3.2.7 Noise

This section describes the methodology used in assessing the existing noise conditions along the proposed HDC Project alignment, provides general information on fundamentals of airborne noise and groundborne vibration issues related to the proposed project, discusses the criteria and models used for evaluating potential noise and vibration impact, and presents the impact analysis, along with abatement recommendations, where appropriate. Construction noise impacts are presented in Section 3.6.

The Nature of Noise

Noise is usually defined as sound that is undesirable because it interferes with speech communication and hearing, or is otherwise annoying.

The decibel (dB) is the accepted standard unit for measuring the amplitude of sound because it accounts for the large variations in sound pressure amplitude. When describing sound and its effect on a human population, A-weighted (dBA) sound pressure levels are typically used to account for the response of the human ear. The term "A-weighted" refers to a filtering of the noise signal in a manner corresponding to the way the human ear perceives sound. The A-weighted noise level has been found to correlate well with people's judgments of the noisiness of different sounds and has been used for many years as a measure of community noise. Figure 3.2.7-1 illustrates typical A-weighted sound pressure levels for various noise sources to enable readers to compare the actual and predicted project noise levels discussed in this section with common activities.

Community noise levels usually change continuously during the day. The equivalent continuous A-weighted sound pressure level (Leq) is normally used to describe community noise. The Leq is the equivalent steady-state A-weighted sound pressure level that would contain the same acoustical energy as the time-varying A-weighted sound pressure level during the same time interval. The maximum sound pressure level (Lmax) is the greatest instantaneous sound pressure level observed during a single noise measurement interval.

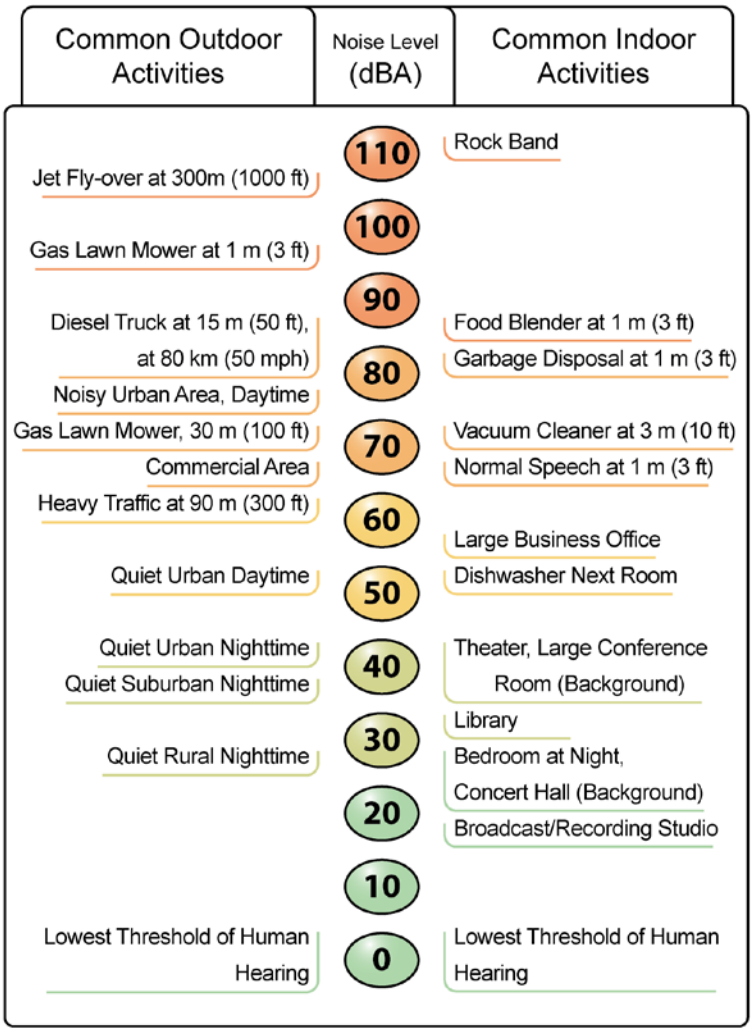
Another descriptor, the day-night average sound pressure level (Ldn), was developed to evaluate the total daily community noise environment. The Ldn is a 24-hour average sound pressure level with a 10-dB time-of-day weighting added to sound pressure levels in the nine nighttime hours from 10:00 p.m. to 7:00 a.m. This nighttime 10-dB adjustment is an effort to account for people's increased sensitivity to nighttime noise events. The Federal Transit Administration (FTA) uses Ldn and Leq to evaluate potential train noise impacts at the surrounding communities.

The Nature of Vibration

Vibration is an oscillatory motion, which can be described in terms of displacement, velocity or acceleration. Displacement, in the case of a vibrating floor, is simply the distance that a point on the floor moves away from its static position. The velocity represents the instantaneous speed of the floor movement, and acceleration is the rate of change of the speed. The response of humans, buildings, and equipment to

vibration is normally described using velocity or acceleration. In this section, velocity would be used in describing ground-borne vibration.

Figure 3.2.7-1 Noise Levels of Common Activities

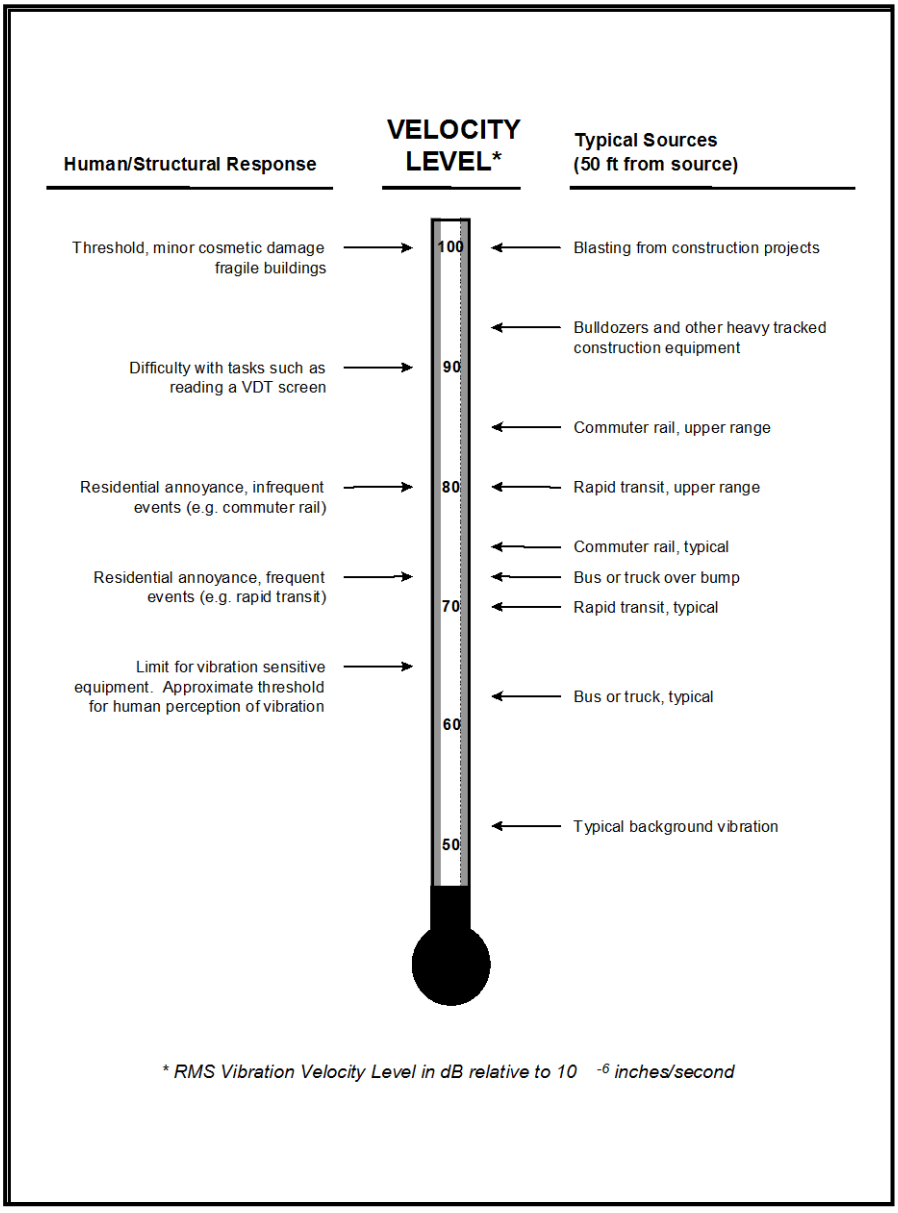


Vibration amplitudes are usually expressed as either peak particle velocity (PPV) or the root mean square (RMS) velocity. The PPV is defined as the maximum instantaneous peak of the vibration signal in inches per second (in/sec). The RMS of a signal is the average of the squared amplitude of the signal in vibration decibels (VdB), or one micro-inch per second. The Federal Railroad Administration (FRA) uses the abbreviation VdB for vibration decibels to reduce the potential for confusion with sound decibel. Although PPV is appropriate for evaluating the potential of building damage, it is not suitable for evaluating human response. Because it takes some time for the human body to respond to vibration signals, RMS amplitude is more appropriate to evaluate human response to vibration than PPV. For sources such as trucks or motor vehicles, peak vibration levels are typically 6 to 14 dB higher than RMS levels.

Decibel notation acts to compress the range of numbers required in measuring vibration. Similar to the noise descriptors, L_{eq} and L_{max} can be used to describe the average vibration and the maximum vibration level observed during a single vibration measurement interval.

Figure 3.2.7-2 shows common vibration sources and the human and structural responses to groundborne vibration. As shown in the figure, the threshold of perception for human response is approximately 65 VdB; however, human response to vibration is not usually substantial unless the vibration exceeds 70 VdB. Vibration tolerance limits for sensitive instruments, such as magnetic resonance imaging (MRI) or electron microscopes, could be much lower than the human vibration perception threshold.

Figure 3.2.7-2 Typical Levels of Groundborne Vibration



Regulatory Setting

The National Environmental Policy Act (NEPA) of 1969 and the California Environmental Quality Act (CEQA) provide the broad basis for analyzing and abating highway traffic noise effects. The intent of these laws is to promote the general welfare and to foster a healthy environment. The requirements for noise analysis and consideration of noise abatement, however, differ between NEPA and CEQA.

Noise and vibration impacts for this project are based on the criteria as defined in the 23 *Code of Federal Regulations* (CFR) 772 and the FRA High-Speed Ground Transportation Noise and Vibration Impact Assessment (September 2012) guidance manual. The criteria contained in this document are applicable for both NEPA and CEQA documentation.

California Environmental Quality Act

CEQA requires a strictly baseline versus build analysis to assess whether a proposed project will have a noise impact. If a proposed project is determined to have a significant noise impact under CEQA, then CEQA dictates that abatement measures must be incorporated into the project unless those measures are not feasible. The rest of this section will focus on the NEPA 23 CFR 772 noise analysis; please see Chapter 4 of this document for further information on noise analysis under CEQA.

National Environmental Policy Act and 23 CFR 772

For highway transportation projects with Federal Highway Administration (FHWA) (and Caltrans, as assigned) involvement, the federal-Aid Highway Act of 1970 and the associated implementing regulations (23 CFR 772) govern the analysis and abatement of traffic noise impacts. The regulations require that potential noise impacts in areas of frequent human use be identified during the planning and design of a highway project. The regulations include noise abatement criteria (NAC) that are used to determine when a noise impact would occur. The NAC differ depending on the type of land use under analysis. For example, the NAC for residences (67 dBA) is lower than the NAC for commercial areas (72 dBA). The following table lists the NAC for use in the NEPA 23 CFR 772 analysis.

According to the Caltrans Traffic Noise Analysis Protocol for New Highway Construction and Reconstruction Projects, May 2011, a noise impact occurs when the predicted future noise level with the project substantially exceeds the existing noise level (defined as a 12-dBA or more increase) or when the future noise level with the project approaches or exceeds the NAC. Approaching the NAC is defined as coming within 1 dBA of the NAC.

Table 3.2.7-1 Noise Abatement Criteria

Activity Category	NAC, Hourly A-Weighted Noise Level, $L_{eq}(h)$	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[1]	67 (Exterior)	Residential.
C[1]	67 (Exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52 (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72 (Exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A through D or F.
F	No NAC—reporting only	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (e.g., water resources, water treatment, electrical), and warehousing.
G	No NAC—reporting only	Undeveloped lands that are not permitted.

[1] Includes undeveloped lands permitted for this activity category.

If it is determined that the project will have noise impacts, then potential abatement measures must be considered. Noise abatement measures that are determined to be reasonable and feasible at the time of final design are incorporated into the project plans and specifications. This document discusses noise abatement measures that would likely be incorporated in the project.

The Caltrans Traffic Noise Analysis Protocol sets forth the criteria for determining when an abatement measure is reasonable and feasible. Feasibility of noise abatement is basically an engineering concern. A minimum 7-dBA reduction in the future noise level must be achieved for an abatement measure to be considered feasible. Other considerations include topography, access requirements, other noise sources, and safety considerations. The reasonableness determination is basically a cost-benefit analysis. Factors used in determining whether a proposed noise abatement measure is reasonable include residents' acceptance and the cost per benefited residence.

FRA Noise Impact Criteria

The criteria in the FRA High-Speed Ground Transportation Noise and Vibration Impact Assessment are for assessing future noise impacts from train operations. They are founded on well-documented research on community reaction to noise and are based on change in noise exposure using a sliding scale. The amount that transit projects are allowed to change the overall noise environment is reduced with increasing levels of existing noise. The FTA noise impact criteria applicable to three categories of land use are summarized in Table 3.2.7-2.

Table 3.2.7-2 Land Use Categories and Metrics for Transit Noise Impact Criteria

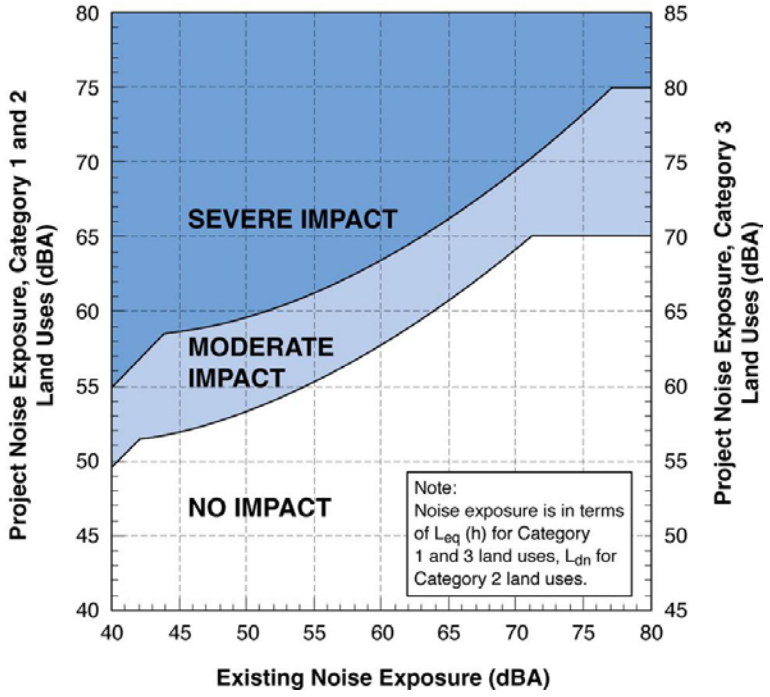
Land Use Category	Noise Metric, dBA	Description of Land Use Category
1	Outdoor $L_{eq}(h)$*	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as national historic landmarks with significant outdoor use. Also included are recording studios and concert halls.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq}(h)$*	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, and museums can also be considered to be in this category. Certain historical sites, parks, campgrounds, and recreational facilities are also included.
* L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.		

L_{dn} is used to characterize noise exposure for residential areas and hotels (Category 2). The maximum 1-hour L_{eq} during the period that the facility is in use is used for other noise-sensitive land uses such as school buildings and parks (Categories 1 and 3). There are two levels of impact included in the FTA criteria, as shown in Figure 3.2.7-3. The interpretations of these two levels of impact are summarized as follows:

- **Severe Impact:** Project noise above the upper curve is considered to cause severe impact because a significant percentage of people would be highly annoyed by the new noise. Severe noise impact is considered "significant" as this term is used in NEPA and implementing regulations. Noise abatement would normally be specified for severe impact areas unless there is no practical method of mitigating the noise.

- **Moderate Impact:** The change in cumulative noise level in this range is noticeable to most people but may not be sufficient to cause strong, adverse reaction from the community. Therefore, other project-specific factors must be considered to determine the magnitude of the impact and the need for abatement. These other factors can include the existing noise level, the predicted increase over existing noise levels, and the types and number of noise-sensitive land uses affected.

Figure 3.2.7-3 Noise Impact Criteria for Transit Projects

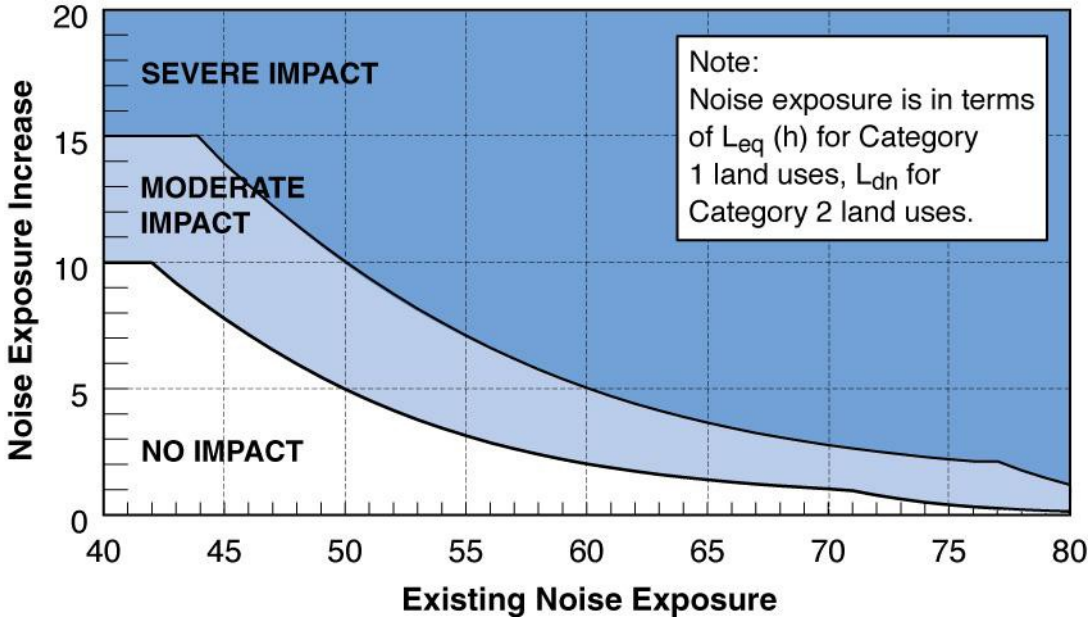


The horizontal axis in Figure 3.2.7-3 is the existing L_{dn} without any project noise, and the vertical axis (right side) is the L_{dn} at residential land uses caused by the project.

Although the curves in Figure 3.2.7-3 are defined in terms of project noise exposure and the existing noise exposure, it is important to emphasize that the increase in the cumulative noise (i.e., when the project noise is added to existing noise) is the basis for the criteria. Figure 3.2.7-3 shows the noise impact criteria for Categories 1 and 2 land uses in terms of the allowable increase in the cumulative noise exposure.

Figure 3.2.7-4 shows that the criterion for impact allows a noise exposure increase of 10 dBA if the existing noise exposure is 42 dBA or less, but only a 1 dBA increase when the existing noise exposure is 70 dBA. As the existing level of ambient noise increases, the allowable level of project noise increases, but the total allowable increase in community noise exposure is reduced. This reduction accounts for an unexpected result: project noise exposure levels that are less than the existing noise exposure can still cause impact.

Figure 3.2.7-4 Increase in Cumulative Noise Levels Allowed by Criteria



The described FRA criteria are normally used for assessing high-speed rail (HSR) projects where the train operation noise would be the dominant noise source. The HDC Project is a multimodal facility where there are both highway and HSR sharing the same corridor, with the HSR running in the median of the freeway. As such, the freeway noise would be the more dominant noise source. Due to this special circumstance, it has been concurred with FRA that peak-hour noise level instead of day-night noise level would be used to assess the rail noise impact for this specific project for all land uses (FRA, 2014). This would allow the rail noise levels to be combined with the peak-hour levels of the highway noise levels. Consequently, this would allow the overall noise impacts and abatement to be assessed and analyzed using the FHWA NAC, which has been agreed upon between FRA and Caltrans as the approach to use for the project.

FRA Vibration Impact Criteria

The criteria set forth in the FRA High-Speed Ground Transportation Noise and Vibration Impact Assessment were used to evaluate vibration impacts from train operations.

Table 3.2.7-3 presents the criteria for various land use categories, as well as the frequency of events. The criteria are related to ground-borne vibration causing human annoyance or interfering with the use of vibration-sensitive equipment. The criteria for acceptable groundborne vibration are expressed in terms of RMS velocity levels in VdB and are based on the maximum levels for a single event (L_{max}).

Table 3.2.7-3 Groundborne Vibration Impact Criteria

Land Use Category	Groundborne Vibration Impact Levels (dB ref. 1 micro-inch/sec)		
	Frequent[1] Events	Occasional[2] Events	Infrequent[3] Events
Category 1: Buildings where low ambient vibration is essential for interior operations.	65 VdB4	65 VdB4	65 VdB[4]
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB

Notes:
[1] "Frequent Events" is defined as more than 70 vibration events of the same source per day.
[2] "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day.
[3] "Infrequent Events" is defined as fewer than 30 vibration events of the same source per day.
[4] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Ensuring lower vibration levels in a building often requires special design of the heating, ventilation, and air conditioning (HVAC) systems and stiffened floors.

Source: FTA, 2006.

The sensitive receptors within the project boundary (i.e., residences, parks, or churches) fall under Land Use Categories 2 and 3; thus, the maximum allowable vibration levels of 75 and 78 VdB, respectively, will be used as project criteria because the estimated number of HSR operations will be between 30 and 70 per day. Hence, the operation can be categorized as "Occasional Events." No Category 1 land use was identified along the proposed commuter rail alignment.

Affected Environment

Caltrans District 7 published a detailed *Traffic Noise Study Report* on June 9, 2014, titled The High Desert Corridor Project from SR-14 in Los Angeles County to SR-18 in San Bernardino County, California, EA 26000, EFIS 0712000035. A separate technical report analyzing the noise and vibration effects of the HSR component, as well as that of the overall project, was published in June 2014.

Field investigations were conducted to identify land uses that could be subject to operation and construction noise impacts from the proposed project. Land uses in the project area were categorized by land use types, Activity Categories as defined in Table 3.2.7-1, and the extent of frequent human use. For this particular project, single-family residences and multi-family residences were identified as Activity Category B, while schools, parks, recreation areas, playgrounds, golf courses, places of worship, medical facilities, and cemeteries were identified as Activity Category C land uses in the project area. Hotels/motels and restaurants were identified under Activity Category E.

Short-term measurement locations were selected to represent each major developed area within the project area. Long-term measurements were conducted to capture diurnal traffic noise level patterns in the project area. Short-term measurement locations were selected to serve as representative modeling locations. Several other nonmeasurement locations were selected as modeling locations. The field survey for

all noise measurements included visiting the project sites to identify land uses within the project limits and to select the noise measurement sites.

The noise measurement sites were selected taking into consideration the following general site requirements:

- Sites were acoustically representative of areas and conditions of interest. They were located at areas of human use.
- Sites were clear of major obstructions between source and receiver. Microphone positions were more than 10 feet away from reflecting surfaces.
- Sites were free of noise contamination by sources other than those of interest. Sites were not located near barking dogs, lawn mowers, pool pumps, air conditioners, etc.
- Sites were not exposed to prevailing meteorological conditions that are beyond the constraints discussed in the Technical Noise Supplement (TeNs).

Field investigations were conducted to determine existing noise levels and gather information to develop and calibrate the traffic noise model that was used for predicting future noise levels. Ambient noise levels were measured along the HDC main alignment area to assess new freeway traffic noise impacts for the HDC Project. Existing noise levels were recorded at 66 locations and modeled at 32 locations. Five long-term (24-hour) noise level readings were conducted to determine the noisiest hour within the project limits. These locations are acoustically representative of the noise environment and land uses within the limits of the project. The existing ambient noise levels measured were between 42 and 70 dBA. These existing noise levels, in addition to 5 other long-term noise measurements conducted along the project corridor, were also used in assessing the rail noise impacts. Existing noise levels at various receptor locations are presented in Tables 3.2.7-4 through 3.2.7-8. Receptor locations are shown in Appendix N.

Environmental Consequences

This section describes the potential impacts related to the operation of the proposed project. Under 23CFR772.7, this project has been deemed to be a Type I project (Type I project is a project that involves construction of a highway on new location or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment or increases the number of through-traffic lanes).

Freeway/Expressway and Freeway/Tollway Alternatives

Noise impacts from these two alternatives and their variations would arise from traffic noise. As detailed in the *Technical Noise Study Report*, there would be substantial noise increases in most of the areas due to the mainline alignment because it is a newly constructed freeway. Conversely, some areas are expected to experience a drop in noise levels postconstruction due to retaining walls from the new connectors shielding traffic noise coming from the main alignment. Overall, according to FHWA's Traffic noise Prediction Model (FHWA-RD-77-108) and Caltrans' Traffic Noise Model (TNM 2.5), future noise levels are predicted to be in the range of 52 to 77 dBA-L_{eq}(h).

The traffic noise analysis indicates that residential areas, a school, a park, and a church within the project limits would be impacted after project completion under the Freeway/Expressway and Freeway/Tollway alternatives including their variations (i.e., the noise level would approach or exceed FHWA NAC) as summarized in Tables 3.2.7-5 through 3.2.7-9.

Freeway/Expressway and Freeway/Tollway with HSR Alternatives

Noise impacts under the alternatives with HSR feeder would arise from both traffic noise and noise associated with HSR operation. Future project noise levels, as well as the combined cumulative noise levels, which include the projected traffic noise levels, were calculated.

Procedures outlined in the FRA High-Speed Ground Transportation Noise and Vibration Impact Assessment were used to predict high-speed train (HST) pass-by noise levels at representative noise-sensitive locations along the project alignment. Per discussion earlier, due to the special circumstance of this project where the freeway noise would be the dominant noise source, it has been decided and agreed upon with FRA that rail noise impact would be assessed using Category 3 (L_{eq}) criteria for all noise-sensitive land uses.

Train pass-by noise levels at the sensitive locations were calculated using the operation schedule, speed, and distance to track alignment that were available at the time of the study. Some of the parameters used in the analysis are as follows:

- A 10-car electric multiple unit (EMU) train would be operating.
- Operating speed of 125 miles per hour (mph) assumed throughout the length of the corridor for worst-case analysis.
- The operating times for the proposed service would be between 6:00 a.m. and midnight. The operating plan for HSR service specifies mid-day headways of 20 minutes, morning and evening headways of 30 minutes, and early morning and late night headways of 1 hour.
- Tracks would be on embankment.

Results of the train noise analysis indicate that there would be no impact expected as a result of the HSR operation and the train noise contribution to the overall project noise levels would be insignificant throughout the entire project corridor. Tables 3.2.7-4 through 3.2.7-8 present the results of the train noise impact analysis, as well as the combined project noise effects along the segment where both HSR and freeway/expressway co-exist. As shown in the tables, the increase in future noise levels as a result of the train noise operations are mostly zeros. It is also shown that all potential project impacts are due to the traffic noise generated by the freeway component of the project.

Table 3.2.7-4 Predicted Train and Overall Noise Levels – HDC Freeway/Expressway Alternative with HSR – Main Alignment Segment 1 (between SR-14 and 100th Street)

						TRAFFIC NOISE		TRAIN NOISE			TRAFFIC + TRAIN NOISE	
Receiver	Direction	Location	Land Use	FHWA Noise Abatement Criteria (dBA)	Existing Noise Level. dBA	Future Worst-Hour Traffic Noise Level, Leq, dBA	FHWA/ Caltrans Impact Type (Appoach/ Exceed, Substantial)	Future Peak Hour Train Noise Level, Leq, dBA	FRA Noise Impact Criteria (Moderate/ Severe), dBA	FRA Train Noise impact Type (None, Moderate, Severe)	Future Peak Hour Overall Project Noise Level, Leq, dBA	Increase of Future Noise Level Due to Train Operations
B0	WB	1018 E. Ave. P5, Palmdale	R	B (67)	49	68	A/E	47	58 / 64	None	68	0
BM0	WB	1045 E. Ave. P5, Palmdale	R	B (67)	49	68	A/E	49	58 / 64	None	68	0
B1	EB	38902 25th St., Palmdale	R	B (67)	58	60	None	40	62 / 67	None	60	0
B5	EB	39149 8th St., Palmdale	CH	B (67)	48	66	A/E	43	58 / 64	None	66	0
B6	WB	39315 Carolside Ave., Palmdale	R	B (67)	53	68	A/E	37	59 / 65	None	68	0

Land Use:
R = Residential
CH = Church

Table 3.2.7-5 Predicted Train and Overall Noise Levels – HDC Freeway/Expressway Alternative with HSR – Main Alignment Segment 2 (between 100th Street and LA/SB County Line)

						TRAFFIC NOISE		TRAIN NOISE			TRAFFIC + TRAIN NOISE	
Receiver	Direction	Location	Land Use	FHWA Noise Abatement Criteria (dBA)	Existing Noise Level. dBA	Future Worst-Hour Traffic Noise Level, Leq, dBA	FHWA/ Caltrans Impact Type (Appoach/ Exceed, Substantial)	Future Peak Hour Train Noise Level, Leq, dBA	FRA Noise Impact Criteria (Moderate/ Severe), dBA	FRA Train Noise impact Type (None, Moderate, Severe)	Future Peak Hour Overall Project Noise Level, Leq, dBA	Increase of Future Noise Level Due to Train Operations
1	EB	13400 E Ave R, Palmdale	R	B (67)	44	55	A/E	41	57 / 64	None	55	0
2	WB	14660 E Palmdale Blvd., Palmdale	R	B (67)	45	63	S	46	57 / 64	None	63	0
3	EB	14745 E Ave Q14, Palmdale	R	B (67)	46	68	A/E	49	57 / 64	None	68	0
4	WB	15366 Palmdale Blvd., Palmdale	R	B (67)	46	62	S	45	57 / 64	None	62	0
M4	WB	15616 E Palmdale Blvd, Palmdale	R	B (67)	46	67	A/E	49	57 / 64	None	67	0
9	WB	20150 Palmdale Blvd., Lancaster	R	B (67)	55	59	None	46	60 / 66	None	59	0
M9	WB	38250 200th St. E, Lancaster	R	B (67)	55	63	None	46	60 / 66	None	63	0
10	EB	20539 Ave R, Palmdale	R	B (67)	57	57	None	42	61 / 67	None	57	0
M10	EB	20847 Ave R, Palmdale	R	B (67)	57	58	None	44	61 / 67	None	58	0
M11	WB	22210 E Palmdale Blvd., +C54Lake Los Angeles	R	B (67)	55	62	None	45	60 / 66	None	62	0

Land Use:
R = Residential

Table 3.2.7-6 Predicted Train and Overall Noise Levels – HDC Freeway/Expressway Alternative with HSR – Main Alignment Segment 2 (between 100th Street and LA/SB County Line), Variation D

						TRAFFIC NOISE		TRAIN NOISE				TRAFFIC + TRAIN NOISE	
Receiver	Direction	Location	Land Use	FHWA Noise Abatement Criteria (dBA)	Existing Noise Level. dBA	Future Worst-Hour Traffic Noise Level, Leq, dBA	FHWA/ Caltrans Impact Type (Appoach/ Exceed, Substantial)	Future Peak Hour Train Noise Level, Leq, dBA	FRA Noise Impact Criteria (Moderate/ Severe), dBA		FRA Train Noise impact Type (None, Moderate, Severe)	Future Peak Hour Overall Project Noise Level, Leq, dBA	Increase of Future Noise Level Due to Train Operations
10	WB	20539 Ave R, Palmdale	R	B (67)	57	65	None	47	61	/ 67	None	65	0
M10	WB	20847 Ave R, Palmdale	R	B (67)	57	60	None	44	61	/ 67	None	60	0

Land Use:
R = Residential

Table 3.2.7-7 Predicted Train and Overall Noise Levels – HDC Freeway/Expressway Alternative with HSR – Main Alignment Segment 3

Receiver	Direction	Location	Land Use	FHWA Noise Abatement Criteria (dBA)	Existing Noise Level. dBA	TRAFFIC NOISE		TRAIN NOISE			TRAFFIC + TRAIN NOISE	
						Future Worst-Hour Traffic Noise Level, Leq, dBA	FHWA/ Caltrans Impact Type (Appoach/ Exceed, Substantial)	Future Peak Hour Train Noise Level, Leq, dBA	FRA Noise Impact Criteria (Moderate/ Severe), dBA	FRA Train Noise impact Type (None, Moderate, Severe)	Future Peak Hour Overall Project Noise Level, Leq, dBA	Increase of Future Noise Level Due to Train Operations
15	WB	17713 Stevens St., Adelanto	R	B (67)	56	56	None	42	61 / 67	None	56	0
16		11301 Air Expressway, Adlanto	R	B (67)	52	63	None	47	59 / 65	None	63	0
M1-17		Richardson Park, Adelanto	R	B (67)	57	58	None	40	61 / 69	None	58	0
M2-17		Adelanto School District Office	C	E (72)	56	56	None	41	61 / 67	None	56	0
18	EB	12200 Hibiscus Rd., Adelanto	R	B (67)	59	60	None	44	62 / 68	None	60	0
19		15059 Turner Rd. , Victorville	R	B (67)	49	58	None	47	58 / 65	None	59	1
20		18003 Westwind Rd., Victorville	G	B (67)	64	64	None	44	65 / 70	None	64	0
20a	WB	Rockview Park, Victorville	P	B (67)	42	52	None	49	57 / 62	None	53	1
21		17442 D St., Victorville	R	B (67)	63	63	None	49	65 / 70	None	63	0
22e		17284 Dante St., Victorville	R	B (67)	48	59	None	43	58 / 64	None	59	0
M22e	EB	Near 17284 Dante St. Victorville	R	B (67)	57	59	None	44	61 / 67	None	59	0

Land Use:
R = Residential
C = Commercial
P = Park
G = Golf Course

Table 3.2.7-8 Predicted Train and Overall Noise Levels – HDC Freeway/Expressway Alternative with HSR – Main Alignment Segment 3, Variation E

Receiver	Direction	Location	Land Use	FHWA Noise Abatement Criteria (dBA)	Existing Noise Level. dBA	TRAFFIC NOISE		TRAIN NOISE			TRAFFIC + TRAIN NOISE	
						Future Worst-Hour Traffic Noise Level, Leq, dBA	FHWA/ Caltrans Impact Type (Appoach/ Exceed, Substantial)	Future Peak Hour Train Noise Level, Leq, dBA	FRA Noise Impact Criteria (Moderate/ Severe), dBA	FRA Train Noise impact Type (None, Moderate, Severe)	Future Peak Hour Overall Project Noise Level, Leq, dBA	Increase of Future Noise Level Due to Train Operations
C	EB	16924 Jurassic Pl., Victorville	R	B (67)	48	54	None	47	58 / 64	None	54	0
M1C	EB	16982 Manning St., Victorville	R	B (67)	48	57	None	52	58 / 64	None	58	1
M2C	EB	16988 Jurassic PL, Victorville	R	B (67)	48	59	None	42	58 / 64	None	59	0
M3C	EB	17092 Jurassic PL, Victorville	R	B (67)	48	60	None	40	58 / 64	None	60	0
M4C	EB	17139 Jurassic PL., Victorville	R	B (67)	48	61	None	39	58 / 64	None	61	0
M5C	EB	17047 Jurassic PL, Victorville	R	B (67)	48	56	None	42	58 / 64	None	56	0
M6C	EB	17103 Jurassic PL, Victorville	R	B (67)	48	57	None	40	58 / 64	None	57	0

Land Use:
R = Residential

Vibration Associated with HSR Operation

Following guidelines and procedures in the FTA High-Speed Ground Transportation Noise and Vibration Assessment manual, the ground vibration related to the HSR pass-bys were estimated and assessed at locations of various distances from track centerline.

As discussed earlier, the FRA limits for groundborne vibration related to train pass-by for this project would be 75 and 78 VdB for Category 2 and 3 land uses, respectively. Assuming that the HSR would be operating at maximum operating speed of 125 mph throughout the entire length of the project corridor, unless there are Category 2 land uses (i.e., homes) located within 100 feet of the track centerline, or Category 3 land uses (i.e., institutional land uses with primarily daytime use) located within 75 feet of the nearest track centerline, there would be no anticipated vibration impact due to HSR operation. The Plant 42/ Lockheed/Los Angeles World Airports (LAWA) facilities located near the project corridor in Palmdale would be considered Category 3, and no impact is anticipated at any of those facilities. In fact, there is no vibration impact expected to occur along the entire length of the project corridor as a result of the HSR operation.

Avoidance, Minimization, and/or Noise Abatement Measures

Project Construction

Measures to minimize noise impacts during project construction are provided in Section 3.6, Construction Impacts, of this environmental document.

Project Operation

Because traffic noise impacts have been identified, noise abatement has been considered for the impacted receptors. As stated in 23 CFR 772 and in Caltrans Protocol, noise abatement is considered where noise impacts are predicted, where frequent human use occurs, and where a lowered noise level would be of benefit. In addition, because no train operation noise impacts are anticipated and the train noise contribution to the overall project noise is minimal, the abatement considered for traffic noise would also be valid and effective for the overall project noise.

Noise abatement is considered for locations where traffic noise levels would approach or exceed the noise abatement criterion or there is a noise level increase of 12 dB. A barrier must meet both the feasible and reasonable criteria to be built. Feasibility of noise abatement is an engineering concern. A minimum 5-decibel reduction in the future noise level must be achieved for an abatement measure to be considered feasible. The preliminary reasonableness determination is made first by achieving the noise reduction design goal. The design goal is that a barrier must be predicted to provide at least 7 dB of noise reduction at one or more benefited receptors for the barrier to be considered reasonable. Second, for a barrier to be considered reasonable, construction cost must be within the established allowance per benefited receptor. Finally, the viewpoints of benefitted receptors (including property owners and residents of the benefitted receptors) must be taken into account for a barrier to be considered reasonable.

Based on the studies completed to date, Caltrans intends to incorporate noise abatement in the form of soundwalls at the location described in the following paragraphs. If during final design conditions have substantially changed, noise abatement may not be necessary. The final decision of the noise abatement will be made upon completion of the project design and the public involvement processes.

A summary of the considered soundwalls is presented in Tables 3.2.7-9 through 3.2.7-13.

Northbound SR-14

Soundwalls SW-100 and SW-101 would be located at the edge-of-shoulder and would benefit single-family homes and the Palmdale Learning Plaza School between Avenue S and Palmdale Boulevard, along northbound SR-14. The proposed soundwall SW-100 would replace an existing 12-foot-high soundwall, which would be removed due to the proposed freeway widening. Soundwall SW-100, in combination with SW-101, would attenuate the predicted noise impacts at the school playground. A combination of the two proposed soundwalls would provide up to 9 dB of noise reduction. The proposed soundwalls were analyzed based on the assumption that they are constructed on retaining walls of the connector and ramp along the northbound side. If the assumption has changed and the proposed connectors and ramps are to be built on piles, all soundwalls in the area would need to be reanalyzed and remodeled.

Soundwall SW-104 would be located at the edge-of-shoulder, along northbound SR-14, between the new HDC freeway and 10th Street West. This soundwall would attenuate the noise impact at the residential area represented by Sites A0 and A3. The height of the soundwall required to meet the design goals for feasibility and reasonableness is 16 feet. The traffic noise analysis for the area is based on the assumption that all soundwalls are built on retaining walls of connectors and ramps. If the assumption has changed and the proposed connectors and ramps are to be built on piles, all soundwalls in the area would need to be reanalyzed and remodeled.

Southbound SR-14

Soundwalls SW-102 and SW-103 would be located at the edge-of-shoulder and would benefit the residential area consisting of single-family homes between Palmdale Boulevard and Avenue S along southbound SR-14. SW-102 would replace the entire existing 12-foot-high soundwall in the area south of Palmdale Boulevard. The existing 12-foot-high soundwall would be removed due to the proposed widening along southbound SR-14 and realignment of the southbound on-ramp from eastbound Palmdale Boulevard. The two proposed soundwalls would provide up to 11 dB of noise reduction.

Soundwall SW-105 would be located at the southbound edge of shoulder between Avenue O and Avenue O-8 W. This soundwall would benefit two residential properties.

Table 3.2.7-9 Summary of Considered Soundwalls on SR-14 – Freeway/Expressway Alternative (Palmdale)

Proposed Soundwall	Design Yr. (2035) Noise level dBA $L_{eq}(h)$	Noise Increase (dBA)	Direction	Location	Acoustically Feasible Height Range (feet)	Approximate Length (feet)	Noise Attenuation Range (dBA)	Number of Benefitted Receivers	Reasonable Allowance
SW-100	67	0	NB	Between Avenue S and Palmdale Boulevard	10 to 16	3,150	5 to 9	1 to 14	$55,000 to $770,000
SW-101	67	0				1,993			
SW-102	77	11	SB	Between Avenue S and Palmdale Boulevard	10 to 16	2,940	7 to 11	36 to 62	$1,980,000 to $3,410,000
SW-103	77	11				970			
SW-104	70	0	SB	Between new SR-138 / HDC and 10th Street W	12 to 16	1,780	5 to 7	11	$605,000
SW-105	71	0	SB	Between Avenue O-8 W and Avenue O	10 to 16	400	6 to 8	2	$110,000

Table 3.2.7-10 Summary of Considered Soundwalls on HDC – Freeway/Expressway Alternative – Main Alignment Segment 1 (between SR-14 and 100th Street)

Proposed Soundwall	Design Yr. (2035) Noise level dBA $L_{eq}(h)$	Noise Increase (dBA)	Direction	Location	Acoustically Feasible Height Range (feet)	Approximate Length (feet)	Noise Attenuation Range (dBA)	Number of Benefitted Receivers	Reasonable Allowance
SW-106	69	15	WB	Between Division Street and 3rd Street E	10 to 16	1594	8 to 11	14	$770,000
SW-107	66	18	EB	Between Sierra Highway and 15th Street E	10 to 16	3400	6 to 7	1	$55,000
SW-109	68	19	WB	Between 10th Street E and 15th Street E	8 to 16	2500	5 to 7	11 to 22	$605,000 to $1,210,000

Table 3.2.7-11 Summary of Considered Soundwalls on HDC – Freeway/Expressway Alternative – Main Alignment Segment 1 (between SR-14 and 100th Street) – Variation A

Proposed Soundwall	Design Yr. (2035) Noise level dBA $L_{eq}(h)$	Noise Increase (dBA)	Direction	Location	Acoustically Feasible Height Range (feet)	Approximate Length (feet)	Noise Attenuation Range (dBA)	Number of Benefitted Receivers	Reasonable Allowance
SW-106	68	15	WB	Between Division Street and 3rd Street E	10 to 16	1594	8 to 11	14	$770,000
SW-107	67	19	EB	Between Sierra Highway and 15th Street E	8 to 16	3000	5 to 9	1	$55,000
SW-109	71	22	WB	Between 10th Street E and 15th Street E	8 to 16	2800	6 to 8	11 to 22	$605,000 to $1,210,000

Table 3.2.7-12 Summary of Considered Soundwalls on HDC – Freeway/Expressway Alternative – Main Alignment Segment 2 (between 100th Street and LA/SB County Line)

Proposed Soundwall	Design Yr. (2035) Noise level dBA $L_{eq}(h)$	Noise Increase (dBA)	Direction	Location	Acoustically Feasible Height Range (feet)	Approximate Length (feet)	Noise Attenuation Range (dBA)	Number of Benefitted Receivers	Reasonable Allowance
SW-111	63	18	WB	Between 140th Street E and 170th Street E	8 to 16	4290	5 to 8	2	$110,000
SW-112	68	22	EB	Between 140th Street E and 170th Street E	12 to 16	2000	6 to 7	1	$55,000
SW-113	67	21	WB	Between 140th Street E and 170th Street E	8 to 16	4500	5 to 9	2	$110,000

Table 3.2.7-13 Summary of Considered Soundwalls on HDC – Freeway/Expressway Alternative – Main Alignment Segment 3 - Expressway

Proposed Soundwall	Design Yr. (2035) Noise level dBA $L_{eq}(h)$	Noise Increase (dBA)	Direction	Location	Acoustically Feasible Height Range (feet)	Approximate Length (feet)	Noise Attenuation Range (dBA)	Number of Benefitted Receivers	Reasonable Allowance
SW-114	63	17	EB	Between Joshua Road and Standing Rock Road	12 to 16	2000	7 to 9	1	$55,000

Westbound HDC Main Alignment 1

Soundwall SW-106 would benefit the residential area consisting of single-family homes located between Division Street and 3rd Street East. SW-106 (range of 10 to 16 feet) would provide noise reduction from 8 to 11 dBA to the residents.

Soundwall SW-109 would benefit the residential area consisting of single-family homes located between 10th Street East and 15th Street East. SW-109 (range of 8 to 16 feet) would provide noise reduction from 5 to 7 dBA to the residents.

Eastbound HDC Main Alignment 1

Soundwall SW-107 would benefit Unity Church located west of 8th Street East along the newly proposed eastbound HDC freeway. SW-107 (range of 10 to 16 feet) would provide noise reduction from 6 to 7 dBA.

Westbound HDC Main Alignment 1, Variation A

Soundwall SW-106 would have the same benefits as mentioned previously for the Westbound HDC Main Alignment 1.

Soundwall SW-109 would benefit the residential area consisting of single-family homes located between 10th Street East and 15th Street East. SW-109 (range of 8 to 16 feet) would provide noise reduction from 6 to 8 dBA.

Eastbound HDC Main Alignment 1 Variation A

Soundwall SW-107 would benefit Unity Church located west of 8th Street East along the newly proposed eastbound HDC freeway. SW-107 (range of 8 to 16 feet) would provide noise reduction of 5 to 9 dBA.

Westbound HDC Main Alignment 2

Soundwall SW-111 would benefit the residential area consisting of two single-family homes located between just east of 140th Street east and 150th Street East. SW-111 (range of 8 to 16 feet) would provide noise reduction of 5 to 8 dBA.

Soundwall SW-113 would benefit the residential area consisting of two single-family homes located between east of 150th Street East and 160th Street East. SW-113 (range of 8 to 16 feet) would provide noise reduction of 5 to 9 dBA.

Eastbound HDC Main Alignment 2

Soundwall SW-112 would benefit a single-family residential home located between 140th Street East and 150th Street East. SW-112 (range of 12 to 16 feet) would provide a 6- to 7-dBA noise reduction.

Eastbound HDC Main Alignment 3 Expressway

Soundwall SW-114 would benefit a single-family residential home located between Joshua Road and Standing Rock Road. SW-114 (range of 12 to 16 feet) would provide a 7- to 9-dBA noise reduction.

A draft Noise Abatement Decision Report (NADR), dated June 10, 2014, was prepared by Caltrans to determine whether the considered noise abatement measures would meet requirements to be recommended. Two determining factors are the feasibility and reasonableness of the soundwalls. Tables 3.2.7-14 through 3.2.7-18 summarize NADR findings on construction cost and calculated reasonable allowance to determine economic feasibility for each noise barrier.

NOI-1: Based on the studies completed to date and the draft NADR, Caltrans intends to incorporate noise abatement in the form of soundwalls that were found to be both feasible and reasonable. The recommended soundwalls would reduce the traffic noise levels by at least 5 dB at the impacted receivers, would meet the design goal by providing a 7-decibel reduction for at least one receiver, and would cost less than the reasonableness cost allowance. If during final design, conditions have substantially changed, noise abatement may not be necessary. The final decision of the noise abatement will be made upon completion of the project design and the public involvement processes.

The recommended soundwalls, determined by the NADR to meet these criteria, are presented in Table 3.2.7-19. The soundwall locations are also graphically shown on figures in Appendix N.

Prior to the formal selection of the Preferred Alternative and approval of the project, all property owners of the benefitted receptors located adjacent to each of the proposed soundwalls will be given an opportunity to vote if they want the soundwall to be constructed to abate the traffic noise in their area or not. For soundwalls located within state right-of-way, if more than 50 percent of the votes from responding benefitted receptors oppose the abatement, the abatement will not be considered reasonable and will not be built. If the soundwall is to be located on private property (or properties), 100 percent of the property owners must vote in favor of the soundwall for it to be constructed. However, at this time, none of the recommended soundwalls are on private property.

Table 3.2.7-14 Summary of Preliminary Noise Abatement Decision for Soundwalls on SR-14

Barrier	Height (ft)	Acoustically Feasible (5dBA min.)	Number of Benefited Residences	Total Reasonable Allowance	Estimated Construction Cost	Cost less than Allowance	Noise Reduction (dBA)
SW-100, SW-101	8	Y	1	$55,000	$1,802,000	N	5
	10	Y	8	$440,000	$2,183,000	N	6
	12	Y	10	$550,000	$2,564,000	N	7
	14	Y	14	$770,000	$2,945,000	N	7
	16	Y	14	$770,000	$3,310,000	N	8
SW-102, SW-103	8	N	0	$0	$1,370,000	N	5
	10	Y	36	$1,980,000	$1,660,000	Y	8
	12	Y	62	$3,410,000	$1,949,000	Y	10
	14	Y	62	$3,410,000	$2,239,000	Y	11
	16	**Y**	**62**	**$3,410,000**	**$2,516,000**	**Y**	**12**
SW-104	8	N	0	$0	$624,000	N	4
	10	N	0	$0	$756,000	N	5
	12	Y	11	$605,000	$887,000	N	5
	14	Y	11	$605,000	$1,019,000	N	6
	16	Y	11	$605,000	$1,145,000	N	7
SW-105	8	N	0	$0	$140,000	N	4
	10	Y	2	$110,000	$170,000	N	6
	12	Y	2	$110,000	$199,000	N	7
	14	Y	2	$110,000	$229,000	N	7
	16	Y	2	$110,000	$257,000	N	8

Table 3.2.7-15 Summary of Preliminary Noise Abatement Decision for Soundwalls on HDC: Main Alignment, Segment 1

Barrier	Height (ft)	Acoustically Feasible (5dBA min.)	Number of Benefited Residences	Total Reasonable Allowance	Estimated Construction Cost	Cost less than Allowance	Noise Reduction (dBA)
	8	N	0	$0	$529,000	N	3
	10	Y	14	$770,000	$648,000	Y	8
SW-106	**12**	**Y**	**14**	**$770,000**	**$766,000**	**Y**	**9**
	14	Y	14	$770,000	$884,000	N	10
	16	Y	14	$770,000	$997,000	N	11
	8	Y	0	$0	$1,191,000	N	3
	10	Y	1	$55,000	$1,443,000	N	4
SW-107	12	Y	1	$55,000	$1,695,000	N	4
	14	Y	1	$55,000	$1,947,000	N	4
	16	Y	1	$55,000	$2,188,000	N	5
	8	Y	11	$605,000	$876,000	N	4
	10	Y	11	$605,000	$1,061,000	N	6
SW-109	**12**	**Y**	**22**	**$1,210,000**	**$1,209,000**	**Y**	**7**
	14	Y	22	$1,210,000	$1,432,000	N	8
	16	Y	22	$1,210,000	$1,609,000	N	9

Table 3.2.7-16 Summary of Preliminary Noise Abatement Decision for Soundwalls on HDC: Main Alignment, Segment 1 (Variation A)

Barrier	Height (ft)	Acoustically Feasible (5dBA min.)	Number of Benefited Residences	Total Reasonable Allowance	Estimated Construction Cost	Cost less than Allowance	Noise Reduction (dBA)
	8	N	0	$0	$529,000	N	3
	10	Y	14	$770,000	$648,000	Y	8
SW-106	12	Y	14	**$770,000**	**$766,000**	**Y**	**9**
	14	Y	14	$770,000	$884,000	N	10
	16	Y	14	$770,000	$997,000	N	11
	8	Y	1	$55,000	$1,051,000	N	2
	10	Y	1	$55,000	$1,273,000	N	2
SW-107	12	Y	1	$55,000	$1,496,000	N	4
	14	Y	1	$55,000	$1,718,000	N	5
	16	Y	1	$55,000	$1,931,000	N	5
	8	Y	11	$605,000	$981,000	N	4
	10	Y	11	$605,000	$1,188,000	N	6
SW-109	12	Y	22	$1,210,000	$1,396,000	N	7
	14	Y	22	$1,210,000	$1,603,000	N	8
	16	Y	22	$1,210,000	$1,802,000	N	8

Table 3.2.7-17 Summary of Preliminary Noise Abatement Decision for Soundwalls on HDC: Main Alignment, Segment 2

Barrier	Height (ft)	Acoustically Feasible (5dBA min.)	Number of Benefited Residences	Total Reasonable Allowance	Estimated Construction Cost	Cost less than Allowance	Noise Reduction (dBA)
SW-111	8	Y	2	$110,000	$1,503,000	N	2
	10	Y	2	$110,000	$1,821,000	N	2
	12	Y	2	$110,000	$2,139,000	N	4
	14	Y	2	$110,000	$2,457,000	N	5
	16	Y	2	$110,000	$2,761,000	N	5
SW-112	8	N	0	$0	$701,000	N	5
	10	N	0	$0	$849,000	N	5
	12	Y	1	$55,000	$997,000	N	7
	14	Y	1	$55,000	$1,145,000	N	7
	16	Y	1	$55,000	$1,287,000	N	8
SW-113	8	N	1	$55,000	$1,577,000	N	3
	10	Y	2	$110,000	$1,910,000	N	4
	12	Y	2	$110,000	$2,243,000	N	6
	14	Y	2	$110,000	$2,577,000	N	7
	16	Y	2	$110,000	$2,896,000	N	7

Table 3.2.7-18 Summary of Preliminary Noise Abatement Decision for Soundwalls on HDC: Main Alignment, Segment 3

Barrier	Height (ft)	Acoustically Feasible (5dBA min.)	Number of Benefited Residences	Total Reasonable Allowance	Estimated Construction Cost	Cost less than Allowance	Noise Reduction (dBA)
SW-114	8	N	0	$0	$701,000	N	4
	10	N	0	$0	$849,000	N	4
	12	Y	1	$55,000	$997,000	N	7
	14	Y	1	$55,000	$1,145,000	N	8
	16	Y	1	$55,000	$1,287,000	N	9

Table 3.2.7-19 Summary of Preliminary NADR Recommended Soundwalls

Barrier	SW Height (ft)	Noise Reduction (dBA)	
SW-102	16	12	
SW-103	16	12	
SW-106, SW-106 (Var A)	12/12	9	9
SW-109	12	7	