mesa to End of 3C	888	6	0	0	0	M

Analysis/Comparison Table - Vibration Potential Impacts – Segment Options
Inland Empire

	Residential (no. of people)	MU (no. of people)	Institutional		Impact Rating (H,M,L)
			Schools	Hospitals	
NO-PROJECT*					
MODAL*					
HST CORRIDOR & STATION OPTIONS					
LOS ANGELES UNION STATION TO MARCH ARB					
Segment 1A					
1A1 – Union Station to Pomona	3464	30	0	1	H
1A2 – Pomona to beginning of Segment 1C	207				L
1A3 – Beginning of 1C to End of 1C, <u>but on the 1A Segment</u>	91				L
1A4 – End of 1C to March ARB	420				M
Segment 1B					
1B1 – Union Station to Pomona	1412				M
Segment 1C					
1C1 – Beginning of 1C to End of 1C	2612				H
MARCH ARB TO MIRA MESA					
Segment 2A					
2A1 – March ARB to Beginning of Segment 2B	290		1	0	L
2A2 – Beginning of 2B to End of 2B	152				L
2A3 – End of 2B to Mira Mesa	862				M
Segment 2B					
2B1 – Beginning of 2B to End of 2B	1220				H
MIRA MESA TO SAN DIEGO					
Segment 3A					
3A1 – Mira Mesa to Qualcomm Stadium	210				L
Segment 3B					
3B1 – Mira Mesa to End of Segment 3C	331				M

	Residential (no. of people)	MU (no. of people)	Institutional		Impact Rating (H,M,L)
			Schools	Hospitals	
3B2 – End of 3C to Downtown San Diego	767				M
Segment 3C					
3C1 – Mira Mesa to End of 3C	353				M

* Vibration impacts are assumed to be non-existent for highway and airport modes

APPENDIX A2

HSR: ALIGNMENTS, SEGMENTS, SUBSEGMENTS FOR ANALYSIS

Segment 1A
Subsegment 1A1: From Union Station to Pomona
Subsegment 1A2: From Pomona to beginning of Segment 1C
Subsegment 1A3: From Beginning of 1C to End of 1C, but on the 1A Segment
Subsegment 1A4: From End of 1C to March ARB

Segment 1B
Subsegment 1B1: From Union Station to Pomona

Segment 1C
Subsegment 1C1: From Beginning of 1C to End of 1C

Segment 2A
Subsegment 2A1: From March ARB to Beginning of Segment 2B
Subsegment 2A2: From Beginning of 2B to End of 2B
Subsegment 2A3: From End of 2B to Mira Mesa

Segment 2B
Subsegment 2B1: From Beginning of 2B to End of 2B

Segment 3A
Subsegment 3A1: From Mira Mesa to Qualcomm Stadium

Segment 3B
Subsegment 3B1: From Mira Mesa to End of Segment 3C
Subsegment 3B2: From End of 3C to Downtown San Diego

Segment 3C
Subsegment 3C1: From Mira Mesa to End of 3C

MODAL: SEGMENTS

Union Station to March ARB: Improvements to I-10, and portions of I-15 and I-215 from I-10 south to March ARB. We are defining the southern boundary of I-15 and I-215 as the same approximate latitude as the March ARB HSR station (we're not over-engineering this, just drawing a horizontal line on a map through the March ARB station, and picking the points where it crosses I-15 and I-215.) This segment also includes the **Ontario Airport** modal improvements.

March ARB to Mira Mesa: Improvements to I-215 and I-15, beginning at March ARB, and ending on I-15 at the Mira Mesa HSR station.

Mira Mesa to San Diego: Improvements to I-15, beginning at Mira Mesa and ending at I-8. Improvements to SR-163, beginning at I-15 split and ending at I-8. This segment also includes the **San Diego International Airport** modal improvements.

Detailed Analysis/Comparison Table
Potential CAHSR Noise Impacts
Inland Empire Region

SEGMENT_ID	miles	# of Noise ander 11 people	People/mile	# of noise ander 16 people	People/mile	# of Hospitals	# of schools	Severity Metric	Rating	# People Impacted	Greatest L	Greatest M	Greatest H	Least L	Least M	Least H
Los Angeles Union Station to March ARB																
OPTION 1 - 1A1, 1A2, 1A3, 1A4	69.9	12909.0	184.6	47.0	1.3	1	4	200.5	H	14023.1						
OPTION 2 - 1A1, 1A2, 1C1, 1A4	76.2	18482.0	242.7	47.0	1.3	1	4	257.3	H	19596.1			76.2			
OPTION 3 - 1B1, 1A2, 1A3, 1A4	66.9	6901.0	103.2	0.0	0.0	0	4	118.1	M	7901.0					66.9	
OPTION 4 - 1B1, 1A2, 1C1, 1A4	73.1	12474.0	170.6	0.0	0.0	0	4	184.3	M	13474.0						
March ARB to Mira Mesa																
OPTION 1 - 2A1, 2A2, 2A3	74.2	3436.0	46.3	0.0	0.0	0	2	53.0	L	3936.0	74.2					
OPTION 2 - 2A1, 2B1, 2A3	74.2	2774.0	37.4	0.0	0.0	0	2	44.1	L	3274.0				74.2		
Mira Mesa to San Diego																
OPTION 1 - 3C1, 3B2	18.9	3786.0	200.1	6.0	1.3	0	0	200.2	H	3787.8						
OPTION 2 - 3B1, 3B2	19.3	3858.0	200.2	0.0	0.0	0	0	200.2	H	3858.0			19.3			
OPTION 3 - 3A1	9.4	378.0	40.2					40.2	L	378.0				9.4		
										Total	74.2	0	95.4	83.6	66.9	0.0

Detailed Analysis/Comparison Table
Potential CAHSR Vibration Impacts
Inland Empire Region

SEGMENT_ID	miles	# of Vib ander 11 people	People/mile	# of vib ander 16 people	People/mile	# of Hospitals	# of schools	Severity Metric	Rating	# People Impacted	Greatest L	Greatest M	Greatest H	Least L	Least M	Least H
Los Angeles Union Station to March ARB																
OPTION 1 - 1A1, 1A2, 1A3, 1A4	69.9	4182.0	59.8	30.0	0.4	1	0	61.4	M	4291.0						
OPTION 2 - 1A1, 1A2, 1C1, 1A4	76.2	6703.0	88.0	30.0	0.4	1	0	89.4	M	6812.0		76.2				
OPTION 3 - 1B1, 1A2, 1A3, 1A4	66.9	2130.0	31.8	0.0	0.0	0	0	31.8	L	2130.0				66.9		
OPTION 4 - 1B1, 1A2, 1C1, 1A4	73.1	4651.0	63.6	0.0	0.0	0	0	63.6	M	4651.0						
March ARB to Mira Mesa																
OPTION 1 - 2A1, 2A2, 2A3	74.2	1304.0	17.6	0.0	0.0	0	1	20.9	L	1554.0				74.2		
OPTION 2 - 2A1, 2B1, 2A3	74.2	2372.0	32.0	0.0	0.0	0	1	35.3	L	2622.0	74.2					
Mira Mesa to San Diego																
OPTION 1 - 3C1, 3B2	18.9	1120.0	59.2					59.2	M	1120.0		18.9				
OPTION 2 - 3B1, 3B2	19.3	1098.0	57.0					57.0	M	1098.0						
OPTION 3 - 3A1	9.4	210.0	22.3					22.3	L	210.0				9.4		
										Total	74.2	95.1	0.0	150.5	0.0	0.0

Detailed Analysis/Comparison Table
Potential Highway No-Project Impacts
Inland Empire Region

SEGMENT_ID	length (miles)	number of people No-Project 11	number of people No-Project 16	people/(linear miles) No-Project 11	people/(linear miles) No-Project 16	# of Hospitals	# of schools	Severity Metric	Rating
East San Gabriel Valley to Ontario Airport	15	3,809		252				252	H
Escondido to Mira Mesa	15	2,939		191				191	M
I-10 to I-215	46	1,114		24				24	L
I-10 to Riverside	7	876		129				129	M
I-15 to I-215	14	604		42				42	L
I-15 to I-8	8			-				-	L
I-215 to Temecula	5	146		29				29	L
I-5 to East San Gabriel Valley	29	25,327		884		1	6	940	H
Mira Mesa to SR-163	4	489		120				120	M
Ontario Airport to I-15	3	3,820		1,357				1,357	H
Riverside to I-15	35	983	19	28	1		1	36	L
SR-163 to I-5	2	1,510		623				623	H
Temecula to Escondido	27	27		1				1	L
Union Station to March ARB	78	34,988	19	449	0	1.00	6	469	H
March ARB to Mira Mesa	118	4,658		39	-	-	-	39	L
Mira Mesa to San Diego	14	2,000		143	-	-	-	143	M

Detailed Analysis/Comparison Table
Potential Highway Modal Impacts
Inland Empire Region

SEGMENT_ID	length (miles)	number of people modal 11	number of people modal 16	people/(linear miles) modal 11	people/(linear miles) modal 16	# of Hospitals	# of schools	Severity Metric	Rating
East San Gabriel Valley to Ontario Airport	15	4,417		293			1	309	H
Escondido to Mira Mesa	15	3,657		237				237	H
I-10 to I-215	46	1,335		29				29	L
I-10 to Riverside	7	1,056		155				155	M
I-15 to I-215	14	704		49				49	L
I-15 to I-8	8							-	L
I-215 to Temecula	5	193		38				38	L
I-5 to East San Gabriel Valley	29	35,516		1,240		1	8	1,313	H
Mira Mesa to SR-163	4	525		128				128	M
Ontario Airport to I-15	3	4,421		1,571				1,571	H
Riverside to I-15	35	1,253	49	36	1		1	44	L
SR-163 to I-5	2	1,806		745			1	848	H
Temecula to Escondido	27	33		1				1	L
Union Station to March ARB	78	46,803	49	600	1	1.00	8	627	H
March ARB to Mira Mesa	118	5,782		49	-	1.00	-	50	L
Mira Mesa to San Diego	14	2,330		166	-	1.00	-	174	M

California High Speed Rail

Inland Empire - Typology Analysis

Noise Impact Analysis - NO MITIGATIONS

Coaches Length (ft)	82	
Num Coaches	15	
Power unit Length (ft)	82	
# powers units	1	
Total length PU	82	0
Train Length (ft)	1312	0

Num.	Landuse	Community	Location and/or Description	Corridor Type	Civil Station
1	Residential	Montebello	W. Roosevelt Ave.	Exist. Rail	Seg. 1B18+000
2	Residential	El Monte	E. Lansdale St.	Hwy/Rail	Seg. 1A23+200
3	Residential	Rialto	Bonnie View Dr.	Exist. Rail	Seg. 1C 86+000
4	Residential	Riverside	Campus View Dr.	Exist. Rail	Seg. 1A 101+000
5	Residential	Sun City	Encanto Dr.	New/Hwy	Seg. 2A 134+000
6	Residential	Rainbow	Los Padres Dr.	Highway	Seg. 2A176+000
7	Residential	Escondido	Woodglen Place	Highway	Seg. 2B200+000
8	Residential	San Diego	Jade Coast Lane	New	Seg. 3B 210+000
9	Residential	San Diego	W. Ivy Dr. at India St.	Exist. Rail	Seg. 3B238+500
10	Hospital	Alhambra	Alhambra Health Center	Exist. Rail	Seg. 1A 11+000
11	School	Industry	Rowland School	Exist. Rail	Seg. 1B 36+800
12	School	River. Co.	Antelope School	Highway	Seg. 2A 142+000
13	Park	San Ber.	Nunez Park	New	Seg. 1C 95+000
14	Park	San Diego	Rancho Bernardo Park	Highway	Seg. 2A 212+500
15	Park	San Diego	Old Town	Exist. Rail	Seg. 3B 234+000

California High Speed Rail

Inland Empire - Typology Analysis

Noise Impact Analysis - NO MITIGATION (continued)

ag = at grade
sc = shallow cut
dc = deep cut
as = aerial structure
emb = embankment
nb = noise barrier

	TOTAL # TRAINS One/Direction			
	7 to 22		22 to 7	
	NB	SB	NB	SB
Gold LIne	11	14	5	0
Green Line	0	0	0	0
Blue Line	37	35	5	3
total trains both direct.	97		13	
train/hr	6.5		1.4	

Train Speed (mph)	Distance to Alignment (ft)	Existing Ambient (Ldn/Leqday)	FRA Landuse Category	Alignment Geometry		Speed Regime	Reference SEL	Speed Coefficient K	Reference Speed	Reference Length
149	400	60	2	as		2	93.0	17	90	634
180	150	66	2	ag		3	99.0	47	180	73
145	50	68	2	ag		2	93.0	17	90	634
90	100	58	2	as		2	93.0	17	90	634
160	300	57	2	ag		2	93.0	17	90	634
173	600	54	2	ag		3	99.0	47	180	73
121	50	65	2	ag		2	93.0	17	90	634
113	450	55	2	ag		2	93.0	17	90	634
127	410	63	2	as		2	93.0	17	90	634
140	200	60	2	dc		2	93.0	17	90	634
95	260	60	3	ag		2	93.0	17	90	634
145	50	65	3	ag		2	93.0	17	90	634
155	50	60	3	as		2	93.0	17	90	634
122	80	67	3	ag		2	93.0	17	90	634
93	50	68	3	as		2	93.0	17	90	634

California High Speed Rail

Inland Empire - Typology Analysis

Noise Impact Analysis - NO MITIGATION (continued)

Shielding Correction	SEL @ 50ft	Leqday @ 50ft	Leqnight @ 50ft	Ldn @ 50 ft	Project Ldn/Leq @ Receiver	No Mitigation Impact
4	99.9	76	70	78	64	SI
0	102.0	75	68	76	69	SI
0	99.7	72	66	74	74	SI
4	96.2	73	66	74	70	SI
0	100.4	73	66	75	63	SI
0	101.2	74	67	75	59	I
0	98.3	71	64	73	73	SI
0	97.8	70	64	72	58	I
4	98.7	75	69	77	63	I
-15	99.4	57	50	59	50	NI
0	96.6	69	63	71	58	NI
0	99.7	72	66	74	72	SI
4	100.2	77	70	78	77	SI
0	98.4	71	64	73	68	I
4	96.4	73	66	75	73	I

California High Speed Rail

Inland Empire - Typology Analysis

Noise Impact Analysis - MITIGATED

Coaches Length (ft)	82
Num Coaches	15
Power unit Length (ft)	82
# powers units	1
Total length PU	82
Train Length (ft)	1245

Num.	Landuse	Community	Location and/or Description	Corridor Type	Civil Station	Train Speed (mph)
1	Residential	Montebello	W. Roosevelt Ave.	Exist. Rail	Seg. 1B18+000	149
2	Residential	El Monte	E. Lansdale St.	Hwy/Rail	Seg. 1A23+200	180
3	Residential	Rialto	Bonnie View Dr.	Exist. Rail	Seg. 1C 86+000	145
4	Residential	Riverside	Campus View Dr.	Exist. Rail	Seg. 1A 101+000	90
5	Residential	Sun City	Encanto Dr.	New/Hwy	Seg. 2A 134+000	160
6	Residential	Rainbow	Los Padres Dr.	Highway	Seg. 2A176+000	173
7	Residential	Escondido	Woodglen Place	Highway	Seg. 2B200+000	121
8	Residential	San Diego	Jade Coast Lane	New	Seg. 3B 210+000	113
9	Residential	San Diego	W. Ivy Dr. at India St.	Exist. Rail	Seg. 3B238+500	127
10	Hospital	Alhambra	Alhambra Health Center	Exist. Rail	Seg. 1A 11+000	140
11	School	Industry	Rowland School	Exist. Rail	Seg. 1B 36+800	95
12	School	River. Co.	Antelope School	Highway	Seg. 2A 142+000	145
13	Park	San Ber.	Nunez Park	New	Seg. 1C 95+000	155
14	Park	San Diego	Rancho Bernardo Park	Highway	Seg. 2A 212+500	122
15	Park	San Diego	Old Town	Exist. Rail	Seg. 3B 234+000	93

California High Speed Rail

Inland Empire - Typology Analysis

Noise Impact Analysis - MITIGATED (continued)

ag = at grade
sc = shallow cut
dc = deep cut
as = aerial structure
emb = embankment
nb = noise barrier

	TOTAL # TRAINS One/Direction			
	7 to 22		22 to 7	
	NB	SB	NB	SB
Gold LIne	11	14	5	0
Green Line	0	0	0	0
Blue Line	37	35	5	3
total trains both direct.	97		13	
train/hr	6.5		1.4	

Distance to Alignment (ft)	Existing Ambient (Ldn/Leqday)	FRA Landuse Category	Alignment Geometry		Speed Regime	Reference SEL	Speed Coefficient K	Reference Speed	Reference Length	Shielding Correction
400	60	2	nb		2	93.0	17	90	634	-10
150	66	2	nb		3	99.0	47	180	73	-5
50	68	2	nb		2	93.0	17	90	634	-10
100	58	2	nb		2	93.0	17	90	634	-10
300	57	2	nb		2	93.0	17	90	634	-10
600	54	2	nb		3	99.0	47	180	73	-5
50	65	2	nb		2	93.0	17	90	634	-10
450	55	2	nb		2	93.0	17	90	634	-10
410	63	2	nb		2	93.0	17	90	634	-10
200	60	2	nb		2					N/A
260	60	3	nb		2					N/A
50	65	3	nb		2	93.0	17	90	634	-10
50	60	3	nb		2	93.0	17	90	634	-10
80	67	3	nb		2	93.0	17	90	634	-10
50	68	3	nb		2	93.0	17	90	634	-10

California High Speed Rail

Inland Empire - Typology Analysis

Noise Impact Analysis - MITIGATED (continued)

SEL @ 50ft	Leqday @ 50ft	Leqnight @ 50ft	Ldn @ 50 ft	Project Ldn/Leq @ Receiver	Mitigation Impact
99.9	62	56	64	50	NI
102.0	70	63	71	64	I
99.7	62	56	64	64	I
96.2	59	52	60	56	NI
100.4	63	56	65	53	NI
101.2	69	62	70	54	NI
98.3	61	54	63	63	I
97.8	60	54	62	48	NI
98.7	61	55	63	49	NI
					N/A
					N/A
99.7	62	56	64	62	NI
100.2	63	56	64	63	NI
98.4	61	54	63	58	NI
96.4	59	52	61	59	NI

California High Speed Rail

Inland Empire

Groundborne Vibration Predictions

Num.	Landuse	Community	Location and/or Description	Corridor Type	Civil Station	Train Speed (mph)	Distance to Alignment (ft)	FRA Landuse Category	Max. Allowed Vib	**OA**	IMPACT?
1	Residential	Montebello	W. Roosevelt Ave.	Exist. Rail	Seg. 1B18+000	149	400	2	72	**66**	**NO**
2	Residential	El Monte	E. Lansdale St.	Hwy/Rail	Seg. 1A23+200	180	150	2	72	**76**	**YES**
3	Residential	Rialto	Bonnie View Dr.	Exist. Rail	Seg. 1C 86+000	145	50	2	72	**80**	**YES**
4	Residential	Riverside	Campus View Dr.	Exist. Rail	Seg. 1A 101+000	90	100	2	72	**73**	**YES**
5	Residential	Sun City	Encanto Dr.	New/Hwy	Seg. 2A 134+000	160	300	2	72	**69**	**NO**
6	Residential	Rainbow	Los Padres Dr.	Highway	Seg. 2A176+000	173	600	2	72	**61**	**NO**
7	Residential	Escondido	Woodglen Place	Highway	Seg. 2B200+000	121	50	2	72	**78**	**YES**
8	Residential	San Diego	Jade Coast Lane	New	Seg. 3B 210+000	113	450	2	72	**62**	**NO**
9	Residential	San Diego	W. Ivy Dr. at India St.	Exist. Rail	Seg. 3B238+500	127	410	2	72	**64**	**NO**
10	Hospital	Alhambra	Alhambra Health Center	Exist. Rail	Seg. 1A 11+000	140	200	2	72	**71**	**NO**
11	School	Industry	Rowland School	Exist. Rail	Seg. 1B 36+800	95	260	3	75	**66**	**NO**
12	School	River. Co.	Antelope School	Highway	Seg. 2A 142+000	145	50	3	75	**80**	**YES**
13	Park	San Ber.	Nunez Park	New	Seg. 1C 95+000	155	50	3	75	**80**	**YES**
14	Park	San Diego	Rancho Bernardo Park	Highway	Seg. 2A 212+500	122	80	3	75	**76**	**YES**
15	Park	San Diego	Old Town	Exist. Rail	Seg. 3B 234+000	93	50	3	75	**76**	**YES**

California High Speed Rail

Inland Empire

Groundborne Vibration Predictions (continued)

PREDICTED VIBRATION LEVELS*																			
1/3OB	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400
63	29	38	44	47	61	63	50	44	40	42	39	34	33	34	(7)	(24)	(26)	(22)	(20)
72	32	42	49	54	69	72	61	57	53	56	51	45	45	45	5	(13)	(16)	(16)	(17)
77	34	44	51	56	73	77	68	66	64	68	66	63	62	63	23	5	1	0	(4)
75	32	43	50	55	71	75	65	61	58	60	56	52	51	52	11	(6)	(10)	(11)	(13)
66	31	40	46	49	64	66	54	49	43	46	42	38	36	37	(4)	(21)	(23)	(21)	(20)
57	26	36	40	44	57	57	45	38	34	37	33	29	28	28	(12)	(29)	(28)	(24)	(21)
77	34	44	51	56	73	77	68	66	64	68	66	63	62	63	23	5	1	0	(4)
61	28	37	44	46	61	61	49	43	38	41	37	33	32	32	(8)	(26)	(26)	(23)	(21)
63	29	38	44	47	61	63	50	44	40	42	38	34	33	33	(7)	(24)	(26)	(22)	(20)
70	31	42	49	52	67	70	59	54	49	52	48	41	41	41	0	(17)	(20)	(19)	(19)
68	31	41	47	50	65	68	56	51	46	48	44	39	38	38	(2)	(20)	(22)	(20)	(20)
77	34	44	51	56	73	77	68	66	64	68	66	63	62	63	23	5	1	0	(4)
77	34	44	51	56	73	77	68	66	64	68	66	63	62	63	23	5	1	0	(4)
76	33	43	50	55	72	76	66	63	60	63	60	56	55	56	16	(2)	(6)	(7)	(10)
77	34	44	51	56	73	77	68	66	64	68	66	63	62	63	23	5	1	0	(4)

California High Speed Rail

Inland Empire

Groundborne Vibration Predictions (continued)

FORCE DENSITY LEVEL																		
6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33
14	21	25	27	41	43	32	28	25	29	27	24	25	30	13	13	21	29	33

California High Speed Rail

Inland Empire

Groundborne Vibration Predictions (continued)

LINE SOURCE REPONSE																		
2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400
15	17	19	20	20	20	18	16	15	13	12	10	8	4	(20)	(37)	(47)	(51)	(53)
18	21	24	27	28	29	29	29	28	27	24	21	20	15	(8)	(26)	(37)	(45)	(50)
20	23	26	29	32	34	36	38	39	39	39	39	37	33	10	(8)	(20)	(29)	(37)
18	22	25	28	30	32	33	33	33	31	29	28	26	22	(2)	(19)	(31)	(40)	(46)
17	19	21	22	23	23	22	21	18	17	15	14	11	7	(17)	(34)	(44)	(50)	(53)
12	15	15	17	16	14	13	10	9	8	6	5	3	(2)	(25)	(42)	(49)	(53)	(54)
20	23	26	29	32	34	36	38	39	39	39	39	37	33	10	(8)	(20)	(29)	(37)
14	16	19	19	20	18	17	15	13	12	10	9	7	2	(21)	(39)	(47)	(52)	(54)
15	17	19	20	20	20	18	16	15	13	11	10	8	3	(20)	(37)	(47)	(51)	(53)
17	21	24	25	26	27	27	26	24	23	21	17	16	11	(13)	(30)	(41)	(48)	(52)
17	20	22	23	24	25	24	23	21	19	17	15	13	8	(15)	(33)	(43)	(49)	(53)
20	23	26	29	32	34	36	38	39	39	39	39	37	33	10	(8)	(20)	(29)	(37)
20	23	26	29	32	34	36	38	39	39	39	39	37	33	10	(8)	(20)	(29)	(37)
19	22	25	28	31	33	34	35	35	34	33	32	30	26	3	(15)	(27)	(36)	(43)
20	23	26	29	32	34	36	38	39	39	39	39	37	33	10	(8)	(20)	(29)	(37)

Exec Summary Charts

Region: Inland Empire - Potential Noise Impacts - Impact Rating

Alternative	Align. Length (mi) L rating	Align. Length (mi) M rating	Align. Length (mi) H rating	Align. Length (mi) Total
No-Project	118.0	14.0	78.0	210.0
Modal	118.0	14.0	78.0	210.0
HST - Least	83.6	66.9	0.0	150.5
HST - Greatest	74.2	0.0	95.4	169.6

Exec Summary Charts

Region: Inland Empire - Potential Vibration Impacts - Impact Rating

Alternative	Align. Length (mi) L rating	Align. Length (mi) M rating	Align. Length (mi) H rating	Align. Length (mi) Total
No-Project	0.0	0.0	0.0	0.0
Modal	0.0	0.0	0.0	0.0
HST - Least	150.5	0.0	0.0	150.5
HST - Greatest	74.2	95.1	0.0	169.3